

SOFTWARE PROJECT MONITORING USING MILESTONES AND PERT-AN EMPIRICAL ANALYSIS

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ABSTRACT

This paper concentrates on monitoring projects through the PERT and MILESTONES. Complex, multilayered and distributed projects require a series of activities, some of which must be preferred sequentially and others parallelly. This collection of series and parallel tasks can be modeled as a network. PERT is statistical technique applied to such a networks. In this paper we attempted to simulate the PERT networks and graphically represented the tasks along with them inter dependencies. Here project identifies the critical and non-critical tasks and evaluates the critical path to determine which tasks have an impact on the schedule. Once a project has advanced to the phase of performance, the focus shifts from the discovery to tracking and reviewing it. MILESTONES are used to track the progress of the project at different stages and the PERT chart, on continual basis. This paper integrated both these techniques for an efficient and easier monitoring. In order to reap the results of the project sooner, we gave a provision to reduce the scheduled completion time with minimum cost burden. This can be achieved by assigning more labor and resources to the various activities.

Keywords: PERT, MILESTONES, Project, Resources, Schedule.

1.INTRODUCTION:

Project monitoring is the ongoing collection and review of information on project implementation , coverage and utilization o f inputs. It also involves the analysis of data about project activities. The should be easy to collect and easy to understand . The focus of monitoring is to use the gained to correct and adjust project implementation and management in order to achieve project objectives. Monitoring allows project participants to keep track of project activities , to determine whether project objectives are being achieved , and to make whatever changes are necessary to improve project performance.

Project monitoring and evaluation serves several purposes:

- facilities the identification and resolution of problems

- enhance project performance and ensures congruence with the required criteria.
- provides the basis for technical and financial accountability
- builds local capacity to implement and manage projects successfully and
- promotes the identification and dissemination of lessons learned by participants themselves.

To be successful monitoring and evaluation begins with clear project design. This project provides guidance about incorporating monitoring and evaluation elements in each stage of the project cycle. Monitoring allows project managers and participants to identify and assess potential problems and difficulties during and program implementation. Adjustments and corrections in project and program design and implementation can then be made and thus enhance chances of project success. However , for monitoring to

lead to the desired results, it needs to be done in a consistent and timely manner. It therefore requires planning, coordination, and systematic reporting and agreement upon these and other matters by all project participants before projects are undertaken. Specifically, monitoring and evaluation activities and reports help projects and programs maintain accountability, achieve sustainability, allow for replicability and provide opportunities for eliciting and communicating lessons learned. Ideally, the results or lessons learned from monitoring will be used to improve project and program design and implementation and more specifically, will enable recipients to carry on project activities well after the period is over.

1.1 Role in the Project Cycle: The first three stages of the project cycle (identification, preparation, appraisal/approval) precede the actual project implementation stage. Once the implementation stage is reached, the “monitoring activity” assumes great importance which is followed by the final stage, i.e. project completion / post completion evaluation. The importance of “monitoring and evaluation” activities hardly needs any emphasis since both provide timely and useful information not only to the project management / implementation agencies but also a feedback to the policy makers. The linkage between the stages is also important. Each stage leads to the next and the last phase, in turn, produces new approaches / ideas, improving the planning and implementation process of future projects. This makes the “Project Cycle” self-renewing. The system of watching / monitoring the progress of programme / project implementation, besides being an important link in the project cycle, helps in the identification / analysis and removal of bottlenecks and expediting action where projects have stalled or fallen behind schedule.

1.2 Requirements for effective monitoring:

For an effective monitoring system, the project document must have the following essential data / information:

- A clear-cut statement of project objectives and benefits.
- Detailed project cost estimates- component / activity-wise.
- Source of funding
- Annual financial phasing conceived on the basis of implementation plan.

v. Physical scope in quantitative terms with components detail and

vi. Phasing of the physical scope as per its implementation schedule, duly based on Bar charts, milestone charts or PERT / CPM networks.

1.3 Techniques For Project Monitoring

1.3.1 Grant Chart :

A Grant chart is a horizontal bar chart developed as a production control tool in 1917 by Henry L. Gantt, an American engineer and social scientist. Frequently used in project management, a Gantt chart provides a graphical illustration of a schedule that helps to plan, coordinate and track specific tasks in a project. Gantt charts may be simple versions created on graph paper or more complex automated versions created using project management applications such as Excel.

A Gantt chart is constructed with a horizontal axis representing the total time span of the project, broken down into increments (for example days, weekly) and a vertical axis representing the tasks that make up the project. Horizontal bars of varying lengths represent the sequences, timing, and time span for each task. As the project progresses, secondary bars, arrowheads or darkened bars may be added to indicate complete tasks or the portions of tasks that have been completed. A vertical line is used to represent the report date.

