PERT TECHNIQUE:

- Before any activity begins related to the work of a project, every project requires an advanced, accurate time estimate. Without an accurate estimate, no project can be completed within the budget and the target completion date.

- Developing an estimate is a complex task. If the project is large and has many stakeholders, things can be more complex.

- Therefore, there have been many initiatives to come up with different techniques for estimation phase of the project in order to make the estimation more accurate.

- PERT (Program Evaluation and Review Technique) is one of the successful and proven methods among the many other techniques, such as, CPM, Function Point Counting, Top-Down Estimating, WAVE, etc.

- PERT was initially created by the US Navy in the late 1950s. The pilot projectwas for developing Ballistic Missiles and there have been thousands of contractorsinvolved.

- After PERT methodology was employed for this project, it actually ended two years ahead of its initial schedule.

The PERT Basics

- At the core, PERT is all about management probabilities. Therefore, PERT involves in many simple statistical methods as well.

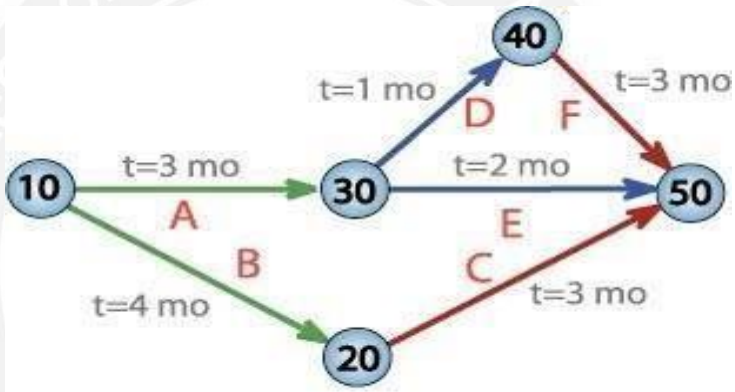
- Sometimes, people categorize and put PERT and CPM together. Although CPM (Critical Path Method) shares some characteristics with PERT, PERT has a different focus.

- Same as most of other estimation techniques, PERT also breaks down the tasks into detailed activities.

- Then, a Gantt chart will be prepared illustrating the interdependencies among the activities. Then, a *network* of activities and their interdependencies are drawn inan illustrative manner.

- In this map, a *node* represents each event. The activities are represented as arrows and they are drawn from one event to another, based on the sequence.
- Next, the Earliest Time (TE) and the Latest Time (TL) are figured for each activity and identify the slack time for each activity.
- When it comes to deriving the estimates, the PERT model takes a statistical route to do that. We will cover more on this in the next two sections.

Following is an example PERT chart:



PERT network chart for a seven-month project with five milestones (10 through 50) and six activities (A through F)

The Three Chances

- There are three estimation times involved in PERT; Optimistic Time Estimate (TOPT), Most Likely Time Estimate (TLIKELY), and Pessimistic Time Estimate (TPESS).
- In PERT, these three estimate times are derived for each activity. This way, a range of time is given for each activity with the most probable value, TLIKELY.

Following are further details on each estimate:

1. TOPT

This is the fastest time an activity can be completed. For this, the assumption is made that all the necessary resources are available and all predecessor activities are completed as planned.

2. TLIKELY

Most of the times, project managers are asked only to submit one estimate. In that case, this is

the estimate that goes to the upper management.

3. TPESS

This is the maximum time required to complete an activity. In this case, it is assumed that many things go wrong related to the activity. A lot of rework and resource unavailability are assumed when this estimation is derived.

