Project Management and Program Evaluation and Review Technique (PERT): An Appraisal

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Abstract

Program Evaluation and Review Technique (PERT) provides the means to manage any kind of project—big or small. It also helps to ensure that work is completed in the shortest possible time with the most economic use of the resources available. It is against this background that this paper is written to appraise PERT, its networks, rules, and errors. Scheduling a project with the use of PERT is also illustrated. All the analysis in PERT-time cost and resources are examined. The benefits of PERT are also discussed. It is clear therefore that if project managers make use of PERT, costs will be minimized and time and resources will be saved.

Introduction

Managers, the world over have something in common, irrespective of whatever type of jobs they do and wherever they are employed. One of the most important aspects of the manager's job includes effective management of projects. In doing so, managers employ various approaches especially in controlling production. They must also determine the jobs that have to be done and the order in which they should be done. Effective management of projects also demands that what has to be done and the schedule for performance must be planned. This type of planning involves the deployment of resources to the total project. To accomplish this, the project manager must determine the activities required for the project, the timing and interdependencies, the requirements of various possible schedules, manpower and other resources, and the relationship of all the foregoing to a project completion date. The project completion date most often is a part of a contract that carries penalties for nonperformance. The objective of this paper therefore, is to assess Program Evaluation and Review Technique (PERT) as a method that are encountered in managing a project effectively. To accomplish the above stated objectives, the paper is divided into five parts. Part one is the introduction. The theoretical framework constitutes part two. Part three discusses PERT Networks and project scheduling. The benefits of effective project management and PERT are contained in part four, while part five is the conclusion.

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Theoretical Framework
Managing materials for a project requires scheduling. Scheduling according to Pride et al (1993:215) "is the process of ensuring that materials are at the right place at the right time". These materials may be raw materials; subassemblies, work in progress, or finished goods. Materials may move from the warehouse to the work stations at which they are needed, they may move from station to station, or they may arrive at the work station "just in time" to be made part of the work in process at that station. Both place and time are important to scheduling. Shobin (1957:215) states that "scheduling is aimed at achieving the required rate of output with a minimum of delay and interruptions". A technique for scheduling a process or project and at the same time maintaining control of the schedule is known as PERT (Program Evaluation and Review Technique).

Griffin and Ebert (1993:309) defined PERT as "A method of diagramming the steps in a project along with the projected time to complete each step, taking into account both the sequence and the critical path of those steps". To Bryan (1974:3) PERT provides "network or diagram of the project showing the jobs that have to be done and the order in which they should be done". The network shows the sequence of jobs and determines the shortest time needed to complete the project and the really critical jobs where any delay means the whole project will be delayed. When a whole project is looked at, it reveals a complete picture of what is planned to be done.

PERT, also known as critical Path Methods, Critical Path Scheduling or Least-Cost Estimating and Scheduling (LES) was developed in the 1950s. According to Bulla (1977:451) the network-planning method was developed by two different groups interdependently. It was first developed as an internal project of Du Pont Company to plan and control the maintenance plants and other engineering functions. Parallel efforts were undertaken by the United States Navy to develop methods for planning and controlling the Polaris Missile Project—a project that involved 3,000 separate contracting organizations. PERT methodologies aided these two organizations—Du Pont and the US Navy—to reduce time for maintenance and the completion of the Polaris program respectively.

Today, PERT has been used, as noted by Anderson et al (1988:387) to plan, schedule, and control a wider variety of projects such as research and development of new products and processes, construction of plants, building highways, maintenance of large and complex equipment, design and installation of new systems etc. In projects such as these, the Project Manager must schedule and coordinate the various jobs or activities so that the entire project is completed on time.

PERT Networks

The essence of PERT planning to Bulla (1974:152) is based on the development of a network representation of the required activities. The starting point is to plan the jobs to be done and the order in which they should be done. At this initial point,
the project management has to:

a) Determine the major jobs in the project: This is done by dividing the project into its major parts and the major operations, which in themselves take time and other resources to complete. Once analyzed, these can be divided into groups of smaller jobs, which can then be analyzed in their turn and so on. The degree to which it is necessary will depend almost entirely on the information needs of the people using the network.

b) Determine which jobs depend on which? Jobs are then analyzed to discover their dependence. This is because obviously, some jobs cannot start until others have been completed. Here, the project manager has to ignore all questions of time and assume that he/she can call on unlimited resources. This is a stage at which the logic of the plan is established so as to consider the time and resources available for implementation.

Network Rules:
There are general rules for drawing a network, some of these rules are:

Rule 1: Every network has a single starting point and a single finishing point and it always flows logically in one direction from left to right.

