NETWORK ANALYSIS AND PROJECT TIME-COST CONTROL USING MATLAB

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Abstract: The aim of this study is to develop a model that finds a proper trade-off between time and cost to accelerate the implementation process. Network analysis using PERT and CPM is used to determine the longest duration and cost required for completing the project, and the time-cost trade–off problem (TCTP) is formulated in which we use crashing to find the minimum required time for effective competition of the project. A MATLAB code is being written for the same in addition to this work we have comprised a new scheduling technique by using the Earliest event time that can easily compute the time and cost of the project. The importance of time-cost trade-off analysis is to reduce the original project duration with possible least total cost. The coding is authenticated by considering the case study of two projects. Now, applying this approach, the result obtained is satisfactory.

Index Terms **- critical path method, trade-off analysis, crashing, MATLAB Programming, Time-cost.**

I. INTRODUCTION

The scope and volume of construction industry can be directly linked with the size and population of the countries. PERT and CPM are two such management techniques or tools that have been accepted in recent years. Both these tools define and coordinate various activities of a project and successfully accomplish the objectives on time. The goal of this study is to develop a network for identifying the optimum total cost associated with project duration. A mathematical programming method is used to find out the total crash costs at several durations. The time costs relation is then analyzed by regression analysis to obtain the objective function. So author has suggested the use linear programming technique for MATLAB.

II. RESEARCH OBJECTIVES

To undertake a comprehensive literature survey about planning technique, costing and controlling the project network.

(i) To minimize ideal resources, the total project cost and trade-off between time and cost of project network.
(ii) To minimize construction industry delay's interruption and total project duration.
To develop a MATLAB program which can draw network diagrams calculate cash flow and draw cash flow diagram table.
Evaluating the developed program is case study.

III. LITERATURE REVIEW

Researchers have extensively discussed scheduling estimation issues for years.

Castro et al. (2003) defined a new rule for the resolution of the slack allocation problem in a CPM network, a new rule for the allocation of slack in a CPM network based on the duration of the activities,

Liu and Shih (2008) proposed a framework of schedule constraints named critical resource chain where three scenarios of schedules were successfully analysed, such as a CPM-based schedule, an (resource-constrained project scheduling problem) RCPSP-based schedule with the goal of minimized overall schedule duration, and considering a time–cost trade-off.

IV. METHODOLOGY

This section gives the detail approach and method adopted for this work along with a brief description as given below:

4.1 Critical Path Analysis of Project Network

In this study, calculation method based on CPM and programming approach with network diagram to be followed is presented in detailed calculation. Here is an example project in design and producing components to consider logical sequence of activities.

This process for shortening the project duration can be summarized in the following steps,

Step1: Calculate EST, EFT, LST and LFT for all the activities.

EST= Earliest start time of all the tail event.

EST=T_E^i

EFT =T_Ei +t_{ij}

It is an earliest finish time by which an activity is completed.

LST =Latest start time of the activity i-j

LST=LFT –tij

LFT= Latest finish time of the activity i-j

LFT=T_Lj

Where t^{ij} is duration for job i-j.

Step6: calculate slack for all the activities.

S=T_L –T_E Slack may be positive, negative or zero.

4.2 Time –Cost analysis of project network

The project time-cost crashing problem can be defined as follows:

The project time-cost trade-off problem (TCTP) emphasis on developing an approach to schedule the activities in such a way that ensures lowest additional cost associated with the reduction of time and accelerates the completing of the project.

Step1: Draw the project network

Step2: Perform CPM calculations and identify the critical path, using normal time and cost for each activities.

Step3: Calculate the cost slope for each activity.

(cslp= cc-nc/nt-ct), where nc=normal cost, cc=crash cost, nt=normal time, ct=crash time.

Step 4: Find the activity with the minimum cost slope and crash that activity by one day.

Step5: Now the new Critical path select the activity with the next minimum cost slope, and crash by one day. Repeat this step until all the activities along the critical path are crashed up to desired time.

Step6: Formulate project time-cost crash problem as a linear programming (LP) method. The time costs trade-off relation is formerly analysed by regression analysis and an optimization problem is formulized which is solved using MATLAB.

