



Activity Planning

Lecture 4 by Professor Vladimir Geroimenko

Module “Software Project Management”

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Textbook reference: Chapter 6

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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)



In SPM: **S**tepwise
Project **M**anagement
Method (Described in
detail in Lecture 2)



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 be 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

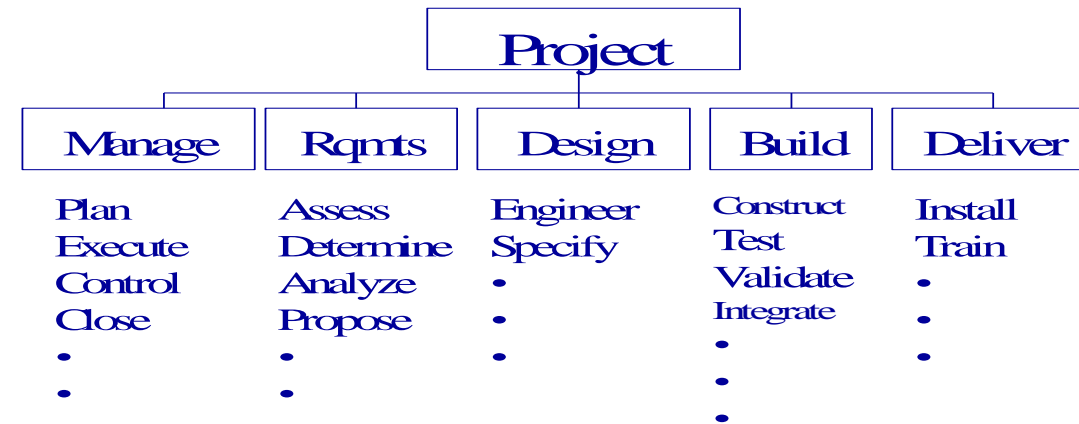
Outline (Indented Format)

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

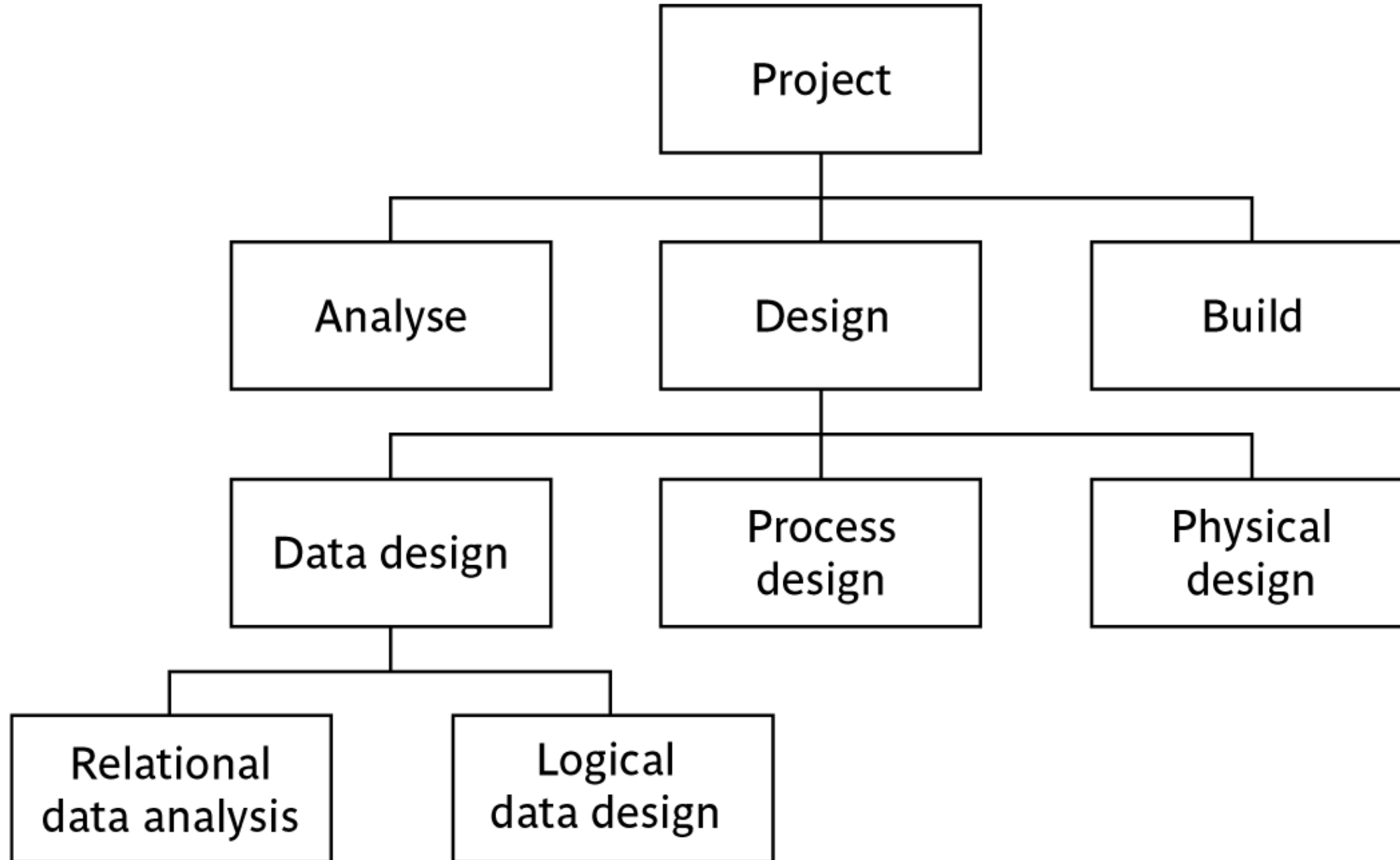


WBS Outline Example

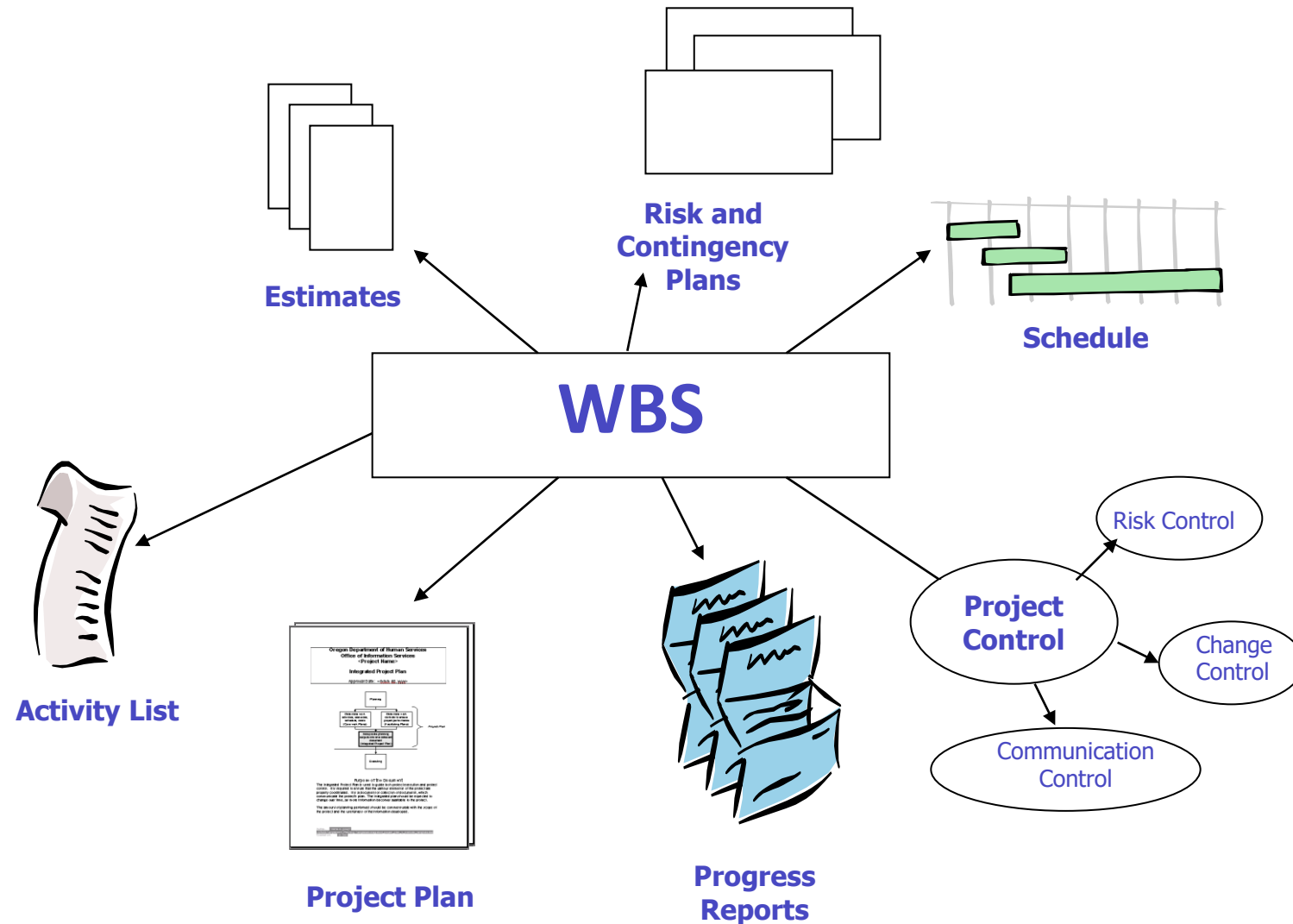
- 0.0 Retail Web Site
 - 1.0 Project Management
 - 2.0 Requirements Gathering
 - 3.0 Analysis & Design
 - 4.0 Site Software Development
 - 4.1 HTML Design and Creation
 - 4.2 Backend Software
 - 4.2.1 Database Implementation
 - 4.2.2 Middleware Development
 - 4.2.3 Security Subsystems
 - 4.2.4 Catalog Engine
 - 4.2.5 Transaction Processing
 - 4.3 Graphics and Interface
 - 4.4 Content Creation
 - 5.0 Testing and Production



