The British University In Egypt
الـجامعة البريطانية في مصر

Activity Planning

Lecture 4 by Professor Vladimir Geroimenko

Module “Software Project Management“

16 October 2016 - Teaching Week 4

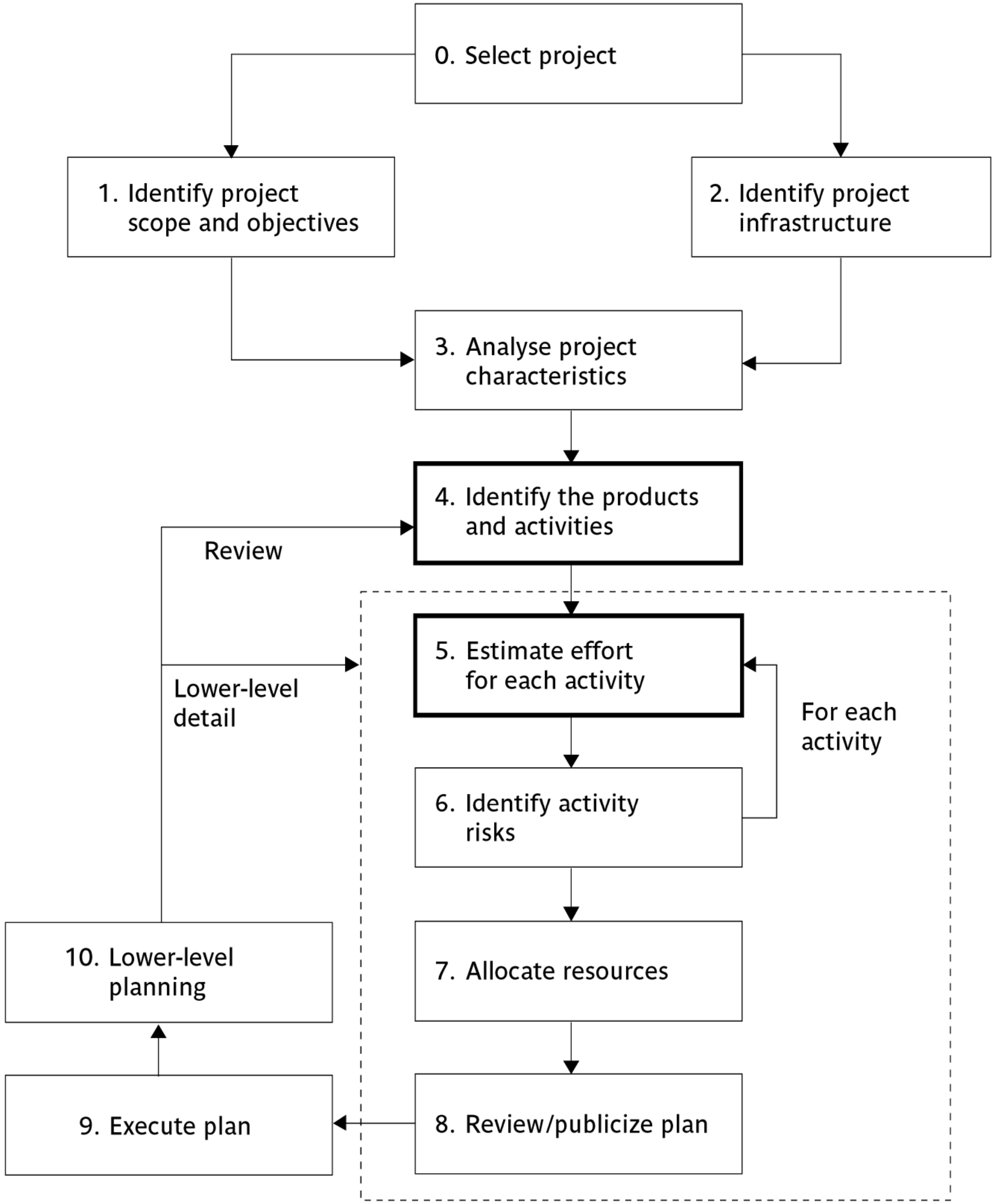
Textbook reference: Chapter 6

Lecture Outline

- Activity planning – why, when and how
- Identifying project activity
  - Activity-based approach - Work breakdown structure (WBS)
  - Product-based approach - Product breakdown structure (PBS)
  - Hybrid approach
- Scheduling Activities
  - Simple sequencing
  - Precedence Network Models
- Critical Path Method (CPM)

Where we are now?

In SPMM: Stepwise Project Management Method (Described in detail in Lecture 2)


0. Select project
1. Identify project scope and objectives
2. Identify project infrastructure
3. Analyse project characteristics
4. Identify the products and activities
Review
5. Estimate effort for each activity
Lower-level detail
For each activity
6. Identify activity risks
7. Allocate resources
10. Lower-level planning
9. Execute plan
8. Review/publicize plan

When to Plan

- Planning is an ongoing process that is each iteration is more detailed and more accurate.

- In each iteration the purpose and emphasis is different:
  1. During feasibility study: purpose is time scale and risks to time and budget
  2. During project: emphasis is production of activity plans for ensuring resources availability and cash availability
  3. During project & at final delivery: monitoring and planning to ensure time and budget targets set are met

Objectives of Activity Planning

- Feasibility assessment
  - Can the project be delivered on time, within budget and resource constraints?
- Resource allocation
  - How to allocate the resources with best results?
  - When should those resources be ready?
- Detailed costing
  - A detailed estimates on the project cost and the timings.
  - A detailed forecast on when the expenditure is likely to take place.
- Motivation
  - Providing targets and being able to monitor the achievement of the targets at the end of the activity can be a good strategy to motivate staff.
- Coordination
  - Help to set the time and requirements of staff (possibly from different departments) provide a good way for the project teams to communicate and collaborate among themselves.

Activity Planning – From Plan to Schedule

A detailed plan for the project must include a **schedule** indicating the start and completion time for each activity.

Main **steps** in producing the project plan:

1. To identify activities (to decide **what activities** need to carried out and in **what order** they are to be done).
2. To construct an **ideal activity plan** (as if no problem with resources).
3. To allocate **resources** (and to correct the ideal plan)
4. To produce a **project schedule** (with planned start and completion date)

Projects and Activities

Activity planning is based on some **assumptions**:

- A project is composed of a number of **activities.**
- A project may **start** when at least one of its activities is ready to start.
- A project will be **completed** when all its activities are completed.
- An activity must have clearly defined **start and end** points.
- An activity must have **resource** requirements that are forecastable.
- An activity must have a **duration** that are forecastable.
- An activity may be **dependent** on other activities being completed first (precedence).

Identifying Project Activities

Three Approaches and Techniques:

1. Activity-based approach = Work breakdown structure (WBS)
2. Product-based approach = Product breakdown structure (PBS)
3. Hybrid approach

Work Breakdown Structure (WBS)

- Each activity is broken down into tasks, until desired level of detail is reached (The amount of work that can be allocated to a single person)
- Maximum task size is usually 10-20 hours
- Shows “is contained in” relationships
- Does not show dependencies or durations

What does a WBS look like?

2 Formats

Outline (Indented Format)
Graphical Tree (Organizational Chart)

Outline Format

1 MANAGEMENT
- 1.1 Initiate
- 1.2 Plan
- 1.3 Execute
- 1.4 Control
- 1.5 Close

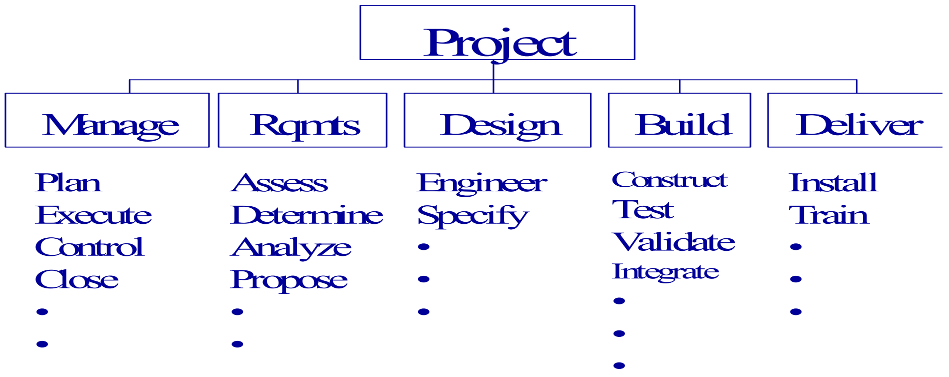
2 REQUIREMENTS
- 2.1 Assess
- 2.2 Determine
- 2.3 Analyze
- 2.4 Propose
- 2.5 ... ..

