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IMPLEMENTING TIME AND COST OPTIMIZATION IN COMMERCIAL BUILDING USING PROJECT MANAGEMENT TECHNIQUES IN MICROSOFT PROJECT

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Abstract - *Project management is main stream which overall makes a civil industry worth into existence in accordance with the control on constraints such as time and cost. This paper will mainly help out to investigate the behavioural improvements in time according to the relative cost. Microsoft project software is used to enhance the scheduling adding Crashing, Slack time and alternative building material to the work planning activity. Crashing makes a proper inventory behavioural time benefits from the overtime of huge workforce and improvement in the duration of an activity using slack time in software. An alteration with the cost is maintained which helpful in retrogression of overall costs of the project. This project is very much applicable where the time and cost is the major constraint which make a building more economical.*

Key Words: **Crashing, Slack time, Critical Path Method, Alternative Building Material, Polycarbonate Sheet.**

1. INTRODUCTION

In today's era there are many heaps of sectors which are increasing globalisation & civilisation such as IT's, Infrastructures, Energy conservative projects. In these, one of the major sector is Infrastructure which is profoundly increasing the economy of the country. Leading to this mainly time & cost is exceedingly more into consideration in this world. Everyone wants to be more conservative when it comes into time constraint & within shorter duration work should be done giving more profitable results. In the other way of profitable results cost constraint is predominating the efficiency of work to be done in construction industry. More often cost is directly proportional to the work to be carried out by the resources.

In other aspects small scale construction industry could not take these constraints into consideration which leads to more cost overrun & time overrun. So it is better to optimize the time and cost which makes constraint flow off. Many projects have some risk and uncertainties which we not consider it orally but it comes into account when we execute it practically which makes increase in time, cost and overallocation of resources. So mainly recognising those uncertainties and doing a proper analysis one should make a project more feasible.

So mainly the easiest way to minimize the cost of the project is the natural sustainable material and using the alternative materials which cut out the excess increase in the overall cost of the project. An analysis of raw materials and resources, from meeting up of parent material to their definitive composition, gives out a preferential judgmatic long term costs benefits. These benefits are paid to the clients, owner, the occupier, & the environment. Accordingly, time and cost of each item of work is estimated which gives ultimate time & cost of the project.

Optimisation is the method of improving profit gain and effectively going through a sensible result under given state of affairs. The method in which the actual cost should not traverse the estimated cost limit is called as Cost Optimisation.

There are mainly two areas where cost is optimised:

1.) Optimising during the pre-construction phase of the project i.e., Design stage.
2.) Optimising when the construction gets started by the project manager or the contractor.

Optimisation means collecting all the data cost of the project and the advancement of work. The motive of the cost optimisation is to gain profit satisfactory without getting more chaos and finishing the work in actual estimated cost or lesser than it.

1.1 Objectives

Key objectives in the construction sector is to complete each project in a timely manner, budget and quality. Building viability requires useful effectiveness, organizational persistence, cheap, swiftness and superiority. The behaviour of the project in various disputed areas is challenging. Often the construction company has to deal with the problems, it is always expensive to reduce time and save time by saving all the parties in the project having a commonality between profit time and expenditure. Time optimization is necessary and very important for construction projects. The purpose of time value optimization is that it is possible to fix the optimum project duration related to the minimum cost and it can be obtained with the help reducing the duration of critical tasks in the network by

violating critical activities reducing total project duration. In this study, the critical path method (CPM) with analysis path is used to find out the crash duration and crash costs and it is analysed to identify the relationship between them. The time and cost to create a model for optimization problems. In the part of the analysis, this will be for solving this problem done by manual methods. After that the explanations for the extension of the project were extended and then thereafter project crashing technology time and expense utility projects will be easy to implement contact with the results obtained satisfactorily, that the construction is an indication of the utility of this approach.

