Guest Lecture
EECE 200
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Project Management --- An Introduction

(Project Planning and Scheduling)

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Outline

- Definitions: project, activity, project plan, schedule, etc.
- Project planning using Work Break-down Structure (WBS) method
- Project scheduling tools: Gantt chart & Critical Path Method (CPM)
- Design structure matrix (DSM) method
- Conclusion

Project

- A project is a "temporary" endeavor undertaken to create a "unique" product or service
  - If project output is not unique but repetitive, then this becomes a process
- A project is composed of a number of related activities that are directed to the accomplishment of a single desired objective
- A project starts when at least one of its activities is ready to start
- A project is completed when all of its activities have been completed

Activity

- An *activity* (also called a *task*):
  - Must have a clear start and a clear stop
  - Must have a duration that can be forecasted
  - May require the completion of other activities before it begins – prerequisite activities
  - should have some 'deliverables' for ease of monitoring

Project Plan

- A project plan is a description of the project that divides it into sub-projects and activities, indicating:
  - The start and completion of each activity
  - When (and how much) a resource is required
  - The cost of each activity

Reasons for Project Planning

- Establish directions for project team
- Motivate normally disorganized people
- Make allowance for risk – Assess amount of damage from possible delays & propose response
- Well planned projects are executed on time and budget

Project Planning

1) Start with: The Scope

Defines at the highest level what has to be done—what must be created and delivered to the project's customers.

2) Create: The Work Breakdown Structure (WBS)

A top-down hierarchical description of the work required to *produce* what is called for in the Project Scope and *achieve the mission*,

•Provides approach for 'decomposing' the work into measurable units, which allows easier and more accurate estimates of duration and needed resources,

•Allows breakdown of work to deliverables, activities, tasks that can be assigned to an owner.

3) Based on the WBS, develop: The Project Schedule

Created by adding resource assignments, task work effort and duration estimates, and dependencies to all tasks in the WBS.

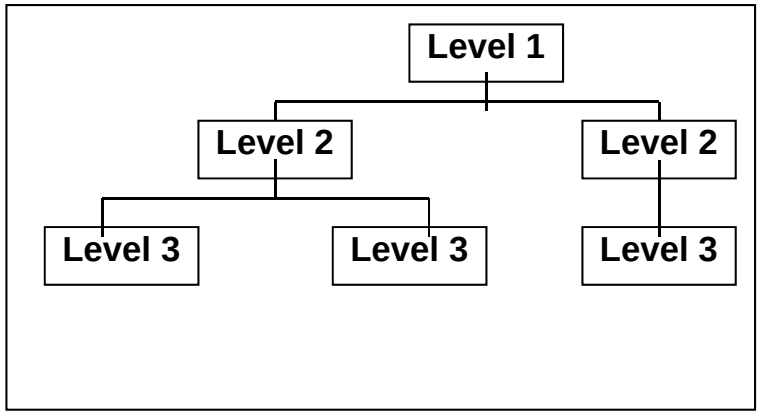
Work Breakdown Structure (WBS)

- Contains a list of activities for a project derived from:
  - Previous experience
  - Expert brainstorming
- WBS helps in:
  - identifying the main activities
  - break each main activity down into sub-activities which can further be broken down into lower level sub-activities
- WBS problems:
  - Too many levels
  - Too few levels

