Use project management tools

Overview

Using project management tools play a large role in all phases of a project - in planning, implementation, and evaluation. This resource will give you a basic understanding of the most common project management tools used (Network Diagrams, GANTT charts, PERT analysis, etc.). Your use of such tools will go a long way to enabling you to manage your project successfully.

Key terms

CASE (computer-aided software engineering) Tools

CASE Tools can assist you in managing a project. Their role is to automate the process of creating Gantt charts, network diagrams, CPM diagrams, calendars, resource lists and activity lists. Using CASE allows designers, code writers, testers, planners, and managers to share a common view of where a project stands at each stage of development. CASE also helps ensure a disciplined, check-pointed process.

CPM (critical path method)

The critical path method (CPM) is another form of a network diagram that shows the order in which the activities follow one another and their interdependency. This method uses nodes, (circles) and links, (arrows).

Critical Path Analysis

Critical path analysis is a project analysis technique used to predict project duration. It is an important tool that helps you to fight project overruns.

Gantt Chart

A Gantt chart is used to represent all of the activities of a project in a visual overview of the project time line. A basic Gantt chart does not display the relationships between the activities; this is normally done with a network

diagram. A Gantt chart lists all the activities on the left-hand side of the chart and the time line is across the top of the chart.

Network Diagram

This is like a roadmap that shows all of the project's activities drawn as an interconnected network of tasks.

PERT (Program Evaluation Review Technique)

This project time management technique is used when there is a high degree of uncertainty about the individual activity duration estimates.

Project Risk Management

Project risk management is a process that recognises, assesses and reduces risk in the life cycle of a project. Risk management should begin at the project definition stage so that assumed risks can be included in the project scope document.

Some features of software tools

The vast majority of project managers rely on the following types of tools to assist in the management of their projects.

- Network diagrams
- CPM charts
- Gantt charts
- PERT analysis
- CASE Tools

We will introduce each of these to you and show some examples of usage.

Network diagrams

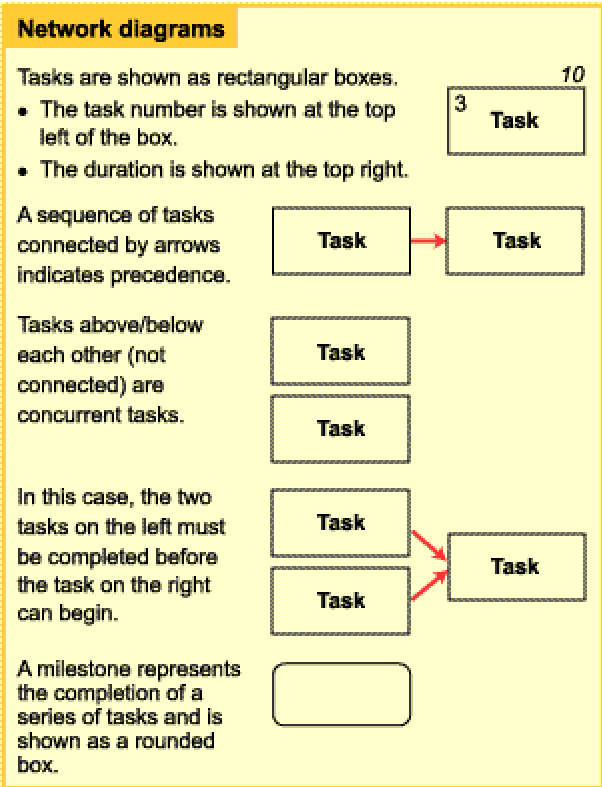
The proven and most accepted way to organise and sequence the tasks of a project is by using a **network diagram**. This is like a roadmap that shows all of the project's activities drawn as an interconnected network of tasks. A low-level version for 50 tasks can be easily drawn with pencil and paper. When managing more complex projects it is usually necessary to use computer based project management software to generate complex network diagrams. In this topic we will introduce and use the simple, low-level, manual version of a network diagram.

To build this network diagram you have to determine the relationships between the tasks involved.