3 DESIGN
- 3.1 Engineer
- 3.2 Specify
- 3.3 ... .
- 3.4 ... ..

4 BUILD
- 4.1 Construct
- 4.2 Test
- 4.3 Validate
- 4.4 Integrate

5 DELIVER
- 5.1 Install
- 5.2 Train
- 5.3 ... ..
- 5.4 ... ..

Graphical Tree Format



Project

Manage: Plan, Execute, Control, Close, •, •

Rqmts: Assess, Determine, Analyze, Propose, •, •

Design: Engineer, Specify, •, •, •

Build: Construct, Test, Validate, Integrate, •, •, •

Deliver: Install, Train, •, •, •

WBS Outline Example

0.0 Retail Web Site

1.0 Project Management

2.0 Requirements Gathering

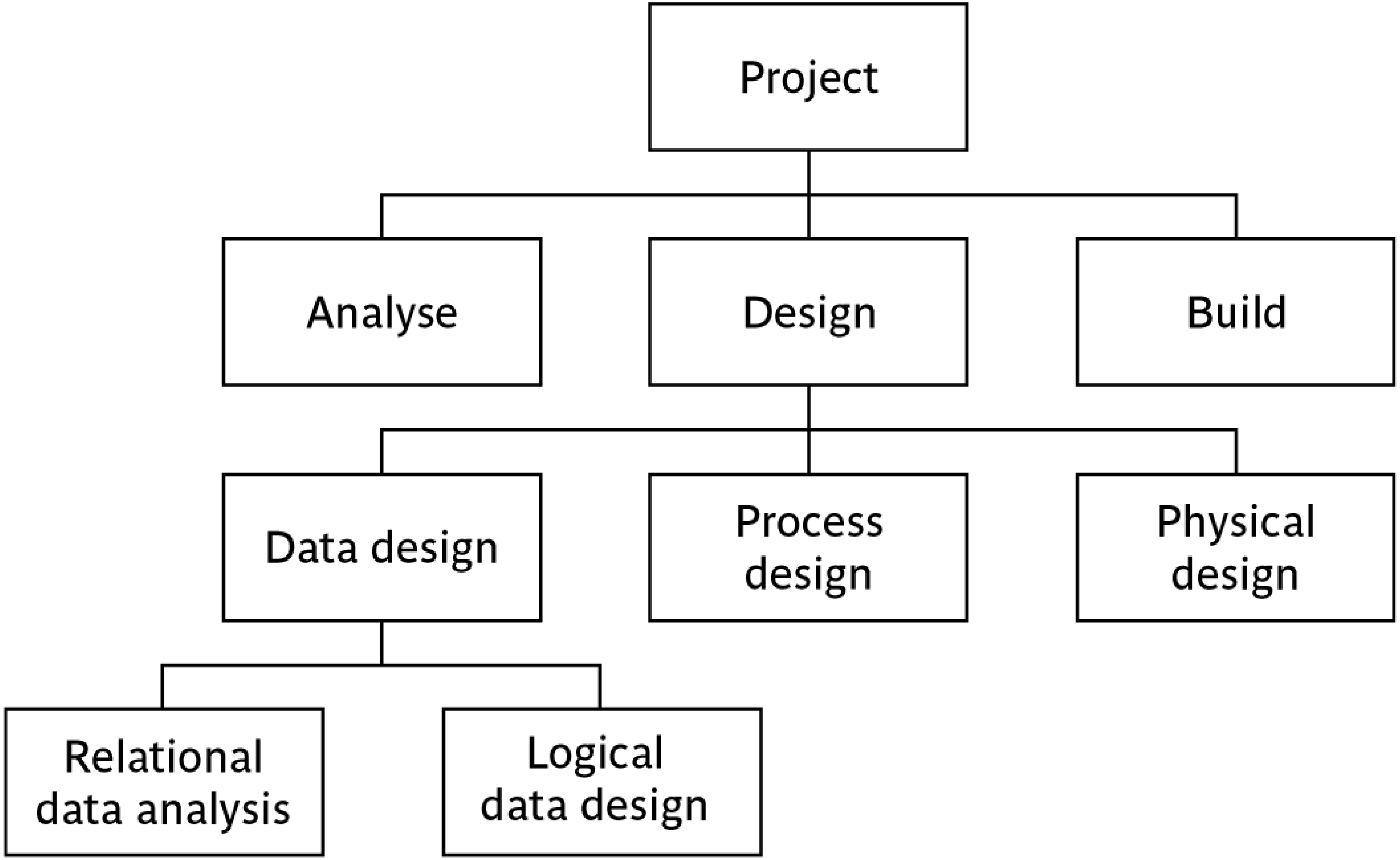
3.0 Analysis & Design

4.0 Site Software Development

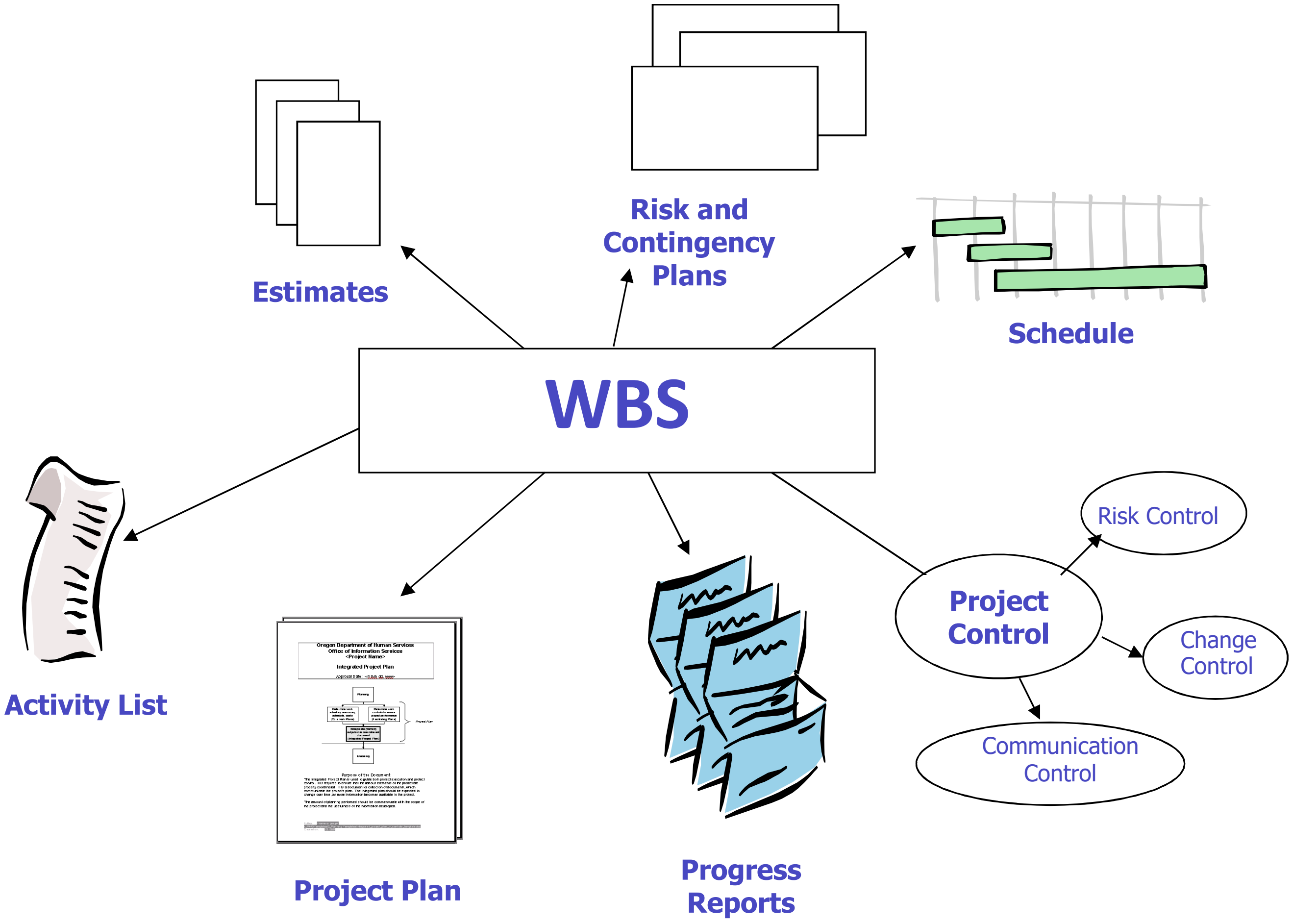
- 4.1 HTML Design and Creation
- 4.2 Backend Software
  - 4.2.1 Database Implementation
  - 4.2.2 Middleware Development
  - 4.2.3 Security Subsystems
  - 4.2.4 Catalog Engine
  - 4.2.5 Transaction Processing
- 4.3 Graphics and Interface
- 4.4 Content Creation

5.0 Testing and Production

WBS Graphical Tree Example



Benefits of the WBS


Estimates
Risk and Contingency Plans
Schedule
WBS
Activity List
Project Plan
Progress Reports
Project Control
Risk Control
Change Control
Communication Control

Oregon Department of Human Services
Office of Information Services
<Project Name>

Integrated Project Plan

Approval Date: <mmm dd, yyyy>

Planning
Determine work activities, resources, schedule, costs (Core work Plans)
Determine work controls to ensure project performance (Facilitating Plans)
Incorporate planning outputs into one coherent document (Integrated Project Plan)
Project Plan
Executing

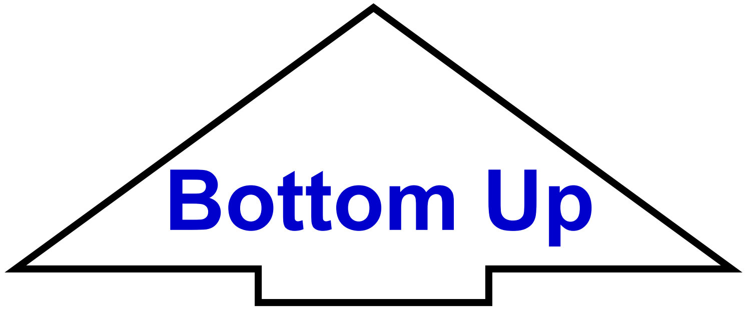
Purpose of the Document

The Integrated Project Plan is used to guide both project execution and project control. It is required to ensure that the various elements of the project are properly coordinated. It is a document or collection of documents, which communicate the project's plan. The Integrated plan should be expected to change over time, as more information becomes available to the project.

The amount of planning performed should be commensurate with the scope of the project and the usefulness of the information developed.

Common Approaches to Creating WBS

Brainstorming all work to be done and then grouping into a hierarchy.



Bottom Up

Top Down

Using a general-to-specific structure to progressively detail the work.

WBS Guidelines -1

- Should be **easy to understand**
- Some companies have corporate **standards** for these schemes
- Some top-level items, like Project Mgmt. are in WBS for each project
    - Others vary by project
- What often hurts most is what's missing
- When to stop: Break down until you can generate accurate time & cost estimates
- Ensure each element corresponds to a deliverable

WBS Guidelines - 2

- How detailed should it be?
  - **Not as detailed** as the final MS-Project plan
  - Each level should have no more than 7 items
  - It can evolve over time
- What tool should you use?
  - Excel, Word, Project
  - Org chart diagramming tool (Visio, etc)
- Re-use a template if you have one

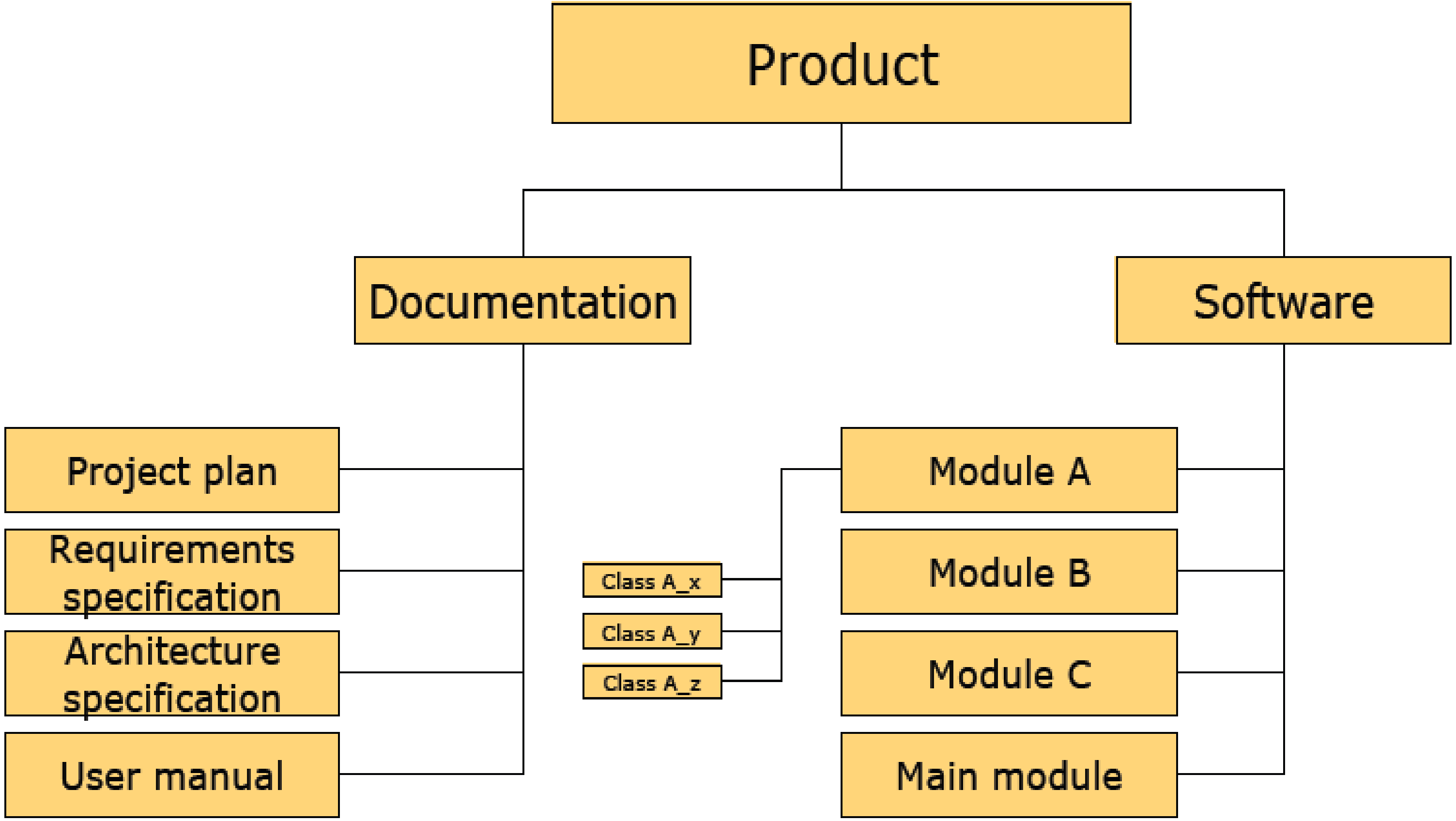
Product-Based Approach

- List the deliverable and intermediate products of project
- Identify the order in which products have to be created
- Work out the activities needed to create the products
- Create Product Breakdown Structure (PBS)