Creating WBS Formats

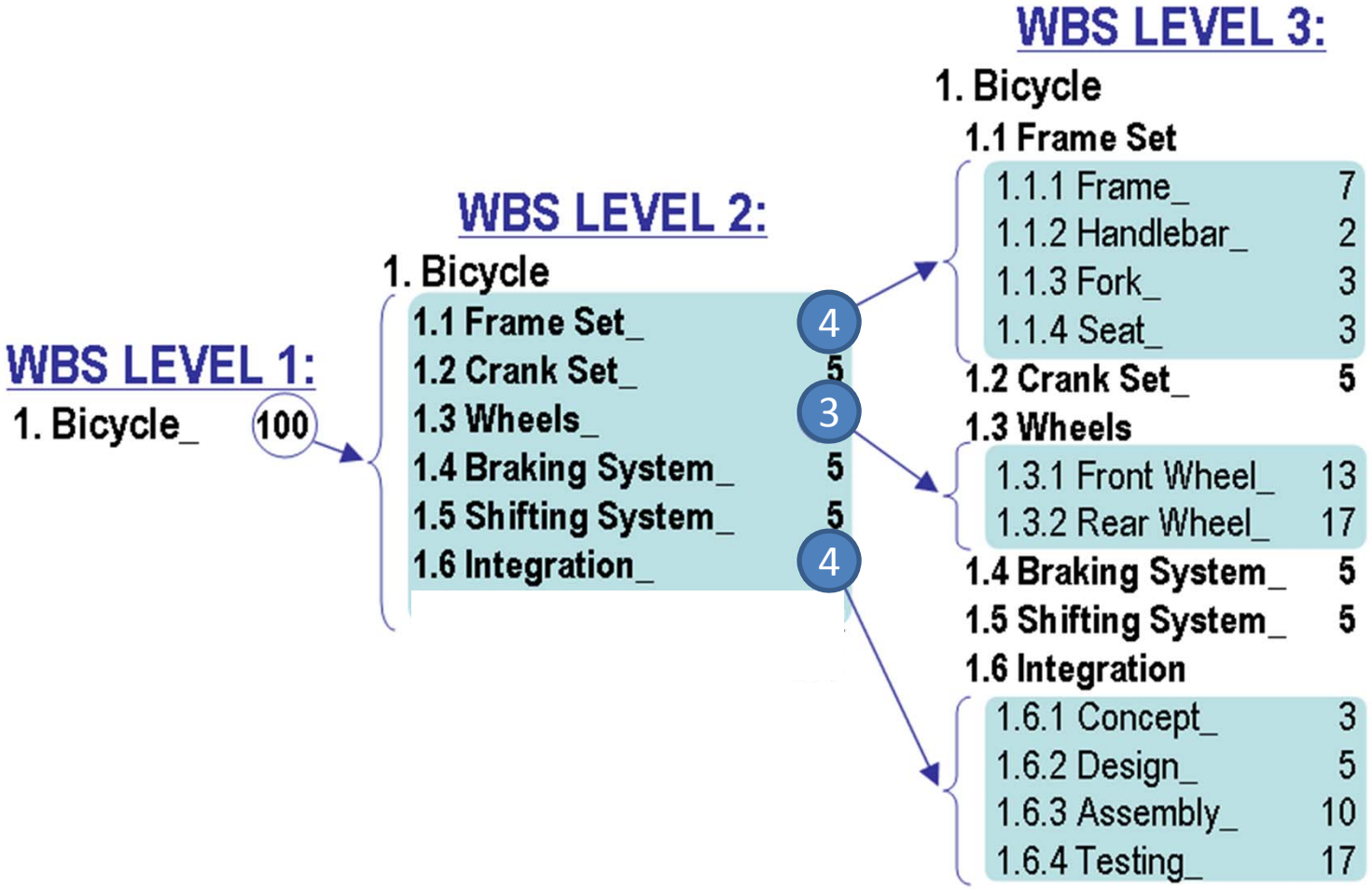
Level 1
- Level 2-1
- Level 2-2
  - Level 3-1
  - Level 3-2
  - Level 3-2

Indented List



Hierarchical Tree

Creating WBS for a Bicycle

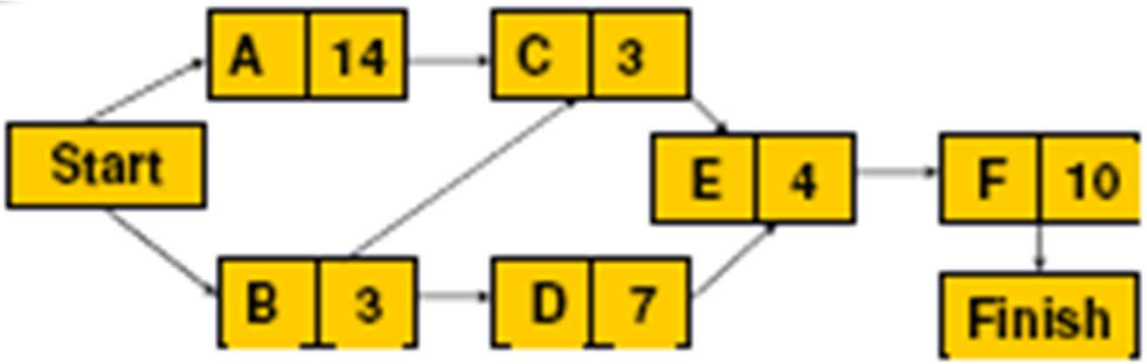


Activity Duration & Predecessors

- *Realistic* estimate of the time for each task
  - Based on prior experience on similar projects
  - Extrapolation
  - Depend on availability of resources
  - Any reasonable “guesstimate” is better than no estimate at all
- Capture and document dependencies

Network Representation - AON

Activity Name	Duration (days)	Predecessors
A	14	None
B	3	None
C	3	A,B
D	7	B
E	4	C,D
F	10	E



Critical Path & Activities

- Critical Path = longest chain of activities
  - Determines the minimum project duration
  - Delaying any task on this path results in an overall project delay by the same amount
  - Resource constraints may also change logic
- Critical activity = an activity on the critical path