- For any particular task, you need to determine whether there are any other activities that must be done **before** this task can begin. If there are any, then they are called **predecessors**.
- Tasks that must be done in a **defined sequence** are shown by placing them in horizontal order from left to right.
- Tasks that can occur in parallel (i.e. at the same time) are called **concurrent,** and are shown in columns.

These relationships are shown in the diagram below.

Figure 1: An example of a network diagram.



Five steps in creating a network diagram

There are five key steps in creating a network diagram. These steps are as follows.

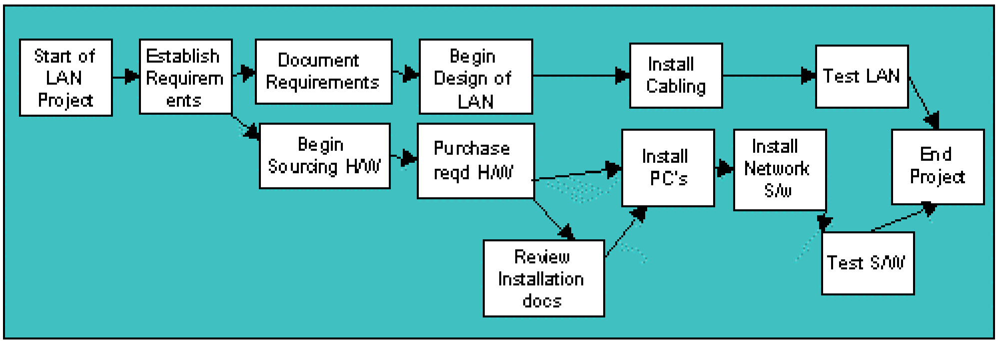
Table 3: Five steps in creating a network diagram (2 cols)

Step	**Activity**
Step 1	
Step 2	Identify the **relationships** between the activities. What tasks

Step	Activity
	must follow this task? What tasks must precede this task? You must establish which tasks can take place concurrently, which tasks have predecessors.
Step 3	Identify the **milestones** in your project. A milestone is usually a where deliverable takes place in the project and where a sign-off is usually required. Milestones are not work, they are markers for summarising work that has been completed to that point.
Step 4	**Graphically** represent the activities and milestones on a **network diagram**. Network diagrams usually start with a box called 'Start project' and end with a box called 'End project'.
Step 5	Review the **logical flow** of the network. Take a look at which activities you have first and then sequence the activities. Do they make sense? Are they in a logical order?

The figure below shows an example of a network diagram for a simple LAN project. It shows the basic steps required for installing a LAN.

Figure 2: An example of a network diagram for a LAN project.



Review your network diagram

After you have drawn your diagram check for the following:

- the tasks start from the left side and sequence left to right, i.e. all predecessors must be to the **left** of their successor tasks
- there are no loops or backward flow sequences
- all tasks except 'start project' and 'end project' have at least one predecessor and one successor node and therefore there are no orphan nodes.

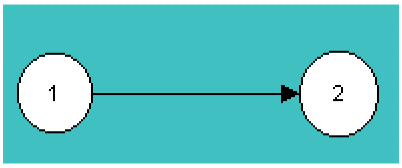
A **path** is a sequence of tasks from the start to the finish. Each network may have several paths from start to finish. The **critical path** is the sequence of

tasks that forms the longest duration of the project, based on the task work estimates. A delay in any of the tasks and all tasks that are on this path affect the final completion date.

Critical path method

The **critical path method** (**CPM)** is another form of a network diagram that shows the **order** in which the activities follow one another and their interdependency. This method uses **nodes**, (circles) and **links**, (arrows), as shown below.

Figure 3: An example of the critical path method using nodes and links.



What is meant by 'critical path'?

