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Level sequencing of network representation for large scale time constrained projects

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Abstract
The research deals with new method of Sequencing of the network diagram into more realistic and constrained project management. This paper give an introduction to proposed technique to manage strict time constrained and step wise funding for a project. This projects generally includes the Stage wise construction projects in which the fund is drained in steps while simultaneous completion of the project in various stages. Such projects cannot be managed by normal float analysis, so a separate flexible networking technique is introduced in this project.

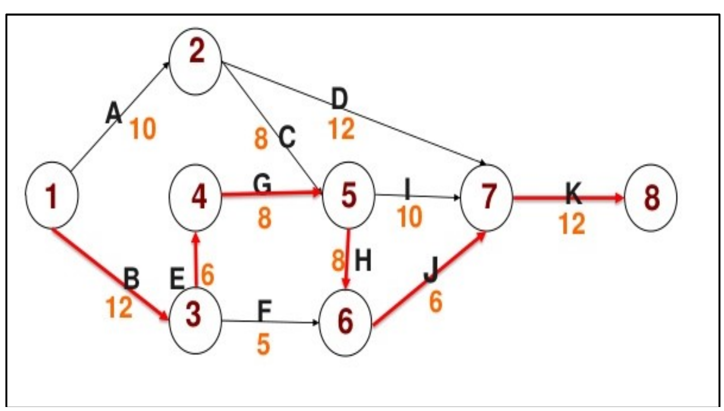
Keywords: Project management, construction planning, PERT analysis, float analysis

1. Introduction

In standard method of Network Analysis of the activity is done by Critical Path Method (CPM). The essential technique for using CPM is to construct a model of the project that includes the following:

A list of all activities required to complete the project (typically categorized within a work breakdown structure). The time (duration) that each activity will take to complete. The dependencies between the activities, Logical end points such as milestones or deliverable items.

Using these values, CPM calculates the longest path of planned activities to logical end points or to the end of the project, and the earliest and latest that each activity can start and finish without making the project longer. This process determines which activities are "critical" (i.e., on the longest path) and which have "total float" (i.e., can be delayed without making the project longer). In project management, a critical path is the sequence of project network activities which add up to the longest overall duration, regardless if that longest duration has float or not. This determines the shortest time possible to complete the project. There can be 'total float' (unused time) within the critical path. For example, if a project is testing a solar panel and task 'B' requires 'sunrise', there could be a scheduling constraint on the testing activity so that it would not start until the scheduled time for sunrise.



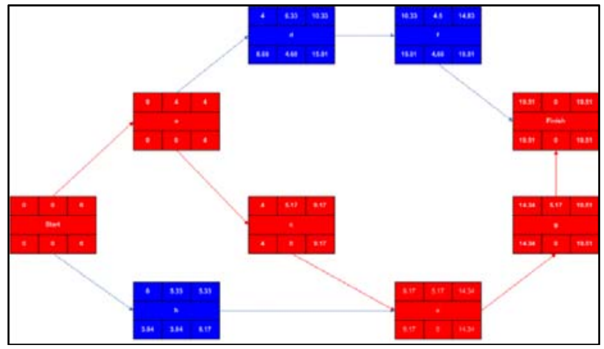
This might insert dead time (total float) into the schedule on the activities on that path prior to the sunrise due to needing to wait for this event. This path, with the constraint-generated total float would actually make the path longer, with total float being part of the shortest possible duration for the overall project. In other words, individual tasks on the critical path prior to the constraint might be able to be delayed without elongating the critical path; this is the 'total float' of that task. However, the time added to the project duration by the constraint is actually critical path drag, the amount by which the project's duration is extended by each critical path activity and constraint.

2. Standard PERT Analysis Mechanism: The first step to scheduling the project is to determine the tasks that the project requires and the order in which they must be completed. The order may be easy to record for some tasks (e.g. When building a house, the land must be graded before the foundation can be laid) while difficult for others (There are two areas that need to be graded, but there are only enough bulldozers to do one). Additionally, the time estimates usually reflect the normal, non-rushed time. Many times, the time required to execute the task can be reduced for an additional cost or a reduction in the quality.

Activity	Predecessor	Time estimates			Expected time
		Opt. (*o*)	Normal (*m*)	Pess. (*p*)	
A	—	2	4	6	4.00
B	—	3	5	9	5.33
C	*A*	4	5	7	5.17
D	*A*	4	6	10	6.33
E	*B*, *C*	4	5	7	5.17
F	*D*	3	4	8	4.50
G	*E*	3	5	8	5.17

In the following example there are seven tasks, labeled A through G. Some tasks can be done concurrently (A and B) while others cannot be done until their predecessor task is complete (C cannot begin until A is complete). Additionally, each task has three time estimates: the optimistic time estimate (o), the most likely or normal time estimate (m), and the pessimistic time estimate (p). The expected time (te) is computed using the formula (o + 4m + p) ÷ 6.

