PERT and CPM Techniques: A Brief Review

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Abstract— In this paper a brief view on various project scheduling techniques that might be helpful to software project managers to deliver the project on time and aiming to support the development of successful systems, the classification of scheduling techniques by how they are implemented is considered in detail through several aspects. Each kind of techniques is used to achieve a particular task and capture the structure and behavior of the system at various levels of detail, this study is aimed at finding trade-off between the cost and minimum expected time that will be required to complete the building project. The data on the cost and duration of activities involved were obtained Angel Estates and Construction Ltd., a construction company based in Ashanti region, Ghana. Both critical path method (CPM) and project evaluation and review technique (PERT) were used for the analysis. The activities underwent crashing of both the time and cost using linear programming, this paved way for the determination of critical path.

Key words: Program Evaluation and Review Technique (PERT), Critical Path Method (CPM)

I. INTRODUCTION

Due to the difficulty and importance to establish a pragmatic strategy for controlling, tracking, monitoring a complex technical project, there is a growing need for developing effective computer aided tools for software project planning in recent years, The project could be the development of a software program, the building of a house or an office building, development of a new drug, a marketing campaign for a new product, and many others. Network models are conventional means of finding the most skilful way to link a number of activities directly or indirectly in order to satisfy supply and demand requirements at different activity locations and project scheduling. For many years, two approaches that have been proven to be useful for planning, scheduling and controlling construction projects have been the Critical Path Method (CPM) and the Project Evaluation and Review Technique (PERT).These techniques enables project managers to evaluate the early and late times at which activities can start and finish, calculate activity float (slack), define critical activities, and evaluate the impact of changes in duration, logical relations and cost on the overall project duration. Both CPM and PERT are network based techniques and therefore help in programming and monitoring the progress of the stages involved so that the project is completed within the deadline. In doing this, it specifies the part of the project that are crucial which if delayed beyond the normal time would increase the completion time of the project, It further assists in allocating resources, such as labor and equipment and thus helps to make the total cost of the building project a minimum by finding the optimal trade-off between various costs and time involved [1]. Although PERT and CPM differ to some extent in terminology and in the construction of the network, their objectives are the same. Furthermore, the analysis used in both techniques is very similar. The major difference is that, in CPM activity times are assumed proportional to the amount of resources allocated to them, and by changing the level of resources the activity times and the project completion time can be varied. Thus CPM assumes prior experience with similar projects from which the relationships between resources and job times are available. On the other hand, PERT incorporates uncertainties in activity times in its analysis. It determines the probabilities of completing various stages of the project by specified deadlines. It also calculates the expected time to complete the project. An important and extremely useful by product of PERT analysis is its identification of various ―bottlenecks‖ in a project. In other words, it identifies the activities that have high potential for causing delays in completing the project on schedule. Thus, even before the project has started, the project manager knows where he or she can expect delays. The manager can then take the necessary preventive measures to reduce possible delays so that the project schedule is maintained. Actually, both techniques, PERT and CPM, were developed almost simultaneously. Project managers often encounter the problem of having to shorten the scheduled completion time in order to expedite the execution of a project. Reducing the project duration can be achieved by adding more resources to the performance of the activity in the form of overtime, resources or by assigning additional labor. This managerial decision of additional resources, overtime and labor will however increases the overall cost of the project thus trimming down the project duration of activities on critical path. This concept of project management which involves investment of extra budget in order to minimize the duration to meet the targeted date is known as crashing. The objective of expediting project by crashing total project duration is helpful so that delays can be recovered and liquidated damages can be avoided

II. BASIC DEFINITIONS

1) Activity Time: The time to complete a particular activity. The activity time can be deterministic or uncertain (probabilistic). When the activity time is deterministic, the activity is completed in a constant time. When the activity time is probabilistic, the activity is completed in a random time value that may have a certain probability distribution.
2) Critical Path: A path that has the longest total activity time.
3) Critical Activity: Any activity on the critical path.
4) Deterministic Project: A project that all activities finish in constant times.
5) End Activity: The activity that is not a predecessor of any other activity is called an end activity of the project.
6) Earliest finish (EF): this is the earliest possible time that an activity can be finished (= earliest start time + activity completion time).