WBS Graphical Tree Example

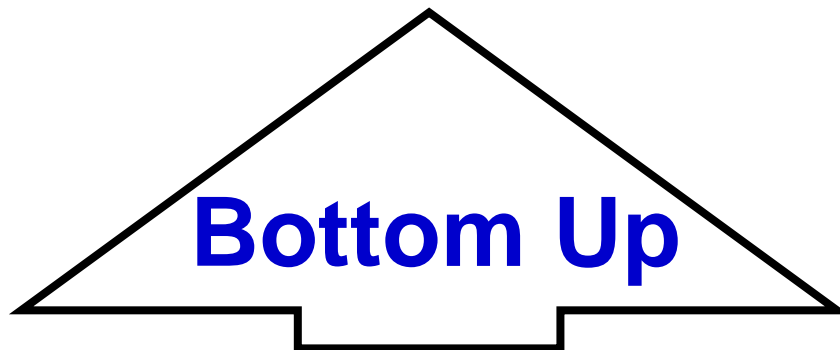


Benefits of the WBS



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 of 2

- 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 of 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

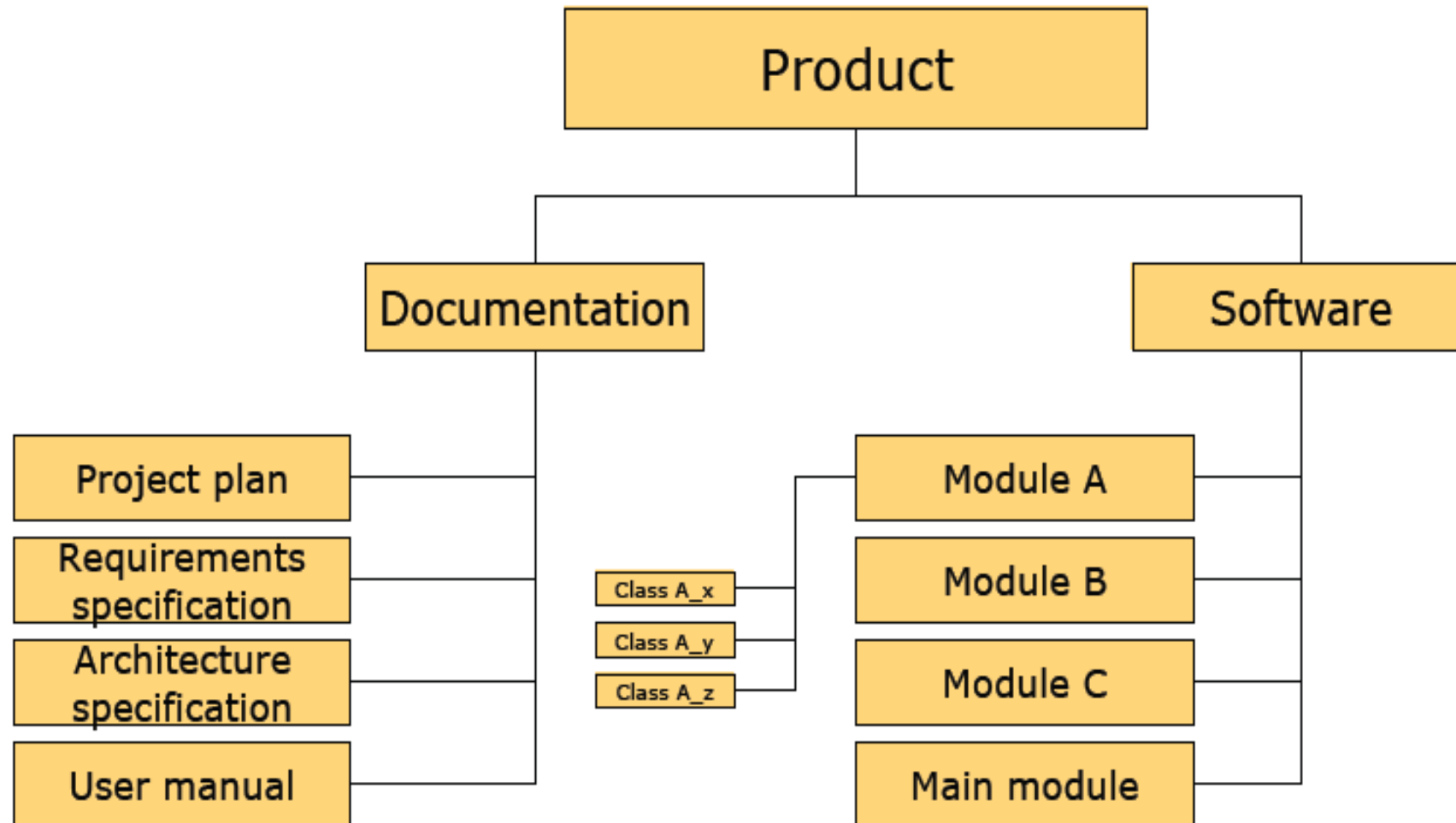
- List the deliverable and intermediate products of project
- Identify the order in which products have to be created
- Work out the activities needed to create the products
- Create **Product Breakdown Structure (PBS)**

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



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')



