Project Planning & Scheduling (3C05/D22)

Unit 2: Project Planning and Scheduling

- Objective
  - To provide a brief introduction to project planning and scheduling. The critical area where project management meets system development.
  - To introduce the basic principles used for project planning and scheduling
  - To show how these principles are applied in industry
    - PERT Charts
    - Gantt Charts

Background

- Most system development is organised in terms of projects
- The management of a project, that is organising the resources (primarily, but not exclusively, people and equipment) to achieve the goals of the project (critically timeliness and budget) are the responsibility of the project manager
- The project manager may be an individual but is commonly a role played by the lead system developer, even if the lead system developer is not the project manager it is essential that he or she has a good understanding of project management task

Focus

- This unit is concerned with projects which are too complex for a “back of the envelope” schedule and for which we need
  - consistent and disciplined thinking
  - a method of summarising this thinking in a systematic manner
- It assumes that we have allocated the right amount of resources to the right projects

Network Scheduling

- A network depicts the sequence of activities necessary to complete a project
- Segments of a project are represented by lines connected together to show the interrelationship of operations and resources
- When a duration is associated with each segment, the model shows the time distribution of the total project and its operations, this information can be used to coordinate the application of resources

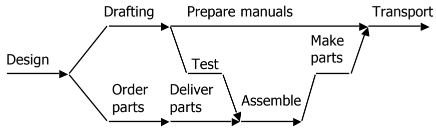
Techniques

- There are three very well known techniques for network scheduling Critical Path Method (CPM), Project Evaluation and Review Technique (PERT) and Gantt Charts
- They all focus on the path of critical activities that control the projects duration and can be considered under the general title Critical Path Scheduling (CPS)
- CPS is a management control tool for defining, integrating and analysing what must be done to complete a project economically and on time

Fundamentals

- Regardless of the name or the graphical conventions the fundamentals are the same
  - determine a list of necessary activities
  - establish a restriction list that sets the order of activity accomplishment
  - combine the two lists to construct a network

Arrow Diagram



shows operations required to produce custom made machine

Activity List

- The initial step in applying CPS is to break the project down into its component operations to form a complete list of essential activities
- Without a valid list all subsequent steps are meaningless!
- An activity is a time-consuming task with a distinct beginning and endpoint
- Some easily identified characteristic should be associated with each start and finish point

Tips on How to Construct an Activity List

- The way in which activities are defined may be influenced by planning purposes
  - for example if certain types of skilled people are in short supply activities requiring the limited resources should be separated from other operations
- The method or systems development process you are using should help you identify a “first-cut” activity list
  - for example the waterfall model identifies activities (and some sequencing)

Checking the Activity List

- A network is a composite picture of an entire undertaking, the activity list needs to be reviewed by suppliers, cooperating departments, subcontractors and anybody whose work impinges on the project

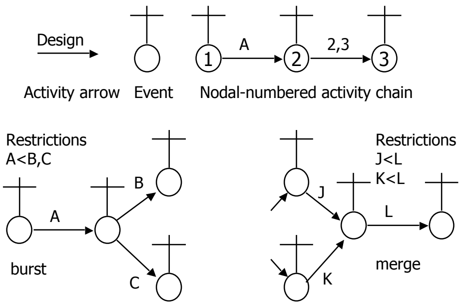
Restriction List

- Establishes the precedence of activities
- Uses the rough sequence generally arising from the activity list
- Each activity bracketed by the activities which must immediately precede it, the prerequisite, and the activity that must immediately follow it, the postrequisite

Activity and Restriction Lists Example

Description	Symbol	Prerequisite	Postrequisite	Restriction List
Design	A		Drafting, Order parts	A<B,C
Order parts	B	Design	Deliver parts	B<D
Drafting	C	Design	Prepare manuals, Make parts	C<E,F
Deliver parts	D	Order parts	Assemble	D<G
Prepare manuals	E	Drafting	Transport	E<I
Make parts	F	Drafting	Assemble	F<G
Assemble	G	Deliver parts, Make parts	Test	G<H
Test	H	Assemble	Transport	H<I

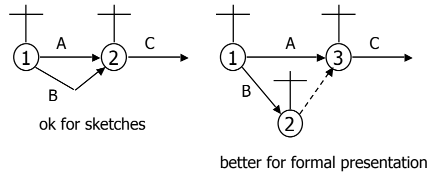
Network Conventions



Dummy

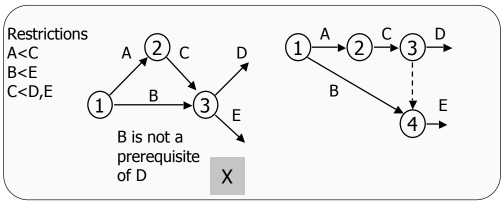
- A dashed line arrow is used in a network to show the dependency of one activity on another
- It is called a dummy activity and has all the restrictive properties of regular activities except that it takes zero time
- There are two types of dummies:
  - logic dummies which represent constraint relationships between nodes
  - artificial dummies which assist in numbering and uniquely identifying nodes