Project Scheduling Tools

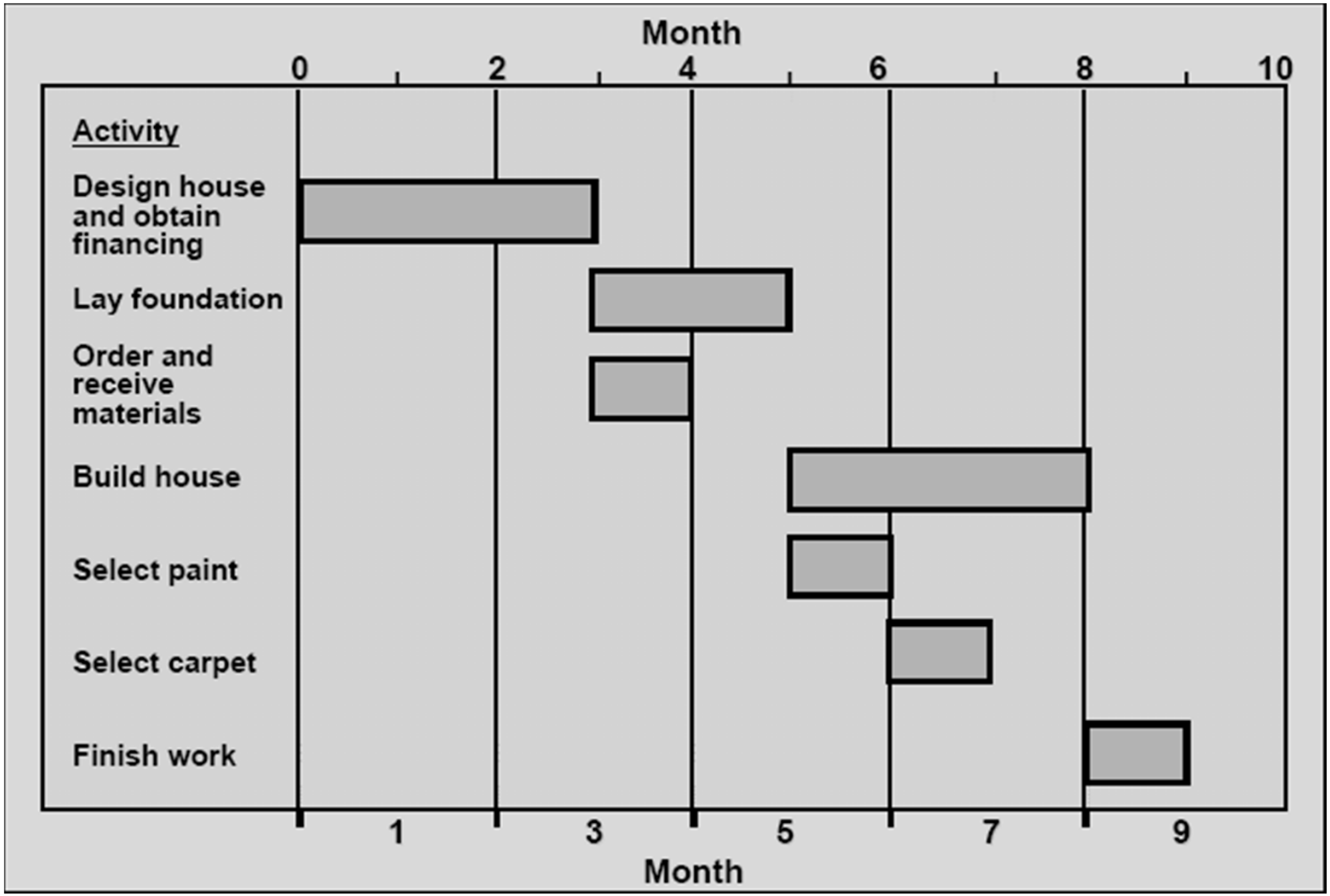
- Gantt chart
- CPM = Critical Path Method
- PERT = Project Evaluation & Review Technique
- LOB = Line of Balance

Gantt Chart

- Developed in 1918 by H.L. Gantt
- Graph or bar chart with a bar for each activity that shows passage of time
- Provides visual display of project schedule
- Limitations

  – Does not give a clear indication of interrelation between the activities

Example of Gantt Chart



Critical Path Method (CPM)

- Developed by Du Pont Chemical Company and published in 1958
- Primary objectives:
  - Plan for the fastest completion of the project
  - Identify activities whose delays is likely to affect the completion date for the whole project
  - Very useful for activities with known completion time

Benefits of CPM Analysis

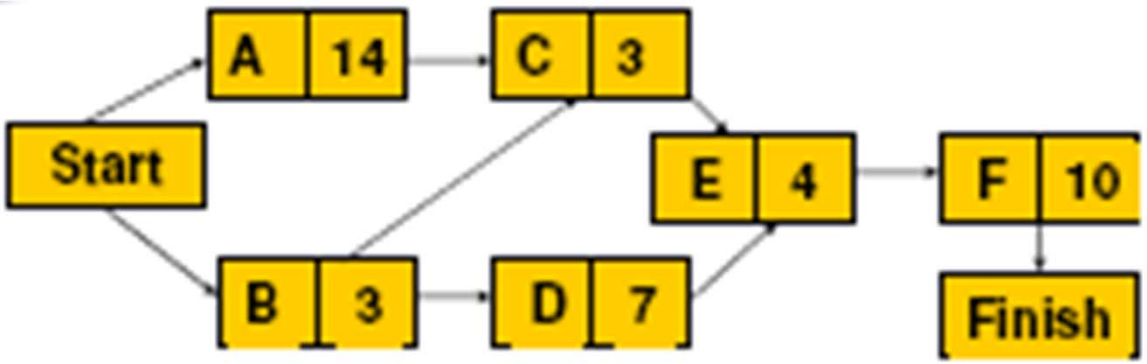
- During planning stage
  - Shortening the critical path will reduce the overall project duration
  - Can we decrease the completion time by spending more money
- During management stage
  - Pay more attention to those activities which fall on the critical path

