PROJECT PLANNING AND CONTROL

1. Introduction

A project is a series of FUNCTIONS or tasks performed by PEOPLE to achieve a predetermined OBJECTIVE.

If a project is to have a reasonable probability of success it must be planned and controlled. This could be summed up as :

> PLAN the FUNCTIONS to be performed;
> ALLOCATE the RIGHT PEOPLE to perform them;
> PERFORM the FUNCTIONS;
> MONITOR and CONTROL the activities to meet the ultimate OBJECTIVE of producing the RIGHT SYSTEM, AT THE RIGHT TIME, AT THE RIGHT COST'.

This is no easy task but unless it is done, and done well, the chances of success are slim. All aspects of planning and control are important but effective planning is essential. Without it there is no base from which to operate - no statement of work to be done, no idea of who should be doing what or when, no check-points or milestones against which to maintain progress, and no basis for communication with DP and User Management.

The functions which make up a project cannot be considered in isolation. Some must be performed alone, some can be done at the same time, some must be done before the next can take place; conversely, some cannot be started until a previous function is completed, and all are subject to an overall sequence and the availability of the correct resources. It is the relationships between the functions, and the variables involved which make planning so essential and highlight the need for techniques to facilitate the process.

The variables in a project are :

- TIME
- RISK
- SPECIFICATIONS
- COST (RESOURCES, i.e. people and equipment).

None of these can be changed without changing one or more of the others.

2. Techniques

2.1 The project should be broken down into measurable functions or tasks. The structured methodology assists in this process by defining Stages, Steps and Tasks.

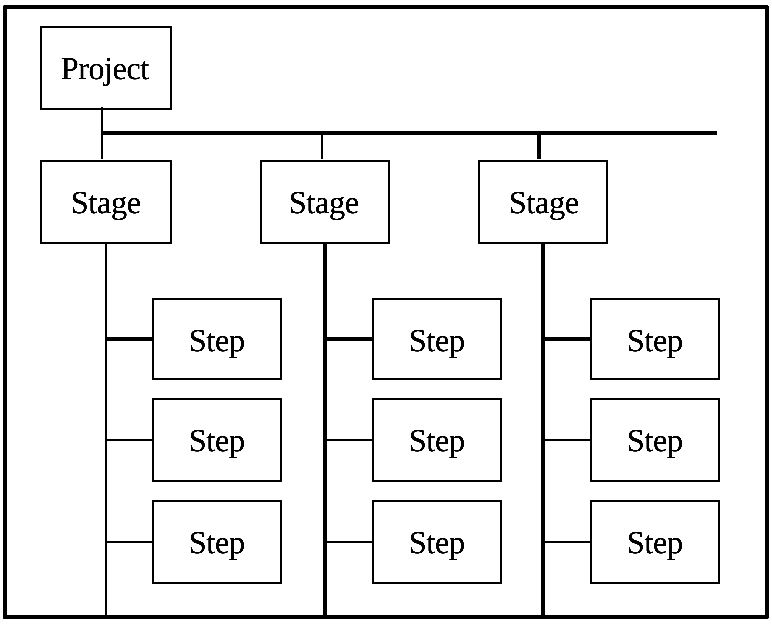

Figure 1 Work Breakdown Structure

The above Work Breakdown Structure can be decomposed to whatever detail level is required:

STEP LEVEL as above;
TASK LEVEL - Stage, Step Task;
SUB-TASK LEVEL - Stage, Step Task, Sub-Task;

The lowest level task identified could be further amplified by a 'Task Description' or 'Task Dictionary'.

2.2 The time and resources required to complete each defined task must now be calculated and recorded. Most organisations have their own estimating guidelines based on experience and history and these should be used.

Several techniques are available for presenting the results and the main ones to be discussed here are :

2.2.1 Schedules and Milestone Charts
2.2.2 Bar or Gantt Charts
2.2.3 Resource Scheduling Histograms
2.2.4 Networks (Pert Chart)

2.2.1 SCHEDULES AND MILESTONE CHARTS

These schedules have a dual role. They are a pictorial representation of the plan, and can be used to record the actual performance against the plan to allow decisions to be made, and can be produced for any level of the project activities:

STEP LEVEL for DP Management and User Management;
TASK LEVEL for Project Management;
INDIVIDUAL TEAM MEMBER LEVEL for Team Leader and individual team member.

