TIME AND COST OPTIMISATION IN PROJECT EXECUTION

Shamsul Haque Hamidullah, Chitranjan kumar (assistant professor)

M. Tech (construction technology & management),

Civil Engineering, Al-Falah University, Haryana, India

ABSTRACT

*The main objective in the field of construction is to complete every project on time, within budget and quality full. The requirements of construction management are useful utility, structural firmness, economy, speed, and quality of construction. In the every construction project time and cost trade-off are two important factors. It is crucial in achieving the project objectives. Dealing between different conflicting facets of project is one of the challenging problems which often Construction Company has to face. Time loss is always costly and time saving can provide profit to all the parties in the project. There is always a mutual affinity between time and cost. Time cost optimisation is necessary and very important for construction project. The objective of time cost optimisation is to determine optimum project duration corresponding to the minimum total cost and this can be achieved with help of reducing the duration of critical activities in the network in order by breaking the activities of critical activities to minimize the overall project duration. In this study, critical path method (**CPM**) with an investigative method is used to find out the crash duration and crash cost and. An analysis is performed to identify the relationship between the time and cost in order to formulize an optimisation problem model. In the analysis part, for this problem solving will be performed by manual methods. Then the reasons are introduced to increase the duration of project, then through project crashing technique optimisation of time and cost will be easy early completion of project applying this approach the obtained result is satisfactory, that is an indication of usefulness of this approach in construction project management problems, a numerical example in the paper shows the advantage of the proposed approach.*

Keyword: - *Critical path method, crashing, cost optimisation, cost.*

1. INTRODUCTION

1.1 Background

There is very huge competition in the global market of construction field. Optimising the cost and time is vital and very challenging in every construction project. The project delay increase uncertainty. There are many reason to delay of project like labour problem, finance related issue, etc. In the construction project execution, objective of project execution is to finish on time, within budget and with best quality. Every project is planed budget and schedule. The budget is defined as the cost that required for project in order to complete the project. Total cost of any project is a blend of direct cost and indirect cost. So, proper planning and scheduling play vital role in solving the problem. Time and cost is the two important factors in construction project. **CPM** is being used since 1950c in construction industries for the project scheduling and control. The critical path method **(CPM)** is very useful tool for planning and controlling project. In the **(CPM)** time is related to cost and the main objective is to develop an optimum time and cost relationship. In the **(CPM)** cost may be estimate along with time estimate and scheduled for finish the activity at minimum total cost. The project duration may be reduced by reducing the duration of critical activity on project network. **(CPM)** is used by researchers to appraise the early start time (EST), early finish time (EFT) and latest start time (LST), latest finish time (LFT) and to calculate the activity float, to specify critical activities, appraise the impact of change in duration logical relation on overall project. **(CPM)** is very useful for

contractor and vender to ascertain that when and how many resources are needed and when to deliver material. To accelerate the execution of project, it required to reduce the scheduled time of project by hiring extra labour and using productive equipment. But by this idea, it will get extra cost thus to reduce the completion time of project on critical path network is required. For real life project, project manager always perform the trade-off between time and cost of project through reducing the duration of activities.

1.2 Objectives

The objective of this study is to reduce the increased project duration from original duration and to meet a specific deadline.

1.3 Scope of work

The main aim of study is to complete the project with minimum cost within the time. This model is very useful in the area of time and cost overrun during the construction

2. LITRATURE REVIEW

- A.S Ali, S.N Kamaruzzama (2010), as per the author for management of construction 4 parameters important is as follows: scope, cost, time and quality. The main of the author is to find out the problem are parameters which contribute for the cost overrun. For this they carried out the quaternary survey on the live projects. For the data analysis the method used is quantitative based I.e descriptive statistics and ranking analysis is used. Frome the investigation they found that factors which contributes to cost overrun was inaccurate and/ or poor estimation of original cost and factor which do not affect is mistake In design for this to control the construction cost method suggested by the author is proper costing and financing. Also they conclude that cost overrun is most serious problem which may affect the construction project effectively.
- Aftab Hameed memon, Ismail abdul Rahman, Ade asmi Abdul Aziz (2012), the conclusion of this paper is poor time and cost performance are major problems faced by today's construction industry. Hence, this study assessed time and cost performance in construction industry of Malaysia and identified major inhibiting factor. Structured questionnaire survey was carried out amongst the contractor, consultant and client personnel who resulted in gathering 140 samples. Analysis was carried out statistically using software package SPSS V17. Also, mitigation measures to improve time and cost performance of construction cost were developed by adopting qualitative mode of study using interview.
- Pathak.U.J, Chavan.C.S, Rathod.L.V, Nachare.VL, Suryawanshi.A.B,(2014) low cost housing technologies aim to reduction in construction cost using alternatives to conventional method. Author examined the cost effectiveness using low cost housing technologies comparing with the traditional construction methods. Frome two case studies in india found that about 22 to 26 % of the construction cost can be saved by using the low cost housing technologies including labour and material cost comparing it with traditional construction methods for walling and roofing respectively.
- T. Subramani , P S Sruthi, M.Kavitha (2014) the main objective of this paper is to identify and analyse the cause of cost overrun in construction. The result carried out from survey showed that, poor contract management, slow decision making, poor schedule management, delay in providing design, rework due to wrong work, long period between design and time of bidding/ tendering and wrong estimation/ estimation method are the major cause of cost overrun.
- Mr.K James babu Raj, Dr. N.S.Elangovan (2016), the objective of this paper is to reduce the increased project duration from original duration and to meet a specific deadline, with the least cost. In addition to that it might be necessary to finish the project in specific time to:

    1. Finish the project in a predefined deadline date.
    2. Recover early delays.
    3. Avoid liquidated damages.

3. METHODOLOGY

Critical path method is most widely used in planning and controlling of the construction project. At first essential data are collected for construction problem through a source. CPM is used to find out the critical path and critical activities. The critical activities are shortened to reduce the duration in order to get their lowest cost slopes. The important objective to use of critical path method is to determine how best reduce time required to perform repetitive and that are needed to support an organisation. The project is crashed up to minimum cost on the point of total cost.

3.1 Various terms are used time cost optimization

1) **Normal cost:** It is lowest cost of completing an activity in minimum time employing normal means that is not using over time or special resources.

2) **Normal time:** Standard time that an estimator would usually allow for an activity.

3) **Crash cost:** Direct cost corresponding to completion of activity within crash time.

4) **Crash time:** Minimum possible time in which an activity can be completed, by employing extra resource.

5) **Cost slope:** It Is the slope of direct cost curve, approximated as a straight line in order to have a single cross slope.

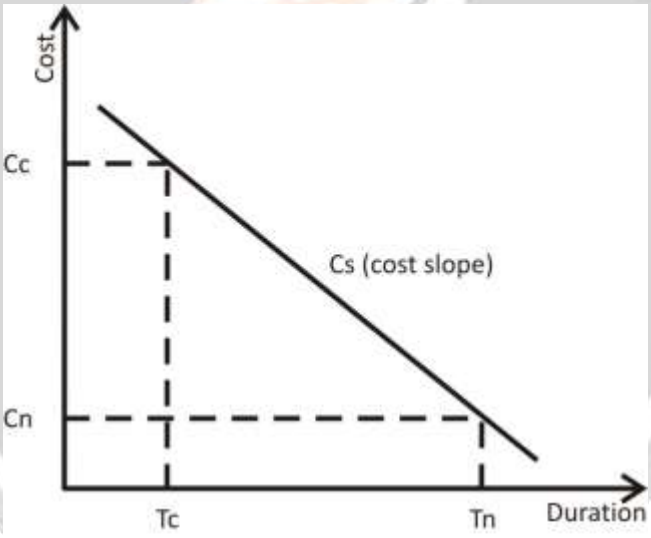

Chart - 3.1 : Cost function of an activity

$$Cs = \frac{Cc - Cn}{Tn - Tc} = \frac{\Delta C}{\Delta T}$$

$$\text{cost slope} = \frac{\text{crash cost - normal cost}}{\text{Normal time - crash time}}$$

3.1 Steps in time cost optimization

Step1: Established direct cost time relationship for various activities of the project.

Step2: Determine cost slope for various activities and arrange them in the ascending order of cost slope.

Step3: Compute direct cost for the network with normal duration activities.

Step4: Crash the activities in the critical path as per rank i.e. starting with the activities having the lowest slope and continue in the ascending order of the slope.

Step5: Parallel non critical activities which have become critical by the reduction of critical path duration due to crashing in step 4.

Step6: continue crashing process through step 4 to 5, till a stage is reached where no further crashing is possible.

Step7: Find total cost of the project at every stage by adding indirect cost to the direct cost determine above.

Step8: Plot total cost-duration curve.

Step9: Get the optimum duration corresponding to which least total project cost is obtained.

4. DATA ANALYSIS

The project indirect costs Rs.60 per week. Find the optimum duration and cost associated with it. Also draw the least cost network. Table 4.1 shows the project data in term of time and cost.

