

# PERT and CPM: Comparison and its Differences

**Sonal Burghate**

Dept. of Business Management,  
Rashtrasant Tukdoji Maharaj Nagpur University,  
Pune, Maharashtra 411027, India  
*sonal.burghate@gmail.com*

**Abstract** - Project management is a systematic way of planning, scheduling, executing, monitoring, and controlling the different phases of the project, so as to obtain the goal made at the time of project creation. PERT and CPM are the two scheduling methods, which shows the flow and sequence of the activities and events. Program (Project) Management and Review Technique (PERT) is suitable for the projects where the time required to complete different activities are not identified. Instead, the Critical Path Method or CPM is appropriate for the projects which are recurring in nature.

In this paper PERT and CPM methods use a common approach for designing the network and for determining its critical path. They are used in the successful completion of a project and hence used jointly with each other. In this paper we emphasized the differences between PERT and CPM.

**Keywords** – PERT, CRM, Project Management, Network Techniques, Scheduling Techniques

## 1. Introduction

### Introduction to PERT and CRM

PERT stands for 'Program Evaluation and Review Technique'. The method was basically developed by the Navy PROJECT MANAGEMENT Special Projects Office in co-operation with Booz, Allen and Hamilton, a management consulting firm and Lockheed Missile System Division for evaluating the feasibility of existing schedules on Polaris missile program and for reporting progress.

The PERT system uses a network diagram consisting of events which must be established to reach project objectives. An event is that particular instant of time at which some specific part of a plan is to be achieved. It indicates a point in time and does not

require any resources. PERT uses event oriented network diagrams in which successive events are joined by arrows. For example, in a foundation construction project, the various events may be 'foundation layout started', 'foundation excavated', 'side boards fixed', 'concreting completed' etc. The approach of event-orientation in network diagram grew out of the desire to report on the project progress via discernible management milestones.

PERT system is preferred for those projects or operations which are of non-repetitive nature or for those projects in which precise time determination for various activities cannot be made. In such projects, managements cannot be guided by the past experience. They are mentioned to as once-through projects or operations. For example, the project of launching a space craft involves the work never done before. For such a project the range of possible technical problem is immense in such research and development projects, the times estimates made for use may be little more than guesses. PERT system is best suited for such projects.

### Introduction to CPM

CPM stands for 'Critical Path Method'. In CPM networks, the whole project consists of a number of clearly recognizable jobs or operations, called activities. Activities are usually operations which take time to carry out, and on which resources are expended. Junctions between activities are termed as events. The CPM networks are often referred to as activity oriented diagrams in which each activity is represented by an arrow, and the sequence in which the activities are performed is shown by the sequence of the arrows. For example, in a foundation construction project, the various activities may be;

'lay out the foundation trench', 'excavate the foundation', 'put side boards', 'concrete the foundation base', etc.

Usually CPM network are used for repetitive type projects, or for those projects for which fairly accurate estimate of time for completion of each activity can be made; and for which cost estimations can be made with fair degree of accuracy. For example, CPM is very useful for construction projects. However, it is not suitable for research and development projects.

## **1. History of PERT and CPM**

PERT (Programme Evaluation and Review Technique) was developed in 1956-58 by a research team to help in the planning and scheduling of the US Navy's Polaris Nuclear Submarine Missile project which involved thousands of activities. The objective of the team was to efficiently plan and develop the Polaris missile system. Since 1958, this technique has proved to be useful for all jobs or projects which have an element of uncertainty in the estimation of duration, as is the case with new types of projects the likes of which have never been taken up before.

At the same time but independently, CPM (Critical path Method) was developed by E.I. DuPont company along with Remington Rand Corporation. The aim behind its development was to provide a technique for control of the maintenance of company's chemical plants. In course of time, use of CPM got extended to the field of cost and resource allocation.

In order to carry out the intended objectives and to have the optimum utilization of scarce resources, it has been established that the use of network Techniques helps in integrated cost planning, and financial and project scheduling on scientific basis. According to Drucker, organized study of "work" did not start until the beginning of 20th century. Taylor was the first one to have systematic observation and study of the work and he Concluded that work is impersonal and objective, i.e., work is a "task" and is something having a logic and needs analysis, synthesis and control.

Therefore, the first step towards understanding work is to analyze it which involves:

- (i) Identifying and analyzing the basic operations and,
- (ii) Arranging the basic operations in a logical, balanced, and rational sequence. This will require the knowledge of production principles, which help in knowing the process of putting together individual operations into individual jobs, and individual jobs into production. This was well observed by Gantt, and thus, the Gantt chart became the basis for today's Bar Charts/Bar Graphs/Calendar schedules/life cycle Curves, etc.

## **HISTORICAL PERSPECTIVE OF NETWORK TECHNIQUES**

The Network techniques have their origin in the late fifties in U.S.A. The techniques were developed to facilitate planning, scheduling, and controlling the projects in an integrated manner with the aim to complete them within the constraints Of given time and cost and required performance.