V. RESULTS AND DISCUSSION

The total required time for successful completion of the project scheduled budget was in 38days and by our process is only 21days. Thus the total reduced time is 17 days of the total required time. The total required project budget is Rs. 8,750.0000 and by our method can decrease the budget is Rs 7,855.0000 therefore, the reduced cost is Rs. 895.0000 of the total required cost of the project. Thus, our estimated budgeting technique will bring a brilliant success to calculate the least possible time-cost for successful completion of any project.

5.1. Determination of cost slope for all the activities

To determine the critical path consisting of all activities with different variables such as normal cost (NC), normal time (NT), crash cost (CC), crash time (CT) are computed. Table1 shows the computation of determining the critical path of the project.

Based on table1 the total duration for the completion of the project is 38 days and the critical path is 1-2-4-6-7-8-9. Project total normal direct cost is equal to sum of normal direct cost of all activities is 8750.000/-.

table 1: cost slope data

Activity	Normal		Crash		Δt	Δc	$\frac{\Delta c}{\Delta t}$
	Time	Cost	Time	Cost			
1-2	4	500	2	650	2	150	75
1-3	12	250	6	350	6	100	16.666
1-4	10	350	5	425	5	75	15
2-4	8	550	4	600	4	150	12.50
2-5	6	400	3	550	3	150	50
3-6	8	300	5	450	3	150	50
4-6	10	150	6	250	4	100	25
5-7	10	100	7	225	3	125	41.00
6-7	0	0	0	0	0	0	0
6-8	8	700	4	825	4	125	31
7-8	10	750	7	900	3	150	50
8-9	6	900	2	1500	4	600	150

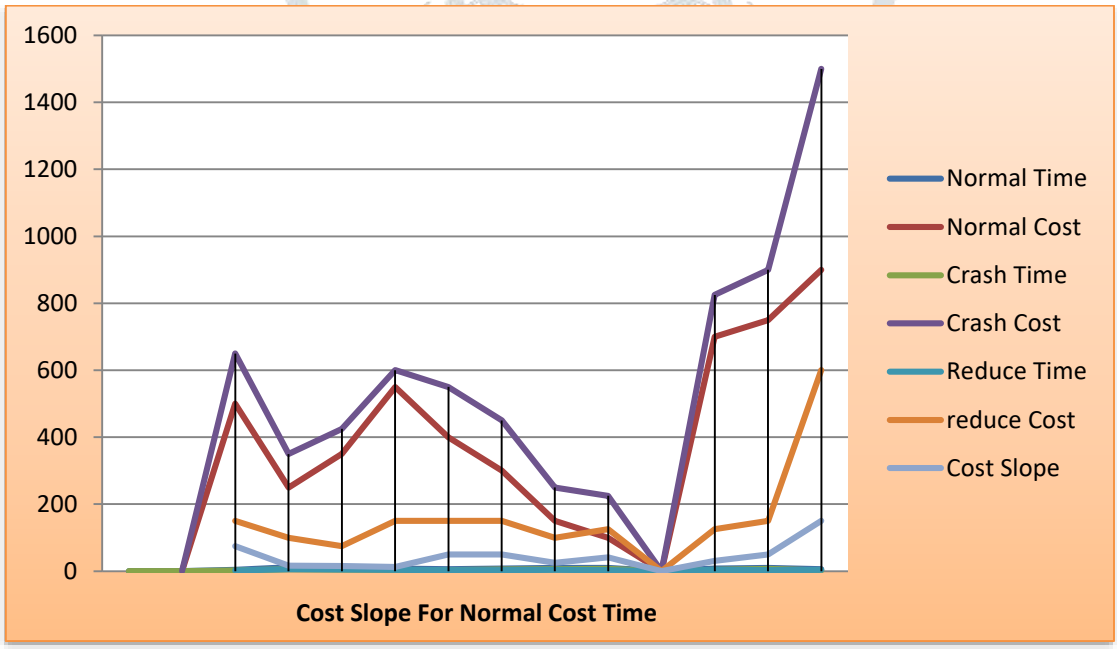

Fig.1 analysis of cost slope for normal cost time

5.2. **Determine the total cost of project data**

Total cost is depending on the direct cost and indirect cost of the project. Linear programming (LP) approach is recommended to crash the activities of the project. Reduction of 17 days from 38 days estimated by CPM decreases the total cost by $895. The model indicates that about 44.4% decrease of time and reduced cost by 10.22%, which is satisfactory. The total net reduction of the estimate cost is