The key project objectives is described below:

1. The main aim of this project is to reduce the improved development period from new time and to meet a specific deadline.
2. The main motivation behind this project is to reduce time using crashing and slack (Time Optimization).
3. For cost optimization alternative building material is used to reduce the cost and making project more well-organized and inexpensive.

2. METHODOLOGY

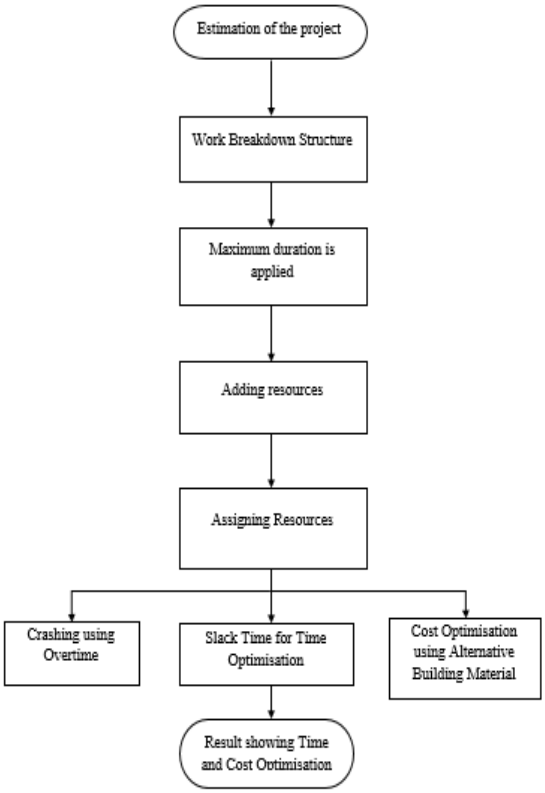

Fig-1 Flowchart of Work Methodology

2.1 Crashing of an Activity

A crashing of an activity is a method of reducing the overall decreasing the duration of an activity with the help of some techniques. Crashing is the performance that had better use when fast tracking has not hold back sufficient time in the database. In this technique the equipment and manual resources are added in terms of lowest possible techniques and cost. The advantage and disadvantages of the cost and the schedule are evaluated to conclude how to attain the highest quantity of firmness at the lowermost incremental cost.

Crashing refers to a particular variety of compression of the project schedule that is carried out for the purpose of decreasing the total period of time (also known as the total duration of the project schedule). The decrease of the duration of the project is usually carried out after a careful and exhaustive analysis of all possible alternatives for minimizing the duration of the project in which each and every one of the methods to reach the maximum duration of the program by the lower additional cost.

Crashing the schedule means adding extra resources in critical path without getting the highest level of efficiency to the important resources.

It is another technique where you add the program to resources for extra time. On contrary to the crashing we are mainly into account of establishing or employing resources which could reduce the overall cost. Once we are aware of those activities crashing can be applied to the manageable activity of the project.

2.2 Crashing of Network Manually

In specific projects, deduction of complete project schedule is necessary, even if its cost is increased. This is habitually desired where thinking of cost is persistent or less important than completing the project in the fullest time. It is generally possible to reduce the resources allocated to the project allocation by reducing the resources. Due to the escalation or reduction in cost of the project, the cost of the project has drop off or improved. For this resolution, time and cost are methodically evaluated.

By scheduling the techniques of construction projects by network technologies, the rate of progress of each activity will produce the lowest practical cost. This is based on the distribution of progress materials, the number of workers available and the type of devices available for each activity at a minimum cost. When these projects are built in these situations, it is mentioned as a general program. However, sometimes it may be desirable to reduce the time needed to build the project. When normal time has been reduced, the project or its part is built under the program crash.

For crashing of an activity following points is to be considered:

1. Rate of materials is increased.
2. Number of workers is increased.
3. Overtime work should be allotted with a higher pay scale per men hour of work.