According to United Nations Publication, Analysis Through the Use of Network Techniques is a managerial device which can satisfy a variety of needs such as system's design, planning, and control. Since older scheduling techniques did not enjoy much success in carrying out such projects, network is considered to be an important advancement in Project Management. There are two analytical techniques developed almost simultaneously (1956-1958) by two different groups for planning, scheduling and controlling the projects. These are the Critical Path Method (CPM) and the Project Evaluation and Review Technique (PERT).

CPM was first developed in 1957 by Morgan R. Walker of the Engineering Services Division of DuPont and James E. Kelley of Remington Rand. Walker and Kelley were concerned with the problem of improving scheduling techniques for such projects as building of a chemical Model Plant. Later on, it was applied for overhauling and maintenance of shutdown at DuPont Works.

At present, CPM is employed widely in different areas of industrial activities, particularly in construction industry. Through CPM, it is not essential to rush through and increase the cost of performing all the jobs, instead, crashing of a few activities alone can serve the purpose of expediting a

project with good savings. PERT was developed in 1958 by U.S. Navy and a team of Management Consultants (Boose Allen and Hamilton) for scheduling the research and development activities for the Polaris Missile Programme. Since then, the use of PERT has spread rapidly throughout defense and space industry as well as in large industrial contracts in the field. Even small business houses found it increasingly necessary to develop PERT capability.

### **Advantages of PERT and CPM:**

#### **PERT**

1. It compels management to plan and predict project before it begins.
2. It establishes approach to planning.
3. It permits control by exception and better management of resources.
4. It focuses attention on critical activities because a delay in the performance delay the whole project will delay the whole project unless managers are able to make up the time by shortening some future activities.
5. PERT is useful for planning and controlling of a project as it takes uncertain factor into consideration.
6. PERT is a comprehensive tool helps management from the inception of project till its completion
7. It provides updated information about the project.
8. It minimizes delays and interruptions.
9. It influence the right action, at right-point and at right time in the organization.
10. It clearly shows dependency relationships between work tasks.

#### **CPM**

1. It helps the management to divert resources from non-critical to critical activities.
2. It facilitates optimum utilization of resources.
3. It evaluates the progress towards the completion of the project.
4. It provides complete information about the advantages, size, duration and performance of an activity.
5. It avoids unnecessary pressure on the path that will not result in earlier completion of the project.
6. CPM helps to know the sequence of jobs that determine the earliest completion date for the project.

### **Limitations of PERT and CPM**

#### **PERT**

1. PERT emphasizes only on time and not cost.
2. Time estimates sometimes acts as a major limitation to the implementation of project.
3. For control of project, PERT requires frequent analysis of the project. It an expensive and time consuming activity.
4. There may be errors in time estimation.
5. It does not suit routine planning of recurring events.

#### **CPM**

1. CPM operates only on assumption basis.
2. CPM ignores statistical analysis of time estimation.
3. Each time changes are introduced, each time new evaluation to be made and project has to be determined new critical path.
4. CPM is not a panacea for all ills. It cannot by itself solve the problems it facilitates solution for the problem.

### **PERT AND CPM DIFFERENCES**

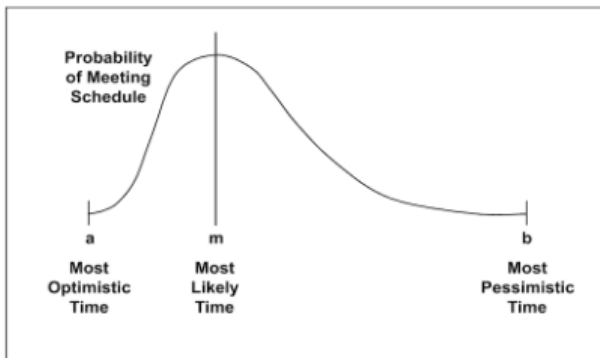
Over the years, PERT and CPM techniques have been developed in different environments. Although, objectives of the two techniques were initially extremely divergent, these are being used more profitably in conjunction with planning, design, scheduling, and control, all over the world. PERT and CPM are basically time oriented techniques, i.e., both lead to determination of time schedule. However, CPM has an inherent capability of activity-cost optimization, while PERT on time estimation. Although, these techniques were developed independently by two different organizations, they are more or less similar and now referred to as the Network Techniques or Network Analysis or Critical Path Analysis or Project Scheduling Techniques.

1. PERT is an event-oriented technique, while CPM is an activity oriented one, i.e., in the former, attention is focused on starting and completion of event, rather than on the activities. Thus, CPM prepares network from activities, while PERT does it from events. Originally, the time estimates for the activities in CPM are assumed deterministic, i.e., single estimate of time, whereas

probabilistic in PERT, i.e., three times (most likely, pessimistic, and optimistic) formula was adopted for PERT analysis.