Product breakdown structure (PBS)

- Product Breakdown Structure (PBS) is a similar construct as WBS, but is based on the structure of product rather than the type of activities
- The top level of PBS is the final product
- Second level may consist of the major components of the product
- Lower levels in PBS describe the structure of item on level above

PBS Example


Product
Documentation
Software
Project plan
Requirements specification
Architecture specification
User manual
Class A_x
Class A_y
Class A_z
Module A
Module B
Module C
Main module

What is a Product?

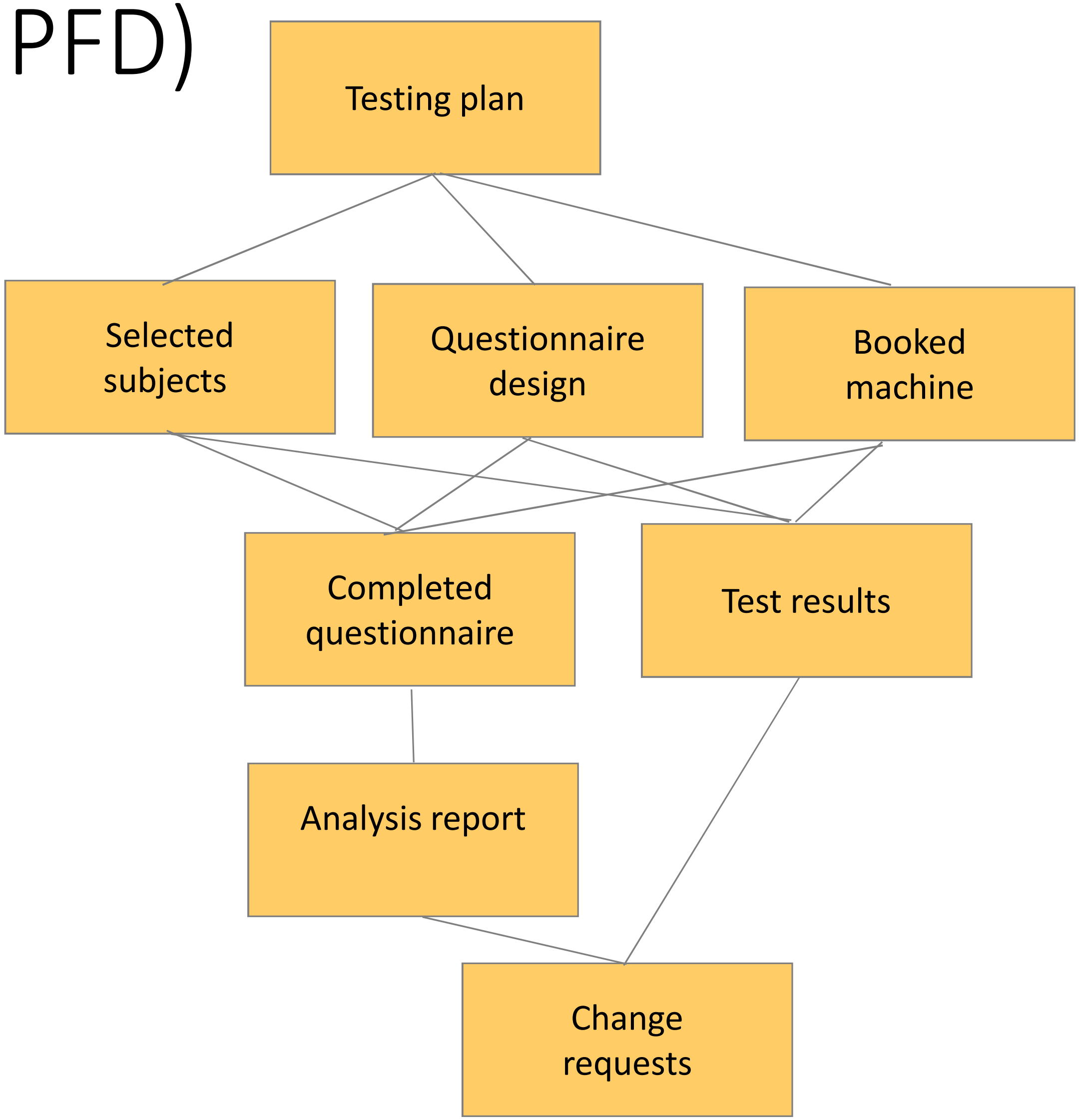
- The result of an activity
- Could be (among other things)
  - physical thing ('installed pc'),
  - a document ('logical data structure')
  - a person ('trained user')
  - a new version of an old product ('updated software')

What is a Product?

- The following are NOT normally products:
  - activities (e.g. ‘training’)
  - events (e.g. ‘interviews completed’)
  - resources and actors (e.g. ‘software developer’)
    - may be exceptions to this
- Products CAN BE *deliverable* or *intermediate*

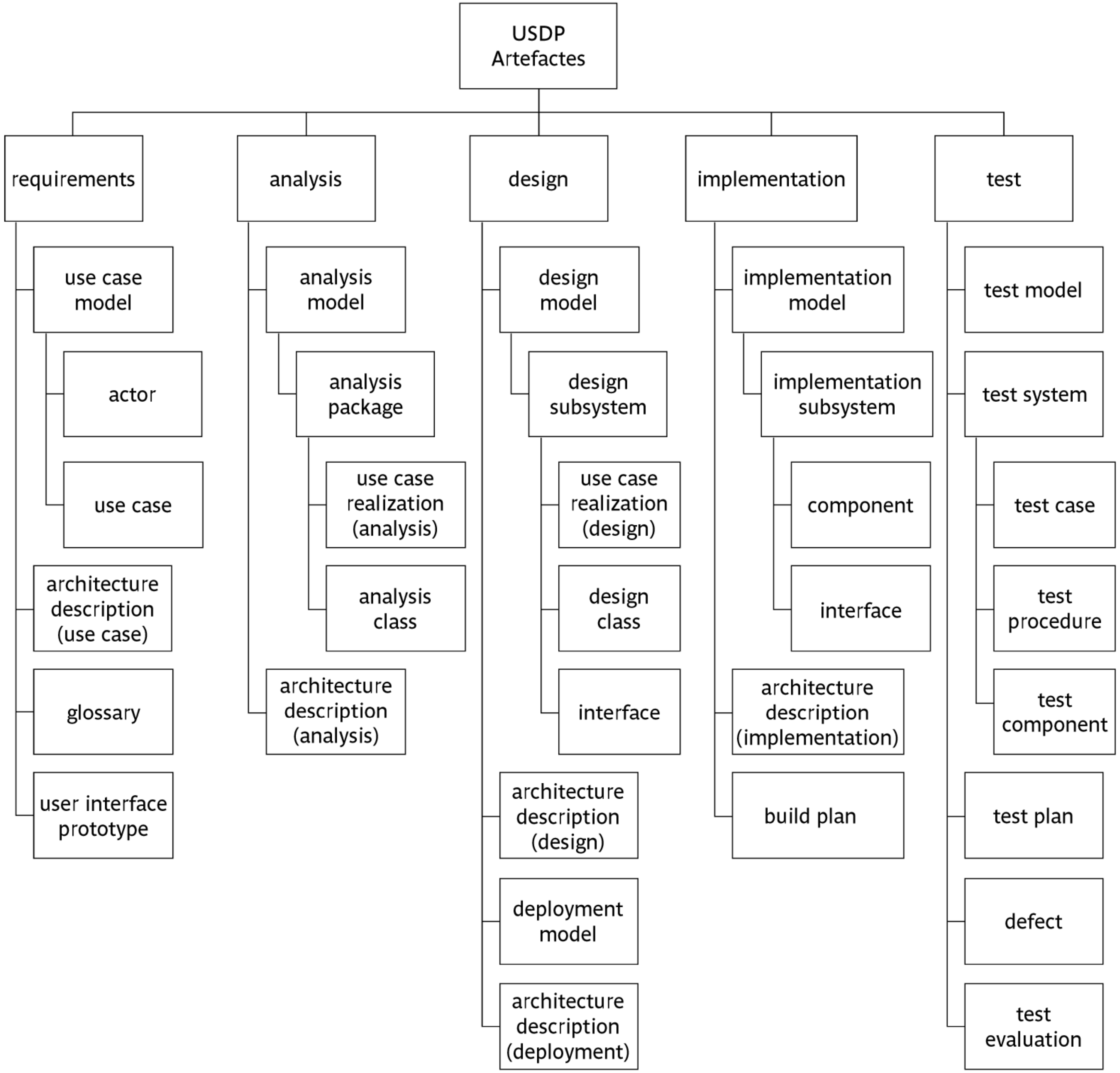
Product Flow Diagram (PFD)

- PFD shows the order in which the products have to be completed
- PFD is generally from top to bottom and left to right.
- No loop back



An example of the USDP methodology that uses the product-based approach.

USDP = Unified Software Development Process.