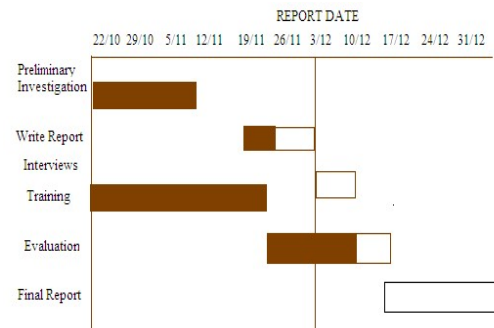


Fig-1.1: Gantt Chart

The above diagram depicts the various stages in manpower planning. The above diagram gives a clear illustration of project status, but the problems with them are:

- They don't indicate task dependencies- you cannot tell how one task falling behind schedule affects other tasks.
- They cannot reflect the project progress. It is so because they represent the time duration of the activity.

- They cannot reflect the project uncertainties in an accurate manner. Sudden technological developments may change the nature of the project and such type of emergencies cannot be handled through Gantt charts.

1.3.2 MILESTONE CHART

Milestone chart is an improvement over Gantt chart. Every task represented by the Gantt chart is sub-divided in terms of milestones. Each milestone is a key event or point in time.

In a Gantt chart, a bar is broken into several pieces, each of which stands for an identifiable major event. Each event is numbered and an explanatory table is given identifying the number with an event. These are specific events or points of time which the management identifies as important reference points during the completion of the project. The breakdown increases the awareness of interdependencies between the tasks.



Fig-1.2 Milestones

1.4 WORK-BREAKDOWN STRUCTURE

A work break down structure is a deliverable – oriented grouping of project elements that organizes and defines the total scope of the project. It can be used to confirm a common understanding of the full scope of the project. Any work not included in the work breakdown structure is not included in the scope of the project.

The work break down structure facilitates the planning and control of cost schedule and technical quality of the project outcome. A work break down structure is developed by identifying the project deliverable and then successively subdividing that deliverable into increasingly detailed and manageable sub subsidiary deliverable or components.

There is single best way to develop a work break down structure. It is acceptable practice to use a work break down structure template or a work break down structure from previous project when developing a project specific work break down structure. In fact this may be preferable in certain organizations for standardization and ease of understanding.

The work break down structure is normally shown in the form of a chart, similar to a family tree. Each level breaking down the scope of the work into more defined components, until the lowest works package level. The recommended method for defining scope is to built-up a Work break down structure. The lowest level of the work break down structure and the most defined group of work tasks is called a 'work package'. The work package components, the lowest level of the work break down structure consists mainly of physical work. For example, manufacturing of components and sub assemblies. Each component of the work break down structure has its own set of goals and project objectives that must be achieved in order for the overall project objectives to be met. The higher levels of the work break down structure are simply aggregation of works packages into logical sets. For example buildings or machines. In general case, a system is broken down to sub-system and each sub-system to sub-sub –systems everyone of which in turn reduces to major components, minor components, and so on. The break down is continued until the assembly is reduced to elements or components representing manageable units for planning and control.

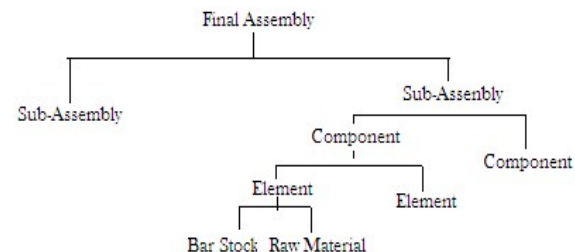


Fig-1.3 Work Breakdown Structure

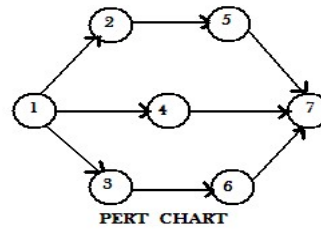
The several units in the break down could be either end-item oriented or product oriented. The end-item oriented units are the ones which form a necessary part of the final item. These could be like a transmitting system or a control unit in the final deliverable system. The product oriented units include organizational or service units which are also essential for the completion of a project. Each unit, whether product oriented or end item oriented must be definable segments of the work to be accomplished, and should form key points, each with a time schedule for satisfactory completion of the entire project. Project success is assured by managing cost, schedule and quality at the works package level.

