Application of PERT On Construction

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Abstract*:* *Management may utilize the Project Evaluation and Review Technique (PERT) and the Critical Route Method (CPM) to identify the most time-consuming path among a network of tasks or activities as a basis for project planning, execution, and oversight. The solutions help managers make the most of the quickest time frame possible to cut project expenses and time in half. This study paper illustrates the application of project planning on the construction. I used the Project Evaluation and Review Technique (PERT) to show the logical flow of steps that should be done in this research paper to achieve the goal of this piece.*

Keywords:* *Activities, Events, Project Evaluation Review Technique, Project Management

Introduction

Operational research is a branch of mathematics that offers a rational approach to task organization and decision-making. By utilizing mathematical approaches and tools, operation research (OR) facilitates decision-making and produces the simplest form of difficult situations.

Network analysis or network scheduling is one of the methods employed for the planning, scheduling, and management of significant projects. These are based on how the Project is depicted as an activity. A network can be examined using the CPM (Critical Path Method) and PERT (Project Evaluation and Review Technique) methods

The US Navy established PERT in 1958 to help with the construction of the Polaris nuclear submarine program. A management tool called PERT can be used to assess, plan, and integrate events. Since the emphasis is on completing a task rather than the steps required to do it, it is also known as an event-oriented strategy [1].

PERT requires probabilistic time since it is used for uncertain projects and never-before-done projects. PERT employs estimated time since the time assumed is unknowabl e[4]. Three-time estimations are made in PERT, and they are as follows:

Optimistic time (to): If everything goes perfectly, in such cases the time required is shortest, and this shortest time taken to complete is Optimistic time

Most likely time (tm): It is an estimate of the normal time an activity could take to be completed. It is the time that would take most often to complete an activity.

Pessimistic time (tp): If everything goes wrong, this is the maximum amount of time that the activity must be finished.

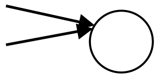
In 1956–1958, the E.I. DuPont Company and the Remington Rand Corporation almost simultaneously developed CPM. The corporation wanted to come up with a way to keep track of the maintenance of its chemical facilities[2]. CPM is a step-by-step project management methodology that concentrates on crucial tasks to keep projects and processes moving forward. Any Project can be finished more quickly by following the Critical Route, which involves moving along only one path through all of the related tasks. Two strategies are used by CPM to complete projects [3].

When all tasks and time are taken into account, the critical path is the route that takes a project from beginning to end in the smallest amount of time. Simply put, the key path establishes the project's actual schedule. Since it is used for Projects that have already been developed under Project management, time is predictable in CPM. As a result, a vital activity has zero float, where float (slack) is the period during which a task may be delayed without affecting subsequent activities or the project's completion date.

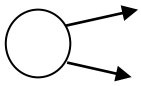
Components

Event: Events in the network diagram represent the project milestones such as the start or the end completion of an activity. Events are usually represented by circles. There are two types of events→ a) Mergeevent b) Burst event

- **Merge event**: An event that represents the joint completion of more than one event is known as a merge event.



- **Burst event**: An event representing the beginning of more than two activities is called a burst event.



Activity: Activity in the network diagram represents project operations to be conducted. Each activity consumes resources like time, money, raw materials, effort, etc. An arrow is commonly used to represent activities.

- **Predecessor activity**: An activity that must be completed before one or more activities start is known as predecessor activity.
- **Successor activity:** An activity that starts immediately after the completion of one or more other activities is called a successor activity.
- **Dummy activity:** The activity that does not consume either resources or time is called a dummy activity.

Fig 1. Representation of Activity and Event

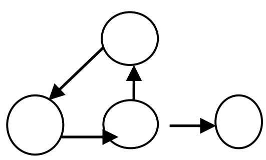


Fig 2. Representation of Looping in Network Diagrams

Where,

○ Indicates an event, also known as a node,

➔ Indicates activity, also known as an edge.

"t" is the amount of time an action takes.

Notation

Ei: Initial occurrence time of an event i.

Li: Newest permissible time of event i.

$ESij$: Earliest preliminary time of an activity (i, j).

$LSij$: Latest preliminary time of an Activity (i, j).

$EFij$: Earliest final time of an Activity (i, j).

$LFij$: Latest concluding time of an Activity (i, j).

tij: Duration of an Activity (i, j)

From these 3 times, we can calculate the expected time of an activity by using: $t_e = {t_0 + 4t_m + t_p}/{6}$

Variance of an activity can be calculated by: $\sigma^2 = ({t_p - t_0}/{6})^2$

The table below shows the activities and their duration [6]:

Activity	Estimated duration (weeks)		
	Optimistic time (t_0)	Most likely time (t_m)	Pessimistic time (t_p)
1-2	1	7	13
1-6	2	5	14
2-3	2	14	26
2-4	2	5	8
3-5	7	10	19
4-5	5	5	17
6-7	5	8	29
5-8	3	3	9
7-8	8	17	32

PERT calculations:

PERT calculations:

Activity	Estimated duration (weeks)			$t_e = {t_0 + 4t_m + t_p}/{6}$	$\sigma^2 = ({t_p - t_0}/{6})^2$
	t_0	t_m	t_p		
1-2	1	7	13	7	4
1-6	2	5	14	6	4
2-3	2	14	26	14	16
2-4	2	5	8	5	1
3-5	7	10	19	11	4
4-5	5	5	17	7	4
6-7	5	8	29	11	16
5-8	3	3	9	4	1
7-8	8	17	32	18	16

From the network diagram we can see the critical path is 1-2-3-5-8

Expected project duration = 7+14+11+4 = 36 weeks

Project length variance = σ^2 = 4+16+1+4 = 25

Project length Standard deviation = $\sqrt{\sigma^2} = 5$

The probability that the project will be completed in 40 days is given by P (Z≤D)

D=$\frac{T_S - T_e}{\sigma} = \frac{40-36}{5} = 0.8$

P (Z≤ 0.8) =0.7881

Conclusion

The benefits of applying PERT scheduling to construction are discussed in this paper. The conclusions show that the construction might be completed in 36 weeks.

Reduced project duration may result in cost, resource, and energy savings without affecting the quality of the finished product. The PERT analysis demonstrates that the Project may still be finished in the intended Project length with a probability of 0.7881 without extending the scheduled Project duration in the face of any fluctuation in the activities time of any important activities. The use of PERT scheduling in the construction of any length with limited resources is anticipated to be supported and promoted as a result of this study.

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