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How to Strengthen Workers Management Relationship Using Network Techniques - A Case Study

Paramveer Singh
Research Scholar, NIMS University, Shobha Nagar, Jaipur, Rajasthan, India
Dr. Harish Singh
Department Of Business Administration
Maharaja Surajmal Institute (Affiliated To Guru Gobind Singh Indraprastha University)
Janak Puri, New Delhi, India

Abstract:
PERT and CPM are two network techniques which were developed independently of each other, during the late 1950s. They are used in planning and controlling projects. They both use similar concepts.While CPM is deterministic, the PERT is probabilistic in nature.The techniques of PERT and CPM prove extremly valuable in assisting the managers in handling such projects and thus discharging their project management responsibilities. The above research paper includes modelling and simulating of the formation of human resources by applying the PERT/CPM and taking into consideration of some risks associated to this activity.The aim of the research paper is to offer practical support to the management of organizations in order to make a formation program of human resources, which implies activities of precedence and interelated, critical paths, the distribution of time resources and necessary costs for the fulfilment of the organisational objectives.

Key words: *modelling, simulation, critical path, nodes, optimistic, pessimistic, probabilistic, critical activities, start times, finish times*

1.Introduction

Network Analysis plays an important role in project management. Programme Evaluation and Review Technique (PERT), and Critical Path Method (CPM) are two network analysis techniques used in planning and controlling projects. They both use similar concepts.

By analysis a network, which is a graphic depiction of 'activities' and events, the planning, scheduling and control of the project becomes much easier. The set of activities is depicted diagrammatically by means of a network/arrow diagram, wherein each activity is represented by an arrow, with a circle on either end.These ends are called 'initial' and 'final' nodes. For precedence relationships, sometimes dummy activities are used for depicting correctly. The times for all the activities are marked along with the length of each of the paths on the network diagram. The longest path is known as the critical path. The activities on it are called critical activities. The length of the critical path is called project duration. By using forward pass calculations and backward pass calculations, scheduling times of various activities are also determined. ES ('Earliest'start times), EF ('Earliest'finish times) , LS ('Latest'start times) and LF ('Latest'finish times) are also determined similarly. We have no float for critical activities. For non-critical activities, Total, Free, Interfering and Independent Floats are calculated by using formulas given in the case studies.

In PERT analysis, for every activity three time estimates are taken, i.e.,

- t_o = the most optimistic time
- t_m = most likely time
- t_p = the pessimistic time

With the help of three time estimates expected duration and variance for activity completion are calculated by using formulas given in the case studies.The critical path is obtained using expected times.Critical activities and the critical path are also determined.We can find the expected duration of the project by using the length of the critical path.Also the summation of the critical activities' variances gives variance of the project completion time.The square root of the variance gives the standard deviation.Probabilities of completion of the project are calculated by considering the project completion time to be nomally distributed with parameters mean and standard deviation.Crashing of a project implies attempting to reduce the duration of the project by employing additional resources.For this,the cost of reduction per unit time for every activity is obtained first.Then, the time reduction is attempted step-by-step by concentrating

on the critical path, choosing the cheapest activity every time.In case of multiple critical paths,the cheapest combination of activities is taken.

2.Steps In Critical Path Method

- Construction of a Network Diagram and Scheduling the activities by calculating earliest and latest times and the critical path:
- The following precedence relationship is given as follows which includes three parameters-

Activity	Immediate Predessors	Time Duration (in weeks)
A	-	5
B	-	4
C	A	3
D	A	4
E	A	6
F	B,C	4
G	D	5
H	D,E	6
I	F	6
J	H,G	4