1.5 Genesis of PERT:

From the work-break down structure and the milestone chart evolved the PERT and CPM

networks. In many situations managers assume the responsibility for planning, scheduling and controlling projects that consists of numerous separate jobs or tasks performed by a variety of departments / individuals. Often these projects are so large and complex that the

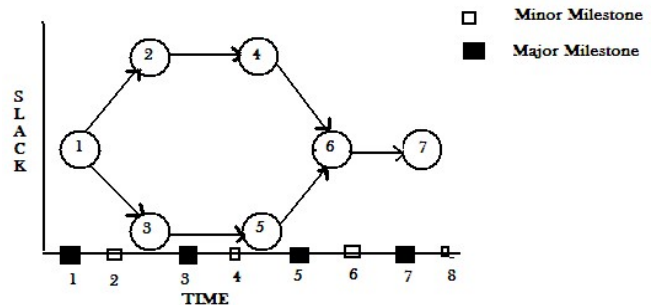
Manager cannot possibly keep all the information pertaining to the plan, schedule and progress of the project in his head. In these situations, the technique of PERT and CPM have proved to be extremely valuable in assisting in managers in carrying out their project management activities. The US Navy created PERT to plan and control the activities of hundreds of who were building the first US Polaris Missile Submarine since many job and activities associated with the Polaris Missile Submarine had never been attempted previously, it was difficult to predict the time to complete the various jobs or activities. Consecutively PERT was developed with the objective of being able to handle uncertainties in activity completion on time. On the other hand, CPM was developed primarily for scheduling and controlling industrial projects where job or activity times were considered known. In today's usage, the distinction between PERT and CPM as two separate techniques has largely disappeared. Modern project planning, scheduling and controlling procedures have essentially combined the features of PERT and CPM so that a distinction between the two techniques is no longer necessary. When planning projects of any nature, activities must be planned, documented and mapped accordingly to reduce losses and costs resulting from poor planning. In estimating the time required for a project, critical path scheduling is commonly used. One of the most popular critical path scheduling techniques is PERT charts. A Program Evaluation and Review Technique (PERT) chart is a method to visually represent a project. PERT charts are effective tools in activities and their relations with other activities. PERT has two major components: arrows and nodes. Activities called nodes are connected by arrows with their previous and following activities. Once the activities are plotted and connected, a project manager can then determine the critical path. The path of a project can be defined as the sequence of activities that are essential to the completion of the project and the duration of the project is affected by changing the duration of any activities on the critical path.



1.6 INTRODUCTION TO MILESTONES

Milestones represent the beginning of the completion of some activity or a group of activities. The emphasis on events has its roots in the milestone method of management, in which program progress is monitored in terms of success or failure in reaching certain important milestones at scheduled points in time. Milestones represent earmarked phases in network planning presenting “deliverable” with dates. The project evaluation or review technique suggests assessment of project progress at milestones. The deliverable represents statistical data showing the details of work performed as against the budgeted to be performed as on the date of the review and also forecast for the remaining work to complete the project.

There are two kinds of milestones: major milestones and minor milestones.



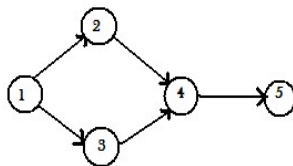
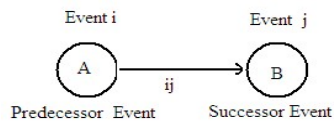
2. PERT CHART DESCRIPTION:

Project management is concerned with the overall planning and coordination of a project from inception to completion aimed at meeting the client's requirements and ensuring completion on time, within cost and to required quality standards. Every organization has finite resources and a limit to the number of projects it can initiate and control. Pushing too many projects through a resource-limited organization causes gridlock and stress. Managing the project portfolio efficiently is a fundamental principle of good project management. Complex projects require a series of activities, some of which must be performed sequentially and others that can be

performed in parallel with other activities. This collection of series and parallel tasks can be modeled as a network.

Net work analysis refers to a number of techniques for the planning and control of complex projects. The basis of network planning is the representation of sequential relationship between activities by means of a network of lines and circles. The idea is to link the various activities in such a way that the overall time spent on the project is kept to a minimum.

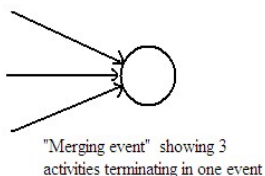
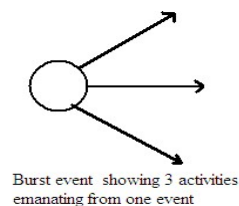
For a project having 5 activities /components , a simple PERT /CPM **DIAGRAM 1** May have the following shape :



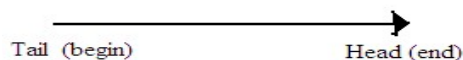
Before going into details we should familiarize ourselves with the following terms and symbols :

a) **NETWORK** :Systematic diagram showing the logical sequence and inter-relationships between events and activities.

