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A STUDY ON DIFFERENCE BETWEEN CPM AND PERT

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ABSTRACT

CPM/PERT or Network Analysis as the technique is sometimes called, developed along two parallel streams, one industrial and the other military. Developed in the late 1950s, Critical Path Method or CPM is an algorithm used for planning, scheduling, coordination and control of activities in a project. Here, it is assumed that the activity duration is fixed and certain. CPM is used to compute the earliest and latest possible start time for each activity. The process differentiates the critical and non-critical activities to reduce the time and avoid the queue generation in the process. The reason for the identification of critical activities is that, if any activity is delayed, it will cause the whole process to suffer. That is why it is named as Critical Path Method. In this method, first of all, a list is prepared consisting of all the activities needed to complete a project, followed by the computation of time required to complete each activity. After that, the dependency between the activities is determined. Here, 'path' is defined as a sequence of activities in a network. The critical path is the path with the highest length. PERT is an acronym for Program (Project) Evaluation and Review Technique, in which planning, scheduling, organizing, coordinating and controlling uncertain activities take place. The technique studies and represents the tasks undertaken to complete a project, to identify the least time for completing a task and the minimum time required to complete the whole project. It was developed in the late 1950s. It is aimed to reduce the time and cost of the project. PERT uses time as a variable which represents the planned resource application along with performance specification. In this technique, first of all, the project is divided into activities and events. After that proper sequence is ascertained, and a network is constructed. After that time needed in each activity is calculated and the critical path (longest path connecting all the events) is determined.

KEY WORDS: CPM , PERT, CRITICAL ACTIVITIES ,LONGEST PATH.

HISTORY OF CPM AND PERT

The earliest concept of critical path was implemented by DuPont between 1940 and 1943 for the Manhattan Project, which was conducted by the US, the UK, and Canada during WWII for the production of the first nuclear weapons.
Later, Morgan R. Walker of DuPont and James E. Kelley Jr. of Remington Rand conceived CPM as a project modelling technique in the late 1950s. The attribution of CPM went to the developers of PERT, which was developed during the same time.
PERT and CPM are commonly used in conjunction with each other during project modelling.

INTRODUCTION TO CPM / PERT TECHNIQUES

Project management can be defined as a structural way of planning, scheduling, executing, monitoring and controlling various phases of a project. To achieve the end goal of a project on time, PERT and CPM are two project management techniques that every management should implement. These techniques help in displaying the progress and series of actions and events of a project.

MEANING OF PERT

Program (Project) Evaluation and Review Technique (PERT) is an activity to understand the planning, arranging, scheduling, coordinating and governing of a project. This program helps to understand the technique of a study taken to complete a project, identify the least and minimum time taken to complete the whole project. PERT was developed in the 1950s, with the aim of the cost and time of a project.

MEANING OF CPM

Critical Path Method or CPM is a well-known project modelling technique in project management. It is a resource utilising algorithm that was developed in the 1950s by James Kelly and Morgan Walker.

CPM is mainly used in projects to determine critical as well as non-critical tasks that will help in preventing conflicts and reduce bottlenecks.

In essence, CPM is about choosing the path in a project that will help in calculating the least amount of time that is required to complete a task with the least amount of wastage.

The Critical Path Method or CPM has been used in many industries starting from defence, construction, software, aerospace, etc.

ADVANTAGES AND DISADVANTAGES OF CPM

Advantages

- CPM identifies dependencies efficiently.
- It can identify critical activities that are of priority.
- CPM takes into account the resources required for a project in the most effective way.
- Project managers can determine the precise cost and time required to complete a project.
- CPM offers an efficient technique to assess the procedural and technical changes that might occur.

Disadvantages

- CPM can be extremely complicated to implement in case of large-scale projects.
- Critical path identification consumes more time for projects on larger scales.
- Creating a CPM can be time-consuming at times.
- CPM is not effective to comply with sudden changes in the project midway.

ADVANTAGES AND DISADVANTAGES OF PERT

Advantages

- PERT is beneficial for conducting a "what-if analysis". By analysing the critical path, the likelihoods and different levels of uncertainties can be identified.
- It promotes coordination among various departments of a project. This improves decision-making proficiencies and planning. Through coordination, ample data is also available that makes it easier for project management.
- PERT networks allow an analysis of all activities, which tell whether the project will be completed within the budget.
- PERT displays the critical path, which identifies activities that cannot be stayed under any condition.

Disadvantages

- PERT methodologies are entirely dependent on predictions, which can lead to going overboard on the estimated budget.
- It can be less accurate to implement as there is no data available to model a project since it is only used for non-repetitive jobs.