Table 1

- Pictorial diagram is as follows

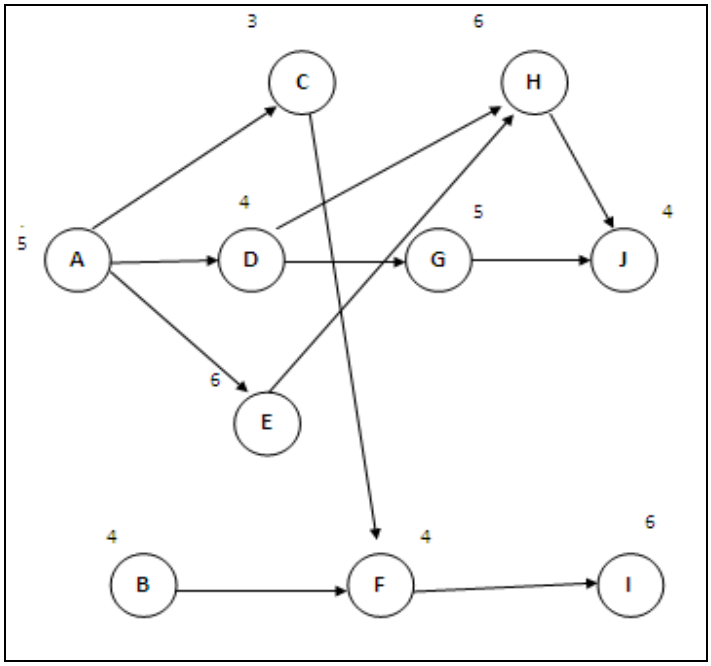

Figure 1

- Calculation of ES and EF times by forward pass calculations and calculation of LS and LF times by backward pass calculations:
- The ES time indicates the earliest that a given activity can be scheduled and EF indicates the time which the activity can be completed, at the earliest. The LS time indicates the latest that a given activity can be scheduled and LF indicates the time which the activity can be completed, at the latest.

Activity	Time Duration (in weeks)	ES	EF	LS	LF	TOTAL SLACK/FLOAT (LF-EF) OR (LS-ES)
A	5	0	5	0	5	0
B	4	0	4	7	11	7
C	3	5	8	8	11	3
D	4	5	9	7	11	2
E	6	5	11	5	11	0
F	4	8	12	11	15	3
G	5	9	14	12	17	3
H	6	11	17	11	17	0
I	6	12	18	15	21	3
J	4	17	21	17	21	0

Table 2

- Calculation of Critical Path: By defination, it is that path that you have any delay on it and it delays the entire project. It means, it has a zero slack time. In other words, it is a path which consists of a set of continuous series of activities through the network that lead from the initial node of the network to its terminal node. With the help of it, we calculate the minimum time required for the completion of the whole project.
- For the network in reference, all the paths and their lengths are as follows:

Activities	Length (in weeks)
ACFI	18
ADHJ	14
ADGJ	18
AEHJ	**21 (Longest Duration)**
BFI	14

Table 3

Relevance of Slack: Now, we have easily identified the critical path is A-E-H-J and also we know which activity has slack time and which have not. The path A-E-H-J has zero slack time.So, what a slack mean - for activity B, we have 7 weeks before we have to start activity B,i.e.we can use our resources somewhere else for 7 weeks.We can free up these resources and can use other parts of the project,ie, analyse how we can allocate our resources and also have some budgeting process etc.

3.Steps In Programme Evaluation Review Technique

PERT is based on three time estimates and used in more uncertain situations.The time estimates are :

- Optimistic time(t_o)- This is the shortest time the activity can take place.
- Most Likely time(t_m)-This refers to the time that would be expected to occur most often if the activity were frequently repeated under exactly the same conditions.
- Pessimistic time(t_p)-This is the longest time the activity could take to finish.

4.Case Study I

XYZ Company was doing quite well in spite of the economic and political adversitise, when it faced a problem from the least expected quarter – its own labour force. Union had been set-up after two years and has now been demanding greater autonomy with representation in the equity as well as enhancement of working conditions. Though the management is thinking of installing a building for canteen and recreational purposes. This would also act a stopgap from the union pressure. The total cost for the canteen project was estimated at Rs. 80.00 lakhs with indirect cost of Rs.300000/- per day. The work will commence with the laying of foundation and building walls and ends with the connection of all services for the canteen to start functioning. While this involves a whole lot of detailed services, the following major list of activities has been prepared with other relevant details. Job codes have been provided to simplify matters. Job A must precede all other jobs while Job E must follow others. Apart from this, jobs can occur concurrently.