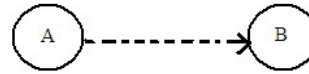
b) **EVENT** : Represented by



c) **ACTIVITY**: Represented by



d) **Dummy Activity** : Represented by



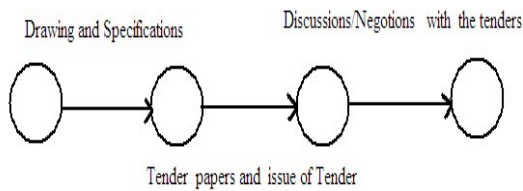
2.1 Network Diagram : In a project , an activity is a task that must be performed and an event is a milestone marking the completion of one or more activities. Before an activity can begin ,all of its predecessor activities must be completed. Project network models represent activities and milestones by arcs and nodes. PERT originally was an **activity on arc** network , in which the activities are represented on the lines and milestones on the nodes. Over time some people began to use PERT as an **activity on node** network. For this discussion ,we will use the original form of activity on arc. The PERT chart may have multiple pages with many sub-tasks. The events generally are numbered so that the ending node of an activity has a higher number than the beginning node. Incrementing the number by 10 allows for a new ones to be inserted without modifying the numbering of the entire diagram.

2.2. SETPS IN NETWORK CONSTRUCTION:

Step 1: Split the work contents involved in the implementation of the project to the level of activities which represent , individually, category of works.

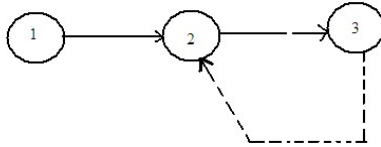
Step 2: Arrange the activities in sequential order of operation. Establish the relationship of the activities. We will note that some of the activities are preceded by completion of other activities-except the first one –when there is no other preceding activity and hence can be designated START. One activity can be started on completion of other preceding activity or activities, depending up on the inter-relationship.

Step 3: We know that the event is happening –a particular point of time representing completion of one or more activities and at the same time , some other activity or activities emerge out of it. i.e the starting time of other activity. We also know that while an activity is represented by a straight line arrow from left to right-with one arrow for each activity-the event is represented by a “circle”. The length of the arrow need not be proportionate with the duration of activities .The arrows may also be bent. Now that we have arranged the activities in a logical sequence we can establish their interrelationship and show the schedule of works by diagram as shown below along with numbering the events and in most cases, the head event having a greater number than the tail event.



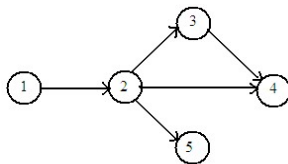
Step 4: In network construction the following two cases are wrong and must be avoided:

a) **LOOPS** : We have mentioned that the directions of arrows are from left to right. Care should be taken that the arrows do not traverse right to left and form a loop depicted as follows.



In the above diagram, the arrow from (3) comes back to (2) and thus forms a loop, which is illogical, as it will indicate a never-ending situation—as the path will indicate an infinite circle between (2) to (3) and back to (2).

b) As we have mentioned earlier, the network shows an interrelationship of all the activities taken together. A dangling activity in the network will indicate an activity left over as shown.



Activity (2) to (5) is left as event (5) represents a 'dangling' and is wrong.

2.2. Rules for drawing a network diagram:

1. A complete network should have only one point of

entry (a start event) and one point of exit (an end event)

2. Every activity must have one preceding event (tail) and one succeeding event (head).

3. No activity can start until its tail event is reached.

4. An event is not complete until all activities leading into it are complete.

5. All the activities must be tied into the network, i.e.

they must contribute to the progression. Events that

are left untied to the overall network are called

danglers.

6. It is better if arrows do not cross each other.

Whenever possible, crossing of arrows should be avoided.

7. An arrow should always be straight and not curved, and head from left to right.

8. The length of the arrow should be uniform.

9. Loop networks should be avoided.

10. Arrows cannot go backward.

11. Use dummies only when required. Use of dummy

activities is to be minimized in the network.

2.3 Steps in the PERT Process:

PERT Process involves the following steps:

- Identify the specific activities and milestones.
- Determine the proper sequence of the activities
- Construct the time required for each activity
- Determine the critical path.: The critical path is determined by adding the times for the activities in each sequence and determine the longest path in the project. The critical path determines the total calendar time required for the project. If the activities outside the critical path speed up or slow down (within limits), the total project time does not change. The amount of time that a non-critical path activity can be delayed without delaying the project is referred to as **slack time**.

If the critical path is not immediately obvious, it may be helpful to determine the following four quantities for each activity:

- ❖ ES- Earliest Start time
- ❖ EF- Earliest Finish time
- ❖ LS- Latest Start time
- ❖ LF- Latest Finish time

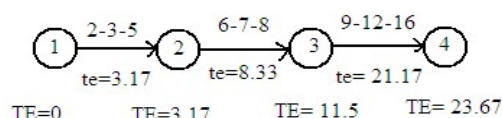
These times are calculated using the expected time for the relevant activities.

- Update the PERT chart as the project progresses.

2.4 Calculations in determining the critical path:

The earliest expected time denoted by TE – refers to

the time when an event can be expected to be completed. It is computed by add the **te**'s of the activity paths leading to that event. Let us consider the network shown below:



From the three times estimates expected time **te** have been calculated. Assuming event 1 as the Initial event, the earliest expected time TE for event 2 is 3.17, as this is the expected time for the completion of activity 1-2. TE for the next event is 3.17 + 8.33 = 11.50. The total TE is 23.67 Which is the sum of the expected times of the activity paths leading to this event.