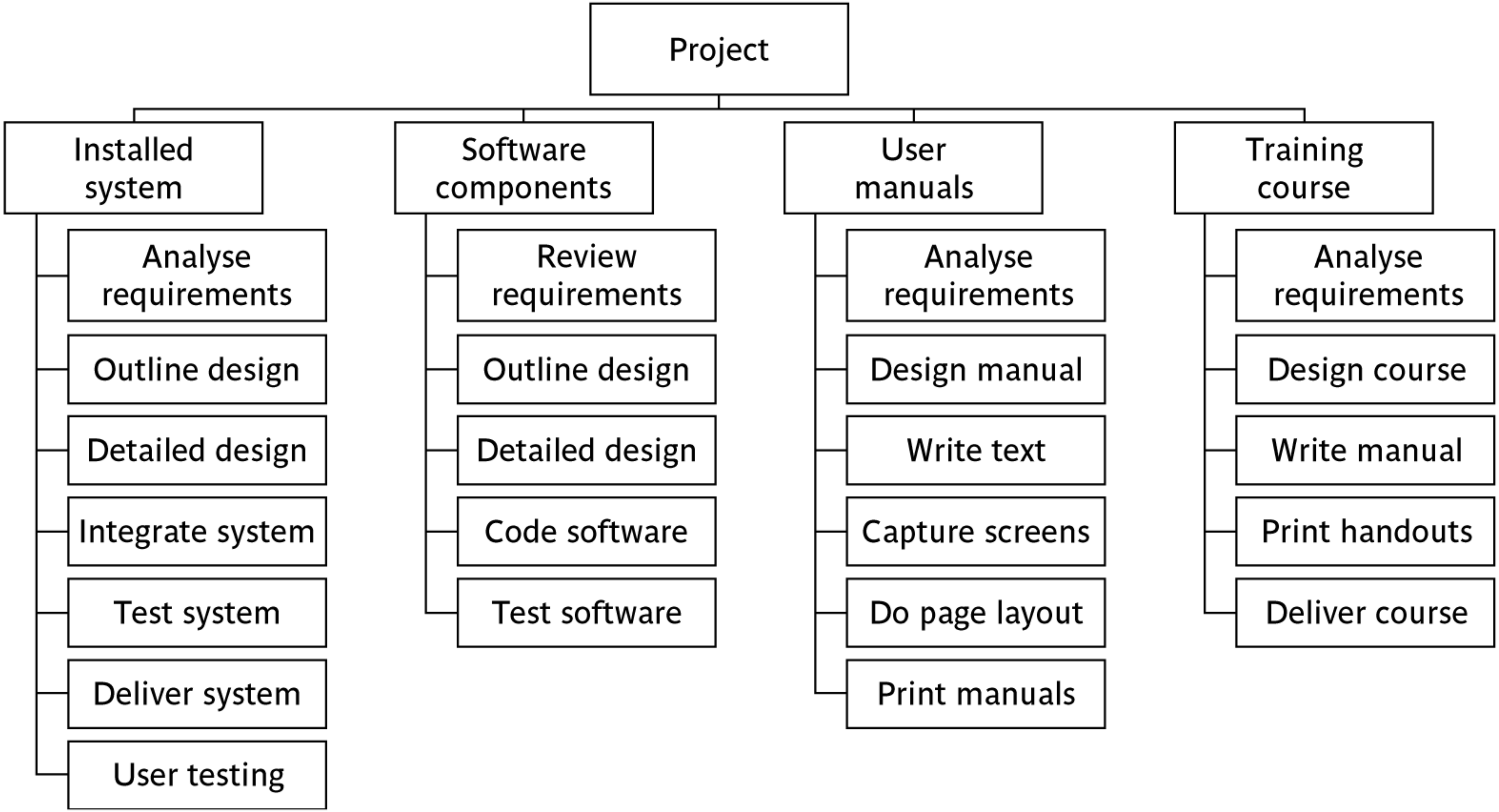
The Hybrid Approach

This approach structures both products and activities (i.e. PBS + WBS)

IBM recommends the following five levels in a WBS:

1. Project
2. Deliverables (software, manuals, training courses)
3. Components (i.e. modules and tests requested to produce software)
4. Work-Packages (collection of tasks, requested to produce a component)
5. Tasks (normally for responsibility of a single person)

A Hybrid Approach – an Example



Summary: Identifying Activity

- Activity-based approach
  - WBS
  - Advantages: produce a task catalogue of non-overlapping activities
  - A structure that maybe refined as the project proceeds
- Product-based approach
  - PBS
  - Advantages: Less likely that a product is left out (an activity may be left out in WBS)
- Hybrid approach
  - Start with products (Based on deliverables)
  - For each product, list activities required
  - IBM recommends five levels in the hybrid approach (check them for your project)

Scheduling Activities

Once we have an **ideal activity plan**, we need to **schedule** the activities in a project taking into account the **resource constraints**.

Scheduling Techniques

- Simple sequencing
  - Suitable for small projects
  - Sequencing and scheduling are combined

- Precedence Network Models
  - Suitable for large software projects
  - Separate sequencing from scheduling
  - Sequence according to logical relationship between activities

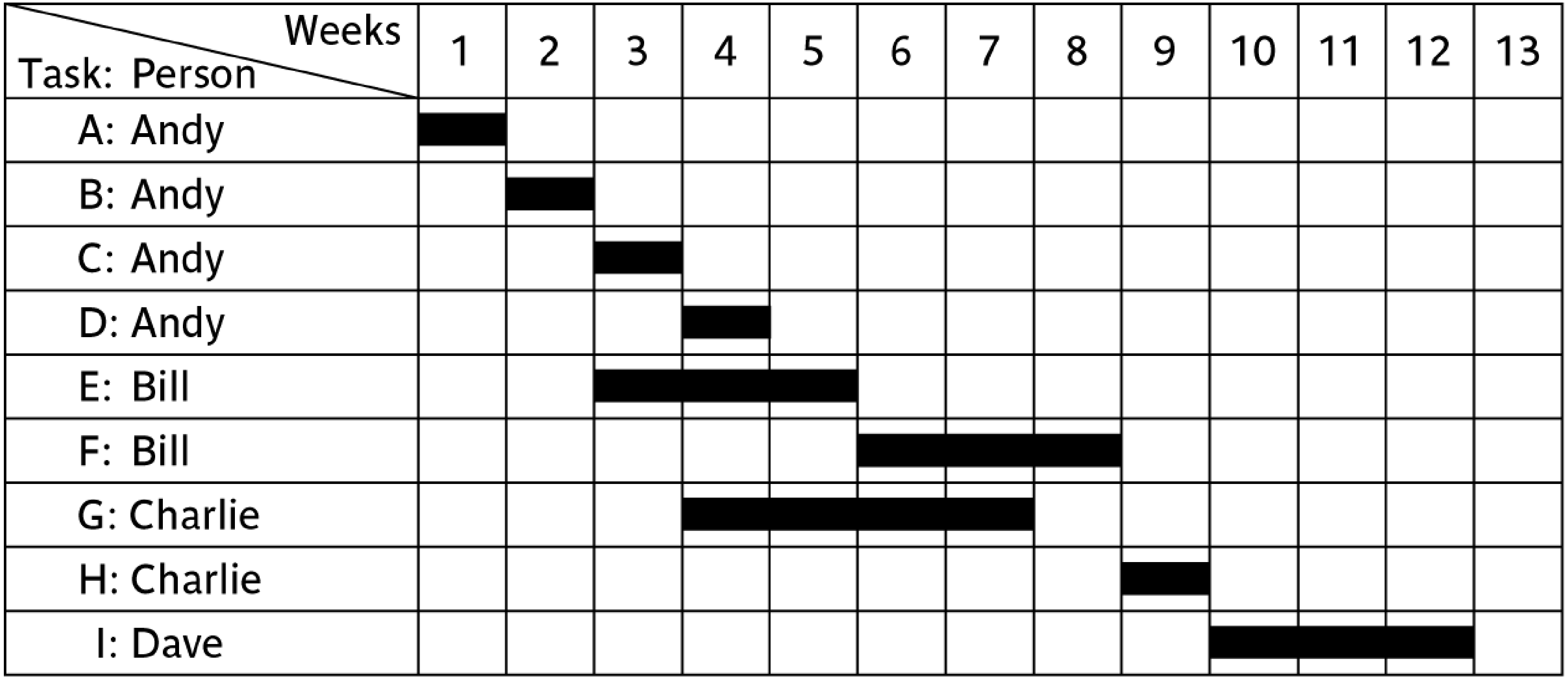
Simple sequencing

- A simple *sequencing* of the tasks and the responsible personnel taken into account of the resources

- Easily presented in a simple bar chart

- Suitable for allocating individuals to particular tasks at an early stage

A project plan as a bar chart



Weeks Task: Person	1	2	3	4	5	6	7	8	9	10	11	12	13
A: Andy	■												
B: Andy		■											
C: Andy			■										
D: Andy				■									
E: Bill			■	■	■								
F: Bill						■	■	■					
G: Charlie				■	■	■	■						
H: Charlie									■				
I: Dave										■	■	■	

Activity key

A: Overall design
B: Specify module 1
C: Specify module 2
D: Specify module 3
E: Code module 1
F : Code module 3
G : Code module 2
H: Integration testing
I : System tesing

Note: The chart tells us who is doing what and when.

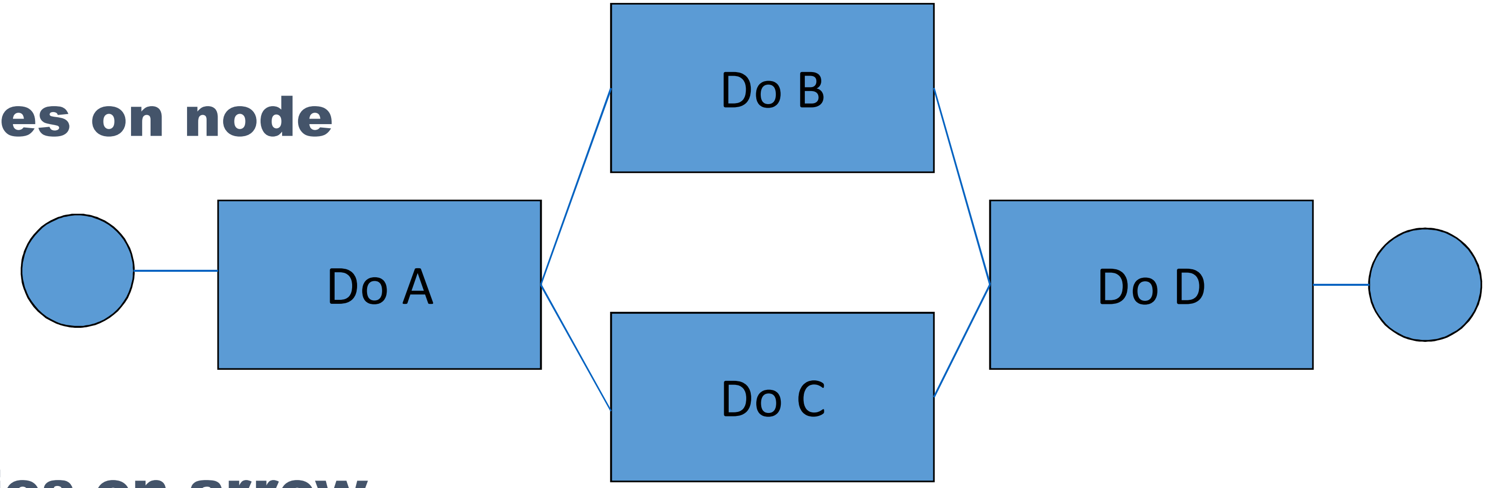
Precedence Network Models

- Models the project activities and their precedence relationship as a network
- Time flows from left to right
- The most commonly used networking technique:
  - Critical Path Method (CPM)
  - Program Evaluation Review Technique (PERT) – will be considered later