Figure 2 illustrates the conventions :

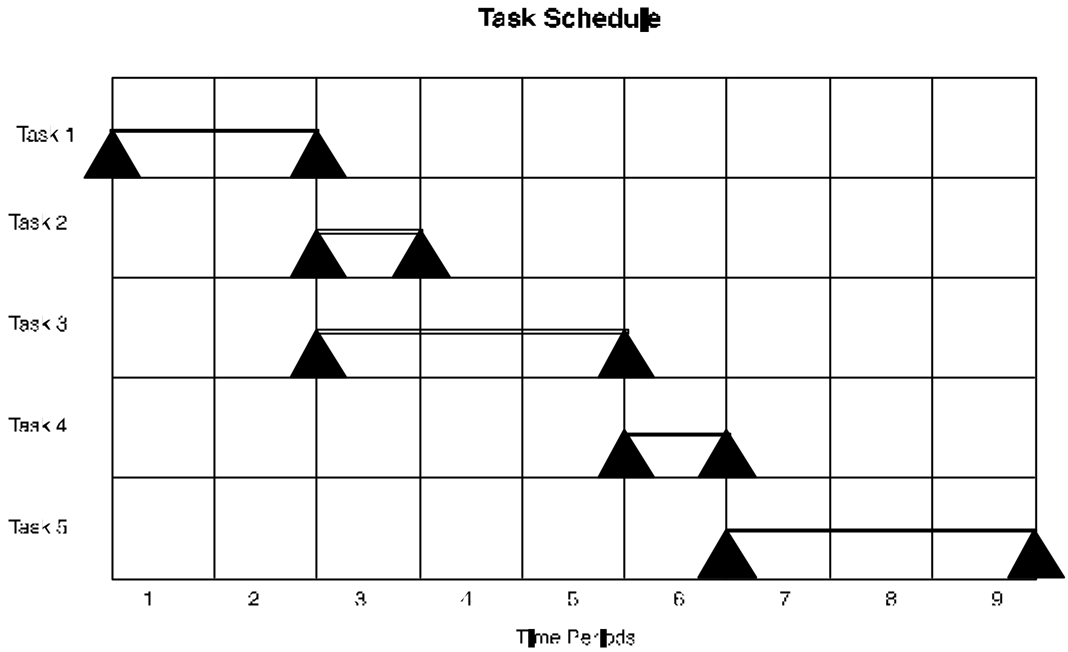

Figure 2 Task Schedule

The planned schedules or charts are completed with open triangles, and a line joining them to show the start, end and duration of a task, i.e., the 'milestone'. The actual performance is shown by shaded triangles.

Figure 2 illustrates a TASK SCHEDULE as it might appear at the beginning of Period 4. It shows Task 1 was completed to plan, Task 2 is starting a period late but Task 3 has started on time. In this case, providing the resources were available for Task 2 during period 4 the delay would not affect the total project.

These schedules are easy to read and easy to draw once the basic information is available. The difficulty is in finding the relationships and inter-dependencies between the various tasks within a complex project.

2.2.2 BAR OR GANTT CHARTS

Originally introduced by Henry Gantt in the early part of this century as an aid to planning. They are very similar to the milestone charts in construction but use lines or bars (usually bars) instead of the triangles.