Artificial Dummies



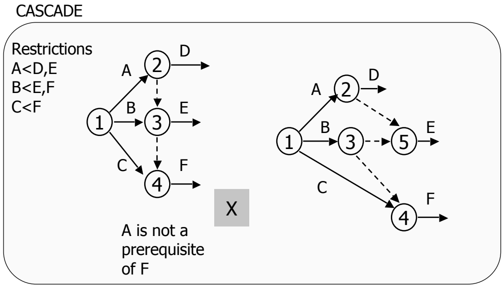
Common Errors I

SPILLOVER



Common Errors II

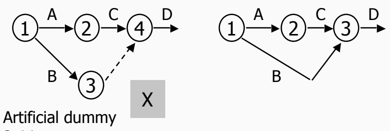
CASCADE



Common Errors III

UNNECESSARY

Restrictions
A<C
B<D
C<D

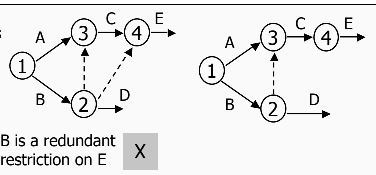


Artificial dummy
3,4 is unnecessary

Common Errors IV

REDUNDANT

Restrictions
A<C
B<C,D,E
C<E



B is a redundant
restriction on E

Critical Path

- The key to network scheduling is the critical path, the chain of activities that determines the total project duration
- Two approaches are available for estimating activity duration
  - a deterministic approach relies on a single most likely time estimate (this is probably sufficient for software projects)
  - a statistical approach uses a range of possible activity times to determine a single duration

Most Likely Time Estimates

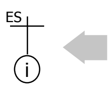
- An estimate of the elapsed time required to accomplish an activity is called the activity duration
- An activity duration may be expressed in months, weeks or days, it should not reflect uncontrollable contingencies, estimates for activity duration MUST be derived from objective sources, once activity durations have been identified it may be necessary to revise the network
- The activity duration should be entered besides the appropriate arrow in the network

Boundary Time Calculations

- earliest start (ES) the earliest time an activity can begin when all preceding activities are completed as rapidly as possible
- latest start (LS) the latest time an activity can be initiated without delaying the minimum project completion time
- latest finish (LF) the LS added to the duration (D)
- total float (TF) the amount of surplus time allowed in scheduling activities to avoid any interference with any activity on the critical path, the slack between the earliest and latest start times (LS — ES = TF)

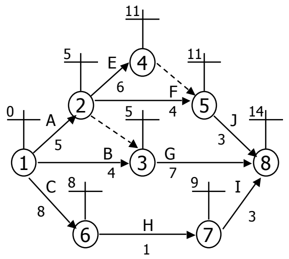
Calculating ES

- Make a forward pass through the network adding each activity duration in turn to the ES of the prerequisite activity, dummies are treated exactly the same as other activities
- When a merge is encountered the largest ES + D of the merging activities is the limiting ES for all activities bursting from the event, each limiting ES is recorded on the left bar of the event markers



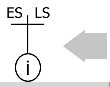
like this

Earliest Start Example



Calculating LS

- Basically the reverse of that for ES, make a backward pass through the network subtracting activity durations from the limiting LS at an event
- The limiting LS, the smallest one at a burst event, is entered on the right bar of the cross
- Subsequent LS's are calculated by subtracting activity durations from the LS on the next node cross

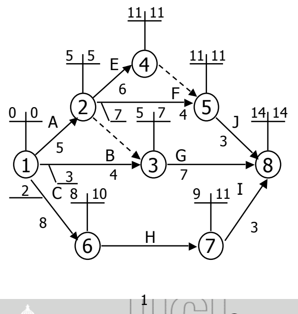


like this

Calculating LS (Continued)

- The main difference between LS and ES calculations is that each activity from a common event can have a different LS while all activities starting from the same event have the same ES, to deal with this a shelf is added to each activity in a burst that has a larger LF value than the limiting one
- The initial step in LS calculations is to make the right bar of the last cross in the network agree with the left bar, successive subtractions of activity durations from each limiting event should eventually lead to a zero LS for the first network node

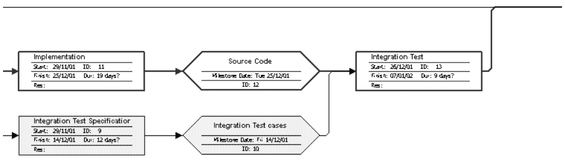
Latest Start Example



each event with the same entries on the bar is critical

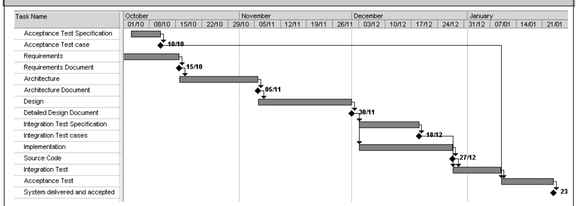
a line connecting these events along activities responsible for the event times is the critical path

Use of Principles: PERT Charts



- Used in industry to:
  - Determine critical path
  - Calculate most likely time estimates for individual tasks
  - Calculate boundary times that define a time window for a task

Use of Principles: Gantt Charts



- Used in industry to
  - Show start and end of tasks
  - Compute critical paths
  - Track progress

Demo: Microsoft Project

- Microsoft Project supports most of the principles discussed in this lecture
  - PERT Charts
  - Gantt Charts
  - Critical Path Scheduling
  - Earliest/Latest Start Scheduling
- Available on UCL-CS WTS
- Use it in your group/individual project!

Key Points

- Project planning and scheduling are essential skills for the software engineer. It is only part of project management which is a complex subject deserving study
- Resource scheduling is a core issue. Critical path scheduling is a simple technique to achieve this, there are many software tools to support it.
- A schedule is only of any use if it is realistic and maintained up to date as the project proceeds.