(8750-7855) (approx...) cost =895.000

The percentage of reduce cost= (895/8750*100) %=10.22%

table2: data for days and total cost

Indirect Cost	Direct Cost	Total Cost	Days
3570	5000	8750	38
3150	5100	8250	34
2835	5250	8085	30
2626	5350	7976	27
2205	**5650**	**7855**	**21**

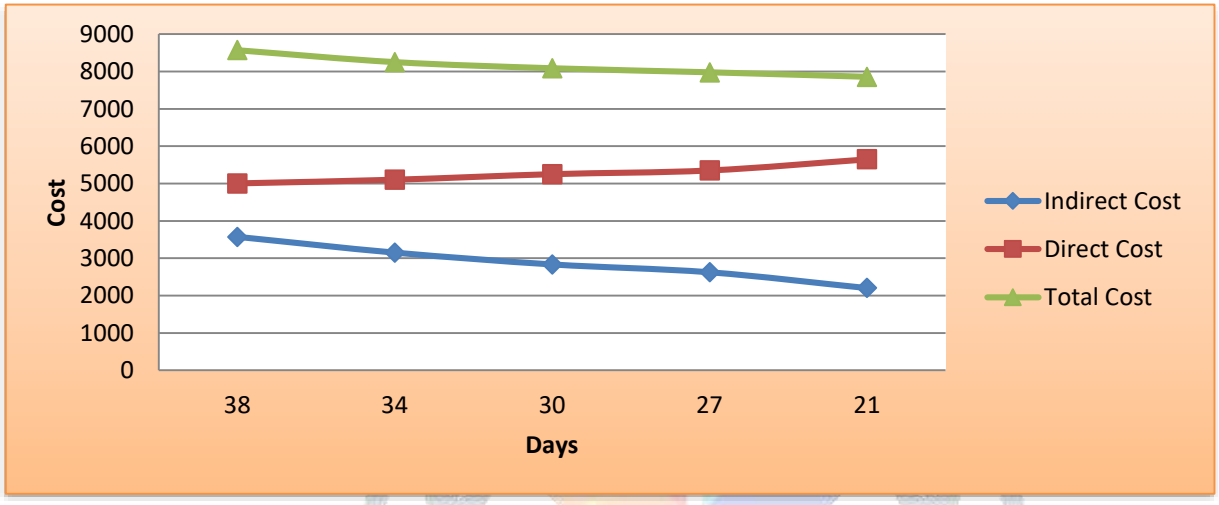

fig2: project optimum cost duration

VI. Conclusions

On the basis of study following conclusion are drawn:

- For the considered MATLAB, the network programming results indicate that project cost are exactly the same as that of the manual method.
- Linear programming approach is suggested to crash the activity of the project.
- In any network when crashing is applying, the cost of project and project time are reducing up to a certain crashing limit. Beyond crashing limit if we applying crashing the project will suffer.

VII. Future Scope

- At the end of the study, the suggested technique will help project managers to develop an effective schedule to make sure the project completion time is finished on time or earlier than the expected time with enough of raw materials and employees in order to minimize the time and reduce the cost.
- The evolution process is taken into account in finding the best solution. In our study on scheduling, NA is used to minimize the time and the cost of the project controlling. In this study, data of the project is collected from a construction industry.

VIII. ACKNOWLEDGMENT

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References

[1] Feng, C.W., Liu, L., & Burns, S. A. 1997. Using genetic algorithms to solve construction time cost trade-off problems. Journal of computing in civil engineering. 11(3). 184-189.

[2] Liu, H., Cao, J. N., & Love, P. E. D. 1999. Using machine learning and GA to solve time-cost trade-off problems. Journal of construction engineering and management, 125(5), 347-353.

[3] Abbasi, G. Y. and Mukattash, A.M. 2001. Crashing CPM networks using mathematical programming, International. Journal of Project Management. 19: 181-188.

[4] Rehab, R. and R.I. Carr. 1989. Time-cost trade-off among related activities. J. Construct.Eng. Manage., 115: 475-486.

[5] Walter, J.G., C. Strauss and M. Toth. 2000. Crashing of stochastic processes by sampling and optimization. Bus. Process Manage. J., 6: 65-83.