Critical path analysis is a project analysis technique used to **predict project duration**. It is an important tool that helps you to fight project overruns. The critical path for a project:

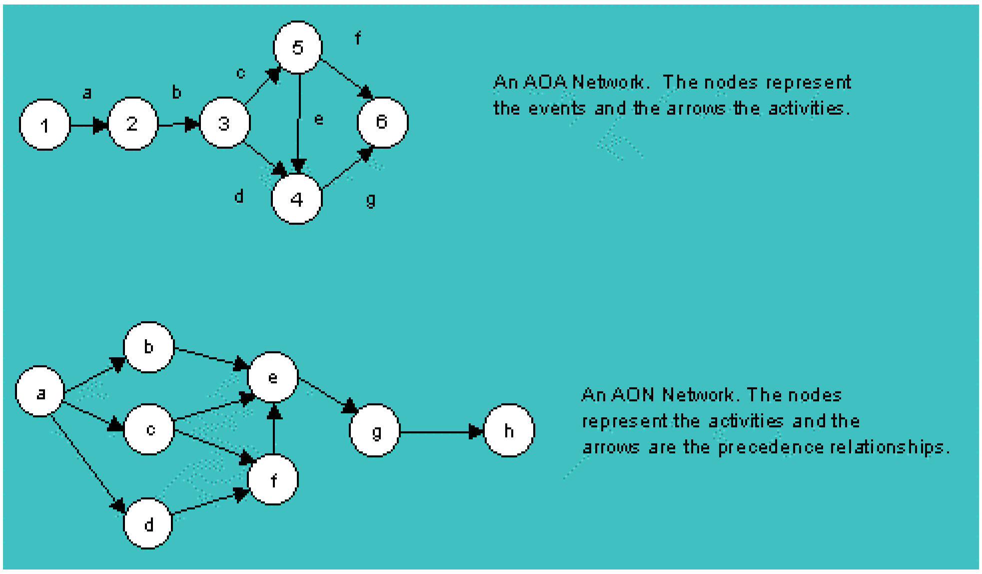
- is the series of activities that determine the **earliest time** that a project can finish
- is the **longest path** through the network diagram
- has the least amount of **slack** or **float**.

Calculating the critical path

There are two methods to represent activities and events using **CPM**. These are:

- **Activity on Arrow (AOA)** method where the **arrows** represent the **activities** and the **circles, (nodes)** represent the **events**.
- **Activity on Node (AON)** method where the **circles** represent the **activities** and the **arrows** represent the precedence between the activities. Look at the sample below.

Figure 4: An example of an AOA network.

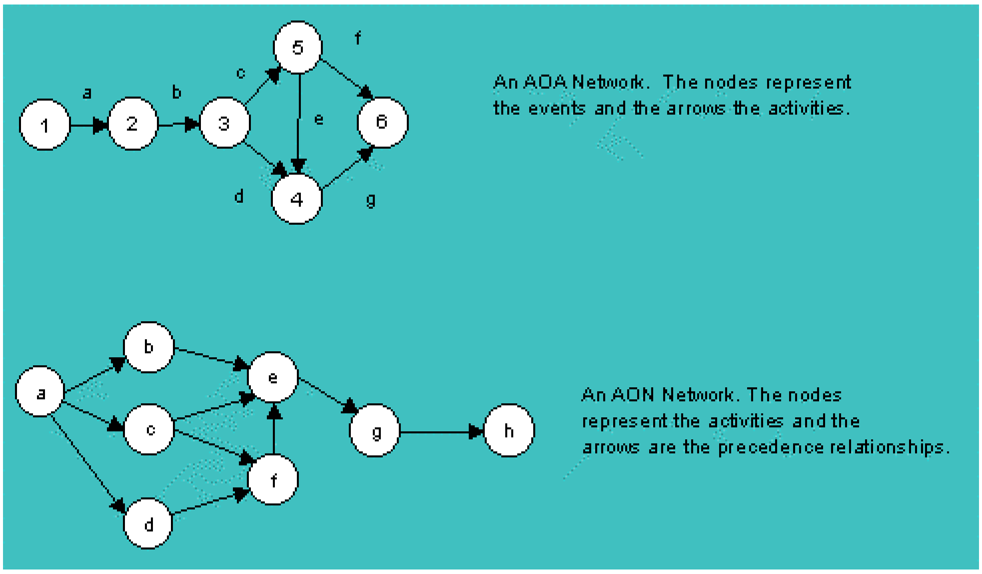


As you can see, in the AOA diagram, an event is represented graphically as a numbered circle. In both cases, the start of the activities is indicated on the left-hand side, and the end of the activities is indicated on the right-hand side. The letters on the links in the AOA diagram represent durations of activity.