In general,

$TE(\text{Succ. event}) = TE(\text{Predecessor event}) + te(\text{activity})$

In this rule TE of successor event is obtained by adding the value of TE for the predecessor Event to the value of **te** for the activity connecting the predecessor and successor events.

Symbolically if 'i' and 'j' refer respectively, to predecessor and successor events and i-j refer to the activity connecting events i and j, then the rule can be written as

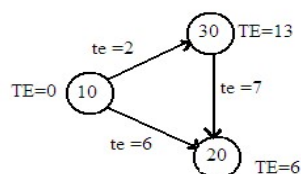
$TE^j = TE^i + te^{ij}$ where the superscripts refer to the events (i and j) or the activity (i-j)

When there are more than one predecessor event for a successor event j, this rule needs modification because an event j cannot occur until all activities leading to that event are Completed. Therefore for the right hand side of the rule we should chose the maximum value,

$TE^j = \text{Maximum}(TE^i + te^{ij})$.

For example consider the following diagram, where

$TE^{20} = TE^{10} + te^{10-20}$ OR $TE^{20} = 0 + 6 = 6$



In event 30 we have two predecessor events 20 and 10. for these

$TE^{30} = TE^{20} + te^{20-30} = 6 + 7 = 13$ and $TE^{30} = TE^{10} + te^{10-30} = 0 + 2 = 2$.

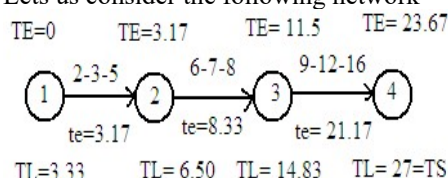
The appropriate value of TE^{30} is 13 since this is the maximum value.

2.5 Latest Allowable Occurance Time:

The latest time by which an event must occur to keep the project on schedule is known as the latest allowable occurrence time, and is represented by TL.

Let us assume that it has been agreed to complete the project within a certain allotted time called the contractual obligation time denoted by Ts. This time refers to the occurrence of the end event.

Lets us consider the following network



Let us say that the contractual obligation time Ts for the project is 27. this means that the end event 4 must occur 27 units of time after the project is initiated. Activity 3-4 takes 12.127 units of time for its completion. Hence event 3 cannot occur lesser than $27 - 12.17 = 14.83$ units of time after the initiation of the project. Since activity 2-3 takes 8.33 units of time, the latest allowable occurrence Time for event 1 is $6.50 - 3.17 = 3.33$. These values of TL for various events are indicated in the diagram above. The importance of TL for the events in this network is fairly evident. Let us

Assume that the project gets started as on schedule, that is event 1 occur at time 0. Activity 1-2 goes on as planned with $TE^2 = 3.17$ Since $t^{2-3} = 8.33$. The earliest expected time $TE^3 = 11.3$. If due to some labour problem, or the non availability of materials activity 2-3 is delayed, the maximum delay that can be tolerated is 3.33 units of time after the occurrence of event 2 since, for event 3, the latest allowable occurrence time is $TL^3 = 14.83$. The same type of analysis can also be applied to other activities. A rule is formulated for the calculation of the latest allowable time for any event i.

We assume again that event j is a successor event and i is the predecessor event.

Then $TL^i = \text{minimum}(TL^j - te^{ij})$

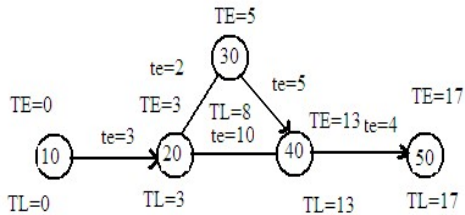
Where te^{ij} represents the expected time for activity i-j.

2.6 Computation Of Slack:

Slack is simply the difference between the latest allowable time and the earliest expected time.

$Slack = TL - TE$

The team refer to an event since both TL and TE refer to events. Hence, we can rewrite this expression as $TS^j = \text{slack for } J = TL^j - TE^j$. Where TS stands for slack time TS^j for the event j . In a tabular form, the value of TS^j is obtained by just taking the difference between TL^j and TE^j occurring in the same row. The values of te^j , TL^j and TE^j are indicated along the arrows and events as shown below.