CPM Calculations

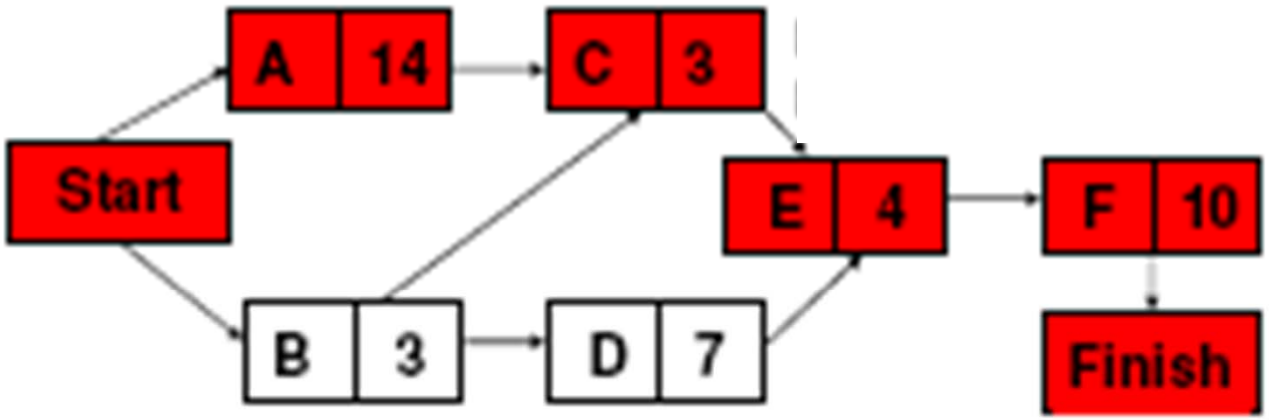
- The forward pass
  – calculate the **earliest start dates of the** activities to calculate the project completion date
- The backward pass
  – calculate the **latest start dates for activities** to identify the critical path

A Simple Example

Activity Name	Duration (days)	Predecessors
A	14	None
B	3	None
C	3	A,B
D	7	B
E	4	C,D
F	10	E