The critical path is determined by adding the path durations together to find the longest one. The notion of finding the **longest** path might initially seem a little strange. This should be clarified by the activity you are about to do.

Try it

Figure 5: An example of an AOA Network to be used in this Try It activity.



In the above figure these are the path duration values for the AOA diagram

Table 4: A table listing the path and duration for Figure 5 above (2 cols)

Path	**Duration**
A	4 days
B	3 days
C	2 days
D	2 days
E	5 days
F	4 days
G	4 days

Calculate the critical path for this project.

Feedback

The critical path will be a + b + c + e + g = 18 days.

This means that you can't complete the project in less than 18 days.

You may be tempted to think that the project can be done in a shorter time by following the shorter path 1, 2, 3, 5 and 6. However, task 4 still has to be

done, and it can't be done until 5 has finished, and 6 can't be started until **both** 5 and 4 are finished.

Program evaluation review technique (PERT)

Another project time management technique is the **Program Evaluation Review Technique (PERT).** This analysis technique is used when there is a high degree of uncertainty about the individual activity duration estimates.

PERT applies the critical path method to a weighted average duration estimate.

PERT uses **probabilistic time estimates**, which are duration estimates based on using:

- optimistic
- most likely, and
- pessimistic estimates of the activity durations.

These three estimates are then statistically averaged using a formula which will be discussed in the next section.

Calculating the duration of activities

PERT is based on a project network diagram, and activity durations are then calculated using a formula. The formula used to calculate the duration of activities is called the **weighted average formula.** Deriving this formula is outside the scope of this topic. If you are interested you could do some further research to read about this. Here, however, we'll just provide you with the formula and show you how it is used.

The formula is: ED=BD + (4*LD) + WD)/ 6

Where:

- ED = Estimated event duration
- BD = Best duration - shortest time needed to complete the activity
- LD = Likely duration - the time most likely needed to complete the activity
- WD = Worst duration - the longest time required to complete the activity.

An example of how to calculate the duration

The following is an example of how to **calculate duration** and how to **plot duration** on a critical path diagram. We will use the **AOA** network diagram that we used for the previous exercise. All durations used in the formula in this example are in days, and are simple estimates for the purpose of performing the calculations.

Table 4: An example of how to calculate and plot duration on a critical path diagram (5 cols)

Activity	**BD**	**WD**	**LD**	**ED**
(a)	2	5	4	a = (2+(4*4) + 5)/6 = 3.8 days
(b)	1	5	3	b = (1+ (4*3) +5)/6 = 3 days
(c)	1	3	2	c =(1+ (4*2) + 3)/6 = 2 days
(d)	1	3	2	d =(1+ (4*2) = 3)/6 = 2 days
(e)	4	7	6	e =(4+ (4*6) + 7)/6 = 5.8 days
(f)	2	6	4	f = (2 + (4* 4) + 6)/6 = 4 days
(g)	2	6	4	g = (2 + (4*4) +6)/6 = 4 days

Look at the **AOA** diagram below. You should see that there are **three paths** that we can take to get from event 1 to event 6. These are:

a---->b---->c---->f---> = 12.8 days

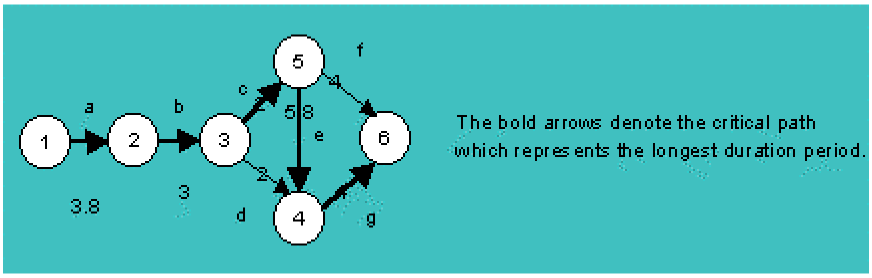
a---->b---->c---->e---->g = 18.6 days

a---->b---->d---->g --->= 12.8 days

Since the **longest** path is the **critical path**, it is therefore

a->b->c->e->g

Figure 6: An AOA diagram illustrating the three paths you can take to get from event 1 to event 6.



