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# CPM AND PERT COMPARISON ANALYSIS IN PROJECT PLANNING

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## ABSTRACT

With the advent of technology and increasing requirement of efficient delivery of projects, many techniques have emerged. Different techniques are adopted by the project managers as per relevance and effectiveness. CPM and PERT are most widely used effective tools in project management with varied potential of delivering efficiency in pertinent fields and nature of projects. Seemingly, both technique share many similarities but an in-depth analysis reveals some striking differences as well. This study aims to underpin the salient features of both techniques and their comparison paired up with pros and cons of each.

**Key Words**: CPM, PERT, project

## Introduction:

CPM, Critical Path Method or Critical Path Analysis is a project management tool that is used in project planning process. Initially CPM was used for defence related long projects. CPM and PERT became a part of project management during early 50s of twentieth century. These techniques were primarily used in the projects that comprise multiple activities and tasks. These activities intermingle together in a complicated manner and CPM/PERT assists in organizing and managing the same in efficient manner. CPM can be described as a project management tool that schedules/categorizes critical and non-critical tasks with the aim of averting potential issues and problems. It eventually helps to accomplish the tasks within a given time-frame and also helps in avoiding process bottlenecks.

## The Process of CPM Application:

Critical Path is the longest route to finish up a project. Since the project is divided into various activities so the completion of one activity induced the next activity and delay in one activity disrupts all activities (Kerzner, 2009). All activities are displayed in the form of flow chart. CPM is not only about scheduling the project but it also helps in monitoring the activities in a subsequent manner. It eventually leads to take precautionary measure if the project manger

foresees any possibility of project delay. The essence of CPM is to identify the tasks that are critical for project completion within estimated time frame and also categorizes the tasks that can be held-back for restructuring the skipped or overrun tasks. Discussed below is the step by step process of CPM:

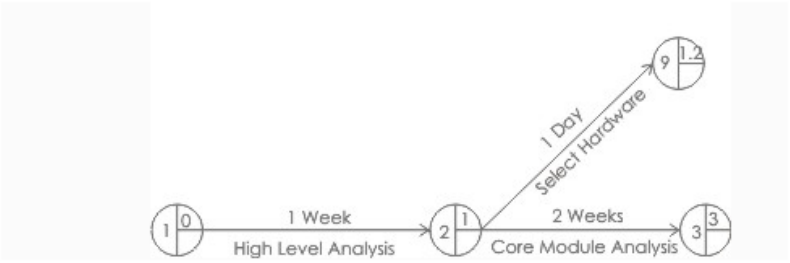
***Listing out all activities in project plan:***

Dividing the whole project into different phases and activities is the initial step of CPM. Against each activity, the start date and expected length of time should be stated. Also the nature of activity, either chronological or parallel, should also be mentioned. In case, the activities are chronological, their associated phase should be identified as well (Sharma, 2006). The figure below demonstrates CPM when converted into activity flow:

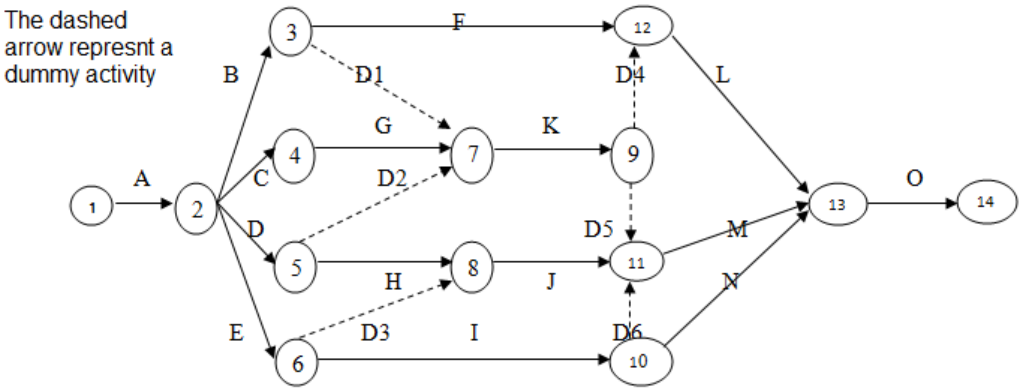
***Placing the activities as circles and arrow flow chart:***

Most commonly, circles and arrows are used for formulating the CPM. The circles are meant for showing activities that are being listed in previous stage with certain numbers being allotted to each. These circles are connected through arrows. A brief description of activity is stated below the arrow while number of days or weeks is stated above. Sometimes, certain alphabets are assigned at each arrow that give note/reference to each activity in a separate schedule. Below figure describes the technique of using circles and arrows:


Since beginning point of one activity depends on the completion of previous one so the arrow of next activity will be started at the finish point of previous one. The figure below explains this more clearly:

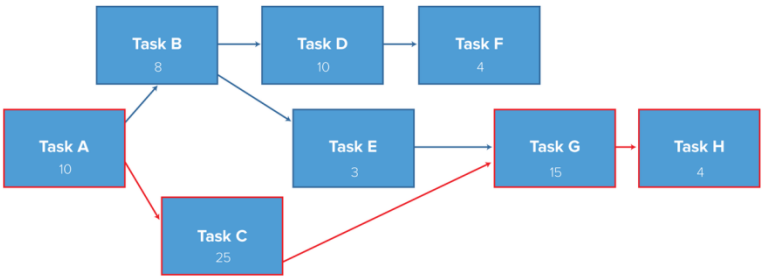



A complete CPM diagram can also look like the following:




***Identifying Critical Path:***

Identifying the Critical Path from flow chart helps to estimate the longest duration throughout the activity network and all the activities located at critical path indicate them as high priority activities (Meredith & Mantel, 2011). A project is delayed if critical activities are delayed. As an illustration, the diagram below shows critical path with red outline:




***Updating the CPM:***

Once the project execution starts, the actual time that is required for completion of each activity gets determined. Now the project manager should keep updating the CPM chart as the actual time of activity completion will require the CPM to be in line with actual and estimated time frame. Consequently, as the project proceeds, a new critical path will emerge. It is significant to keep on calculating the actual time given to each activity and its impact over the next activities.

***Other Possibilities in CPM:***

As the project advances, it is quite possible that project manager realizes the potential for an earlier completion. He sometimes perceives that the critical path is a little longer than it should actually be. In this situation, the project manager can cut down the estimated time for certain activities to curtail the overall project deadline. There are two methods that can be adopted to shorten the overall time limit of the project (Kloppenborg, 2014).

**Fast Tracking:** This method allows the project manager to run some activities at the same time, if possible. This automatically subtracts the time assigned to the activities separately thus reducing the overall time limit of the project. While, fast tracking guides to cuts down the time

frame of the project, nevertheless, it inherits some potential risks during implementation. Since the activities that were supposed to be executed separately are run parallel therefore, risk factor increases.

**Crash Duration:** This involves employing more resources in the project with the intention of reducing time assigned for each activity. It is done by determining the earliest possible time against each activity and then allocating additional resources accordingly. This method also comes with a compromise at project quality since the main focus during implementation stage is to speed up everything.

***Managing Resource Limitations:***

Once the project implementation begins, the manager realizes some resources getting short. This situation leaves a lot of impact at overall critical path. Consequently, the manager has to arrange additional resources and for this purpose some of the activities require rescheduling. This process is called resource levelling as the manager strives to resolve the issues arising.

## PERT Analysis

A PERT stand for Program Evaluation and Review Technique and this analysis method is preferably used for planning and executing large scale projects. As a matter of fact, PERT is mainly used for controlling the project activities and it acts as a guiding tool for a given project and helps in identifying major activities of the project and their relationship with each other. The PERT is usually structured from end to start since the end date is already decided by the project manager while there could be some flexibility for start date (Nicholas, 2004).

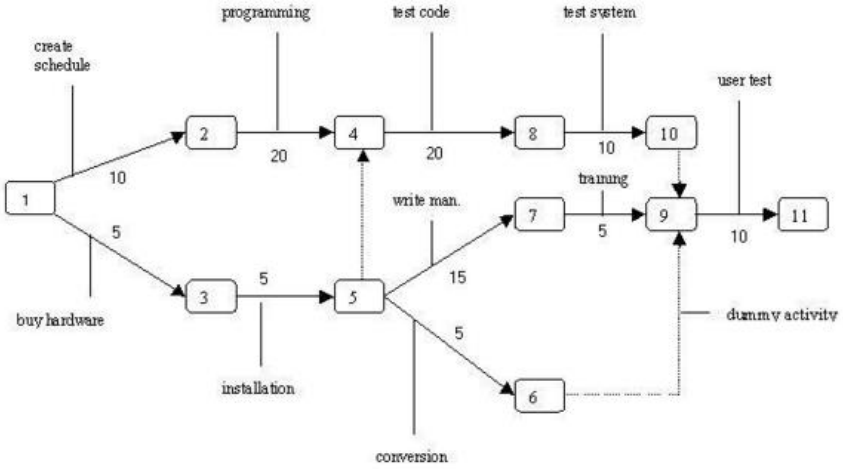
Background: PERT was initially used by defence projects. US Naval forces used this technique for developing missile in late 50s and it substantially helped to carry on all the procedure much faster. The effectiveness and possibility of broader implication of this technique enabled to utilize this method in other scenarios as well.