Critical Path by Enumeration



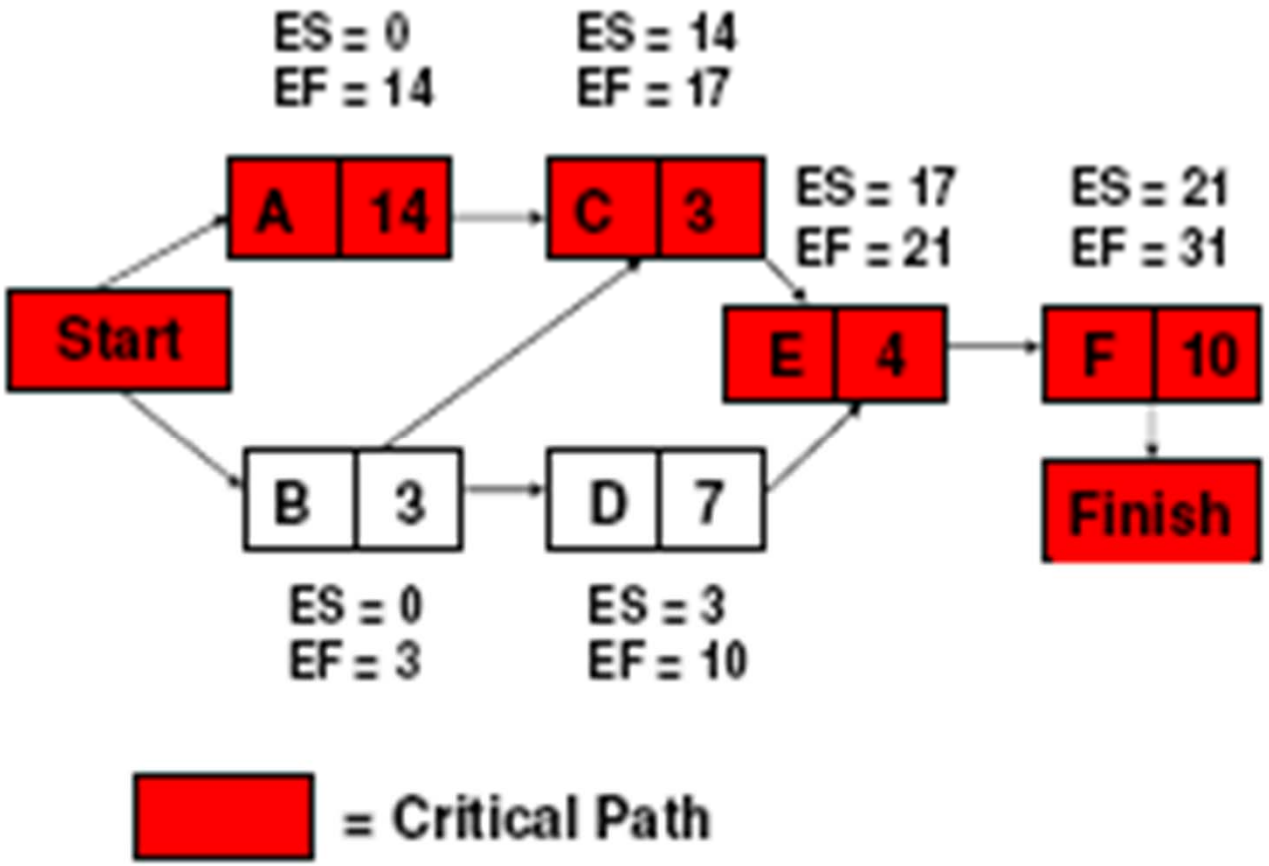
A-C-E-F
14+3+4+10=31 weeks

B-D-E-F
3+7+4+10=24 weeks

B-C-E-F
3+3+4+10=20 weeks

= Critical Path

Forward Pass

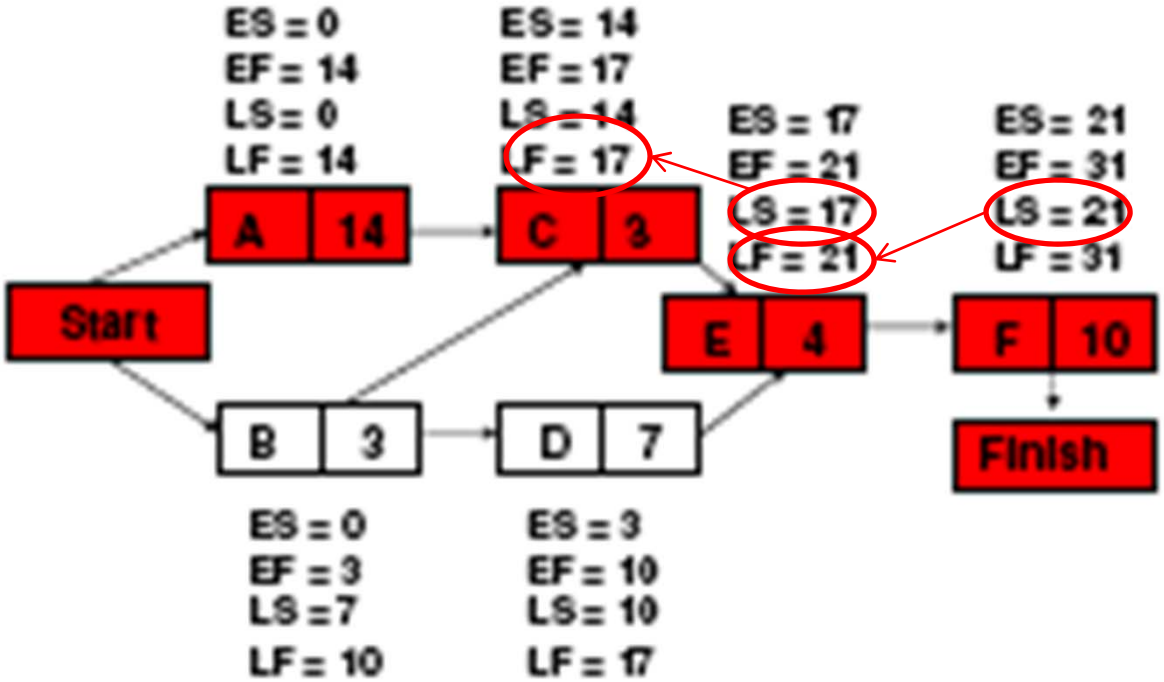


A-C-E-F
14+3+4+10=31 weeks

B-D-E-F
3+7+4+10=24 weeks

B-C-E-F
3+3+4+10=20 weeks

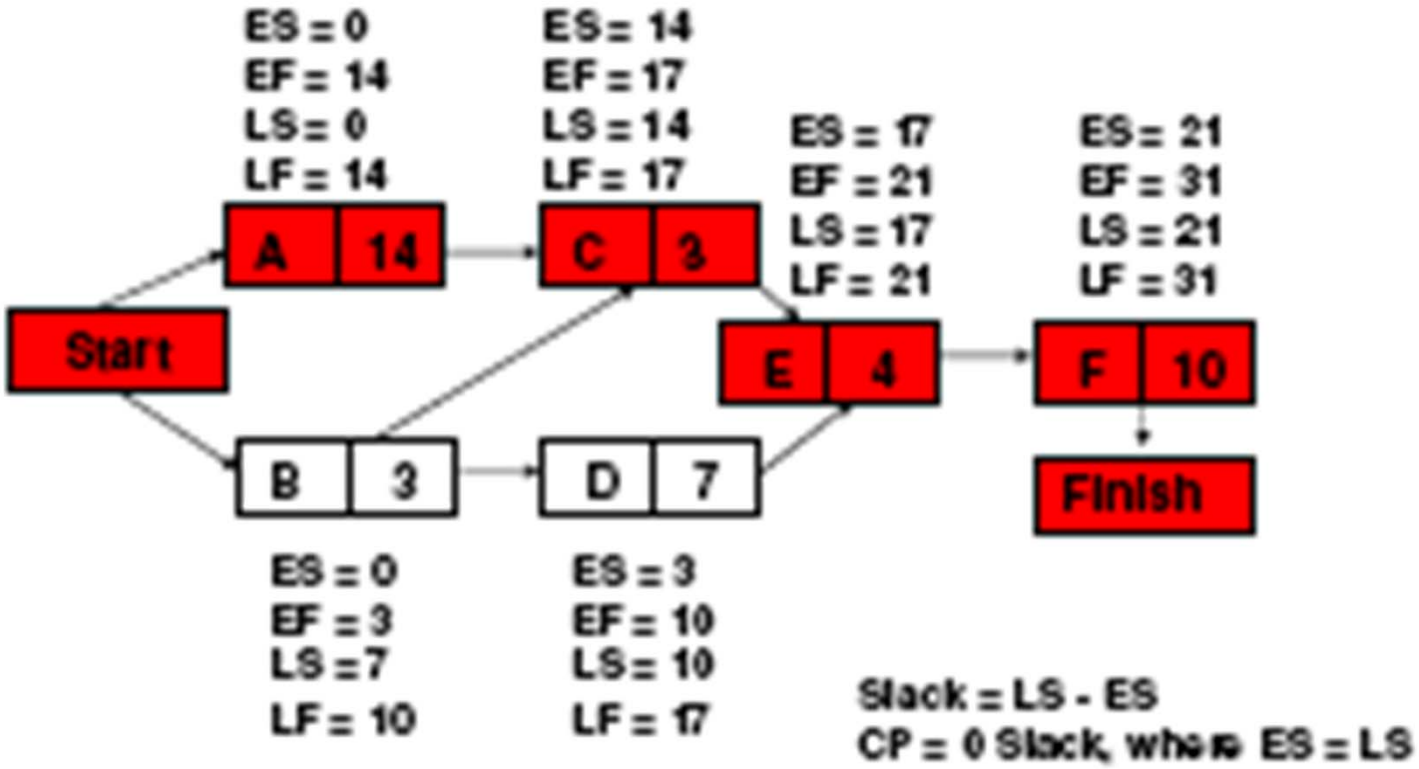
… and backward pass



Activity Slack or Float

- Time allowed for an activity to delay
- 2 different types:
  - **Total float (without affecting project completion)**
    = latest start– earliest start
  - **Free float (without affecting the next activity)**
    = earliest start of *next activity* – *latest finish of previous activity*