Slack time

Slack time means that a completion date can float between two dates without affecting the final completion date. In other words, you may be able to finish a particular task in 4 days, but you could take another few days while waiting for another critical task to be completed. Tasks which involve slack time are said to be **non-critical** - their earliest and latest completion dates are different.

What are the advantages and disadvantages of PERT?

PERT has one main advantage but several disadvantages.

The **advantage** is that it tries to address the risk associated with duration estimates.

The **disadvantages** are that it:

- involves more work
- requires several duration estimates and so it is rarely used in practice.

Usually people confuse PERT with project network diagrams and misuse the term. You will often hear the expression PERT chart. This is actually a normal network chart with PERT calculated task durations displayed.

Gantt charts

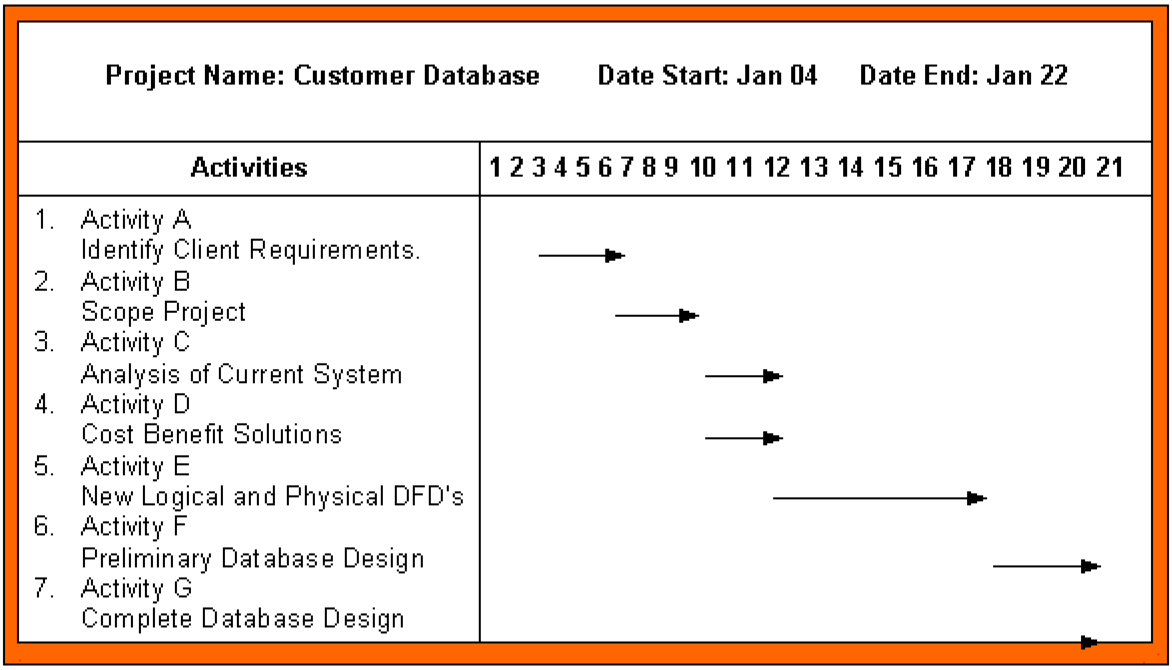
A **Gantt chart** is used to represent all of the activities of a project in a visual overview of the project time line. A basic Gantt chart does not display the relationships between the activities, this is normally done with a network diagram. The **Gantt chart** should be used in conjunction with

network diagrams, including the **critical path method (CPM),** and the project schedule to give a clear overall picture of the project.

A Gantt chart lists all the activities on the left-hand side of the chart and the time line is across the top of the chart. The detail of the Gantt chart is dependent of the level of detail that you put into the time line. A Gantt chart has to be easy and clear to read so you must ensure that appropriate time frame is used for the timeline.