Code	Job Description	Time in Days			Normal Cost*	Crash Days	Crash Cost*
		t_o	t_m	t_p			
A	Lay foundation and build walls	3	5	7	3,000	4	4,000
B	Tile roofing	5	6	7	1,200	2	2,000
C	Install electricity	1	3	11	1,000	3	1,800
D	Install plumbing	2	4	12	1,200	3	2,000
E	Connect all service to finish and handover	1	3	5	1,600	3	1,600

Table 4

** Cost In Thousand Of Rupees*

The labour union is threatening to go on strike and given a notice period of 21 days under the Industrial disputes Act. It is imperative for the management to complete this project and appease the work force. A strike will play havoc with the production schedule, not to mention the loss of bulk order from the middle, a market the company is penetrating for the first time. You have been appointed a project consultant and you are expected to expedite the project with optimal considerations of cost and time with avoidance of strike.

- Network diagram is as follows:

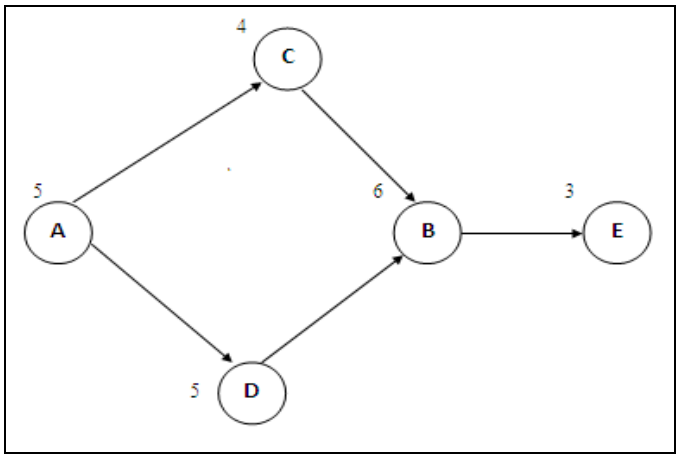

Figure 2

Code	**Job Description**	**Time in Days**			**$t_e = (t_o + 4t_m + t_p)/6$ Single expected time**	**$\sigma = (t_p - t_o)/6$**	**σ^2**
		t_o	**t_m**	**t_p**			
A	Lay foundation and build walls	3	5	7	5	0.66	0.43
B	Tile roofing	5	6	7	6	0.33	0.10
C	Install electricity	1	3	11	4	1.66	2.75
D	Install plumbing	2	4	12	5	1.66	2.75
E	Connect all service to finish and handover	1	3	5	3	0.66	0.43

Table 5

To find the critical path,we have two paths:

1. A – C – B – E with time period 18 days
2. **A – D – B – E with time period 19 days,**

Since, the time period of the second path is more than the first path, hence the second path is the critical path.
Thus,we have the expected project length(Normality of the project),

T_e = 5+5+6+3= 19 days

And the variance of the project length,

V_T = 0.43+2.75+0.10+0.43 = 3.71

Now .the project being normally distributed with mean Te =19 days and the standard deviation , **$\sigma = \sqrt{\sigma^2} = 1.926$ days,**

Now, we can determine the probability of the project being completed in 21 days.This would be equal to the area under the normal curve lying to the left of X= 21 as shown below:

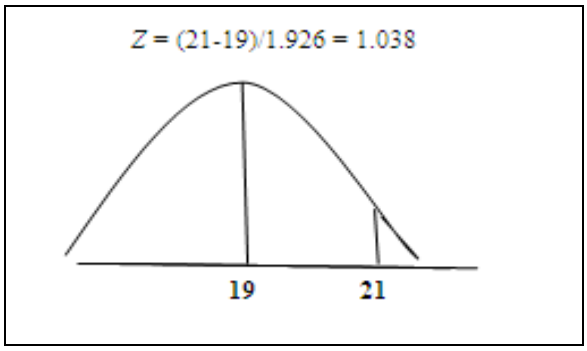

Figure 3

5.Distribution Of Project Duration

From the normal area table, the area between mean and Z = 1.038 under the normal curve is found to be equal to 0.3485. Thus the required probabilty is 0.5 + 0.3485 .i.e. 0.85.

Realising that 0.85 is the probably an optimistic approximation of meeting the deadline to the current plan,Therefore, rather than taking the significant chance of the company incurring the extra cost of Rs. 300000/- per day.Now, the company is concerned with determining how much(if any) to crash each of the activities in order to reduce the anticipatory duratio of the project to the desired level. It is important to investigate how much extra it would cost to reduce the expected project duration to desired level.

Activity	Normal Time (in days)	Crash Time (in days)	Normal Cost Rs. (in Thousands)	Crash cost Rs. (in Thousands)	Crash Cost /per day Rs. (in Thousands)
A	5	4	3000	4000	1000
B	6	2	1200	2000	200
C	4	3	1000	1800	800
D	5	3	1200	2000	400
E	3	3	1600	1600	-

Table 6

- Time cost trade for individual Activities

Activity Crashed/Critical Path	Project duration in days	Total direct cost Rs. (in Thousands)	Total indirect cost Rs. (in Thousands)	Total cost Rs. (in Thousands)
None A-D-B-E	19	8000	5700	13700
Activity B/	15	8800	4500	13300
Activity D/	**14**	**9600**	**4200**	**13800**

Table 7

The total cost of the project is Rs.1330000/- which is completed in 14 days after crashings .From the above table, it is derived that by putting some extra cost on crashing the activity, the project duration is reduced to 14 days instead of targeted duration of 21 days as provided in the Union Notice. In doing so, we can save Rs.400000/-.

6.Recommendations And Conclusions

To deal with the uncertainties and developing atmosphere of trust and commitment in the mind of workers to develop a better working enviroment. Recall that company will occur a large extra cost of Rs.300000/- if the deadline is missed, therefore one is need to know the probabilty of meeting the deadline.In this case we got the probabilty of 85%.If this probability is not very high, one will need to consider taking costly measures to shorten the duration of some of the activities.

It is somewhat reassuring that PERT/CPM scheduling procedure obtain a estimate of 19 days for the project duration. Based on the assumption that the actual duration of each activity will turn out to be the same as its estimated duration for at least the activities on the critical path.

On analysis, it is revealed that management was committed to complete the project in the said duration to develop a atmosphere of trust and cordial relations among the workers to avoid strike and loss of production.

Using the network technique, the company can complete the project in 14 days and successfully increase the level of trust and satisfaction among the workers.The workers will be motivated and bound to do more productive jobs.The commitment shown by the management towards the completion of the said project before time will save more than Rs. 4 lakhs in the form of cost of the project and develop a goodwill in the market, which is intangible.

7.References

1. Soloman E., Theory of Financial Management (New Yorkial Management and Policy, 1983.
2. Vohra,N.D., Quantitative Techniques in Management,Tata McGraw Hill Publishing Company Limited,Third Reprint,2002.
3. Mishra M. N., Principles and Practices of Insurance,S.Chand and Company Ltd.,2011.
4. Mishra S.K.,"IFRS – The New Era of Accounting", The Management Accountant, August 2010.
5. Kothari,C.R., Quantitative Techniques,Vikas Publishing House,2007
6. Agarwal L.N. & Diwan P., Research Methodology and Management Decisions, Global Business Press,1998.
7. Tripathi P.C., A textbook of Research Methodology in Social Sciences, Sultan Chand and Sons,2003.