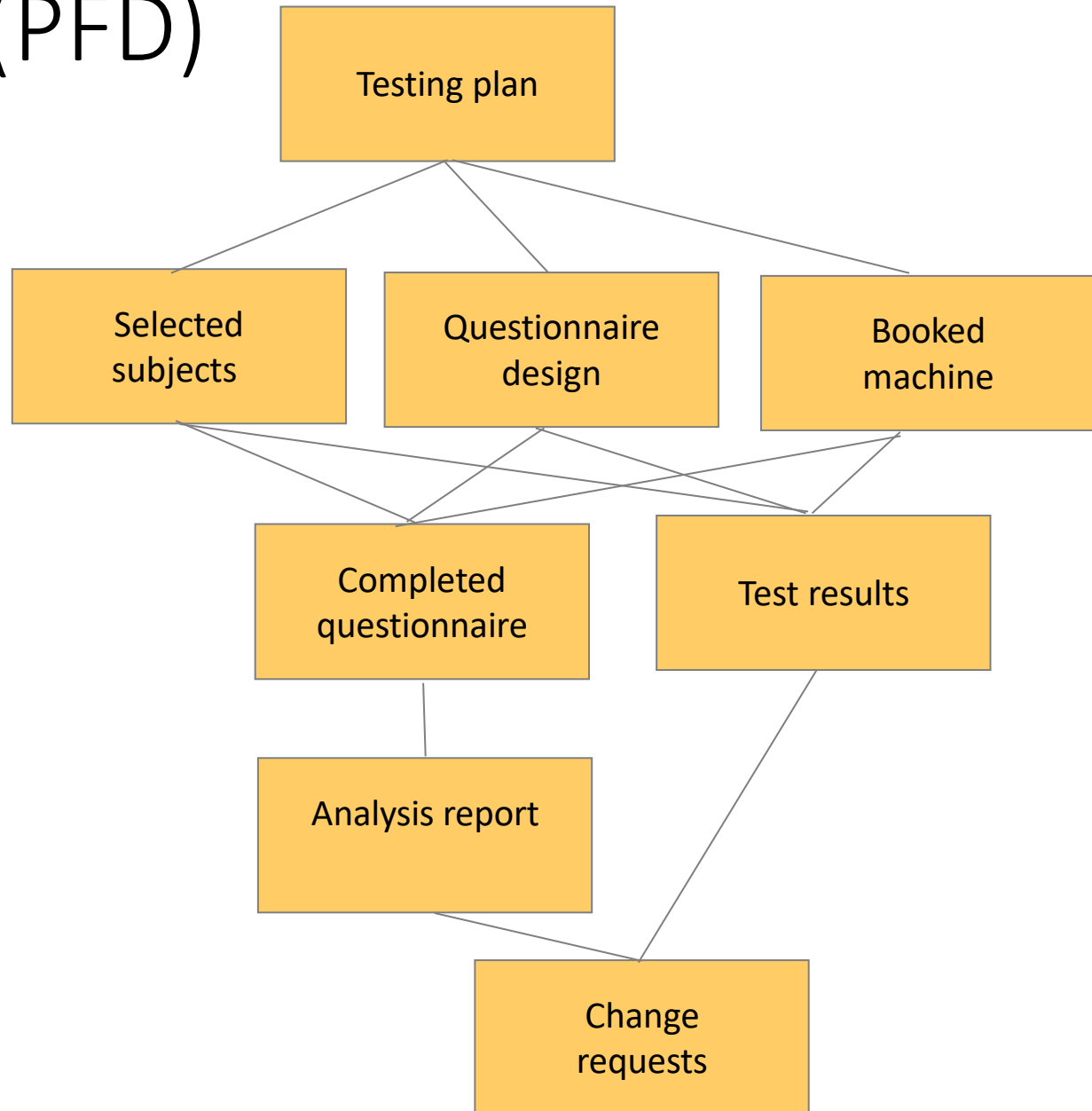
What is a Product?

- 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



The Hybrid Approach

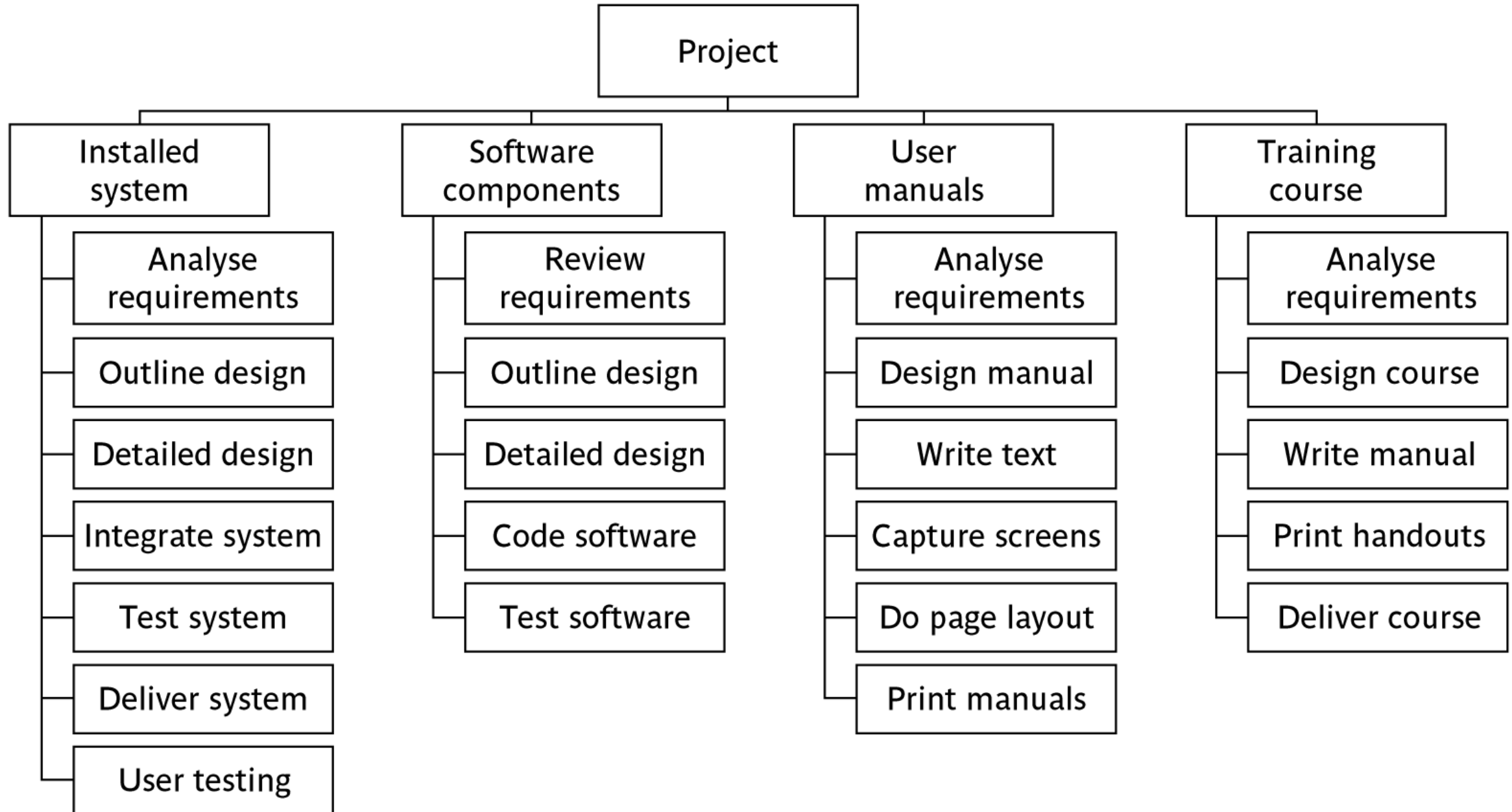
This approach structures both products and activities (i.e. PBS + WBS)

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**.

schedule¹ S2 W3 AC

/ˈʃedju:l, 'ske- \$ 'skedʒʊl, -dʒəl/

noun [countable]



1 a plan of what someone is going to do and when they are going to do it:

on schedule (= at the planned time)