Rule 2: Each job in the project is shown by an arrow (→) pointing (more or less) to the right. The arrow can be long or short, straight or bent sometimes will even cross each other. It is a question of what fits best.

Rule 3: The technical term for each job shown by an arrow is called an activity.

Rule 4: The circles, which precede and follow each activity, are called events. These circles are used to record information - activity start, numbering the event itself and finish times.

Rule 5: The starting point for an activity should always have a lower number than its finishing point.

Rule 6: Additional graphical devices are used to assist in drawing the network. They are called Dummy activities or simply called Dummies. They are Dummy because nothing at all happens in this sort of activity. Two types of dummies exist:

a) Logic Dummy: is used to show the dependence of one activity on another when they are in different paths and are not otherwise linked.

b) Identify Dummy: this is used to distinguish between two or more activities, which would otherwise have the same even numbers, and thus, the same identity. Dummies are represented by broken arrows (→→).

Errors in Network:
When drawing a network, there are two types of errors in logic that most managers fall them at one time or another especially drawing complicated network. Errors in
network, according to Bryan (1974:8) are an indication that the plan has not been thought out thoroughly or that it has not been illustrated properly. Two types of errors are identified:

i. Looping: Looping error occurs when the project manager finds out that he/she has drawn an activity, which appears to depend on a later one. Though this is impossible.

ii. Dangling: A “dangler” is any activity, other than a final activity, which is not followed by another. This breaks the rule of dependency, which governs the logic of a network (see rule 1).

Project Scheduling with PERT

From the above explanation, some of the information can be used to draw up a network for instance in modernizing and expanding a shopping complex. If the expansion of the project is undertaken, it would add 10 tenants to the shopping complex.

Table 1: Activity list for the Shopping Complex Expansion Project

<table>
<thead>
<tr>
<th>Activity</th>
<th>Description</th>
<th>Immediate Predecessor</th>
<th>Completion Time (weeks)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Prepare architectural drawing of planned expansion</td>
<td></td>
<td>5</td>
</tr>
<tr>
<td>B</td>
<td>Identify potential new tenants</td>
<td>A</td>
<td>6</td>
</tr>
<tr>
<td>C</td>
<td>Develop prospectus for tenants</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>D</td>
<td>Select contractor</td>
<td>A</td>
<td>3</td>
</tr>
<tr>
<td>E</td>
<td>Prepare building permits</td>
<td>A</td>
<td>1</td>
</tr>
<tr>
<td>F</td>
<td>Obtain approval for building</td>
<td>E</td>
<td>4</td>
</tr>
<tr>
<td>G</td>
<td>Construction</td>
<td>D, F</td>
<td>14</td>
</tr>
<tr>
<td>H</td>
<td>Finalize contracts with tenants</td>
<td>B, C, G, H</td>
<td>12</td>
</tr>
<tr>
<td>I</td>
<td>Tenants move in</td>
<td></td>
<td>2</td>
</tr>
</tbody>
</table>

The above information can now be used to draw a PERT Network as shown in figure 1 below.
Figure 1:
PERT Network for a Shopping Complex Expansion Project


While Table 1 shows the specific activities that make up the expansion project, Figure 1 shows the PERT network for the project. The network maintains the immediate predecessor relationships. The information in Table 1 shows that 51 weeks are required to complete the expansion project. To facilitate the PERT computations, both the activity letter and time are indicated.

Analysis in PERT:
Having drawn the network, the project manager can proceed to make analysis of
(a) Time (b) Cost and (c) Resources.

i) Time Analysis: Time analysis enables the project manager to identify the critical activities and the ones where there is time to spare. Here we have according to Bryan (1974:12) the duration times, the earlier event times, the latest times, the float and the critical path.

ii) Duration Time: Duration time is the time that is estimated to be spent in carrying out an activity, which is recorded in the most convenient units—days, weeks, or months. This same unit is used throughout the network. These estimates must always be realistic taking full account of the resources available and acceptable by the people involved.
iii) Earliest Event Time: This is the earliest time by which all the activities arriving at an event can finish. It is also the earliest time that any activity leaving it can begin. The process of calculating the earliest event time in a project involves working from the starting event in a network to its end event. This process is called a forward pass. The earliest event time for the starting event is always a naught i.e. zero hour for the project. The duration time for each activity is then added to its earliest start time thus arriving at its earliest finish time.

