SOS POLITICAL SCIENCE AND PUBLIC ADMINISTRATION

MBA FA 204

SUBJECT NAME: OPERATION RESEARCH

TOPIC NAME:

Critical Path Analysis and PERT Charts

Planning and Scheduling More Complex Projects

Related variants: AOA or Activity-on-Arc Diagrams

© iStockphoto
TonyMarinella

Multiple activities are often linked.

Critical Path Analysis and PERT are powerful tools that help you to schedule and manage complex projects.

They were developed in the 1950s to control large defense and technology projects, and have been used routinely since then. As with Gantt Charts

, Critical Path Analysis (CPA) or the Critical Path Method (CPM) helps you to plan all tasks that must be completed as part of a project.

They act as the basis both for preparation of a schedule, and of resource planning. During management of a project, they allow you to monitor achievement of project goals. They help you to see where remedial action needs to be taken to get a project back on course.

Within a project it is likely that you will display your final project plan as a Gantt Chart (using Microsoft Project or other software for projects of medium complexity or an excel spreadsheet

for projects of low complexity).The benefit of using CPA within the planning process is to help you develop and test your plan to ensure that it is robust. Critical Path Analysis formally identifies tasks which must be completed on time for the whole project to be completed on time. It also identifies which tasks can be delayed if resources need to be reallocated to catch up on missed or overrunning tasks. The disadvantage of CPA, if you use it as the technique by which your project plans are communicated and managed against, is that the relation of tasks to time is not as immediately obvious as with Gantt Charts. This can make them more difficult to understand.

A further benefit of Critical Path Analysis is that it helps you to identify the minimum length of time needed to complete a project. Where you need to run an accelerated project, it helps you to identify which project steps you should accelerate to complete the project within the available time.

How to Use the Tool

As with Gantt Charts, the essential concept behind Critical Path Analysis is that you cannot start some activities until others are finished. These activities need to be completed in a sequence, with each stage being more-or-less completed before the next stage can begin. These are "sequential" activities.

Other activities are not dependent on completion of any other tasks. You can do these at any time before or after a particular stage is reached. These are non-dependent or "parallel" tasks.

Drawing a Critical Path Analysis Chart

Use the following steps to draw a CPA Chart:

Step 1. List All Activities in the Plan

For each activity, show the earliest start date, estimated length of time it will take, and whether it is parallel or sequential. If tasks are sequential, show which stage they depend on.

For the project example used here, you will end up with the same task list as explained in the article on Gantt Charts (we will use the same example as with Gantt Charts to compare the two techniques). The chart is repeated in figure 1 below:

Figure 1. Task List: Planning a custom-written computer project

Task	Earliest start	Length	Type	Dependent on...
A. High-level analysis.	Week 0	1 week	Sequential	
B. Selection of hardware platform.	Week 1	1 day	Sequential	A
C. Installation and commissioning of hardware.	Week 1.2	2	Parallel	B

Task	Earliest start	Length	Type	Dependent on...
		weeks		
D. Detailed analysis of core modules.	Week 1	2 weeks	Sequential	A
E. Detailed analysis of supporting modules.	Week 3	2 weeks	Sequential	D
F. Programming of core modules.	Week 3	2 weeks	Sequential	D
G. Programming of supporting modules.	Week 5	3 weeks	Sequential	E
H. Quality assurance of core modules.	Week 5	1 week	Sequential	F
I. Quality assurance of supporting modules.	Week 8	1 week	Sequential	G
J.Core module training.	Week 6	1 day	Parallel	C,H
K. Development and QA of accounting reporting.	Week 5	1 week	Parallel	E
L. Development and QA of management reporting.	Week 5	1 week	Parallel	E
M. Development of Management Information System.	Week 6	1 week	Sequential	L
N. Detailed training.	Week 9	1 week	Sequential	I, J, K, M

Step 2. Plot the Activities as a Circle and Arrow Diagram

Critical Path Analyses are presented using circle and arrow diagrams.