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

se·quenc·ing AC 

/ˈsiːkwənsɪŋ/

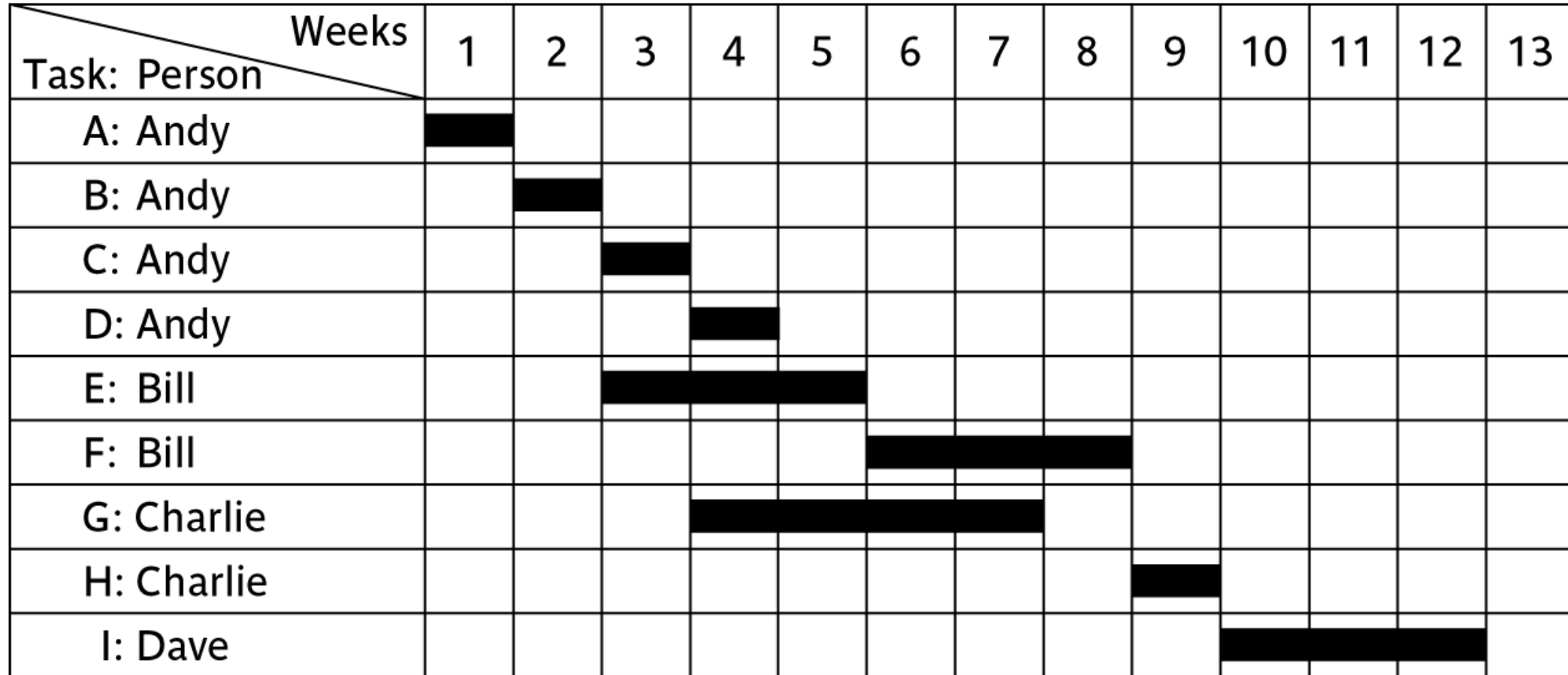
noun [uncountable] (formal) UK US

when things are arranged in an order, especially events or actions

SYN ordering



A project plan as a bar chart



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 drawn on arrows)

pre·ce·dence AC

/ˈpresɪdəns/

noun [uncountable]



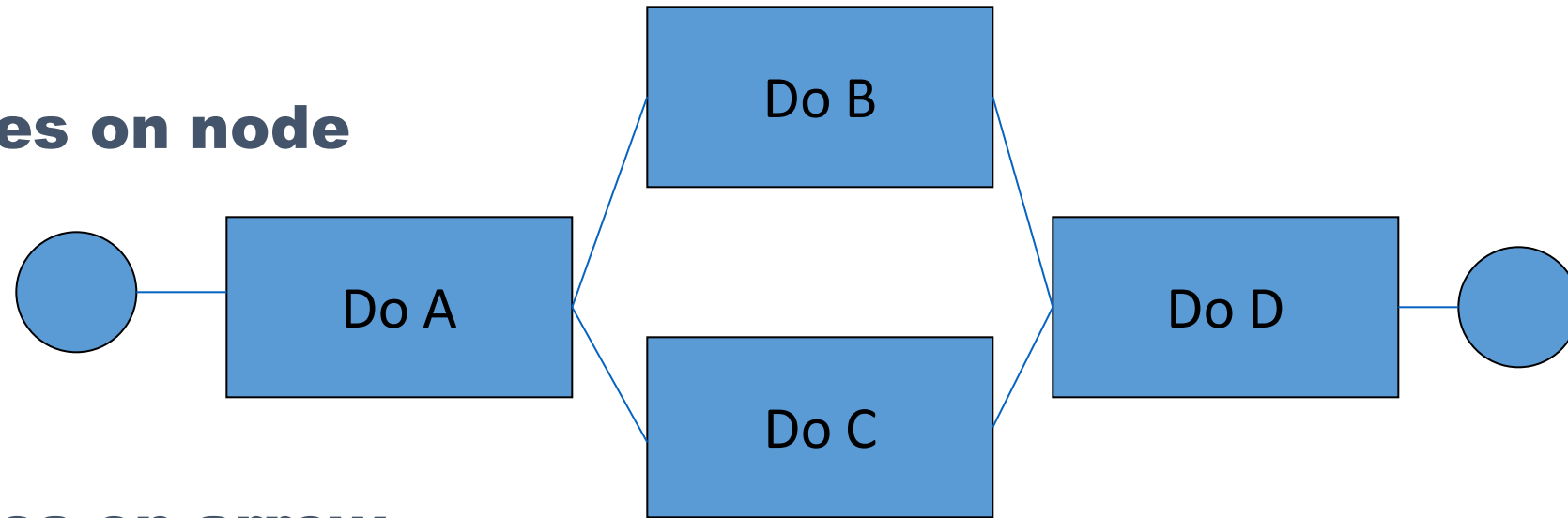
when someone or something is considered to be more important than someone or something else, and therefore comes first or must be dealt with first

SYN **priority**:

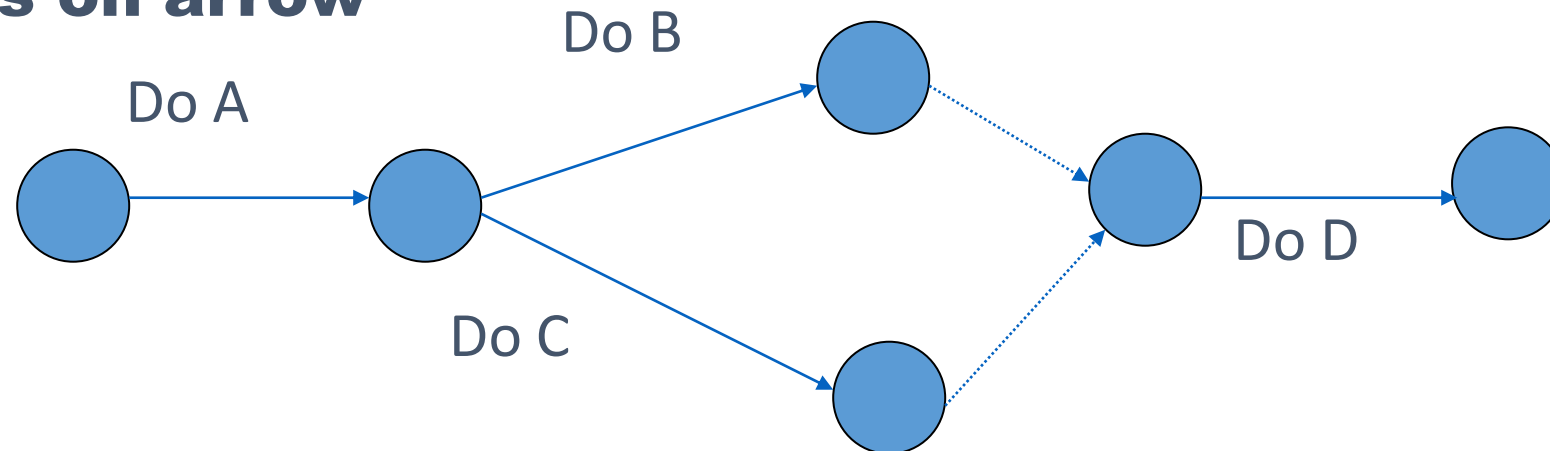


Precedence Network Notations

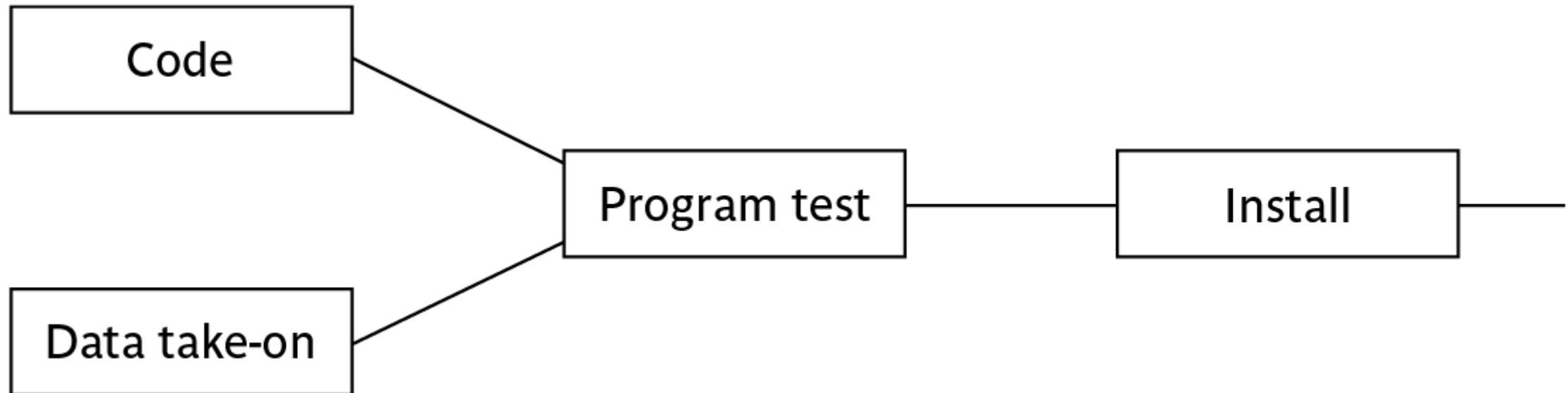
Activities on node



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

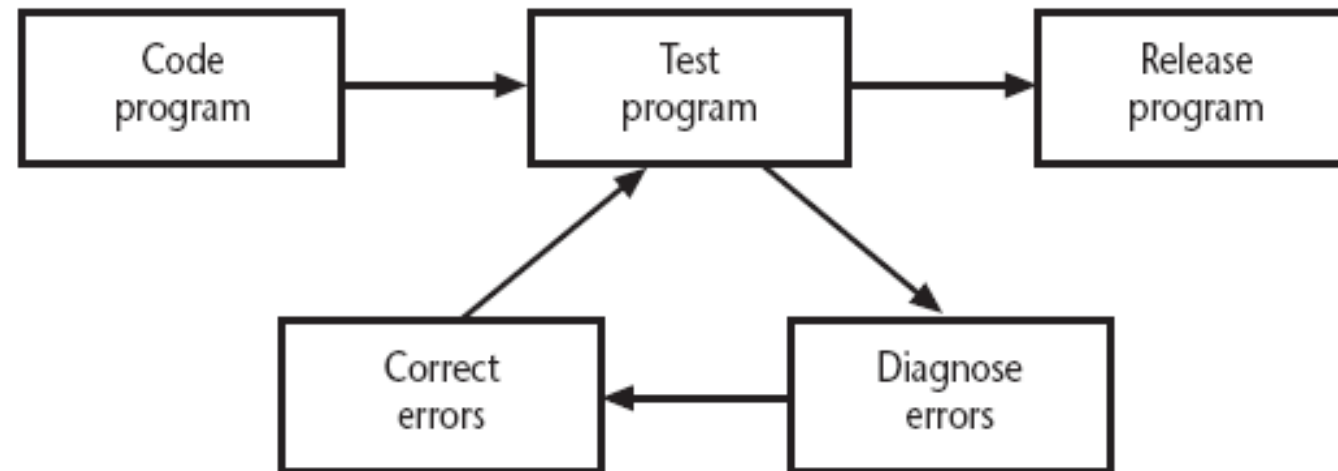


Figure 6.10 A loop represents an impossible sequence

Constructing Precedence Networks

8. A network should not contain dangles

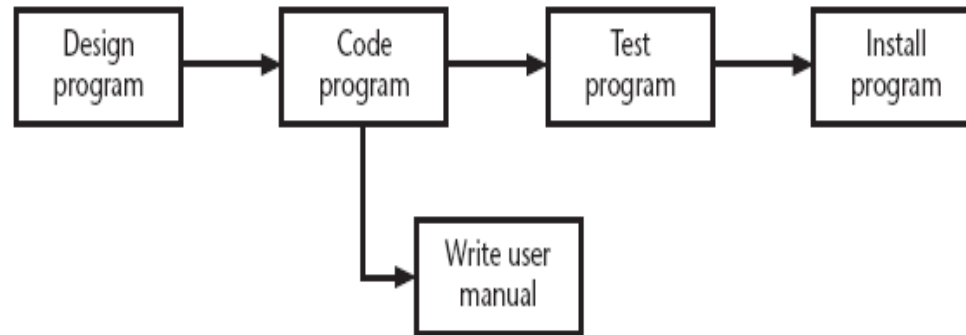


Figure 6.11 A dangle

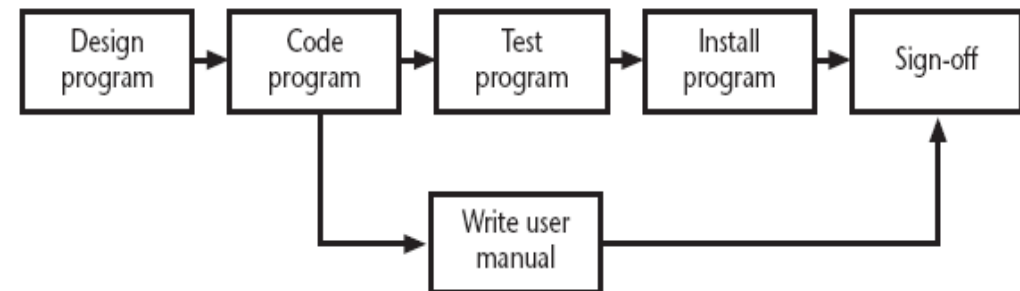
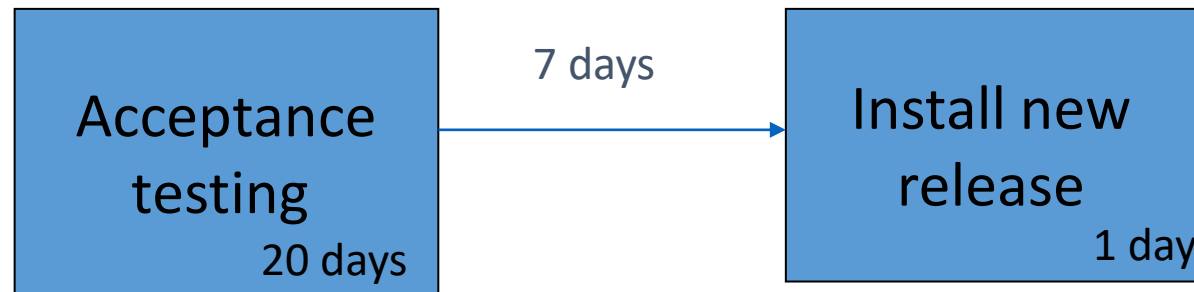