The PERT Mathematics

BETA probability distribution is what works behind PERT. The expected completion time (E) is calculated as below:

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E = (TOPT + 4 x TLIEKLY + TPESS) / 6
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At the same time, the possible variance (V) of the estimate is calculated as below:

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V = (TPESS - TOPT)^2 / 6^2
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Now, following is the process we follow with the two values:

- For every activity in the critical path, E and V are calculated.
- Then, the total of all Es are taken. This is the overall expected completion time for the project.
- Now, the corresponding V is added to each activity of the critical path. This is the variance for the entire project. This is done only for the activities in the critical path as only the critical path activities can accelerate or delay theproject duration.
- Then, standard deviation of the project is calculated. This equals to the square root of the variance (V).
- Now, the normal probability distribution is used for calculating the project completion time with the desired probability.

Monte Carlo simulation

- Having been named after the principality famous for its casinos, the term Monte Carlo Analysis conjures images of an intricate strategy aimed at maximizing one'searnings in a casino game.

- However, Monte Carlo Analysis refers to a technique in project management where a manager computes and calculates the total project cost and the project schedule many times.
- This is done using a set of input values that have been selected after careful deliberation of probability distributions or potential costs or potential durations.

Importance of the Monte Carlo Analysis

- The Monte Carlo Analysis is important in project management as it allows a project manager to calculate a probable total cost of a project as well as to find a range or a potential date of completion for the project.
- Since a Monte Carlo Analysis uses quantified data, this allows project managers to better communicate with senior management, especially when the latter is pushing for impractical project completion dates or unrealistic project costs.
- Also, this type of an analysis allows the project managers to quantify perils and ambiguities in project schedules.

A Simple Example of the Monte Carlo Analysis

- A project manager creates three estimates for the duration of the project: one being the most likely duration, one the worst case scenario and the other being the best case scenario. For each estimate, the project manager consigns the probabilityof occurrence.

The project is one that involves three tasks:

- The first task is likely to take three days (70% probability), but it can also becompleted in two days or even four days. The probability of it taking two days to complete is 10% and the probability of it taking four days to finishis 20%.
- The second task has a 60% probability of taking six days to finish, a 20% probability each of being completed in five days or eight days.
- The final task has an 80% probability of being completed in four days, 5% probability of being completed in three days and a 15% probability of beingcompleted in five days.

- Using the Monte Carlo Analysis, a series of simulations are done on the project probabilities. The simulation is to run for a thousand odd times, and for each simulation, an end date is noted.
- Once the Monte Carlo Analysis is completed, there would be no single project completion date. Instead the project manager has a probability curve depicting the likely dates of completion and the probability of attaining each.
- Using this probability curve, the project manager informs the senior management of the expected date of completion. The project manager would choose the date with a 90% chance of attaining it.
- Therefore, it could be said that using the Monte Carlo Analysis, the project has a 90% chance of being completed in X number of days.
- Similarly, a project manager can adjudge the estimated budget for a project using probabilities to simulate different end results and in turn use the findings in a probability curve.

How is the Monte Carlo Analysis Carried Out?

- The above example was one that contained a mere three tasks. In reality, such projects contain hundreds if not thousands of tasks.
- Using the Monte Carlo Analysis, a project manager is able to derive a probability curve to show the ambiguity surrounding the duration and the costs surrounding these hundreds or thousands of tasks.
- Conducting simulations involving hundreds or thousands of tasks is a tedious job to be done manually.
- Today there is project management scheduling software that can conduct thousands of simulations and offer the project manager different end results in a probability curve.

The Different Types of Probability Distributions/Curves

- A Monte Carlo Analysis shows the risk analysis involved in a project through a

probability distribution that is a model of possible values.

- Some of the commonly used probability distributions or curves for Monte Carlo Analysis include:

  - **The Normal or Bell Curve -** In this type of probability curve, the values inthe middle are the likeliest to occur.
  - **The Lognormal Curve -** Here values are skewed. A Monte Carlo Analysis gives this type of probability distribution for project management in the realestate industry or oil industry.
  - **The Uniform Curve -** All instances have an equal chance of occurring.This type of probability distribution is common with manufacturing costs and future sales revenues for a new product.
  - **The Triangular Curve -** The project manager enters the minimum, maximum or most likely values. The probability curve, a triangular one,will display values around the most likely option.