Table 4.1:- Project crashed and normal duration and cost

Activity	Normal time (in week)	Crash time (in week)	Normal cost (in rupees)	Crash cost (in rupees)
1-2	9	6	640	700
1-3	8	5	500	575
1-4	15	10	400	500
2-4	5	3	100	120
3-4	10	6	200	260
4-5	2	1	100	140
			1940	

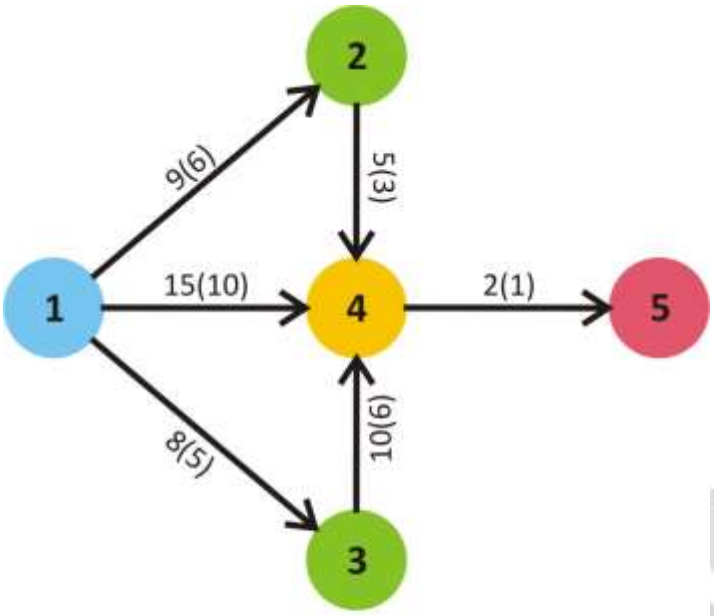

Fig - 4.1 : Network Diagram

Table 4.2:- Cost slope of various activities

Activity	Δc (in rupees)	Δt (in weeks)	Cost Slope Δc/Δt
1-2	60	3	20
1-3	75	3	25
1-4	150	5	30
2-4	20	2	10
3-4	60	4	15
4-5	40	1	40

There are various path on the network diagram, normal time has three path the longest path has maximum duration in 20 weeks and crash time has also three path the longest path also has maximum duration in 12 week. Therfore crashing will be done from 20 weeks to 12 weeks.

Table 4.3:- Crash table

No of week	Direct cost Normal cost	Crash cost	Total	Indirect cost @ 60 rs	Total cost (DC + IC)
20	1940	Nil	1940	1200	3140
19	1940	15	1955	1140	3095
18	1940	30	1970	1080	3050

17	1940	45	1985	1020	3005
16	1940	85	2025	960	2985
15	1940	130	2070	900	2970
14	1940	195	2135	840	2975
13	1940	260	2200	780	2980
12	1940	325	2275	720	2995

Figure 4.2 shows the time cost trade-off. During crashing process the direct cost start toincreas while the indirect cost decreas as it is a function of time.

Chart - 4.2 : Project Time Cost Relationship

5. RESULT AND DISCUSSIONS

Reducing the crash time increases the crash cost. The result is shown in fig no 4.1 that total cost decrease while project duration is increased. After some time, total cost reaches to its minimum value then it starts to increases with increasing the duration. The regression analysis shows the relationship between the crash time and crash cost. This analysis shows the real behaviour of construction project. The time cost optimisation of this project results in optimum cost of RS 2970 with optimum duration of 15 week. In this research, only deterministic value of activities duration and cost are used.

6. CONCLUSION

The objective of this research was time and cost optimisation in project execution for construction project. The critical path method **(CPM)** has been used to find out the crash time and crash cost. The relation between crash time and crash cost have led to develop the optimisation model. Manually has done to get the minimum total cost of the project with the minimum duration. All technique used in this research have shown satisfactory result.

7. REFERENCE

[1]. Chitkara, k, k. (2005) construction project management: planning, scheduling, and controlling. Tata McGraw hill publishing company Ltd.

[2]. Anuja, rajguru. , prag, Mahatma. (2016). "Effective technique in cost optimisation of construction projects". International journal of informative and futuristic research. volume(3), issue (5).ISSN:2347-1697.

[3]. Mr. Bhushan V. Tatar and prof. Rahul S. Patil. (2016). "Time and cost optimisation technique in construction project management". International journal of latest trends in engineering and technology. Vol.(7).e-ISSN:2278-621X.

[4]. A.S Ali, S.N kamaruzzama (2010) "cost performance for building construction project in klang valley". Journal of building performance. ISSN 2180-2106 Volume 1.

[5]. Aftab Hameed Memon, Ismail Abdul Rahman. (2012). "Time and cost performance in construction projects in southern and central region of penisular Malaysia". International journal of advances in applied science. Volume 1. ISSN: 2252-8814.

[6]. Pathak. U.J, Chavan.C.S, Rathod.L.V, Suryawanshi.A.B, (2014) "cost effective house by using various construction techniques and material"Indian journal of Applied research volume: 4.

[7]. T.Subramni, P S Surthi, M. Kavitha, (2014). "Cause of cost overrun in construction" Iosr journal of engineering volume: 4.

[8]. Mr. K. James Babu Raj, Dr.N.S Elangovan, (2016). " Time and cost optimisation in construction using M.S Project". International journal of advanced research trends in engineering and technology.volume:3, Issue:2.ISSN:2394-3785.