Figure 6.12 Resolving the dangle

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



Start and finish times of activity

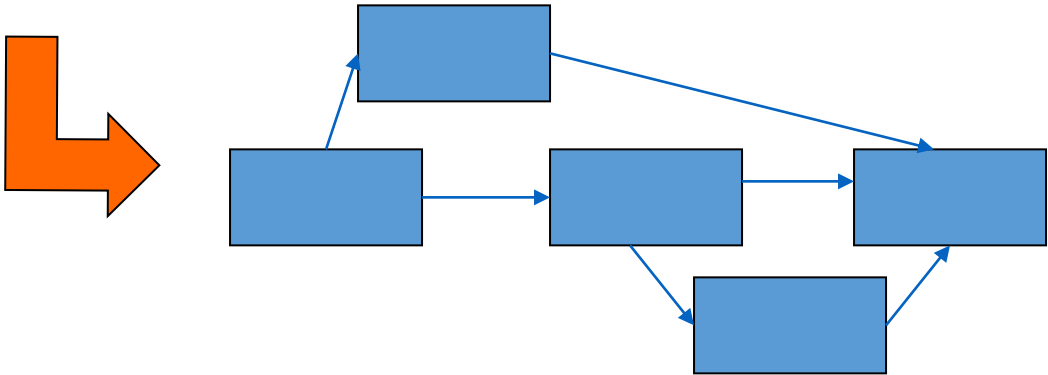


- Earliest start (ES)
- Earliest finish (EF) = ES + duration
- Latest finish (LF) = latest task can be completed without affecting project end
- Latest start = LF - duration

Labelling conventions

British Standard
BS4335

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

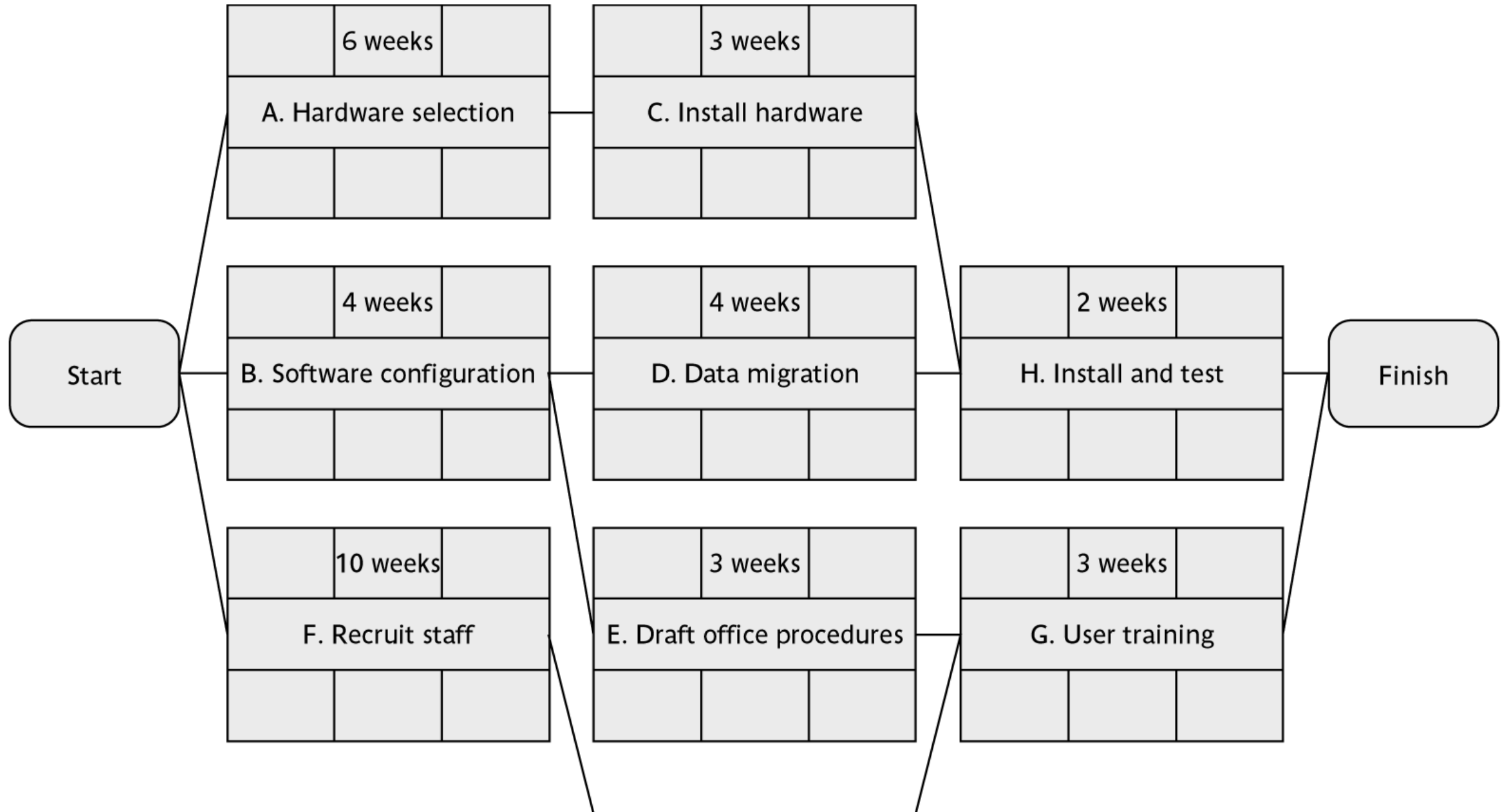


Example

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

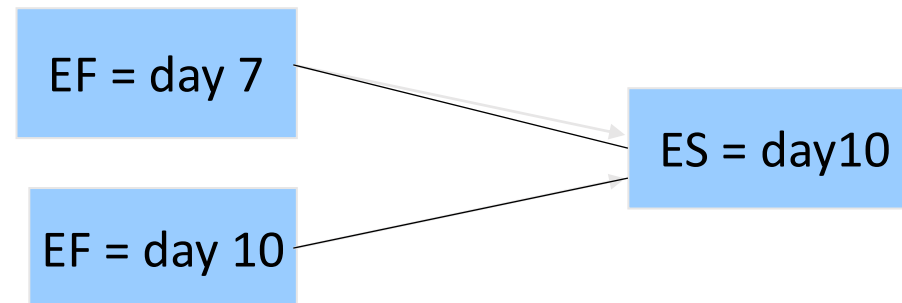
<i>Activity</i>		<i>Duration (weeks)</i>	<i>Precedents</i>
A	Hardware selection	6	
B	Software design	4	
C	Install hardware	3	A
D	Code & test software	4	B
E	File take-on	3	B
F	Write user manuals	10	
G	User training	3	E, F
H	Install & test system	2	C, D