For example, if the project is planned for three months, then a weekly timeline may be useful. If the project is planned for thirty days then a daily timeline would be more useful. A simple Gantt chart is presented in the figure below. Review the example of the CPM diagram that we calculated earlier to determine duration periods. This is the Gantt chart for that CPM diagram. The duration of the activities on this Gantt chart, are represented by arrows. They try to resemble as close as possible the duration periods we calculated earlier.

Figure 7: An example of a Gantt chart based on the CPM diagram in Figure 4.



Four relationships between activities on a Gantt chart

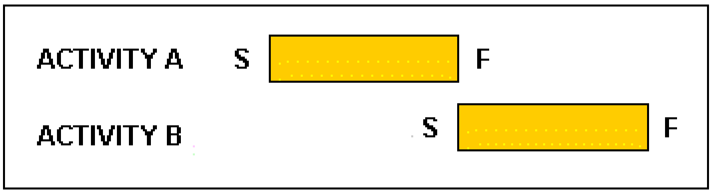
There are four ways that activities can relate to one another:

Finish to Start

The start of an activity depends on the finish of the previous activity.

For example, you cannot begin select a solution for an information system until a cost-benefit analysis has been completed for the different alternative solutions. The figure below represents a finish to start plan.

Figure 8: An example of a finish to start plan.

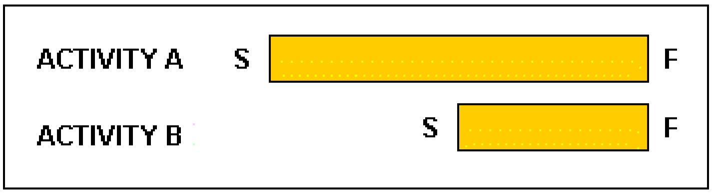


Finish to Finish

This is when the finish of one activity coincides with the finish of the previous activity. When you want two activities to finish at the same time this is the relationship that you should use between activities.

For example, when writing the user manuals, they need to be completed at the same time as the training manuals. The figure below represents a finish to finish plan.

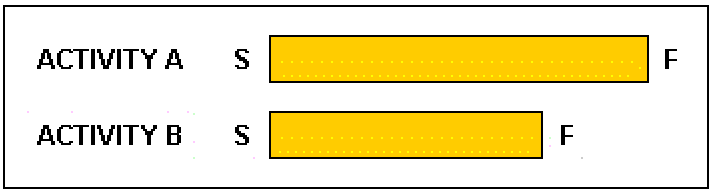
Figure 9: An example of a finish to finish plan.



Start to Start

This is when two activities are due to start at the same time and both must be completed before the following activity starts. The figure below represents a start to start plan.

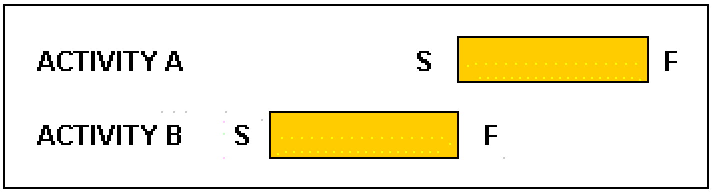
Figure 10: An example of a start to start plan.



Start to Finish

This is where the start of one activity coincides with the finish of another.

Figure 11: An example of a start to finish plan.

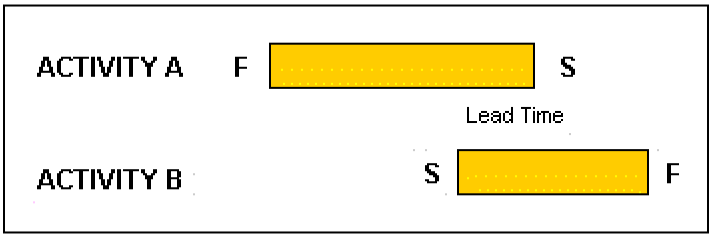


Lead time, lag time and float time on a Gantt chart

Lead Time

Lead time occurs when an activity can start before its dependent activity has finished. Look at the diagram below. Activity B is dependent on activity A, but it can start once activity A has progressed a little. The difference between the start of activity B and the finish of activity A is called **lead time**.