COMPARISION OF CPM AND PERT

BASIS FOR COMPARISON	PERT	CPM
Meaning	PERT is a project management technique, used to manage uncertain activities of a project.	CPM is a statistical technique of project management that manages well defined activities of a project.
What is it?	A technique of planning and control of time.	A method to control cost and time.
Orientation	Event-oriented	Activity-oriented
Evolution	Evolved as Research & Development project	Evolved as Construction project
Model	Probabilistic Model	Deterministic Model
Focuses on	Time	Time-cost trade-off
Estimates	Three time estimates	One time estimate
Appropriate for	High precision time estimate	Reasonable time estimate
Management of	Unpredictable Activities	Predictable activities
Nature of jobs	Non-repetitive nature	Repetitive nature
Critical and Non-critical activities	No differentiation	Differentiated
Suitable for	Research and Development Project	Non-research projects like civil construction, ship building etc.

APPLICATIONS OF CPM / PERT

These methods have been applied to a wide variety of problems in industries and have found acceptance even in government organizations. These include

- Construction of a dam or a canal system in a region
- Construction of a building or highway
- Maintenance or overhaul of airplanes or oil refinery
- Space flight
- Cost control of a project using PERT / COST
- Designing a prototype of a machine
- Development of supersonic planes

BASIC STEPS IN PERT / CPM

Project scheduling by PERT / CPM consists of four main steps

1. Planning

- The planning phase is started by splitting the total project in to small projects. These smaller projects in turn are divided into activities and are analysed by the department or section.
- The relationship of each activity with respect to other activities are defined and established and the corresponding responsibilities and the authority are also stated.
- Thus the possibility of overlooking any task necessary for the completion of the project is reduced substantially

2. Scheduling

- The ultimate objective of the scheduling phase is to prepare a time chart showing the start and finish times for each activity as well as its relationship to other activities of the project.
- Moreover the schedule must pinpoint the critical path activities which require special attention if the project is to be completed in time.
- For non-critical activities, the schedule must show the amount of slack or float times which can be used advantageously when such activities are delayed or when limited resources are to be utilized effectively.

3. Allocation of resources

- Allocation of resources is performed to achieve the desired objective. A resource is a physical variable such as labour, finance, equipment and space which will impose a limitation on time for the project.

- When resources are limited and conflicting, demands are made for the same type of resources a systematic method for allocation of resources become essential.

- Resource allocation usually incurs a compromise and the choice of this compromise depends on the judgment of managers.

4. Controlling

- The final phase in project management is controlling. Critical path methods facilitate the application of the principle of management by expectation to identify areas that are critical to the completion of the project.

- By having progress reports from time to time and updating the network continuously, a better financial as well as technical control over the project is exercised.

- Arrow diagrams and time charts are used for making periodic progress reports. If required, a new course of action is determined for the remaining portion of the project.

Network Diagram Representation

In a network representation of a project certain definitions are used

1. Activity

Any individual operation which utilizes resources and has an end and a beginning is called activity. An arrow is commonly used to represent an activity with its head indicating the direction of progress in the project. These are classified into four categories

1. Predecessor activity – Activities that must be completed immediately prior to the start of another activity are called predecessor activities.

2. Successor activity – Activities that cannot be started until one or more of other activities are completed but immediately succeed them are called successor activities.

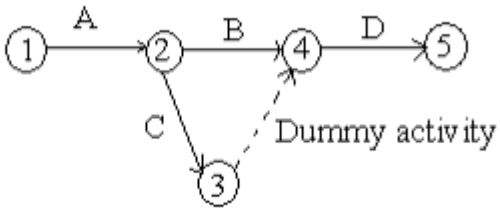
3. Concurrent activity – Activities which can be accomplished concurrently are known as concurrent activities. It may be noted that an activity can be a predecessor or a successor to an event or it may be concurrent with one or more of other activities.

4. Dummy activity – An activity which does not consume any kind of resource but merely depicts the technological dependence is called a dummy activity.

The dummy activity is inserted in the network to clarify the activity pattern in the following two situations

• To make activities with common starting and finishing points distinguishable • To identify and maintain the proper precedence relationship between activities that is not connected by events.

For example, consider a situation where A and B are concurrent activities. C is dependent on A and D is dependent on A and B both. Such a situation can be handled by using a dummy activity as shown in the figure.