The activity network for the example

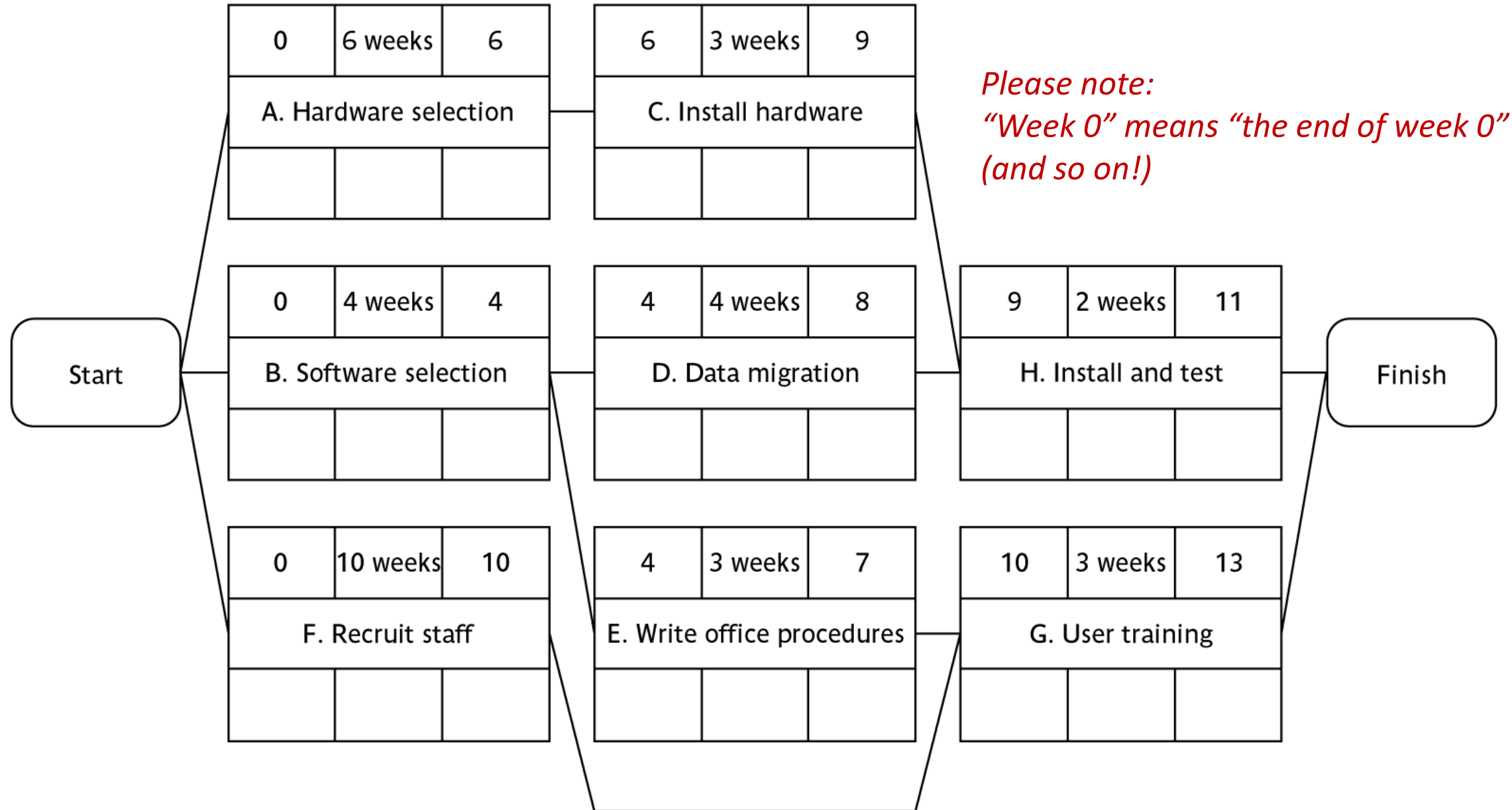


The Forward Pass

- 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



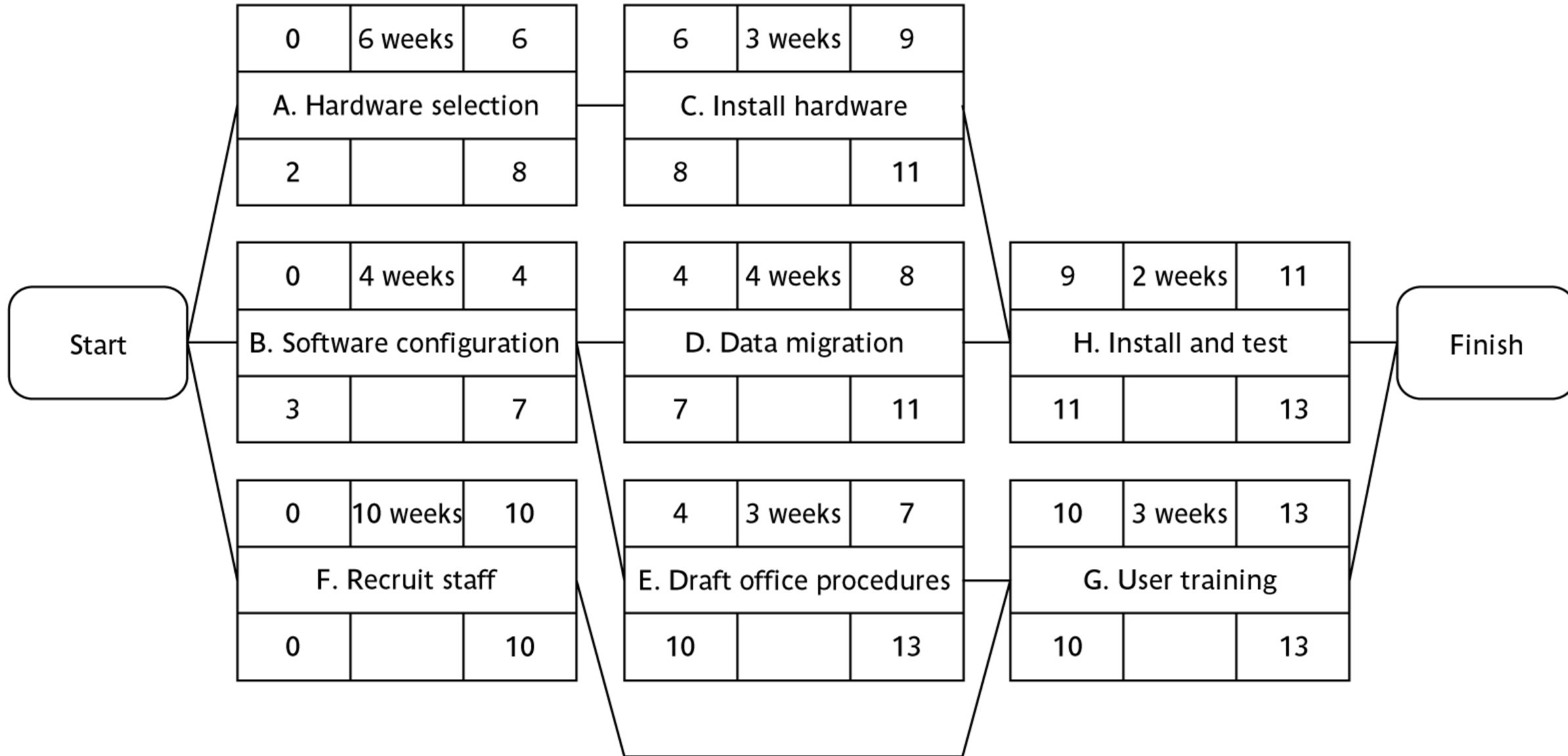
The Backward Pass

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



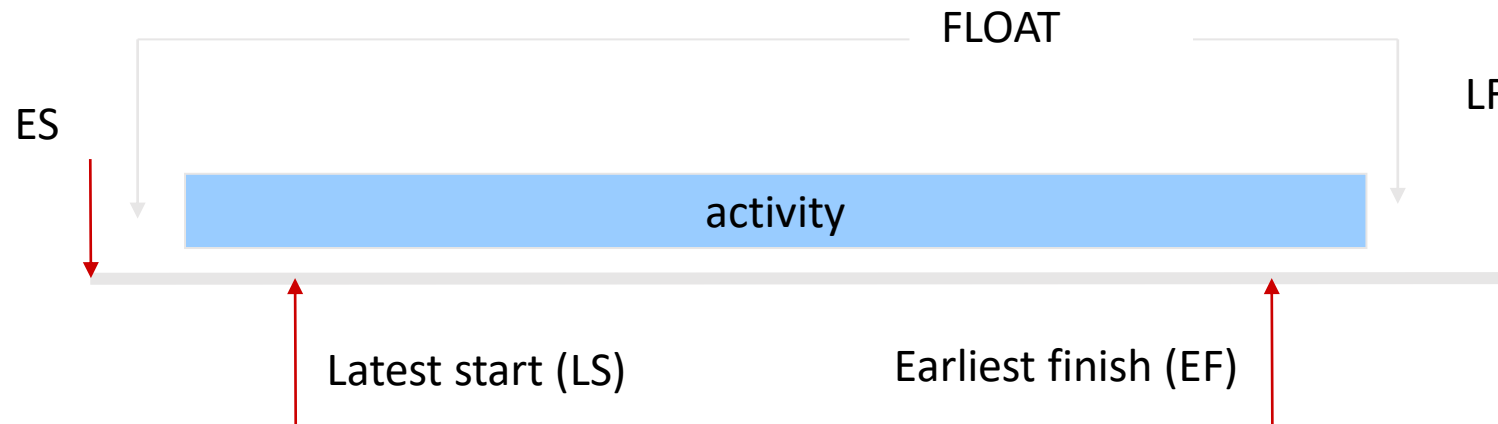
The network after the backward pass



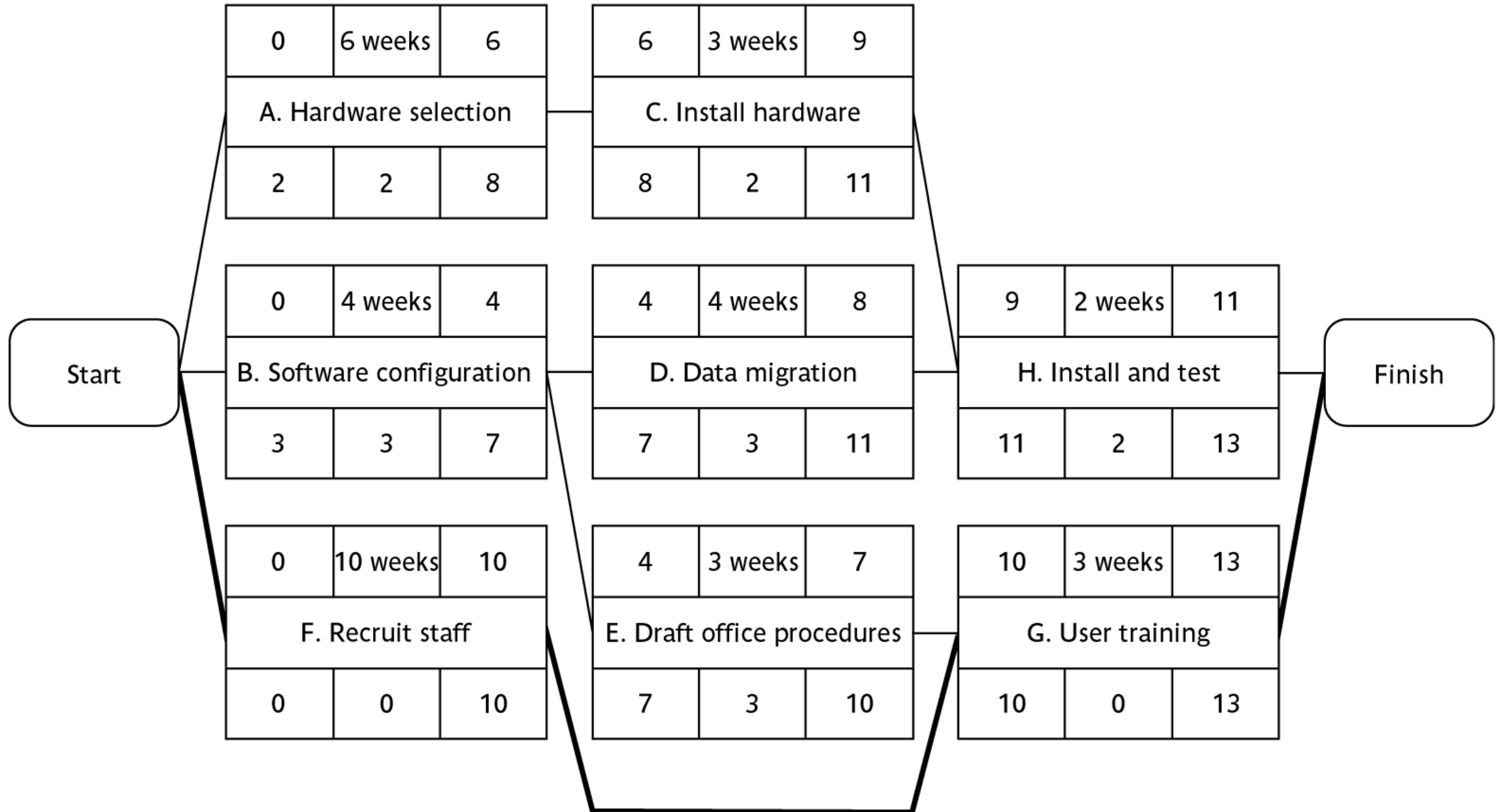
Float

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

$$\text{Float} = \text{Latest Finish} - \text{Earliest Start} - \text{Duration}$$