4. Additional unit of equipment is allotted to the critical activities.

Furthermore, in crashing of an activity the two main constraints that is time and cost is always been inversely proportional to each other. Proper handling and making the project smooth one should be very careful against disputes which will make overall project more disturbed and may increase the total investment and capital budgeting of the project.

2.3 Crashing using Microsoft Project

The main approaches for crashing of an activity in Microsoft project is:

1. Apportioning additional resources to the project which makes easy way for crashing of an activity.
2. Overtime allocated to the resources mainly human resource.
3. Hiring additional resources.
4. For Early completion extra payments.

It would be possible to complete the outsourcing parts of the project within a short period of time if the same work was to be completed by internal resources.

With the help of critical activity (The sum up of longest duration in a particular project) a in a particular project we can easily crash the duration of an activity. Non-critical activity may be unresolved and may not give better result and hence it is ineffective to crash an activity which is in Non-critical area. If a project regulates with a proper cost, time and quality material bound then it is easy to get a virtuous result with an ease of getting nicely quoted budget with reduced quality time. Meanwhile both the functions time and cost mainly stretch the proper way of budgeting.

2.4 Method of Crashing using Overtime Allocation

According to the bureau of labour statistics the overtime is totally depend on the total wages of the construction project. Overtime can be calculated from total main hour worked on an activity should be 15 percent working on land project whereas it should be 25 percent for the work under dredging projects. For a project which is individually constituted the percentage should 1 to 34 on ground jobs and it should be 17 to 34 for dredging project. Due to extensive overtime in the nature of work under the study. By using modern equipment's for allied operations as an alternative of human resources may increase the overall cost but has a tendency to decrease the overall duration of the project. This modern equipment eventually worked in an outdoor different seasonal condition which may extensively increase the overall operational cost of the project. The equipment should be used accordingly best suited seasonal conditions.

So, it is good to increase the daily working time for heavy construction where modern equipment is required. In ideal conditions, 10 hours of working a day and 6 days a week in land operations when modern equipment's is involved whereas dredging projects take a longer working hour because the dredge operated continuously. For dredging works in ideal condition, shifts have been prepared with at least one day off and organised 84 hours of work per day.

It is mandatory to be very condemnatory whether to use the human resource or the modern mechanisation resource. For an enthusiastic result it should be a proper balance between the guidelines in accordance with the employing resources and the investments.

3. Slack Time

Slack time in project management is a time in which an activity can increase or decrease the duration of the project without affecting succeeding overall tasks and overall duration of the project. It is also known as "Float time".

Slack time can be calculated by subtracting the time allotted from the overall duration of task. Such as if 12 days is being allotted for a particular project but it can be completed in 6 hours than the slack would be 6 days. Critical path designates zero slack of the construction project because any increase in time will indirectly affect the overall duration of the project.

With the help of critical path and the overall slack in every non-critical activity, maximum slack can be calculated.

3.1 Types of Slack

1. Total slack.
2. Safety slack.
3. Free slack.

1. Total Slack: Without affecting the overall duration of the project the total slack is equivalent to the permissible increase in duration. It can be calculated as

$$LF_i - EF_i = LS_i - ES_i$$

With the LS_i and LF_i is denoted as latest start and latest finish time of an activity whereas EF_i and Es_i denotes the earliest start and earliest finish.

2. Safety Slack: When all predecessors finish late possibly then the safety slack is equal to provided delay of an activity.

$$LS_i - \max_{\text{all predecessors } j} (LF_j)$$

Latest finish time (LFj) of an activity i that succeeds activity j.

3. Free slack: Free slack has not at all conclude on the earliest start of successor activity.

$$Min_{\text{all successor's j}} (ES_j) - EF_i$$

With Earliest start time (ES_j) of an activity i that precedes activity j.

3.2 Total Slack

Total slack is used to reduce the time in Microsoft Project. Microsoft Office Project bases its counts of Total slack on examinations of the dates in the Early Start, Early Finish, Late Start, and Late Finish fields for the assignment, which thus consider the dates for any successor errands. Add up to slack is figured as the littler estimation of the Late Finish short the Early Finish field, and the Late Start less the Early Start field.