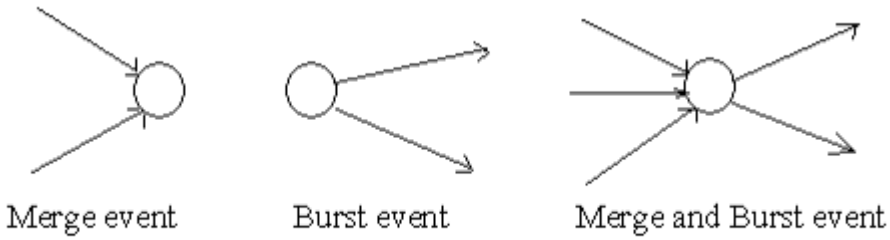
2. Event

An event represents a point in time signifying the completion of some activities and the beginning of new ones. This is usually represented by a circle in a network which is also called a node or connector. The events are classified in to three categories

1. Merge event – When more than one activity comes and joins an event such an event is known as merge event.

2. Burst event – When more than one activity leaves an event such an event is known as burst event.

3. Merge and Burst event – An activity may be merge and burst event at the same time as with respect to some activities it can be a merge event and with respect to some other activities it may be a burst event



3. Sequencing The first prerequisite in the development of network is to maintain the precedence relationships. In order to make a network, the following points should be taken into considerations

• What job or jobs precede it?

• What job or jobs could run concurrently?

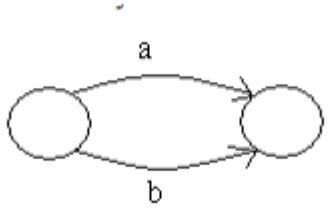
• What job or jobs follow it?

• What controls the start and finish of a job? Since all further calculations are based on the network, it is necessary that a network be drawn with full care

Rules for Drawing Network Diagram

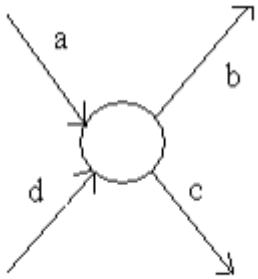
Rule 1

Each activity is represented by one and only one arrow in the network



Rule 2

No two activities can be identified by the same end events



Rule 3

In order to ensure the correct precedence relationship in the arrow diagram, following questions must be checked whenever any activity is added to the network

• What activity must be completed immediately before this activity can start?

• What activities must follow this activity?

• What activities must occur simultaneously with this activity? In case of large network, it is essential that certain good habits be practiced to draw an easy to follow network

• Try to avoid arrows which cross each other

• Use straight arrows

• Do not attempt to represent duration of activity by its arrow length

• Use arrows from left to right. Avoid mixing two directions, vertical and standing arrows may be used if necessary.

- Use dummies freely in rough draft but final network should not have any redundant dummies.

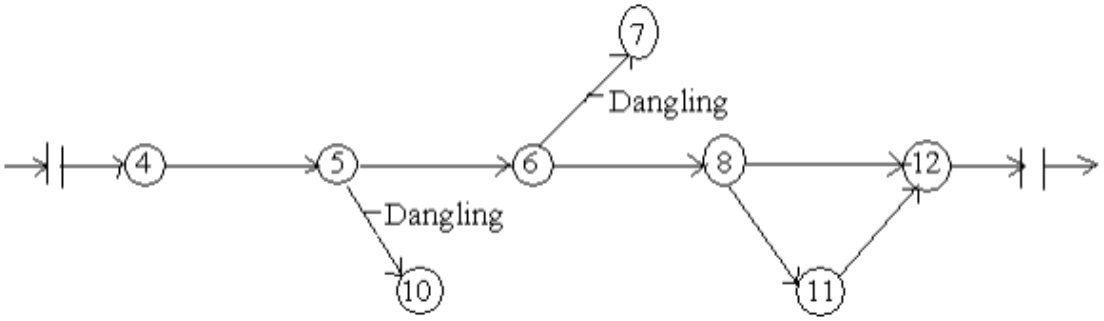
- The network has only one entry point called start event and one point of emergence called the end event.

Common Errors in Drawing Networks

The three types of errors are most commonly observed in drawing network diagrams

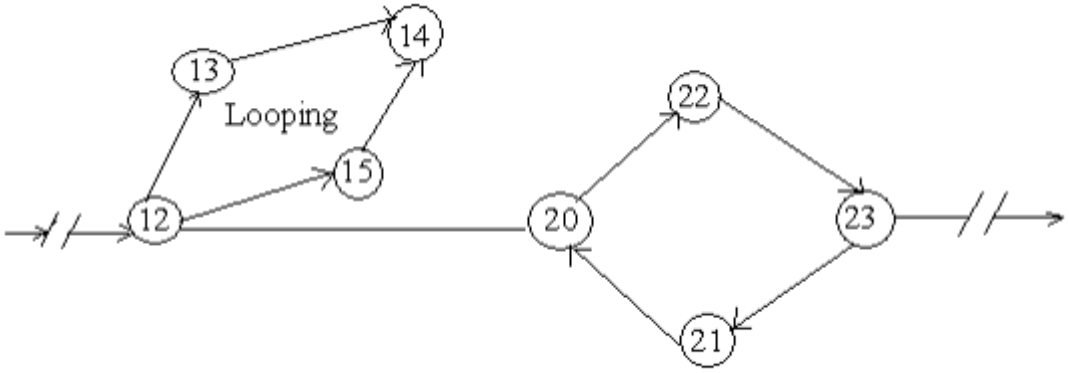
1. Dangling To disconnect an activity before the completion of all activities in a network diagram is known as dangling. As shown in the figure activities