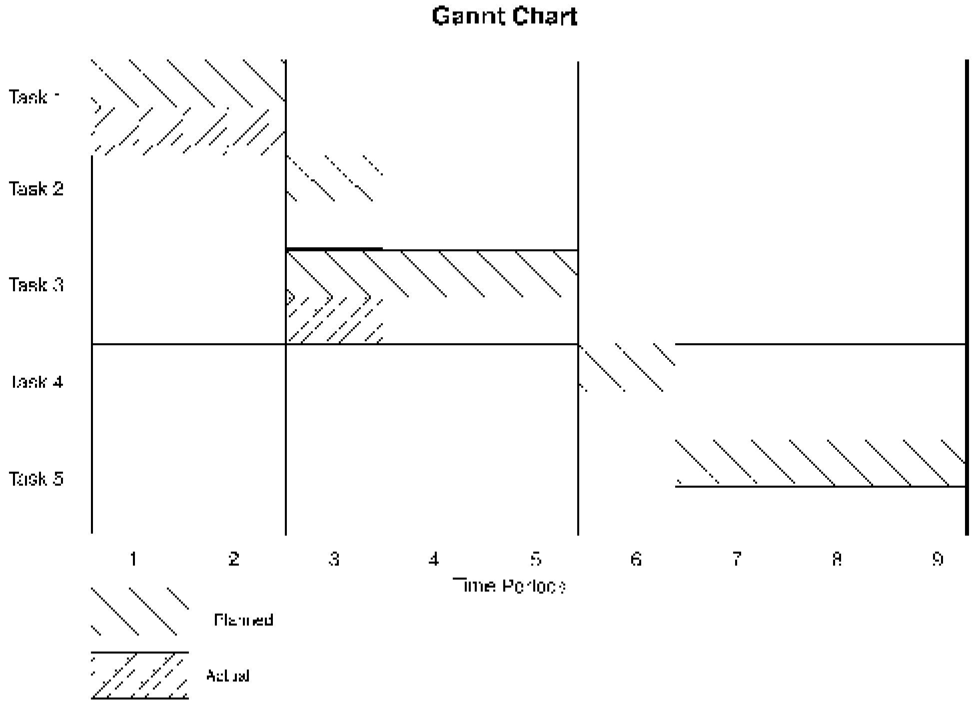

Figure 3 - Gantt Charts

The actual performance can be shown by shading in the bars, changing the colour (if planning boards used), or by drawing a line through the centre of the bar (illustrated). Assuming the same conditions as for Fig 2, at the beginning of Period 4 the chart would appear as in Fig 3 using the line technique.

The charts are easy to construct but have the same disadvantages as the schedules. Whilst a limited amount of linking activities can be undertaken the charts soon become so complicated as to be useless.

All projects have three dimensions, logic, time and resources and all are equally important. to use a Gantt chart when considering all three at the same time, is difficult, if not impossible.

2.2.3 RESOURCE SCHEDULING HISTOGRAM

This is basically a bar chart with the task times shown horizontally at the top of the chart, and the cumulative resource requirements for each time period shown vertically at the bottom of the chart.

Using the Fig 3 example let us assume that the resource requirements are :

Task 1 - 3 people
Task 2 - 3 people
Task 3 - 1 person

Task 4 - 3 people
Task 5 - 2 people

The histogram would be shown as in Figure 4:

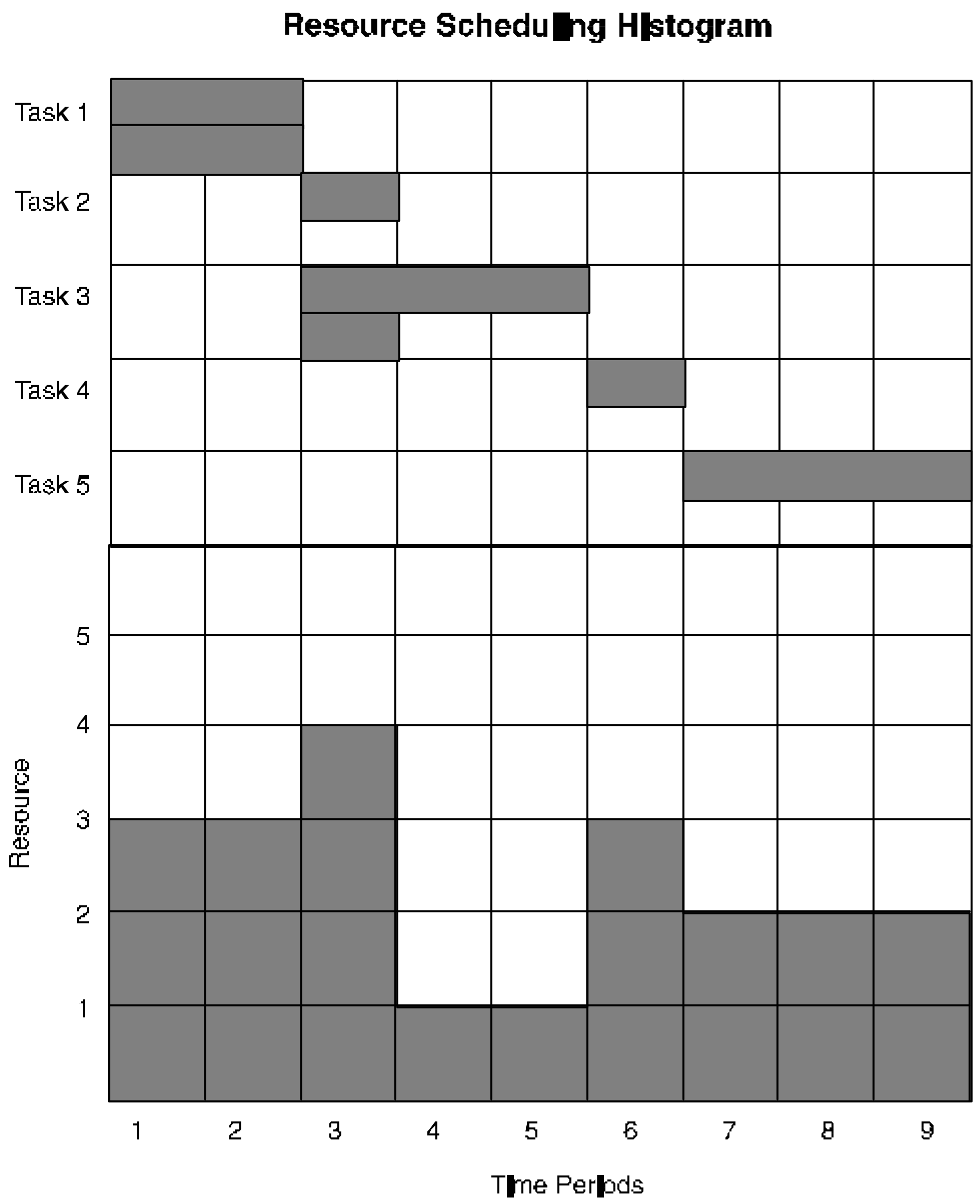

Figure 4 - Resource Scheduling Histogram & Gannt Chart

This representation has the advantage that it does relate resources to tasks and time but still does not solve the problem of task interdependencies.

2.2.4 NETWORKS (PERT CHARTS)

Networks or Pert Charts (Programme Evaluation & Review Technique) are used to assist in planning and controlling a project. By helping to decide and chart the sequence and duration of each activity, networks help to identify the Critical Path through any sequence of activities.

The critical path is that sequence of activities within a project which, if delayed at any point will increase the total duration of the project.

Parts of a Network

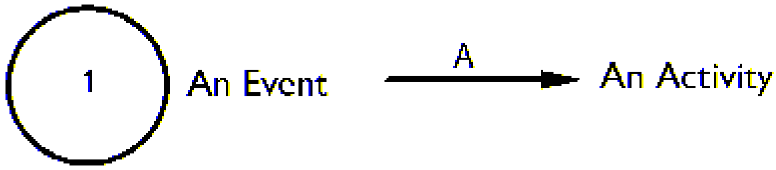

Figure 5

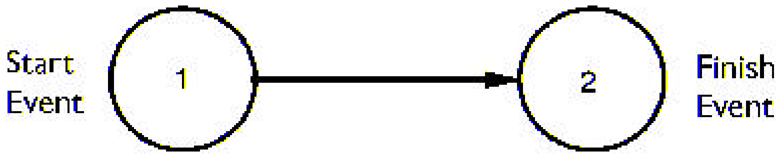

Figure 6

Network Elements

An EVENT represents a point in time from which an activity starts or at which an activity ends. Here shown as a circle but some conventions use other shapes.

An ACTIVITY represents a task and is displayed as an arrow. Activities always start and finish at events. The butt (or tail) of the arrow is the start of the activity and the point (or head) is the finishing point. EVENTS are numbered and ACTIVITIES lettered.