Network Diagram: The key feature of PERT method is formulation of network diagram. This diagram demonstrates all major activities of project in a certain order that must be followed in order to get these activities completed. All the activities are displayed in separate steps that are moving toward completion of project. All the activities are listed against resources and time requirements (Schwalbe, 2015)

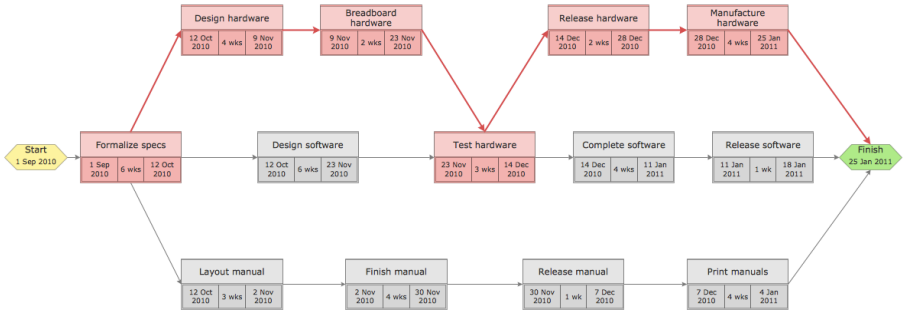
The diagram comprises of arrows and nodes. The arrows symbolize activities in activity-on-arrow whereas the nodes symbolize activity-on nodes. Against each activity, manager should be able to allocate some estimated time to forecast its completion. The order of activities being guided from initial point towards the end point of diagram is called path. The total time required for the completion of a given path can be determined by adding up all activities present at that path.

Once the time is estimated for all paths, the time calculated for longest path is named as 'critical path'. Critical path, as the name indicates, is the most important path for project manager since it helps in determining completion date of the project. If the activities located at critical path are delayed then the completion date for project also gets extended. On the contrary, if a manager wished to complete the project quicker than the estimated time, he must focus to reduce the time allocated for the activities at critical path. Consequently, the critical path plays key role in completion of the project at desired time.

The time estimated for different activities entail different tendencies of certainties. If the network diagram demonstrates order of activities with high certainty then they are called deterministic estimate. Conversely, if the time estimation has flexibility of time they are called probabilistic estimates. The later provides three types of possibilities against activity i.e. most likely, worst and best case. Various statistical tools help in determining the level of certainty. Most commonly used technique is standard deviation that helps in calculating the deviation of estimated and actual time frames. Figure below illustrates the network diagram for PERT technique:




In the above figure, the tasks 1,2,4,8 and 10 are dependent in each other. They should be completed in the given orders and the completion of next step is linked with completion of previous. Such tasks are called dependent or serial tasks. On the other hand task 3 and 4 or 5 and 8 are not linked in an order and they are not dependent. These tasks can be carried out simultaneously and called parallel or concurrent task. The path from task 1 to 11 is the longest path thus it can be identified as critical path for this figure. The network diagram below also displays critical path in PERT in red colour rectangles more clearly:




**Comparison between CPM and PERT Analysis:**

Seemingly, there are many similarities in both CPM and PERT but they are different in many ways as well. PERT analysis has broader implication since it can be applied to any field that requires systematic planning, coordination, evaluation and analysis while CPM is primarily used in construction projects. CPM aims focuses at activities while PERT focuses events. CPM allows more closer estimates to actual implementation of project plan while PERT may come up with a fair degree of variation in time estimates (Vallabhaneni, 2013).

The basic goal for PERT analysis is to plan the project in terms of time whereas CPM aims at coordinating both time and costs of the project. CPM focuses to carry on the activities with having a primary focus to remain within the costs allocated so; cost is the dominant factor in CPM method. Conversely, PERT analysis is mainly concerned with accomplishing the project deadlines within the planned/estimated time frame or even quicker. The activities in CPM are already identified and determined while in PERT analysis the events are more likely unpredictable and so is the time estimations. Therefore, the activities are categorized in term of degree of certainty. For instance, research and development projects are uncertain and unpredictable and PERT analysis acts as a best tool to coordinate such projects.

**Pros and Cons CPM:**

CPM helps in systematizing the large scale projects and further guides to implement, execute and manage the project. It helps in calculating the slack of every activity and also gives an option to speed up the project and finish it in shorter duration. Also, CPM allows incorporating more resources and their better utilization. Once the critical activities are determined, CPM enables to control all risk factors.

On the other side, CPM has many shortcomings such as large scale projects are segregated into thousand of activities thus requiring efficient software to cope with the situation. In such case, if one activity at critical path is delayed, whole CPM needs revision. Moreover, in order to manage the resources during a project, the guidelines provided in CPM are nit sufficing so a manger has to use another separate tool to efficiently manage the resources.

**Pros and Cons of PERT Analysis:**

PERT is concerned with giving attention to the events that are critical for timely completion of project and it helps in integrating the information obtained through various departments. It considers three possibilities of events happening and subsequently enables to cope with the situation as per requirements. On the other hand, PERT is more concerned with time factor and gives secondary importance to costs and budgets. The analysis done through PERT is subjective and data may become unreliable if the circumstances change (Chen & Liew, 2002).

**Summary:**

This document has described the Critical Path Method (CPM) and PERT analysis in extensive detail. This discussion comprises an in-depth study of each method along with the comparison of both methods. Pros and cons of CPM and PERT is also added in the end.

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