The network example with floats

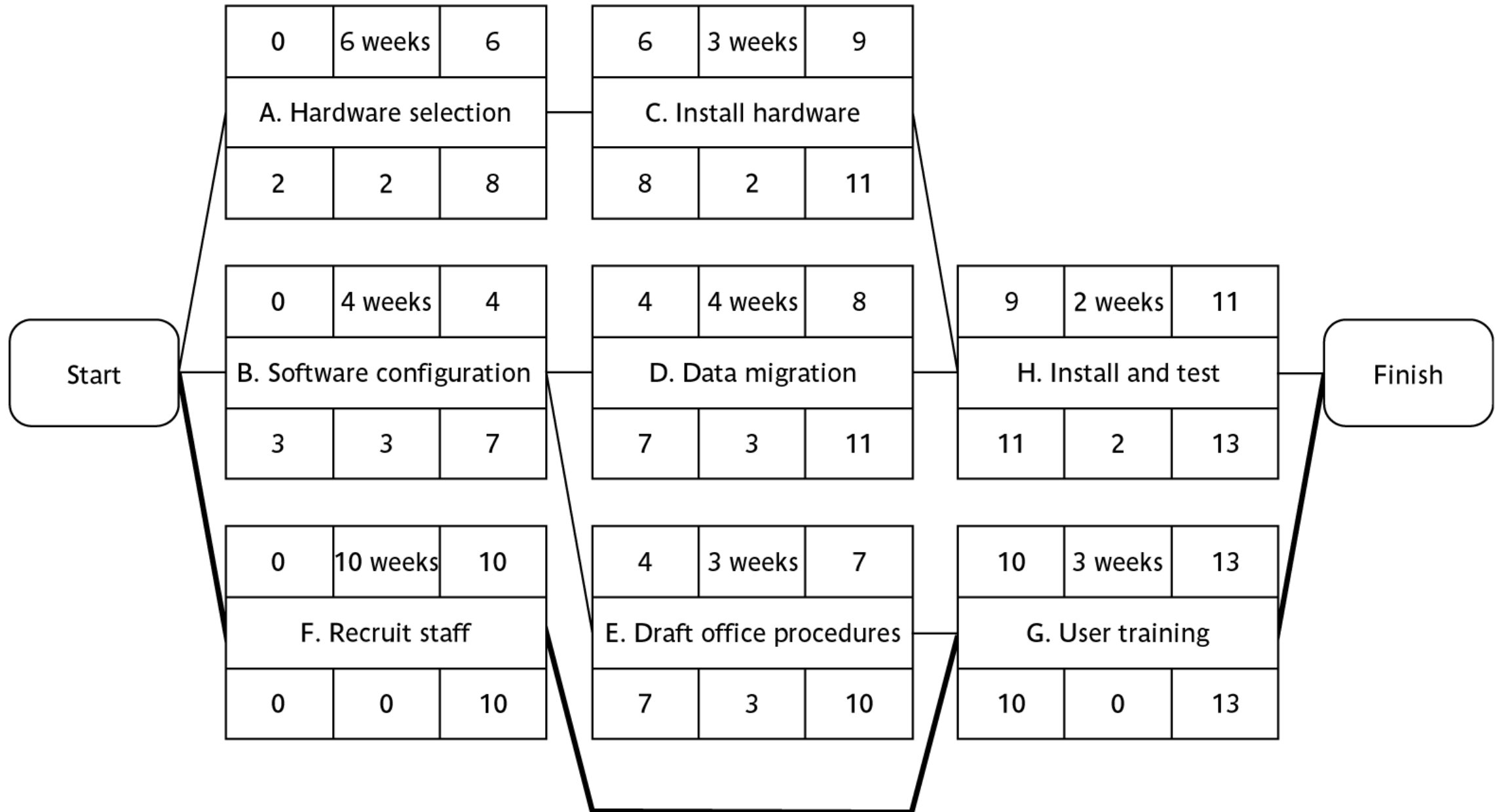


Critical Path

- 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



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

$$\text{Span} = \text{LF} - \text{ES}$$

$$\text{Float} = \text{LF} - \text{ES} - \text{duration}$$

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

Critical Path **Method** (CPM) – 1 of 2

- 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 of 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?