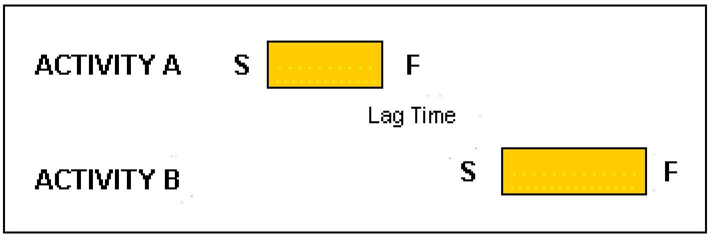
Figure 12: An example of lead time.



Lag Time

Lag time is when there is a time delay between one activity and the next dependent activity. For example, after a system is implemented, the project may need to wait a few months before commencing a post-implementation review.

Figure 13: An example of lag time.



Slack / Float Time

Slack time occurs when two or more activities must be completed before the next activity can begin. Both activities do not have to finish on the same day but there is an end date by which both must be completed. The best way to represent **slack / float time** is to show two activities with one longer than the other.

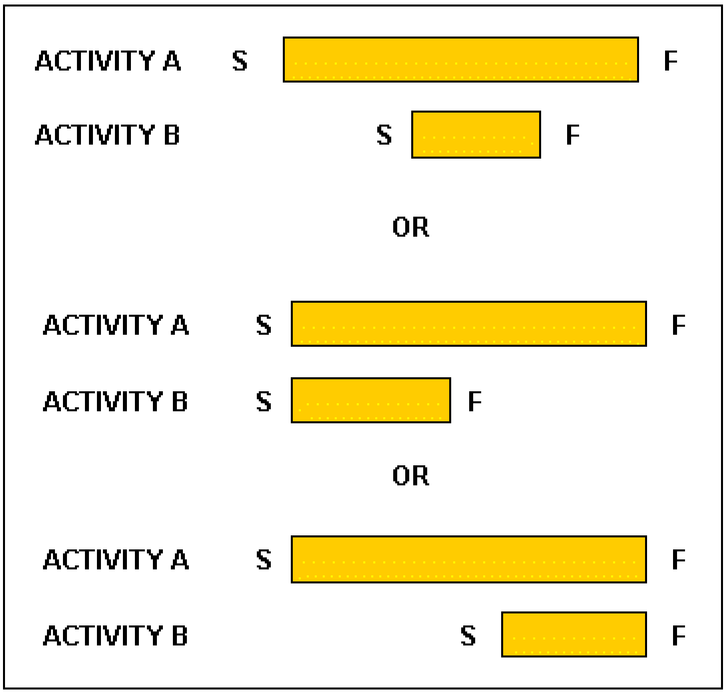
In the following figure, activity A is the longer one and has to be completed in 8 days. Activity B is the shorter one and has to be completed in 4 days. The difference between the two activity durations is: (8 - 4 = 4). So 4 days is the **slack / float time**.

Activity B, the shorter activity, can do one of the following:

- It can start any time during the activity A, as long as it is completed by activity A's end date
- It can start at the same time as activity A, and finish before activity A
- It can finish at the same time as activity A.

The figure below shows the three ways **slack / float time** can be represented.

Figure 14: An example of slack or float time.



Detailed Gantt charts

We have reviewed a **basic Gantt chart** and how they can be derived from a **critical path method (CPM)** diagram. Most Gantt charts are far more detailed, as in the next figure. Complex Gantt charts can show the slack times and the absolute latest finish times by using different kinds of lines such as:

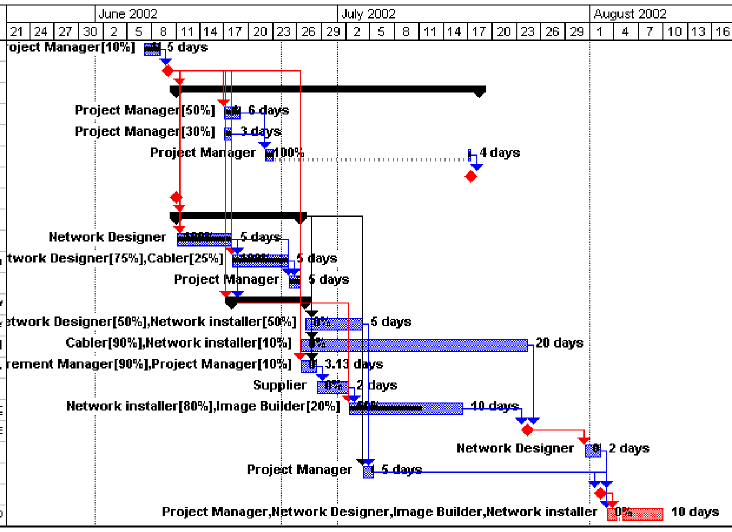
- solid
- striped
- zig zag
- dotted
- shaded.

They can show **milestones** and the **current project status**. When creating complex Gantt charts, it is always a good idea to include a **legend** so that others reading it can associate what the different lines represent.

The example in the figure below shows the level of detail that can be put on a Gantt chart using Microsoft Project 2000. We can see **resource names**, the **task interrelationships** and **percentage of completion** for each task. **Milestones** have been represented as red diamonds.

Figure 15: An example of a detailed Gantt chart.

ID	Task Name	Duration	Predece:	Resource Names
1	Scope	5 days		Project Manager[10%]
2	Approve	1 day	1	
3	**Plan**	**27.13 days**	**2**	**Project Manager[30%]**
4	WBS Breakout	6 days	2	Project Manager[50%]
5	Schedule	3 days		Project Manager[30%]
6	Work Package All	4 days	5FS+3 d:	Project Manager
7	Plan approval	1 day	6	
8	Commence Desig	0 days		
9	**Design**	**11.13 days**	**2**	**Network Designer**
10	Network	5 days	2	Network Designer
11	Cabling System	5 days	2,10	Network Designer[75%],Ca
12	Room Layout	5 days	10,11	Project Manager
13	**Image**	**7 days**	**2,10**	**Image Builder[85%],Netv**
16	Pilot Test	5 days	15,9	Network Designer[50%],Ne
17	Cabling	20 days	9	Cabler[90%],Network instal
18	Order	3.13 days	2,9	Procurement Manager[90%
19	Deliver	2 days	18	Supplier
20	Build	10 days	13,19	Network installer[80%],Imag
21	Install	8.13 days	17,20	Network installer,Project Ma
22	Test Network	2 days	21	Network Designer
23	Train	5 days	16,9	Project Manager
24	Signoff	1 day	22,23	Project Manager
25	Project Review	10 days	22,23,24	Project Manager,Network D



CASE Tools

CASE (computer-aided software engineering) was originally the use of a computer-assisted method to organise and control the development of software, especially on large, complex projects involving many software components and people. Using CASE allows designers, code writers, testers, planners, and managers to **share a common view of where a project stands at each stage of development.**

CASE helps ensure a disciplined, check-pointed process. A CASE tool may portray progress (or lack of it) graphically. It may also serve as a collection of data that can be linked into other business systems such as marketing and service plans. **CASE** originated in the 1970s, when computer companies were beginning to borrow ideas from the hardware manufacturing process and applying them to software development. Now CASE tools are commonly used to mean **project management software**.

Examples of case tools

There are a number of **CASE** tools that can assist you in managing a project. Their role is to automate the process of creating Gantt charts, network diagrams, CPM diagrams, calendars, resource lists and activity lists. Most project management CASE tools have linked functions. This means that if you make a change to a 'due date', this updates all other areas that are affected by that change. If you have ever used an accounting software package, like **MYOB**, then you will understand this principle. For example, if you make a change to a ledger in MYOB, it updates all other areas.

Research

Do a search on the web and see how many project management packages you can find.

There is no single package that is best in all situations Choose a package that suits your project criteria and budget. Ease of use, functionality, ease of reporting and charting all can influence your choice of package.

You can purchase project management CASE tools from any computer software store. The most commonly one you are likely to find is MS Project.

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