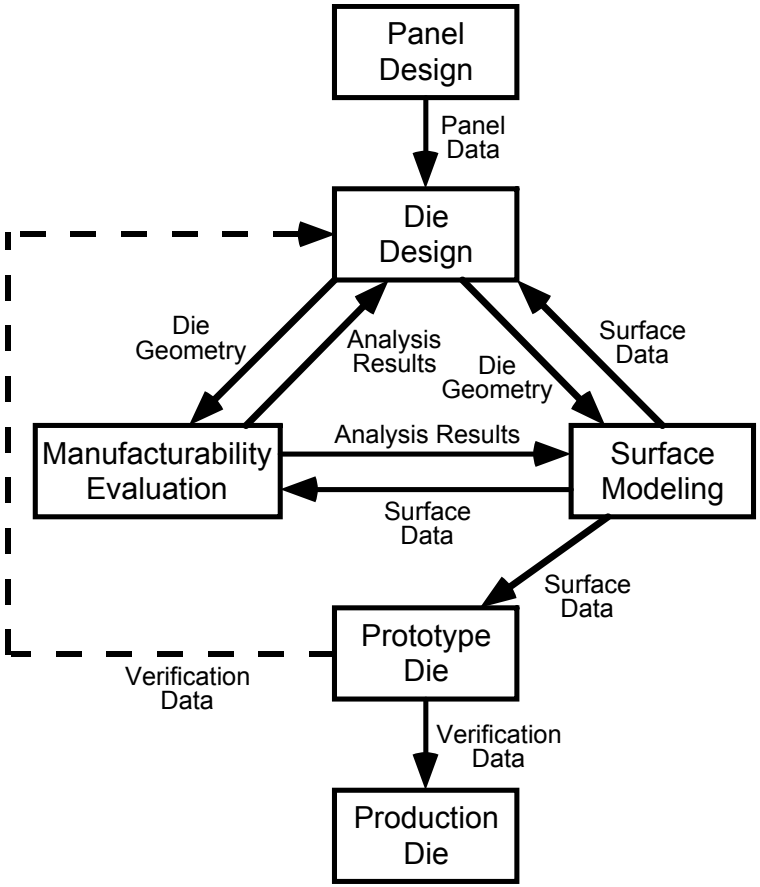
… and Slack Calculations



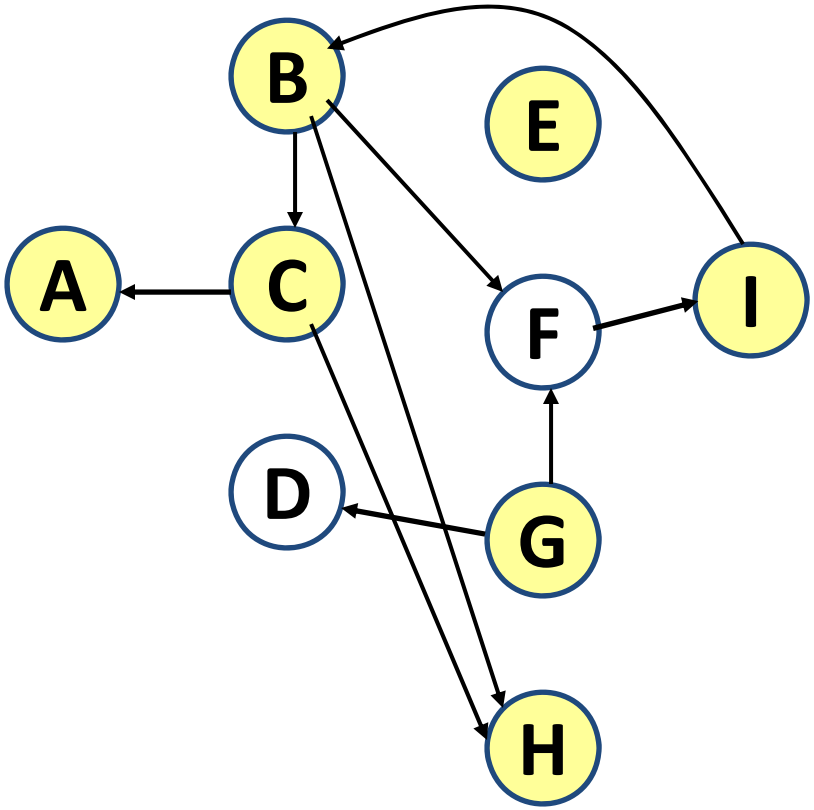
Traditional Project Management Tools Fail to Manage Design Iteration?

- Rework & Iteration
  - Test results, Planned design reviews, Design mistakes, Coupled nature of the design

Automotive Stamping Die Design



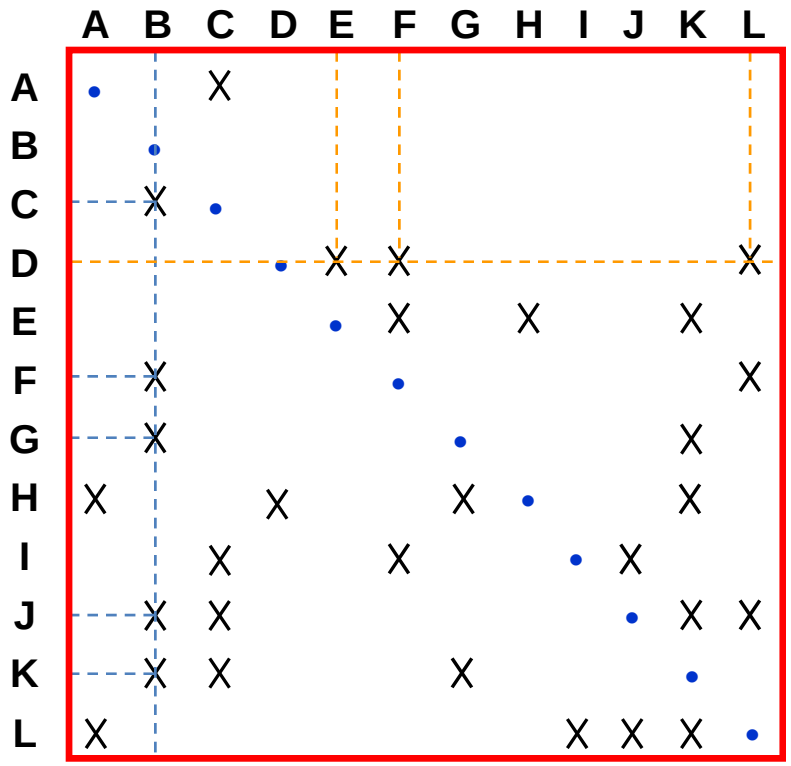
A Graph and its Corresponding Matrix Representation



	A	B	C	D	E	F	G	H	I
A	A		X						
B		B							X
C		X	C						
D				D			X		
E					E				
F		X				F	X		
G							G		
H		X	X					H	
I						X			I

The Design Structure Matrix:

An Information Exchange Model



Interpretation:

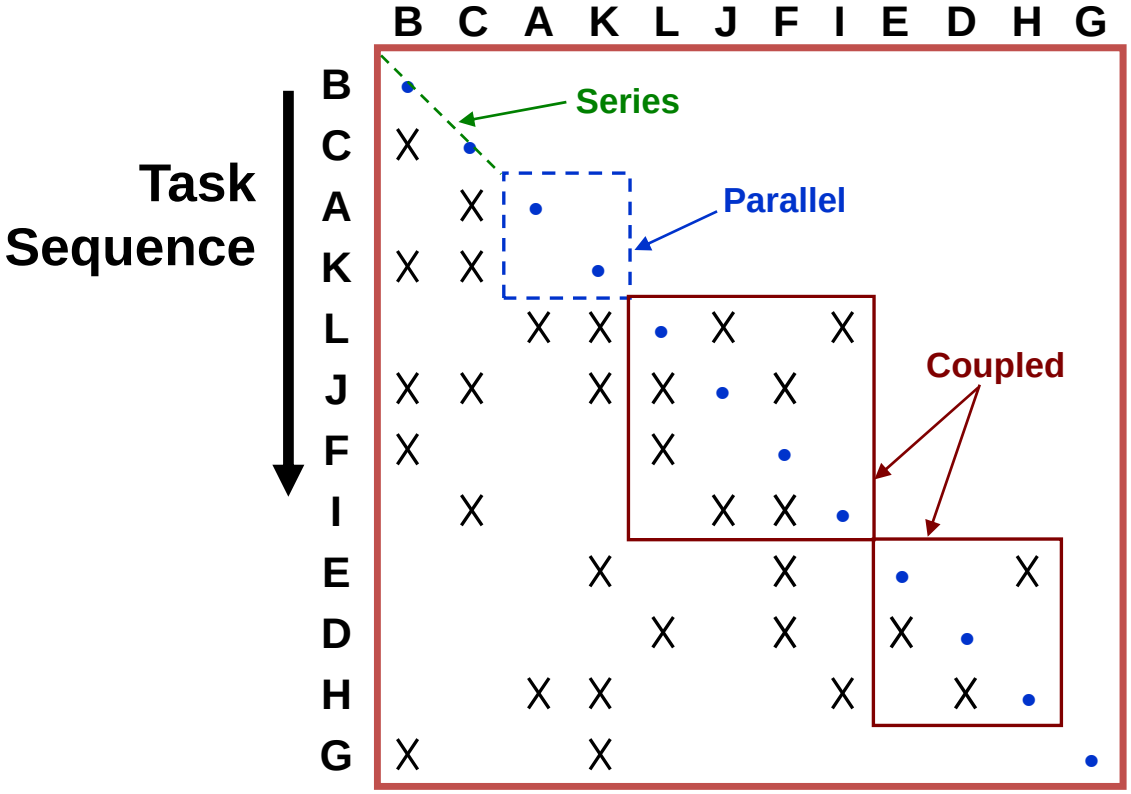
- Task D requires information from tasks E, F, and L.
- Task B transfers information to tasks C, F, G, J, and K.

Note:

- Information flows are easier to capture than work flows.
- Inputs are easier to capture than outputs.

The Design Structure Matrix

(Partitioned or Sequenced)



Note:

Coupled tasks can be identified uniquely.

The display of the matrix can be manipulated to emphasize certain features of the process flow.

Sequencing Algorithm

- **Step 1**: Schedule tasks with empty rows first
- **Step 2**: Once scheduled, delete the row and column for that task
- **Step 3**: Repeat (Go to step 1)

- **Step 4**: Schedule tasks with empty columns last
- **Step 5**: Once scheduled, delete the row and column for that task
- **Step 6**: Repeat (Go to step 3)

- **Step 7**: All the tasks that are left unscheduled are coupled. Group them into blocks around the diagonal

Example: Brake System Design

		1	2	3	4	5	6	7	8	9	10	11	12	13
Customer_Requirements	1	1												
Wheel Torque	2		2		X									
Pedal Mech. Advantage	3	X		3	X	X			X		X			X
System_Level_Parameters	4	X			4									
Rotor Diameter	5	X	X	X	X	5		X	X		X	X		X
ABS Modular Display	6		X				6			X				
Front_Lining_Coef._of_Friction	7			X	X	X		7	X		X			X
Piston-Rear Size	8		X		X				8		X			
Caliper Compliance	9			X	X					9	X			X
Piston- Front Size	10		X		X				X		10			
Rear Lining Coef of Friction	11			X	X	X			X		X	11		X
Booster - Max. Stroke	12												12	X
Booster Reaction Ratio	13		X	X	X	X		X	X	X	X	X	X	13

Partitioned DSM: Brake Design

		1	4	2	10	8	3	11	7	13	5	12	9	6
Customer_Requirements	1	1												
System_Level_Parameters	4	X	4											
Wheel Torque	2		X	2										
Piston- Front Size	10		X	X	10	X								
Piston-Rear Size	8		X	X	X	8								
Pedal Mech. Advantage	3	X	X		X	X	3			X	X			
Rear Lining Coef of Friction	11		X		X	X	X	11		X	X			
Front_Lining_Coef._of_Friction	7		X		X	X	X		7	X	X			
Booster Reaction Ratio	13		X	X	X	X	X	X	X	13	X			
Rotor Diameter	5	X	X	X	X	X	X	X	X	X	5			
Booster - Max. Stroke	12									X		12		
Caliper Compliance	9		X		X		X			X			9	
ABS Modular Display	6												X	6

END

Questions

- What is a project?
- What is work breakdown structure (WBS)?
- What does the term CPM stand for?
- What is a critical path?
- What is a critical activity?