7) Earliest start (ES): this is the earliest possible time that an activity can begin. All immediate predecessors must be finished before an activity can start.
8) Immediate Predecessor: The immediate predecessors of an activity are the activities that must immediately precede the activity.
9) Latest finish (LF): this is the latest time that an activity can be finished and not delay the completion time of the overall project (= latest start time + activity completion time). As with start times, the activity is critical if the earliest finish and latest finish times are the same.
10) Latest start (LS): this is the latest time that an activity can begin and not delay the completion time of the overall project. If the earliest start and latest start times are the same then the activity is critical
11) Path: A sequence of activities in a project leading from the start activity to the completion activity of the project.
12) Precedence Relation: It tells which activity must be completed before another can be started.
13) Probabilistic Project: A project that has activities finish in uncertain times.
14) Slack time: this is the difference between the earliest start time and the latest start time (which in turn is equal to the difference between the latest start time and the latest finish time), i.e. Slack = LS-ES = LF-EF
15) Start Activity: The activity that has no immediate predecessor is called a start activity of the project. 16.
16) Optimistic time: This is the shortest possible time in which the activity can be completed, and assumes that everything has to go perfect.
17) Most-likely time: This is the most likely time in which the activity can be completed under normal circumstances.
18) Pessimistic time: This is the longest possible time the activity might need, and assumes a worst-case scenario.

III. PROJECT SCHEDULING TECHNIQUES:

Program Evaluation and Review Technique (PERT), Critical Path Method (CPM), Resource Constrained Project Scheduling Problem (RCPSP) Model, Search based techniques, Event Based Scheduler Software Project Management Net (SPMnets) Model are the few of the existing notable project scheduling techniques titled in [1] [4].

By analyzing all these existing techniques, it is found that the primary objective is to deliver the project on time, effort distribution, managing human and technical difficulties. Each technique is designed on a particular principle to meet the end user requirements and to manage the projects.

IV. PROGRAM EVALUATION AND REVIEW TECHNIQUE (PERT)

PERT chart explicitly defines and makes visible dependencies (precedence relationships) between the work breakdown structure elements. It facilitates identification of the critical path and makes this visible and also facilitates identification of early start, late start, and slack for each activity. PERT provides for potentially reduced project duration due to better understanding of dependencies leading to improved overlapping of activities and tasks where feasible. The large amount of project data can be organized & presented in diagram for use in decision making

PERT is a method to analyze the involved tasks in completing a given project, especially the time needed to complete each task, and to identify the minimum time needed to complete the total project

A. Critical Path Method (CPM)

CPM helpful for scheduling, monitoring, and controlling projects and it is widely used in industry; it determines slack and floats times. A project manager can determine actual dates for each activity and compare what should be happening to what is taking place and react accordingly. CPM determines the project duration, which minimized the sum of direct and indirect costs. It evaluates which activities can run parallel to each other and can define multiple, equally critical paths. The activities and their outcomes can be shown as a network.

A Critical Path Method is a project management tool used to formulate a time frame for a project in order to determine where potential delays are most likely to occur. The process includes a step by-step process that provides the developer with a visual representation of potential bottlenecks throughout the course of the project.

B. Program Evaluation and Review Technique (Pert) vs Critical Path Method (CPM)

Both CPM and PERT (Program Evaluation and Review Technique) provide the user with project management tools to plan, monitor, and update their project as it progresses. There are many similarities and differences between the two. Similarities between PERT and CPM are, both follow the same steps and use network diagrams, both are used to plan the scheduling of individual activities that make up a project and they can be used to determine the earliest/latest start and finish times for each activity. Differences found between PERT and CPM are, PERT is probabilistic whereas CPM is deterministic. In CPM, estimates of activity duration are based on historical data and in PERT, estimates are uncertain and we talk of ranges of duration and the probability that activity duration will fall into that range and CPM concentrates on Time/Cost trade off.

V. CONCLUSION

The existing models only focused on staffing and the problem of task scheduling was not considered. In all of the existing models, there is an assumption that preemption is not allowed. This assumption reduces the flexibility of human resource allocation for software projects. Task preemption in software projects is only considered in a few studies.

The Existing techniques are increasingly considered to be inadequate for modeling the unique characteristics of today's software projects. The main reason is that, differently from other projects, a software project is a people-intensive activity and its related resources are mainly human resources. Techniques like PERT and CPM lack the consideration of resource allocation and scheduling models like the RCPSP do not consider the allocation of employees with various skills. The tools based on the traditional project management techniques usually regard task scheduling and human resource allocation as two separated activities and leave the job of human resource allocation to be done by project

managers manually resulting in inefficient resource allocation and poor management performance, the schedule proposed by us provides much shorter completion time as compared to the actual time taken by the project and paves the way for use of CPM scheduling.

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