In these, circles show events within the project, such as the start and finish of tasks. The number shown in the left-hand half of the circle allows you to identify each one easily. Circles are sometimes known as nodes.

An arrow running between two event circles shows the activity needed to complete that task. A description of the task is written underneath the arrow. The length of the task is shown above it. By convention, all arrows run left to right. Arrows are also sometimes called arcs.

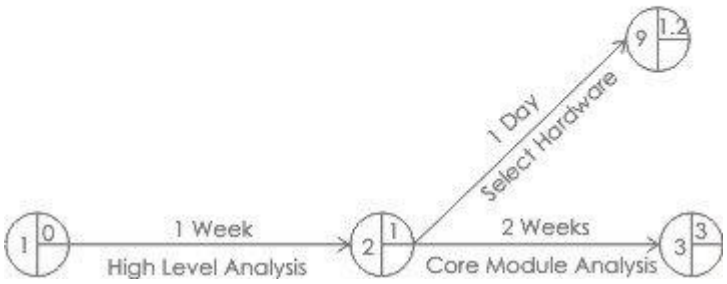
An example of a very simple diagram is shown below:

Figure 2: Simple Circle and Arrow Diagram

This shows the start event (circle 1), and the completion of the "High-Level Analysis" task (circle 2). The arrow between them shows the activity of carrying out the High-Level Analysis. This activity should take 1 week.

Where one activity cannot start until another has been completed, we start the arrow for the dependent activity at the completion event circle of the previous activity. An example of this is shown below:

Figure 3: Circle and Arrow Diagram showing two activities that cannot be started until the first activity has been completed.

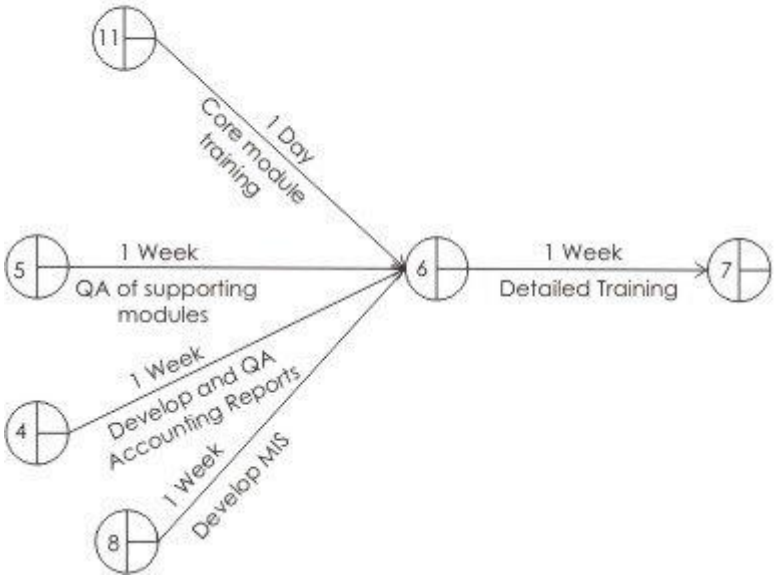


Here the activities of "Select Hardware" and "Core Module Analysis" cannot be started until High Level Analysis has been completed. This diagram also brings out a number of other important points:

- Within Critical Path Analysis, we refer to activities by the numbers in the circles at each end. For example, the task "Core Module Analysis" would be called activity 2 to 3. "Select Hardware" would be activity 2 to 9.
- Activities are not drawn to scale. In the diagram above, activities are 1 week long, 2 weeks long, and 1 day long. Arrows in this case are all the same length.
- In the example above, you can see a second number in the top, right hand quadrant of each circle. This shows the **earliest start time** for the following activity. It is conventional to start at 0. Here units are whole weeks.

A different case is shown below:

Figure 4: Circle and Arrow Diagram showing an activity (6 to 7) that cannot start until other activities (11 to 6, 5 to 6, 4 to 6, and 8 to 6) have been completed.



Here activity 6 to 7 cannot start until the other four activities (11 to 6, 5 to 6, 4 to 6, and 8 to 6) have been completed.