Dependency

Networks show dependency - they show how the start of one activity is dependent on the completion of one or more earlier activities.

In Figure 7:

Activities B and C cannot start until A is complete
Activity D cannot start until B is complete
Activity E cannot start until C is complete
Activity F cannot start until D and E are complete

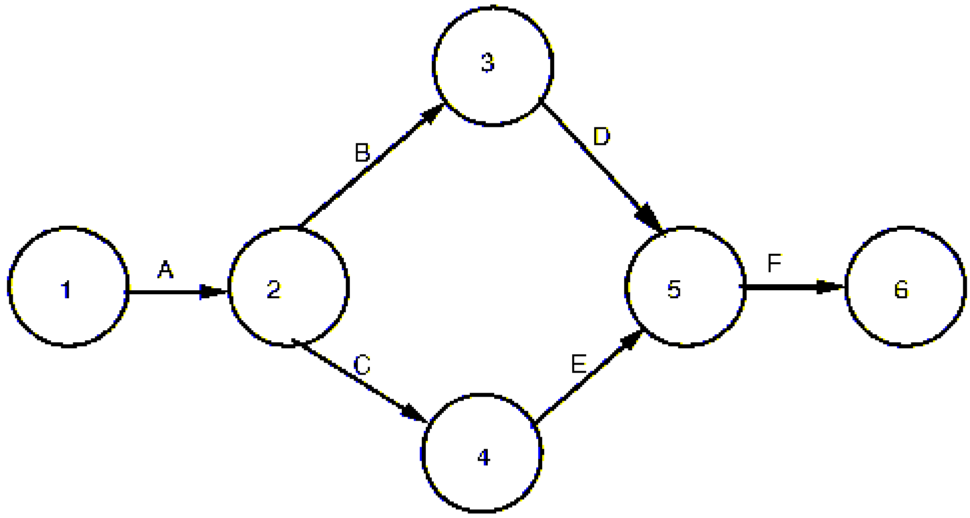

Figure 7 Network

Dummy Activities

It is possible for two activities to start from one event, and both of them to finish at the next event. However, if drawn as Fig 8 an ambiguous network is created :

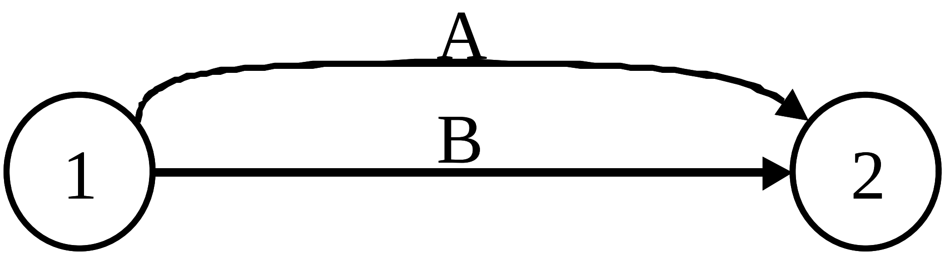

Figure 8

Activities are identified by their letter or by their identifier, which is the event number sequence. In Fig 8 both activities have the same identifiers, 1.2 which is ambiguous. To avoid this a DUMMY ACTIVITY is introduced (Fig 9) :

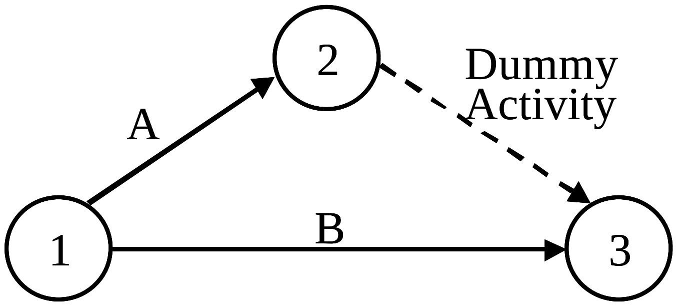

Figure 9 Dummy Activity

The DUMMY ACTIVITY 2 - 3 has no duration in time; its only value here is to prevent ambiguity.