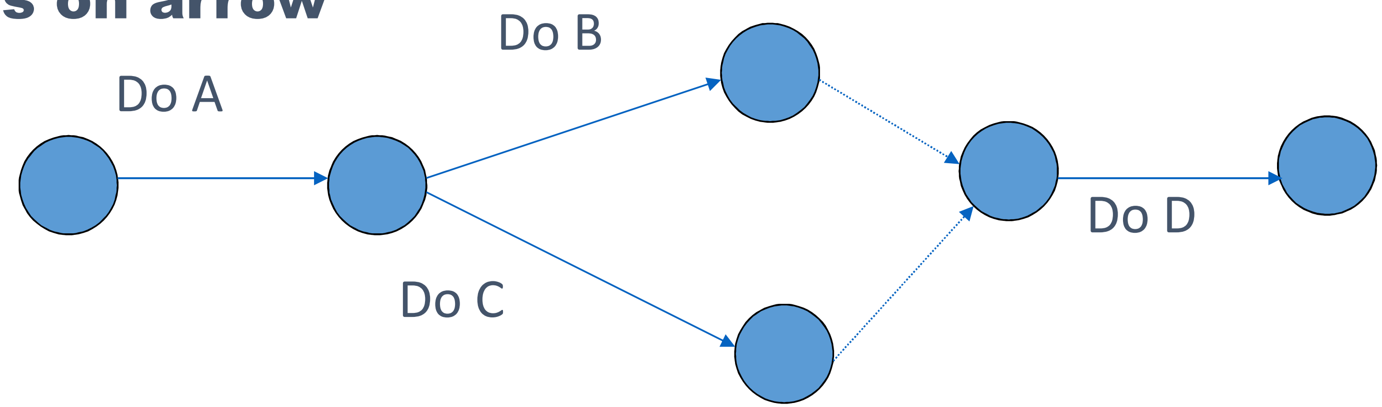
- Both techniques represented in either/or:
  - Activity-on-node (activities are represented as nodes)
  - Activity-on-arrow (activities are drown on arrows)

Precedence Network Notations

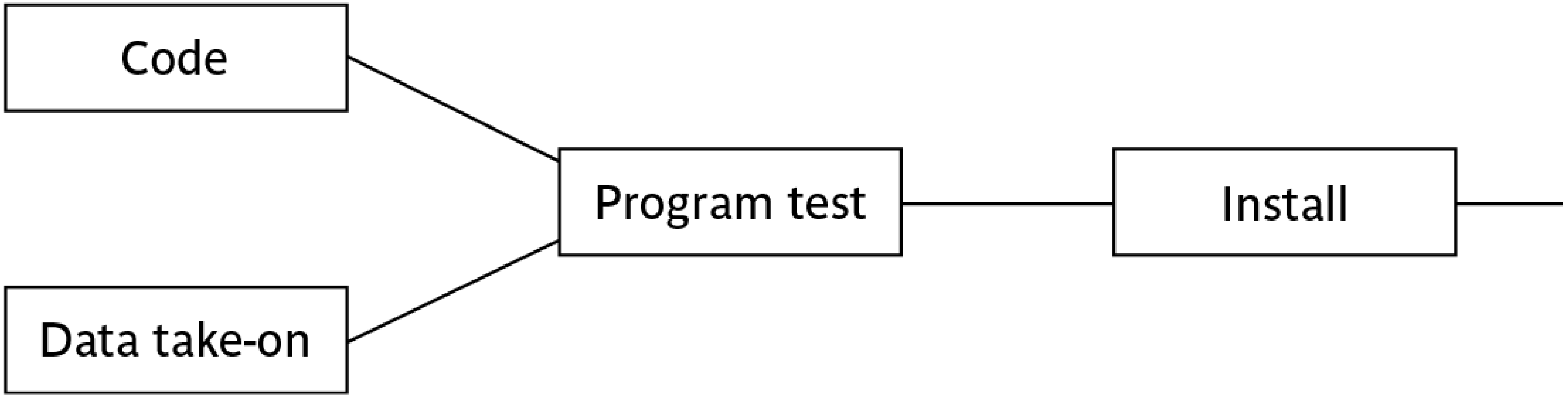
Activities on node



Activities on arrow



Fragment of a Precedence Network (Activity-on-node)



Constructing Precedence Networks: Rules

1. A project network should have only one start node
2. A project network should have only one end node
3. A node has duration
4. Links normally have no duration
5. Precedents are the immediate preceding activities
6. Time moves from left to right
7. A network may not contain loops (see next slides)
8. A network should not contain dangles (see next slides)

Constructing Precedence Networks

7. No looping back is allowed – deal with iterations by hiding them within single activities

✗

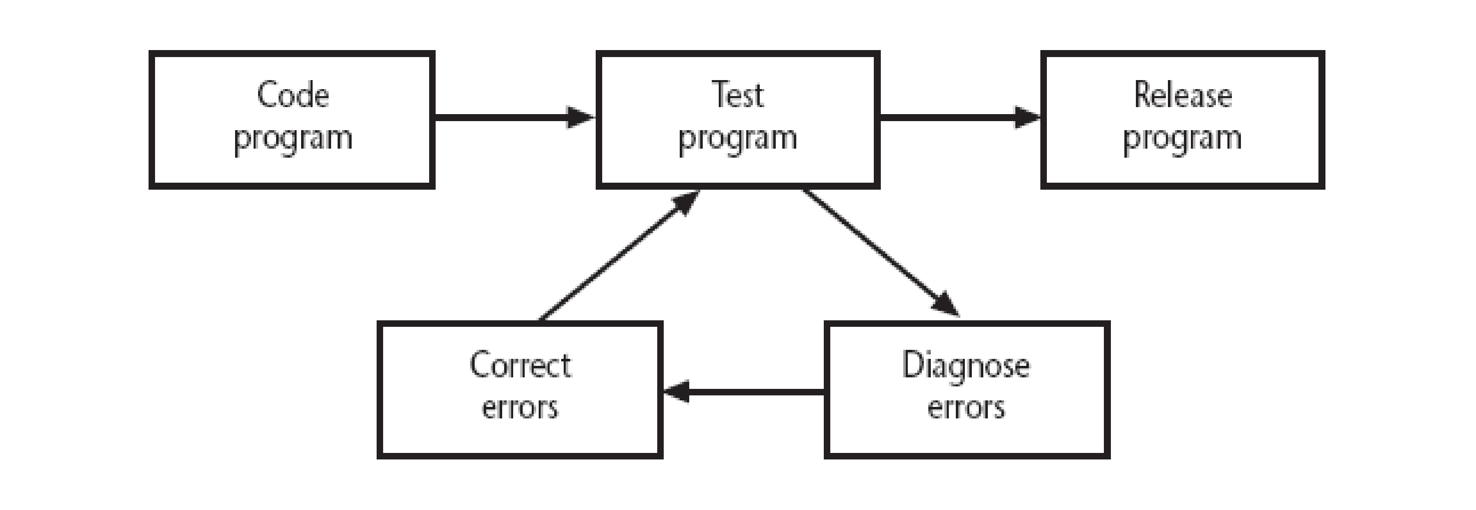


Figure 6.10 A loop represents an impossible sequence

Constructing Precedence Networks

8. A network should not contain dangles

✗

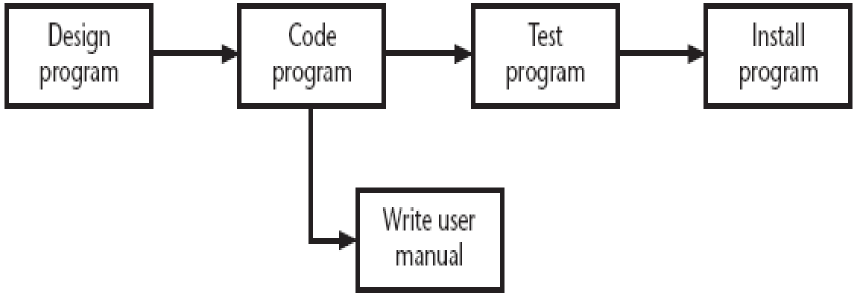


Figure 6.11 A dangle

✓

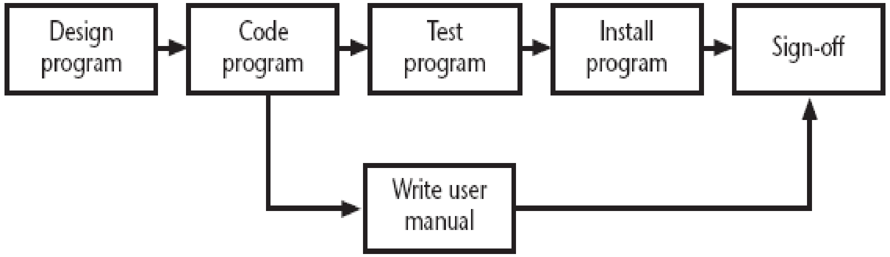
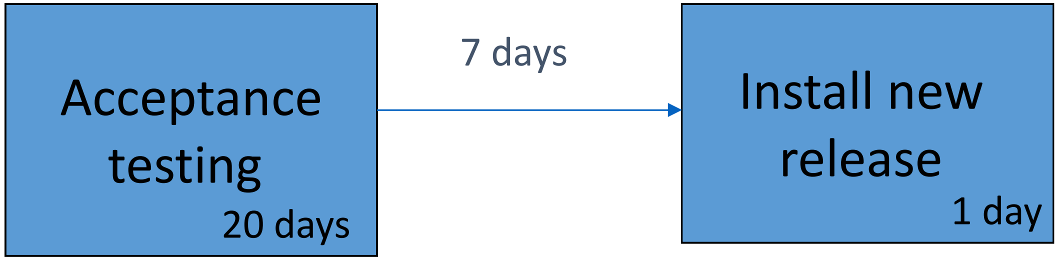


Figure 6.12 Resolving the dangle

Lagged activities

- Where there is a fixed delay between activities e.g. seven days notice has to be given to users that a new release has been signed off and is to be installed