iv) Latest event Time: Latest event time is the latest possible time by which all the activities arriving at an event can finish without delaying the project. It is the latest possible time that any of the activities leaving it can begin. This process is called Backward Pass, and it involves working from the end event in a network to its starting event. The latest event time of the end event is usually the earliest completion date for the project. The duration time of each activity is subtracted from its latest finishing time, thus arriving at its latest start time.

v) Float: In calculating the earliest and the latest start times of the activities, there is always time to spare. This spare time is known as float, and is the difference between the time available to complete an activity and the time required. There are two types of float: Total Float is calculated by abstracting the earliest start time of an activity from its latest finish time (i.e. the time available) and then subtracting its duration time (i.e. the time required). Free Float is calculated by subtracting the earliest start time of an activity from that of its immediately succeeding activity (i.e. the time available and then subtracting its duration time) i.e. time required.

vi) Critical Path: According to Heden and Melvvo in Bryan (1974:14) a critical path "is the path taken by those activities which have no float". In other words, a critical path is the longest path through the sequence from start to finish. The activities on this path determine the minimum time in which the process can be completed. These activities are the ones that must be scheduled and controlled carefully. A delay in any one of them will cause a delay in completion of the project as a whole. The critical path enables the manager to know where to direct attention and whatever to meet additional costs of accelerating these activities in order to accelerate the whole project.

vii) Cost Analysis: Costs reflect a special nature of money as a resource. Unlike men and machines costs cannot be used repeatedly. And so they warrant a close control in any project. This control by calculating the planned costs of a project on a per unit of time basis. If for example, the project manager assumes that days are the unit, then the network tells him/her which activities are planned for each day. Graphically, the total daily cost can be determined. In analyzing costs, an improvement can be made by adopting an approach known as "Crash Costing". Crash costing refers to the method of shortening
the critical path and thus, the time needed to complete a project. It involves shortening the time of those critical activities with the lowest cost analysis. Crash costing occurs if the time required for a project is more than the time available, or if the work has fallen behind time, then the manager has to look for ways to accelerate the project. The essence of crash costing is to reduce only those activities, which can be reduced at the least additional cost. This is known as reducing the activities with the lowest “Cost Slopes”.

viii) Resource analysis: Resource analysis also known as resource smoothing, is the process of using the float available in a project to minimize variation in resource requirements. Resource analysis enables the manager to modify some finish times to as to make the best use of resources. The times, already estimated have implied that the use of certain quantities of resources, and their relationship is a linear one i.e., the more resources allocated to an activity, the shorter its duration time. Resources analysis, as a process begins when a manager records on the network.

The Benefits of PERT

When fully applied, PERT offers five direct benefits, which result in considerable saving of time and money. These benefits according to Bryan (1974:3) occur in the following areas:

a) Planning: The first benefit of PERT occurs in the early stage of planning a project – the job that need to be done and the order in which they should be done. The very act of drawing a network means that each new step must be a logical progression from the cost. And this means that any illogical planning will show up immediately rather than as very expensive mistake later on.

b) Scheduling: Scheduling involves an estimate of time for each job in the project. From these estimates, the project manager can work a time for the project as a whole. Through scheduling, jobs that are important and there is time, to spare, and the really critical jobs identified. In critical jobs, any delay means the whole project is delayed.

c) Allocating resources: Resources and their allocation are factors in any project. Resources, whether expendable, like money and materials, or reusable, like men and machinery are of great importance to a project and the organization. A manager’s knowledge of the spare time he has enables him to work out the most economical allocation of resources. Allocating resources in the most economical way is an ingredient in any good plan.

d) Controlling: Control, according to Wright and Noe (1998:110) involves “measuring performance, comparing it with a (predetermined) standard, and making corrections as needed”. Control determines if an organization is carrying out its strategy and meeting its objectives. The benefit of PERT occurs when plans are translated into action. That is when the control function
comes into play. It is easier to check progress against a network and the overall picture of the project. In addition, by recording actual costs against the planned costs along the network, it is possible to compare variances at any point in time. And if the time table is getting out of hand, then the network can help again by pin-pointing those activities that can be accelerated at the least additional cost.

e) Communicating: Better communication offers the biggest benefit. The network is a “picture” of the complete project. It gives clearly and concisely the information that is needed. Everyone involved knows the part he has to play and how that interacts with others. Most organizations use PERT as a communication technique alone.

Conclusion

PERT is used for planning and control of projects. The basic idea in this technique is to link the various activities in such a way that the overall time spent on a project is kept to a minimum. And in view of the great benefit of PERT, managers are expected to apply it so that they can reap the benefits in their organizations. Once they apply this technique, they will, as a matter of fact, always want to use it.

References


Function, 5th edition, Los Angeles: John Willey and Sons, Inc.