PERT was introduced as an event-oriented, probabilistic technique to increase a PM's control in project where time was the critical factor time estimates were difficult to make with confidence. The events used in this technique represent the start and finish of the activities. PERT uses three time estimates for each activity: optimistic, pessimistic, and most likely. From these estimates, an expected time is calculated based on a beta probability distribution for each activity. The developers of the PERT use the beta probability distribution because it could accommodate nonsymmetrical situations. They assumed that the probability of an estimate being too optimistic would not be equal to the probability that the same estimate would be too pessimistic. That is, if estimated times could be compared against actual completion times in a number of cases, the variation would look like the curve in Figure 1. The expected time,  $t$  is the weighted average, or mean time, for an activity on the distribution and is determined from the following formula:

$$t = \frac{4m + a + b}{6}$$



1. Figure: Beta Distribution with PERT time estimates

Using the expected times and other statistical properties of the beta distribution for each activity, it is possible to determine an expected time for completion of the project and the likelihood (probability) that this expected completion time will

be met. It is also possible to determine the critical path for the project—the most time-consuming path through the network activities to project completion. Any delay on this path delay the completion of the project.

CPM is activity oriented, concentrating on activity start (early start, late start) and finish times (early finish, late finish) whereas PERT is event-oriented, concentrating on early event time and late event time. The network diagrams for CPM and PERT are essentially the same (see Figure 4-3), as are procedures for using them. As discussed earlier, certain actions are essential to applying network scheduling techniques. The activities / events composing the project, the relationships among them, and their time estimates must be identified, and a network diagram developed. Once the diagram is completed, the following procedures are applied:

Complete and annotate the cumulative time required to reach each node along the paths—this will indicate the earliest time work can start on the next activity. The final number will indicate total time required to complete a particular path. Identify the critical path—this is the sequence of events, or route, taking the longest time to complete. Starting at the program completion node on the right side of the diagram, working backward and compute the latest time an activity can start without delaying the overall program—For example, if the total program takes 40 weeks and the final activity requires 5 weeks, this activity cannot begin later than week 35. For CPM, the difference between the latest and earliest start of an activity is the slack or float. The critical path contains no slack or float time.

For PERT, the difference between the earliest event time and the latest event time at each event is the slack/float time.

2. PERT allows for uncertainties in time, whereas CPM ignores chance element and employs only normal and crash cost time.
3. CPM stresses on cost concept, i.e., deploying additional resources to shorten the duration of the job, whereas in PERT, more emphasis is on shortening and controlling project time on the understanding that reduction in time

element would eventually lead to reduction in cost.

4. CPM is used mainly for construction programme, while PERT devotes its attention in areas like research and development programmes.
5. CPM relies on past experience, which is not taken into consideration by the PERT method.
6. The notations used in the two techniques are quite different. PERT makes use of notations like Network, event activity, slack, etc., whereas in CPM, notations like arrow diagram, node, job, float, etc., are invariably used.

Over the years, the distinction between the two techniques has diminished to a great extent due to various refinements, extension, change in formats, etc. This has given rise to a host of several other variations, namely, PEP (Programme Evaluation Procedure), SCANS (Scheduling and Controlling by Automated Network Systems), LCES (Least Cost Estimating and Scheduling), etc. In spite of PERT and CPM extensions, the thumb rule is, when the time can be estimated fairly well and when costs can be calculated in advance.

CPM is used, while the PERT is used in an extreme degree of uncertainty and control over time outweighing control over costs. In other words differences of the PERT and CPM. Although there are no essential differences between PERT and CPM as both of them share in common the determination of a critical path and are based on the network representation of activities and their scheduling that determines the most critical activities to be controlled so as to meet the completion date of the project. However, following are the some of the other major differences.

CPM vs PERT Project management can be understood as a systematic way of planning, scheduling, executing, monitoring, controlling the different aspects of the project, so as to attain the goal made at the time of project formulation. PERT

and CPM are the two network-based project management techniques, which exhibit the flow and sequence of the activities and events. Program (Project) Management and Review Technique (PERT) is appropriate for the projects where the time needed to complete different activities are not known.

### **Conclusion**

PERT and CPM are used as a network management techniques. Better understanding of these network techniques let project managers and executioners to maximize resources and improve productivity, contributing to both personal development and successful project execution. The crucial point that distinguishes PERT from CPM is that the past, it gives the extreme importance of time. If the time is lessened, accordingly the cost will also be reduced. However, cost optimization is the elementary element while concluding.

### **Bibliography**

1. Project Planning and Control with PERT & CPM By Dr. B.C. Punmia & K.K. Khandelwal
2. Operation Research: Pert, Cpm & Cost Analysis By S.C. Sharma
3. Entrepreneurship Development By S. Anil Kumar
4. <https://keydifferences.com/difference-between-pert-and-cpm.html>
5. <https://theconstructor.org/construction/const-management/pert-cpm-gantt-chart-project-management/94/>