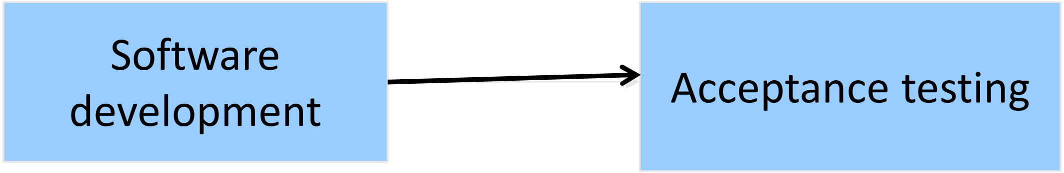
Acceptance testing
20 days

7 days

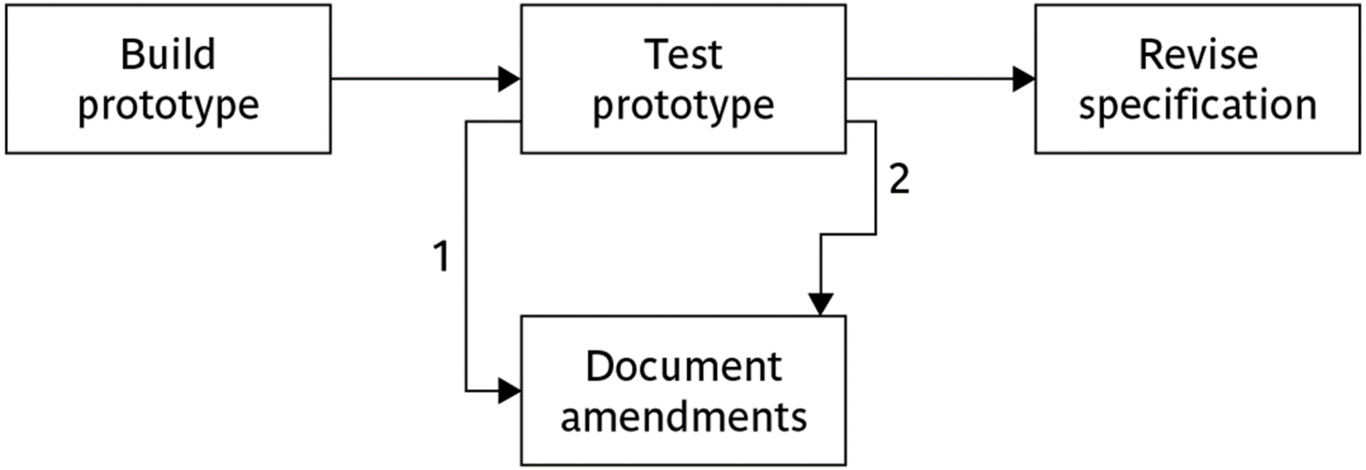
Install new release
1 day

Types of links between activities

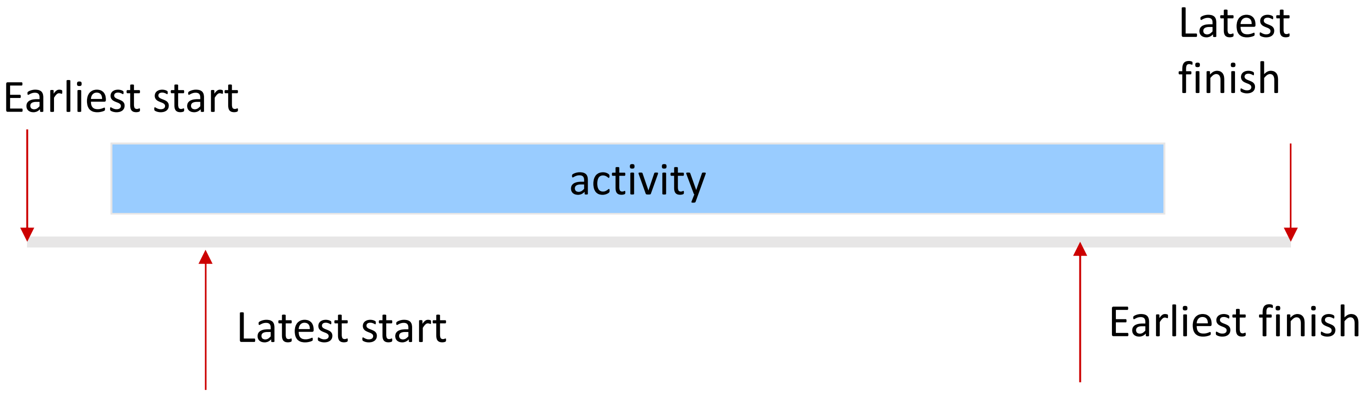
- Finish to start



- Start to start/ Finish to finish



Start and finish times of activity

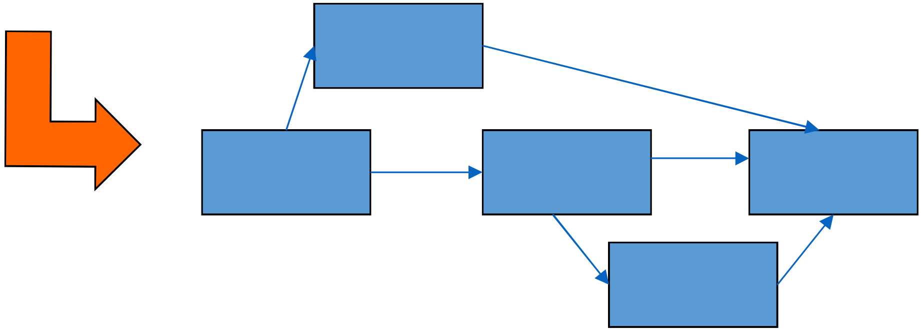


- Earliest start (ES)
- Earliest finish (EF) = ES + duration
- Latest finish (LF) = latest task can be completed without affecting project end
- Latest start = LF - duration

Labelling conventions

British Standard BS4335

Earliest start	Duration	Earliest finish
Activity label, activity description		
Latest start	Float	Latest finish



Example

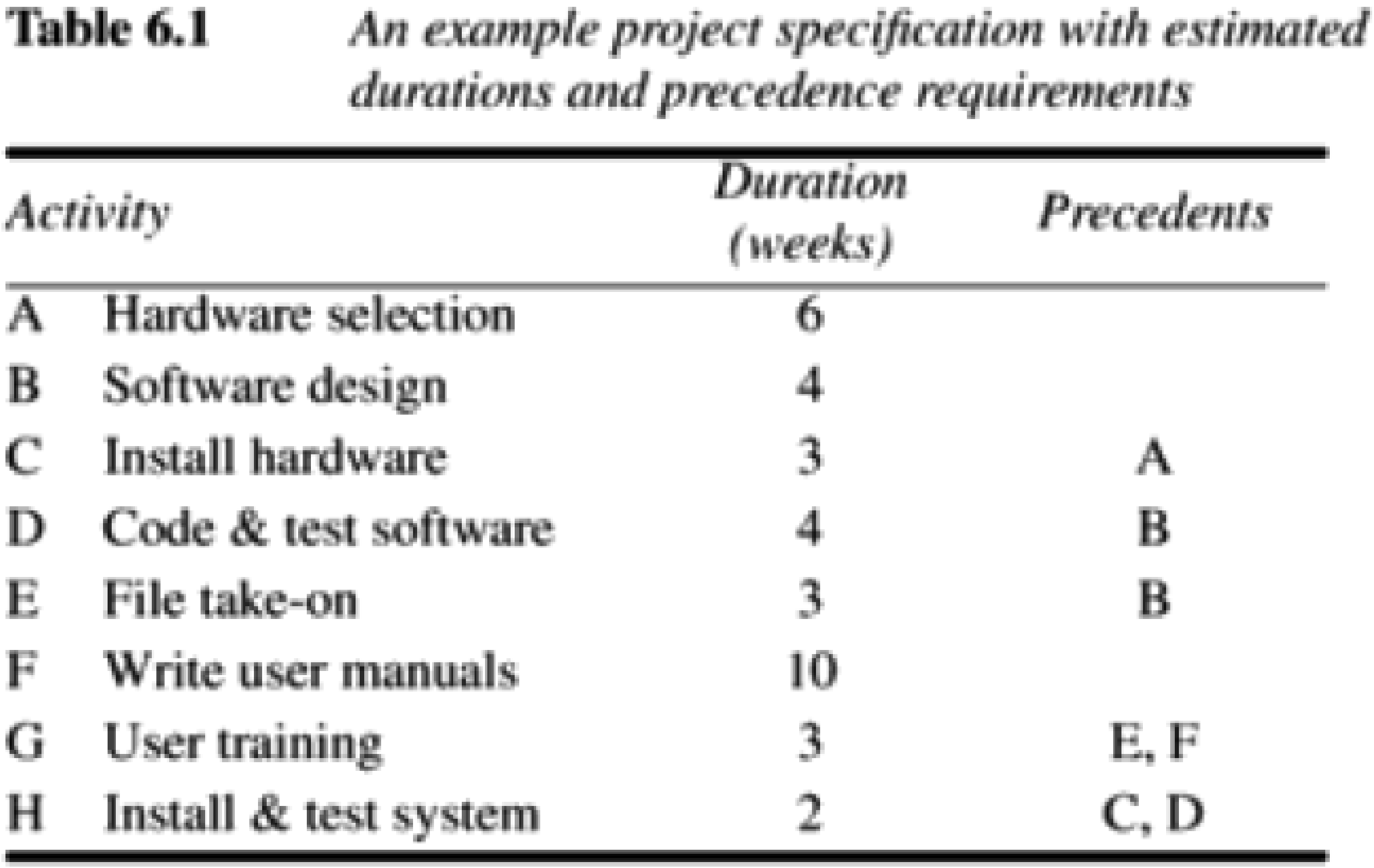
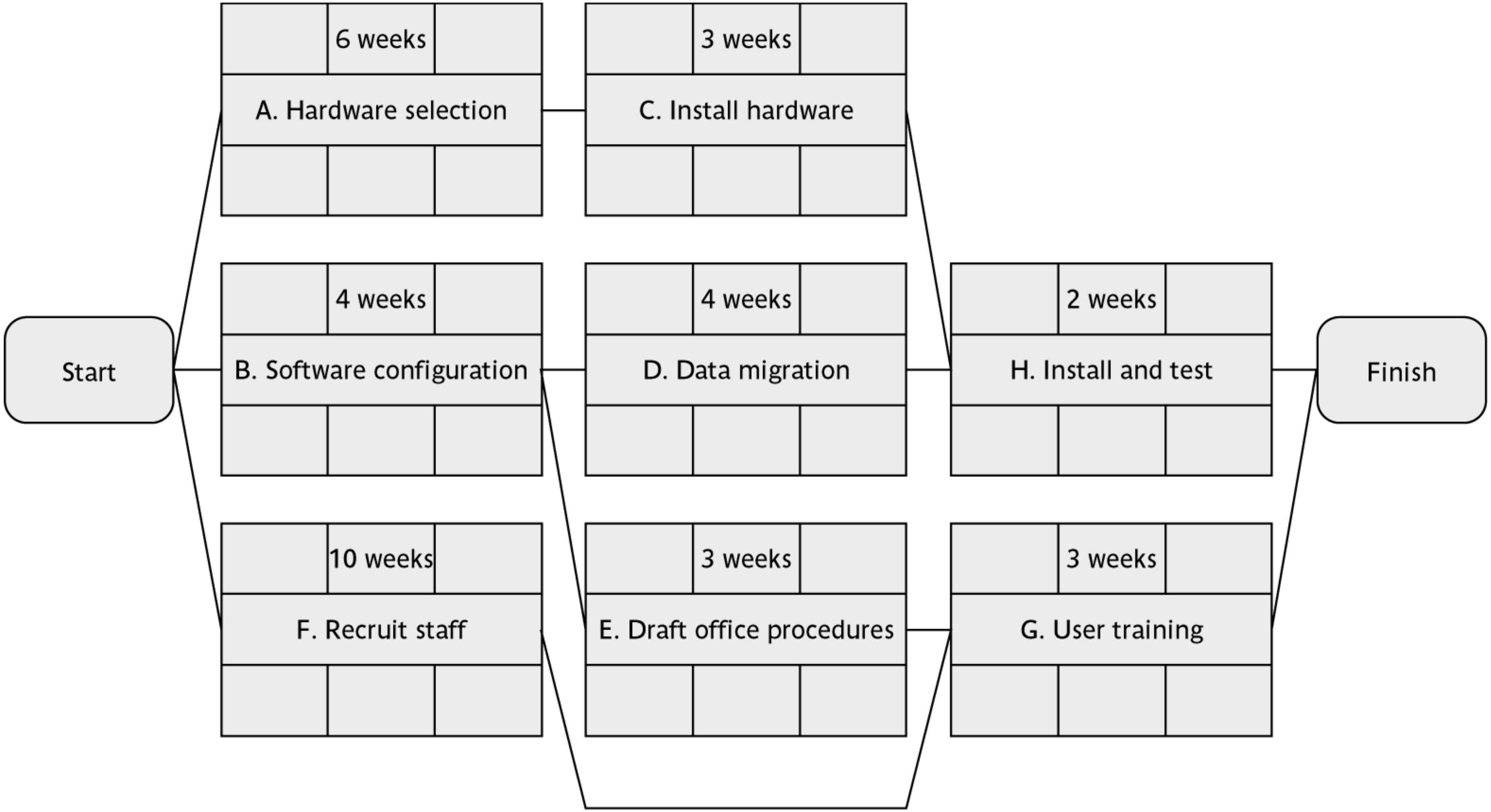