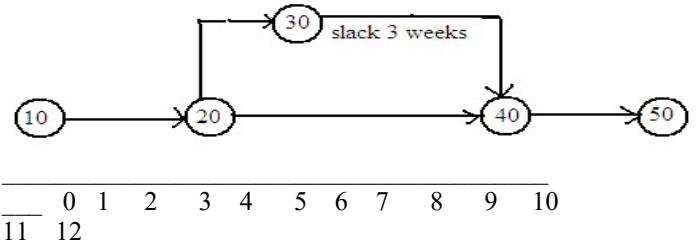
The following figure gives the tabular entries. $(TE^j)^*$ and $(TL^j)^*$ refer to the earliest expected time and the latest allowable time for the events irrespective of the maximum or minimum values. The maximum value for any event j in column $(TE^j)^*$ is underscored and entered in the column TE^j .

Similarly, the minimum values in TL^j are underscored and re-entered in the column TL^j . With the appropriate value for event j . The difference $TE^j - TL^j$ is entered in the column TS^j as the for event j . here we have assumed that for the end event 50 and the scheduled completion time TS for the project is same as TL.

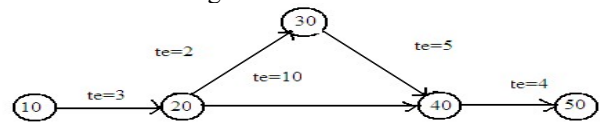
Job i-j	Te	$(TE^j)^*$	TE^j	$(TL^j)^*$	TL^j	TS^j
Succ. Event j	Predec. Event i					
50	40	4	17	13	17	
40	30	5	10	8	13	
40	20	10	13	3	13	
30	20	2	5	6	8	
20	10	3	3	0	3	

For event 30, we notice that there is a slack time of 3 weeks which means that after the occurrence of event 20 and event 30 can occur after 2,3,4 or 5 weeks later. In other words, activities 20-30 and

30-40 can be started late up to a combined total slack time of 3 weeks without affecting the scheduled completion date. The other events 10,20, and 40 do not have any time and their occurrence is critical if the contractual obligation time is to be met. In order to make the meaning of slack clearer, we can redraw the network, in a slightly different manner, called the Time-scaled version.



In the previous figures and table, we observe that path 10-20-40-50 connecting the initial and end events, consists of events all having zero or minimum lack times. This path is called as critical path. The events lying the path are critical in the sense that their occurrence cannot be delayed if the scheduled completion time is to be met. The network can be redrawn with the critical path indicated in heavy lines. This is the longest path time-wise connecting the start and end events.



Chapter 3

3 PROJECT CRASHING:

Project crashing is a method for shortening the project duration by reducing the time one or More of the critical project activities to less than its normal activity time. The object crashing is to reduce duration while minimizing the cost of crashing. The object crashing is to reduce duration project while minimizing the cost of crashing. The project manager is confronted with having to reduce the scheduled completion time of a Project to meet a deadline. Project duration can often be reduced by assigning more labor to Project activities, in the form over time and by assigning more resources, such as material equipment etc. However, the additional labor and resources increase the project cost. So, the decision to reduce the project duration must based on an analysis of the trade-off between time and cost.

- CRASHING is reducing project time by expending additional resources.

- CRASH TIME is an amount of time activity is reduced.
- CRASH COST is the cost of reducing activity.

3.1 Reasons Of Crashing:

- To reduce the scheduled completion time to reap the results of the project sooner.
- As soon as continue over time, the team indirect costs.
- There may be direct financial penalties for not completing a project on time.

The goal of crashing is to reduce project duration at minimum cost. To reduce project duration while minimizing the cost of crashing, the project team should estimate required time, require

The cost, crash time, crash cost for each activities. And then the team can estimate total crash time, total crash cost, the crash cost per week to reduce project duration at minimum cost.

3.2 Time Cost Trade-Off:

We know the critical path in a network is the sequence of critical activities showing the longest path in the network from starting event to the final event of the project. We also that time, in implementation of a project is very much related to the project cost. While reduction in duration may reduce the administrative cost it may cause extra cost on account of more labour, overtime, extra machines etc. In general reduction of activity duration causes reduction in indirect cost but increases over direct costs.

There may be a situation the project earlier than what has been envisaged in a network plan for the project showing the critical path, completed on the basis of normal activity duration and consuming the normal resources. It is possible, to a certain extent to reduce the activity duration by employing additional resources and as such, additional direct cost. Of course, such reduction is possible only up to a limit which is the minimum duration. This process of shortening the activity is called 'crashing'. The time cost trade-off represents adjustments of project schedule with a view to reduce the total cost projected time –over at extra cost-and the process is known as 'project crashing'.

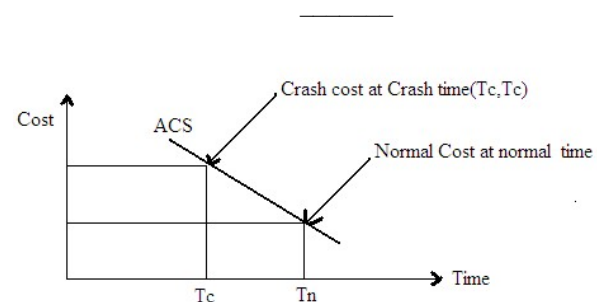
The term used in the activity cost slope are: Normal time T_n = the maximum time required to complete an activity under normal conditions.