LOGICAL DUMMY ACTIVITIES can also be used to show dependance, when two activity chains have a common event, yet they are in themselves wholly or partly independent of each other e.g.

Activity X depends on Activity A

Activity Y depends on Activity B

Activity Y depends on Activity A

The diagram in Fig 10 might look correct but Activity X only depends on Activity A and not on Activity B.

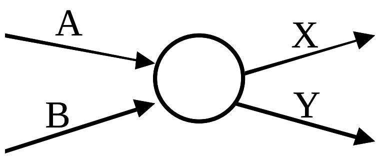

Figure 10

To correct this a LOGIC DUMMY is introduced to separate X from B (fig 11).

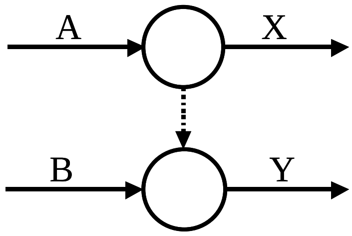

Figure 11 : Logic Dummy

This now means that X can proceed when A is complete, but Y cannot start until both A and B are complete.

Activity Duration

There has to be some way of calculating the duration of a project in order to identify the critical path. This is done by adding four sets of figures to the network diagram i.e. :

the duration of each activity
the earliest start of each activity
the latest finish of each activity
the 'float' or 'slack' i.e. the difference between the last two.

The DURATION of an activity is shown as follows :

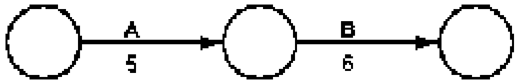

Figure 12 : Activity Duration

The other figures are best illustrated by quartering the event circle as shown in Fig 13.

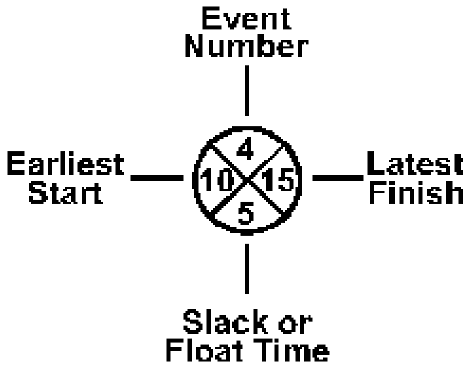

Figure 13 : Quartered Event Symbol

To illustrate the techniques for calculating these values and hence finding the critical path let us take a hypothetical network with the dependencies and duration shown (Fig 14).

Now it is possible to proceed with the completion of the chart. The EARLIEST START figures (left-hand quadrant) are added working from left to right (Fig 15).

Note that the earliest start figure is always the highest total duration to that event e.g. the earliest start figure in EVENT 6 is 14, obtained from path 1.2.4.6 and not 13 (from 1.2.5.6). Similarly EVENT 4 has the earliest time of 9 (from 1.2.4) and not 6 (from 1.2.3.4).