Table 6.1 *An example project specification with estimated activity durations and precedence requirements*

Activity		*Duration (weeks)*	*Precedents*
A	Hardware selection	6	
B	Software design	4	
C	Install hardware	3	A
D	Code & test software	4	B
E	File take-on	3	B
F	Write user manuals	10	
G	User training	3	E, F
H	Install & test system	2	C, D

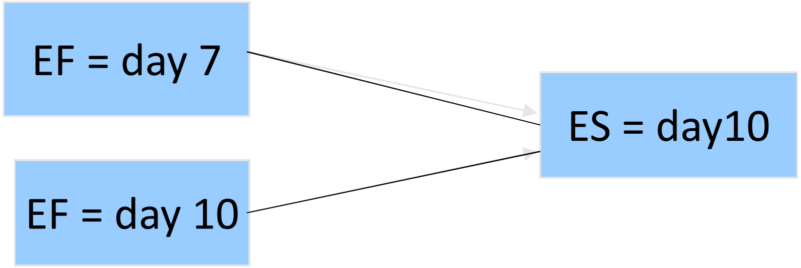
The activity network for the example



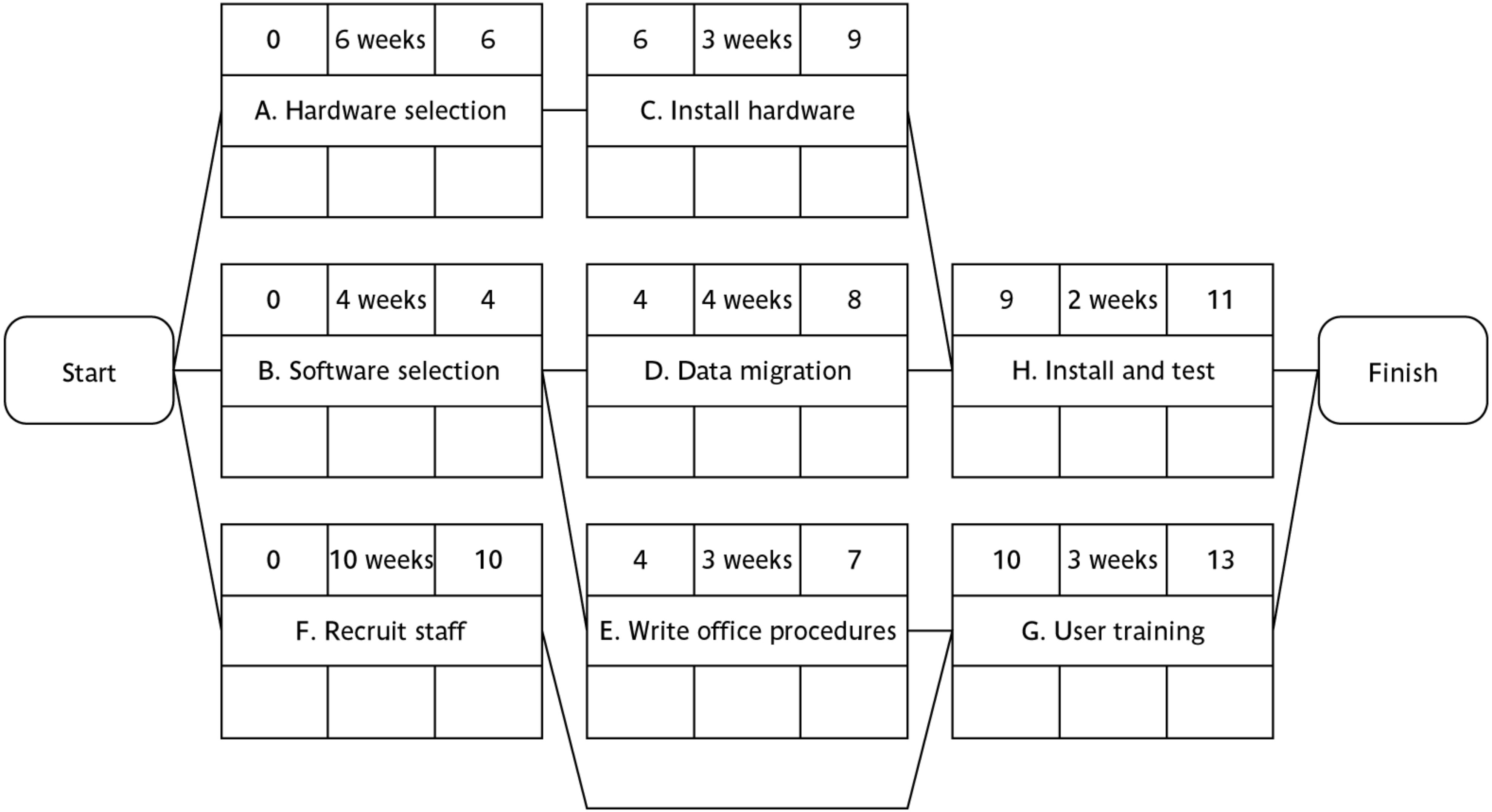
The Forward Pass

- Calculate the earliest date on which each activity may be started (ES) and completed (EF).
  - *ES = EF for the previous*
  - *EF = ES + Duration*

- When there is more than one previous activity, take the *latest* earliest finish



The network after the forward pass

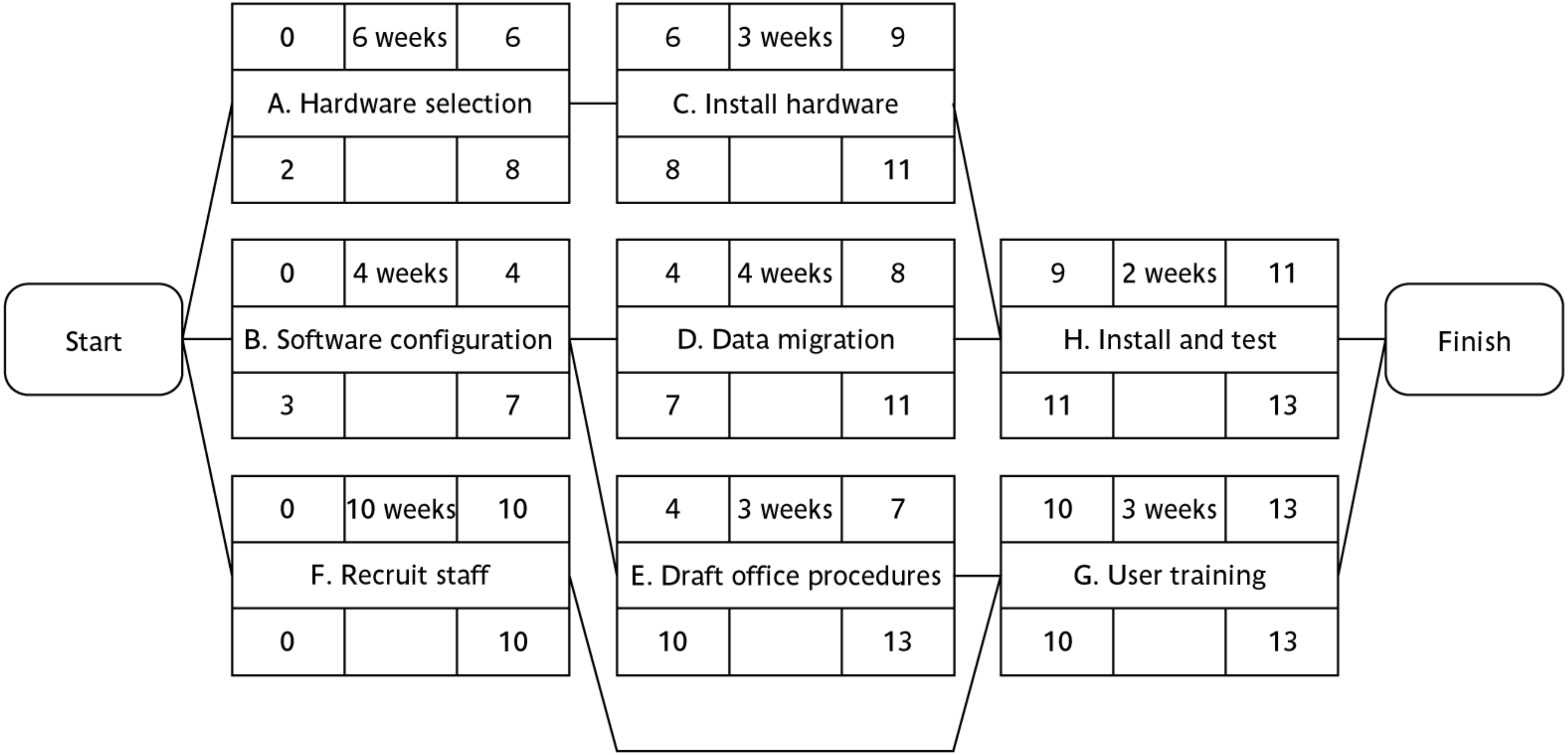


The Backward Pass

Calculate the latest date at which each activity may be started (LS) and finished (LF) without delaying the end date of the project.