Normal Cost C_n = the lowest cost estimated to complete an activity, in normal time

Crash time T_c = the minimum time required to complete an activity using extra resources, that is by extra cost

Crash Cost C_c = the direct cost that is estimated in completing the activity by crash time.

Activity Cost slope (ACS) represents the additional direct cost incurred per unit of time saved in completing an activity and is expressed as

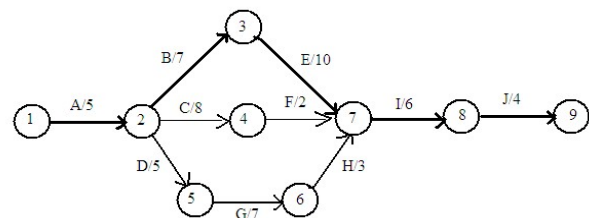


3.3 Steps for crashing:

A process to establish the total possible crashing and the relevant increase in the project cost for the entire project is called project crashing. This can be elaborated with an example as follows:

The project database scheduling is as follows :

- Project duration of 32 weeks.
- Project cost of Rs.7,50,000
- Critical path activities as given below
- Critical activities A,B,E,J and I.



The possibilities of crashing the projects are explored and the revised schedule of operation with the time crashed, extra cost and crash cost as estimated are produced in the next diagram.

Activity	T _n		Extra direct Cost C _c		Per week	Rs
	C _n	T _c	(Reduction)	(Rs)		
A	5	70	4	(1)	5	75
B	7	90	5	(1)	3	96
C	8	100	5	(3)	5	115
D	5	60	4	(1)	6	66
E	10	120	9	(1)	4	124

F	2	30	2	---	---	30
G	7	90	6	(1)	5	95
H	3	50	3	---	--	50
I	6	80	6	---	--	80
J	4	60	4	---	--	60

750

791

The total cost estimated is Rs,3,20,000 i.e @10,000p.w

Step 1: we know ,firstly that the critical path is the longest one and as such ,reducing the duration of non-critical activity will not help. Hence , we would like to deal with crashing the critical activities. Study of the critical activities suggest that the activities, I and J cannot be reduced. But other critical activities can be reduced at extra costs as detailed below. The duration of the non-critical activities F and H cannot be reduced.

Activities	Reduction in weeks	C
A	1	5
B	2	3
E	1	4

C= Extra Crashing Cost per week / RS 1000

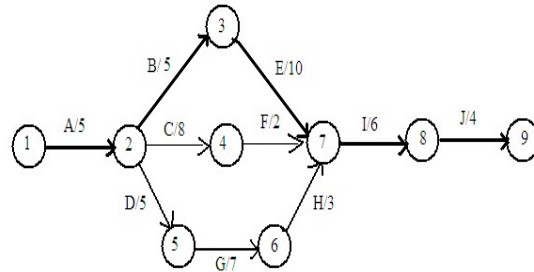
Step 2: Crashing is done generally from the cheapest one to crash to the costliest one, in sequence.

The cheapest being the activity B, we start crashing B till the critical path does not change , that is, We crash one week, review the critical path , and then we crash the second week(which is the maximum possible to crash). Review again , after crashing B for two weeks.

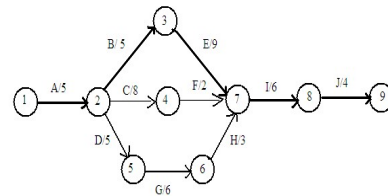
a) Project duration will be 32 weeks – 2 weeks = 30 weeks

b) Project cost Rs. 750 + extra cost 3+ 3 = Rs. 7,56,000.

c) The network after B crashed by two weeks will appear as follows.



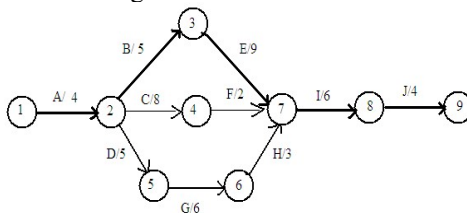
d) the critical path is not disturbed , that is A,B,I and J . The next crashing is E, being cheaper than A and the maximum possible reduction is by one week. Therefore , activity duration will be nine weeks. This reduction of E by one week will change the timing of the events 7, 8 and 9 as $19, 19+6=25$ and $25+4= 29$,respectively. But again , this will change the time of the event 6 also , as, going backward from 7 , it will be $19-3=16$. This will change the activity H also as critical and to a second critical path, when we crash the non –critical activity G by one week to six weeks and review the position. The network will appear as follows with two different critical paths.