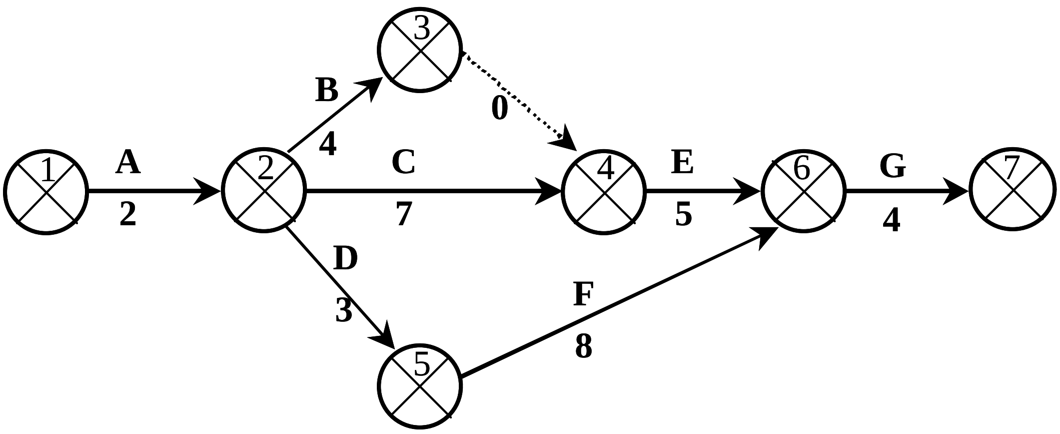

Figure 14

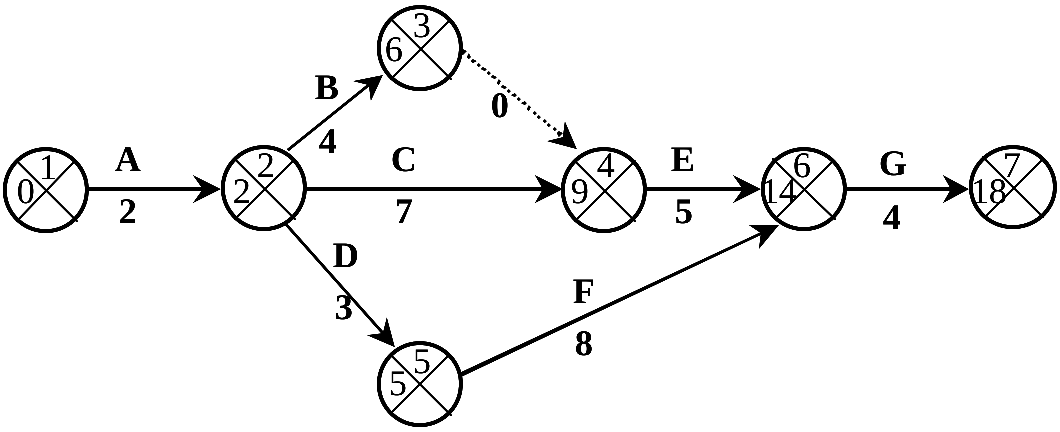

Figure 15

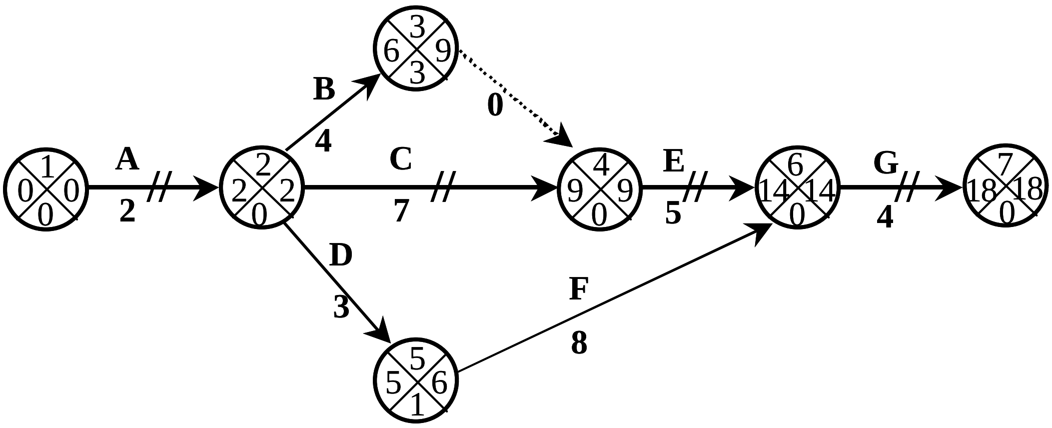

Figure 16

The LATEST FINISH TIMES are calculated by subtracting from right to left so that the figure for EVENT 1 becomes zero. The SLACK or FLOAT is calculated by subtracting the EARLIEST START from the LATEST FINISH. (Fig 15).

Note that the latest finish figure is always the lowest, e.g., in EVENT 2 it is 2 (from path 7.6.4.2) and not 3 (from 7.6.5.2) or 5 (from 7.6.4.3.2).

The CRITICAL PATH is the path through the network with no float or slack. It is 1.2.4.6.7 and is depicted by double lines (Figure 16):

In these notes the construction of networks and hence CPA, has been shown last, but it should now be appreciated that it would probably be advantageous to undertake them first. They are a valuable aid in creating the other types of schedules and charts.