- Start from the *last* activity
- Latest finish (LF) for last activity = earliest finish (EF) for the *preceding*
- Work backwards
- Latest finish for *current* activity = Latest start for the *following*
- More than one following activity - take the *earliest* LS
- Latest start (LS) = LF for activity - duration

The network after the backward pass



Start

0 | 6 weeks | 6
A. Hardware selection
2 | | 8

6 | 3 weeks | 9
C. Install hardware
8 | | 11

0 | 4 weeks | 4
B. Software configuration
3 | | 7

4 | 4 weeks | 8
D. Data migration
7 | | 11

9 | 2 weeks | 11
H. Install and test
11 | | 13

0 | 10 weeks | 10
F. Recruit staff
0 | | 10

4 | 3 weeks | 7
E. Draft office procedures
10 | | 13

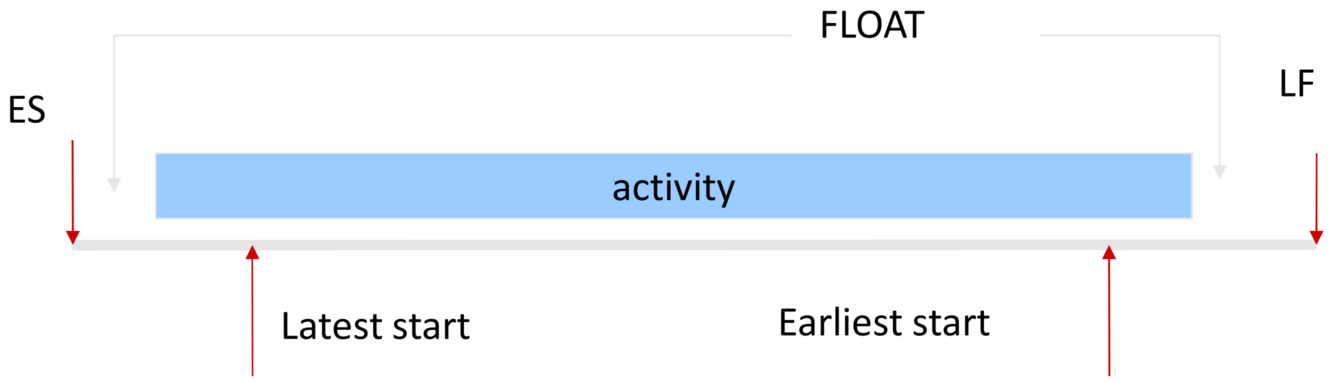
10 | 3 weeks | 13
G. User training
10 | | 13

Finish

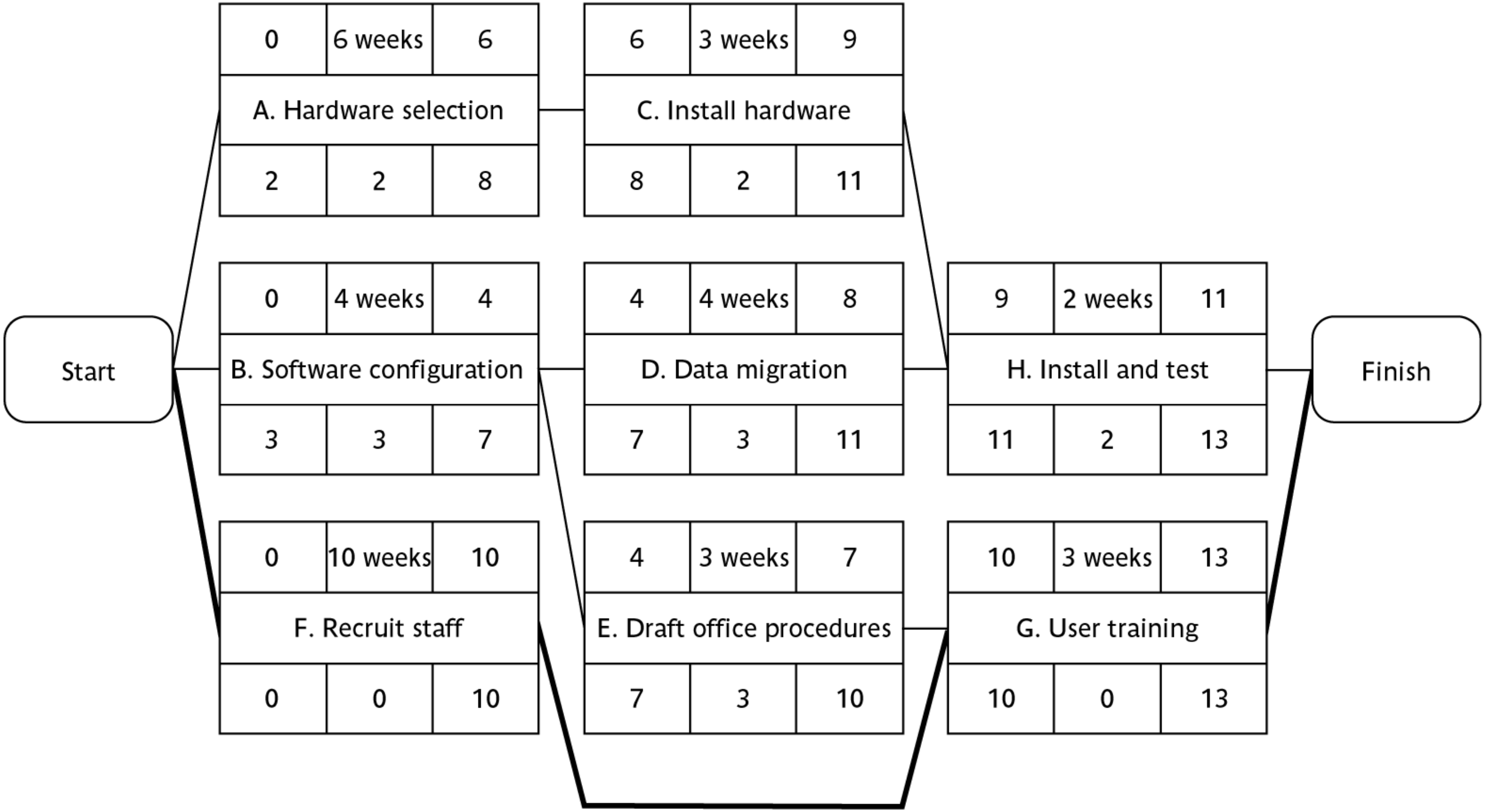
Float

How much the start or completion date of an activity may be delayed without affecting the end date of the project

Float = Latest Finish – Earliest Start - Duration



The network example with floats



Start

0	6 weeks	6
A. Hardware selection		
2	2	8

6	3 weeks	9
C. Install hardware		
8	2	11

0	4 weeks	4
B. Software configuration		
3	3	7

4	4 weeks	8
D. Data migration		
7	3	11

9	2 weeks	11
H. Install and test		
11	2	13

0	10 weeks	10
F. Recruit staff		
0	0	10

4	3 weeks	7
E. Draft office procedures		
7	3	10

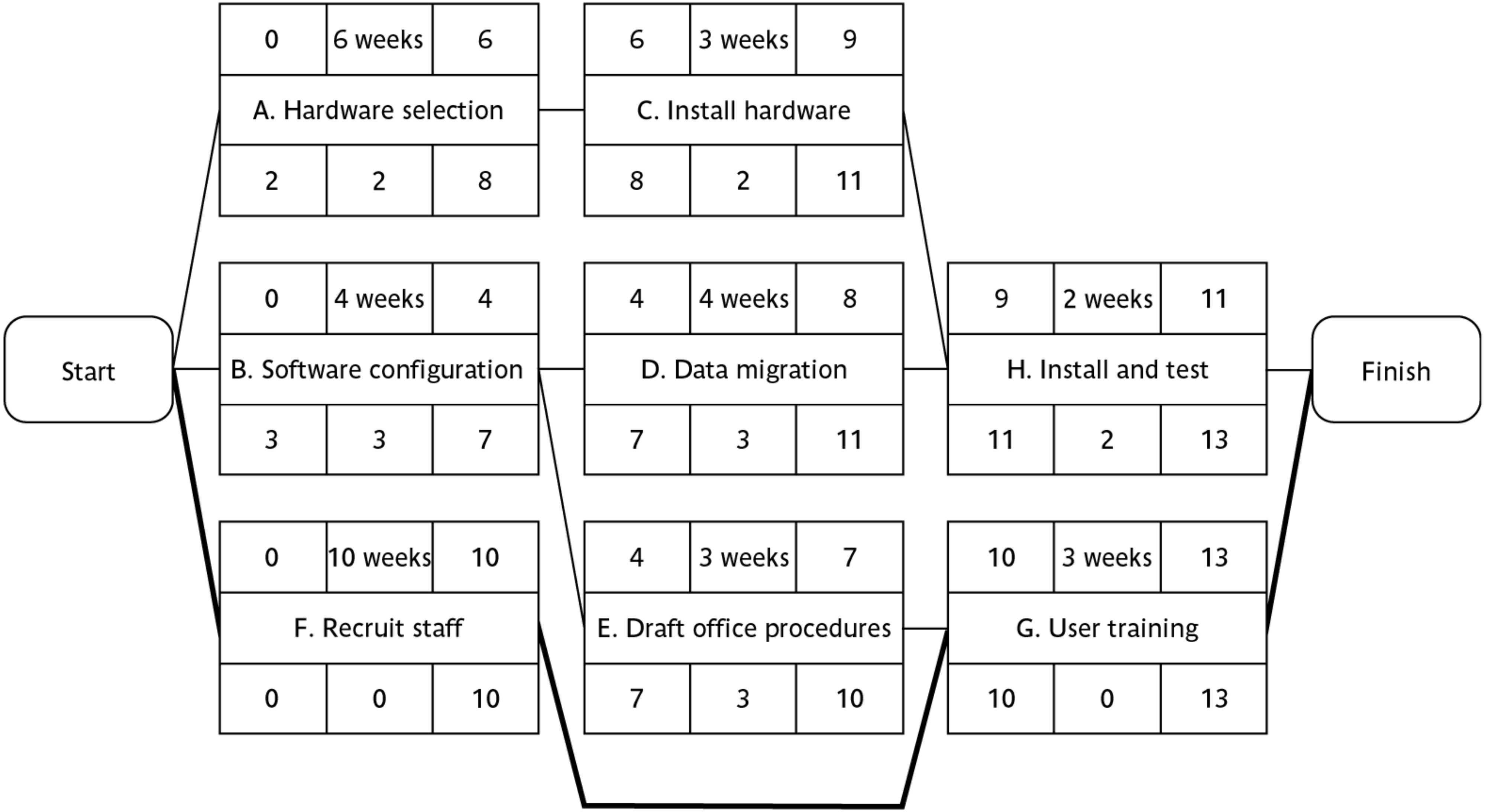
10	3 weeks	13
G. User training		
10	0	13

Finish

Critical Path

- Any delay in an activity on this path will delay the whole project
- The path through network with zero floats
- Sub-critical paths
  - chains of activities, not on the planned critical path, but with small floats

The Critical Path



Start

0	6 weeks	6
A. Hardware selection		
2	2	8

6	3 weeks	9
C. Install hardware		
8	2	11

0	4 weeks	4
B. Software configuration		
3	3	7

4	4 weeks	8
D. Data migration		
7	3	11

9	2 weeks	11
H. Install and test		
11	2	13

0	10 weeks	10
F. Recruit staff		
0	0	10

4	3 weeks	7
E. Draft office procedures		
7	3	10

10	3 weeks	13
G. User training		
10	0	13

Finish

The significance of the Critical Path

- ***In managing:*** Paying attention to monitoring its activities
- ***In planning:*** It is the critical path that we must shorten if we want to reduce the overall duration of the project

Example

- earliest start = day 5
- latest finish = day 30
- duration = 10 days

- earliest finish = ?
- latest start = ?

The earliest finish (EF) would be day 5 plus 10 days i.e. day 15.
The latest start (LS) would be day 30 – 10 days i.e. day 20

Span = LF - ES
Float = LF - ES – duration

- Float = 30 – 5 – 10 = 15 days
- This also is the same as LF – EF or LS - ES

Critical Path Method (CPM) - 1

- Developed by Du Pont Chemical Company and published in 1958
- Primary objectives:
  - Planning the project so that it can be completed as quickly as possible
  - Identifying those activities where their delays is likely to affect the overall project completion date

Critical Path Method - 2

- Capturing the activities and their inter-relationships using a graph
  - Nodes and lines are used to represent the activities and the start and stop
- Adding time dimension
  - The forward pass
  - The backward pass
- Identifying critical path and critical event
  - Critical activity: an activity that has zero float
  - Critical path: a path joining those critical activities

Thank you for your attention

Any questions, please?