Project duration now becomes 29 weeks. Project cost increases further by Rs.9000 , that is $7,56,000+ 9,000 =Rs7,65,000$. Now to explore the probability of the duration of activity common to both the critical paths, that is , activity A and one week possible at an extra cost of Rs. 5000. The status is reviewed after crashing the activity A as follows.

Project duration -28 weeks and project cost – $7,65,000+Rs.5000= Rs 7,70,000$.

Network diagram .



The critical paths are a) A,B,E,I and J b) A,D,G,H,I and J.

Project cost revision a after crashing:

We have reached the time limit of possible crashing. We can tabulate our findings with a complete project crashing.

Project schedule	Amount in Rs.			
'000				
Activities	inweeks	Ext.cost	Dir.cost	Ind.cost
T.C				
Normal A-J	32	NIL	750	320
1070				
Crash B	30	6	756	300
1056				
Crash E&G	29	9	765	290
1055				
Crash A	28	5	770	280
1050				

From the above table, the management may review the overall cost of crashing and take a decision. On the course of crashing, that is, if the management is considered with the total minimum cost, then the decision should be to crash A, B, E and G as above and decide the total project schedule estimate of 28 weeks.

4. RESULTS :

The following figures provide a manual for the user.

This is the first dialog box that checks for authentication.



On clicking Ok a dialog box pop up asking for project identification and today's day



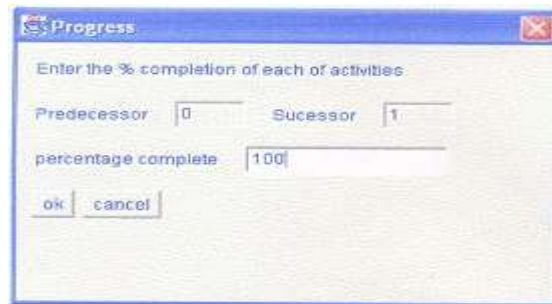
On clicking Ok the main dialog of the program is shown. It shows all the operations that can be performed.



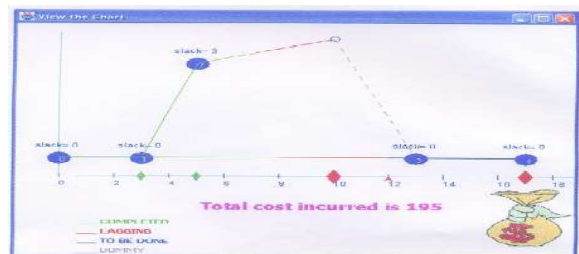
The view chart button when clicked shows the pert chart with milestones. The following diagram shows the pert chart for the project id given in the previous dialog.



On clicking progress the each activities can be entered



This Chart shows the completion of various activities

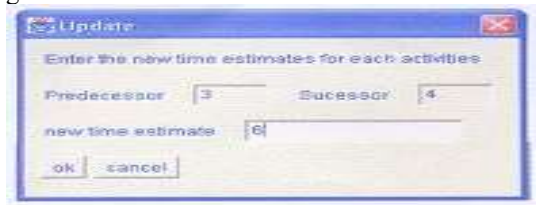




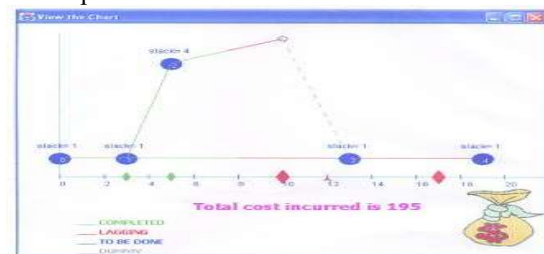
The milestone is entered and is displayed as below



On clicking the update new time estimates can be given



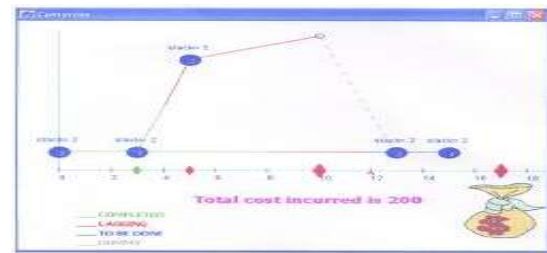
The updated chart is as show below



On clicking compress the following appears where Compressing time can be entered. If the cost is feasible for the project manager, it can be accepted otherwise original values are restored.



The compressed chart is shown below. New cost is shown.



On clicking new chart a dialog appears where the new chart information can be entered.



After all the information for the new chat is entered click" View Chart" to view the new chart.



5.CONCLUSION:

Project is collection of inter related activities are going to executed in a certain order. Project manager plays the crucial role, he is the responsible to see the company does not suffer from time over runs and cost over runs. Cost over runs can be achieved by accurate effort estimations. Where as time over runs can be achieved by the effective monitoring. The effective monitoring can be achieved by so many techniques. This paper emphasized on How effective monitoring can be achieved by using PERT and Milestones.

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