A network diagram can be created by hand or by using diagram software. There are two types of network diagrams, activity on arrow (AOA) and activity on node (AON). Activity on node diagrams are generally easier to create and interpret. To create an AON diagram, it is recommended (but not required) to start with a node named start. This "activity" has a duration of zero (0). Then you draw each activity that does not have a predecessor activity (a and b in this example) and connect them with an arrow from start to each node. Next, since both c and d list a as a predecessor activity, their nodes are drawn with arrows coming from a. Activity e is listed with b and c as predecessor activities, so node e is drawn with arrows coming from both b and c, signifying that e cannot begin until both b and c have been completed. Activity f has d as a predecessor activity, so an arrow is drawn connecting the activities. Likewise, an arrow is drawn from e to g. Since there are no activities that come after f or g, it is recommended (but again not required) to connect them to a node labeled finish.



3. Drawbacks and Limitations for Standard Method: The limitation in the standard lies in cases of step fund projects and strictly level bound constructions. In these type of projects two or more activities which are parallel in network diagram but are bounded by step wise fund. For example the activity in above diagram activity "a" and "b" might fall under same category as the total fund might include these activities under one stage.

Following methods will fail in defining step bound construction project:

Float or slack which is a measure of the excess time and resources available to complete a task. It is the amount of time that a project task can be delayed without causing a delay in any subsequent tasks (free float) or the whole project (total float). Positive slack would indicate ahead of schedule; negative slack would indicate behind schedule; and zero slack would indicate on schedule. Critical path which is the longest possible continuous pathway taken from the initial event to the terminal event. It determines the total calendar time required for the project; and, therefore, any time delays along the critical path will delay the reaching of the terminal event by at least the same amount.

Critical activity which are activity that has total float equal to zero. An activity with zero float is not necessarily on the critical path since its path may not be the longest. Lead time would also need to be modified which is the time by which a predecessor event must be completed in order to allow sufficient time for the activities that must elapse before a specific PERT event reaches completion. Lag time would not hold meaning for the earliest time by which a successor event can follow a specific PERT event.

Some of the Limitations for Step payment projects are:

- Actual project will not always follow critical path, but in reality that is not the case.
- There will be only one path for completion, i.e. critical path itself. But the network give us many paths.
- Two or more activities will have to be combined into a Stage Activity, which is not allowed in normal network.
- Float values using standard method will not hold any meaning for step bound project.

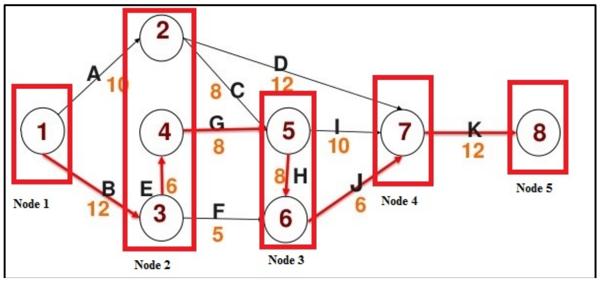
4. Proposed Method: Proposed method will collapse the network into a one path network or work progress path. The one path will represents the Critical path and will not allow standard calculations for Float and Crashing.

Some of the Features for the proposed method:

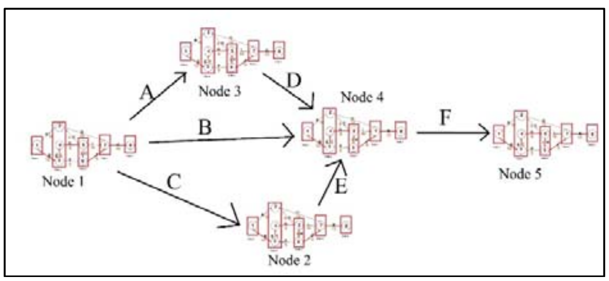
- The network will only constitute of one path.
- The project duration will be the Critical path duration, which would be finite and absolute.
- The activities with lying in same level or step in terms of the fund drain, will be collapsed into one activity.

- Two or more activities can be collapsed, there is no limit for collapsing unless they lie in same payment group or step construction group.
- New Float values will be calculated using new rules.

The new values of the Float or Slack will be Zero in a simple network but as the path will follow Critical Path only.



5. Application on Macro Level: This method can be applied to simplify the network for a very large project with combination of such small networks. A very large projects can be contained with such network as their nodes. In such cases Slack and Float can be compromised on micro level to achieve more simplicity on macro level.



Further Float Calculations can be done following the Critical Path Method by considering the small network duration as the Node completion times.

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7. Reference

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