(5 – 10) and (6 – 7) are not the last activities in the network. So the diagram is wrong and indicates the error of dangling



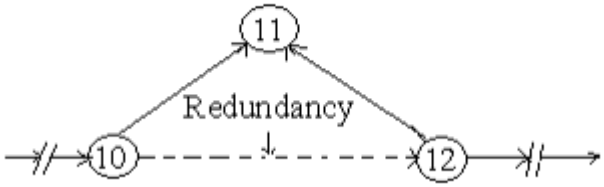
2. Looping or Cycling

Looping error is also known as cycling error in a network diagram. Drawing an endless loop in a network is known as error of looping as shown in the following figure



3. Redundancy

Unnecessarily inserting the dummy activity in network logic is known as the error of redundancy as shown in the following diagram



CRITICAL PATH METHOD :

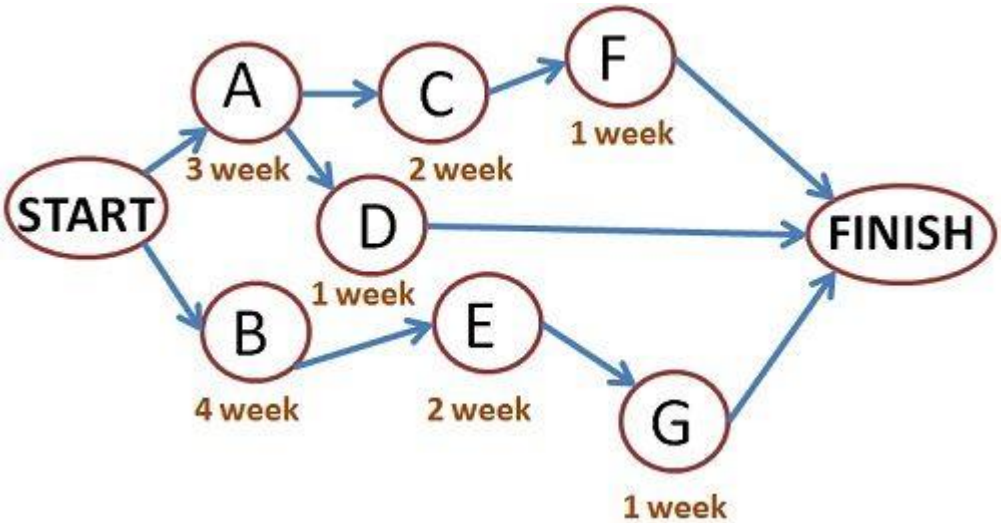
The **Critical Path Method** or **CPM** is a network analysis technique concerned with planning and controlling of complex, but routine projects. Simply, Critical path method is generally used for the projects whose time duration is known with certainty and also the amount of resources required for the completion of the project is assumed to be known.

First of all, the activities comprised in a project are identified along with their importance, i.e. the dependency of activities on each other. For each activity, it is identified that which other activities are required to be completed before it starts and how long the activities takes to get finished.

Once the critical activities are identified, the network is drawn connecting all the crucial activities and depicting which activity to be carried first, so that successor activities could be performed effectively. For each activity the following parameters need to be determined:

- **Earliest start time (ES):** How early, the successor activity begins once the predecessor activity finishes.
- **Earliest Finish Time (EF):** Earliest Start Time + duration of each activity.
- **Latest Finish Time (LF):** The latest time within which the activity finishes without delaying the project.
- **Latest Start Time (LS):** Latest Finish Time – Activity duration

The critical path method follows the "activity-on-arc" diagram to illustrate a critical path of activities (as shown below). This diagram comprises of a numbered nodes that represent the stages required for the project completion while the arc shows the crucial activities as identified earlier.



The Critical Path method is deterministic in nature, since the required amount of resources and the time needed for the completion of the whole project is known, and is mainly used in the construction projects. This method was developed by Du Pont Company and the Univac Division of Remington Rand Corporation as a technique for controlling the maintenance of chemical plants.

CONCLUSION

The difference between these two project management tools is getting blurred as the techniques are merged with the passage of time. That is why, in most projects, they are being used as a single project. The primary point that distinguishes PERT from CPM is that the former gives the extreme importance of time, i.e. if the time is minimized, consequently the cost will also be reduced. However, cost optimization is the basic element, in the latter.

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