Utilize the Total Slack field to decide if the errand has whenever accessible for a postponement. This can be helpful if an asset needs additional time on an errand, or in the event that you need to allocate an asset to another assignment. You can likewise utilize the Aggregate Slack field to decide how to recoup a timetable that is slipping.

4. Alternative Building Material

For this project work mainly, polycarbonate glasses are alternative for the structural glazing. It cuts down overall costs by 2-3 lakhs.

Polycarbonate is a material which contains a group of carbonates in their chemically build structure. Polycarbonate is mainly as similar to a conventional transparent glass but inflexible as plastic. Polycarbonate glass is easily installed, cut and easily available in ribbed single sheet or flat twin-wall thicknesses.

Advantages of Polycarbonate Glass Glazing:

1. Use of polycarbonate sheet is much lesser than the cost of insulated glass. Polycarbonate sheet may cut down the cost one-third to half from the insulated glass.
2. Polycarbonate sheet is 200 times stronger than insulated glass i.e. it provides structure with a very high impact resistance. This quality helps in getting stronger benefits to structure giving a proper maintained temperature resistance.
3. Polycarbonate sheet has a good fire resistance. Class 1 rating is given to polycarbonate sheet when tested according to BS476 part 7.
4. For heat reduction and controlling solar power it has a 25mm opal which provides a light transmission as low as 24%.
5. Polycarbonate sheets has a tendency to provide UV protection on the outer surface which helps in preventing sheets from UV radiation.
6. Polycarbonate sheet is very light weight and allows a greater deflection in comparison to glass. It can be easily available in sheet up to 39 feet which helps in reducing overall duration.
7. According to 2006 IBC slop glazing code polycarbonate is a safe glazing technique.

5. RESULTS AND DISCUSIONS

5.1 Results for Time Optimization

The below figure shows optimizing the duration using planning and scheduling. The duration which is conventionally observed is 377 days which is being decreased by crashing and with the help of slack time. The approximately reduced duration is 349 days. Hence these constraints are mainly helpful in considering and reducing the overall costs of an activity or the whole project. These results are mainly helpful to induce more results from labour productivity using the overtime allocation. As we know that an individual labour can do minimum of 8 hours of work a day. But this project eventually distributed certain working activity into number of labours which does not make much hectic to the labour. Moreover, in construction project labours doesn't engage to a specific activity but they are in huge number working of multi sets of work. As from case study practical labours actually applied in the project is dissimilar to the theoretical calculated labour so the number of labour applied in the software is from the actual working labours and their wages. Proper wages also attract the labours to work more which make project progress more into right way off time optimisation.

Majorly for optimising time the methodology practically implemented is shift wise work schedule so that at a separate shift of schedule that is day and night shift labours and workers work easily without any hectic situations. Similarly using more modern equipment in construction project will also reduce time oriented objectives. But it is directly concerned with the availability issues. So overtiming allocation majorly attracts worker which is directly results into their weekly incentives and with a major workforce working at a site will also decrease the exertion on labour. The time optimisation is also depending on how well a contractor organises his work schedule with a proper utilisation of material, machineries and human resource.

5.2 Results for Cost Optimization

The result mainly shows that how well organised material helps out in getting the cost more into economic zone. As we know that crashing of an activity consequently decreases the time by using several methods in construction project. But it will make an owner more satisfactory in consideration of before completion of project but it also makes more satisfying if the owner gets the result under the budgeted investments. So, in this project cost optimisation is done by using the alternative building oriented materials which

readily cut down the cost of the whole project but also satisfies owner with an economical result.

So for alternative building material an insulated structural glass glazing is replaced by polycarbonate sheets which cuts the overall cost of the project. The cost of polycarbonate sheet is Rs. 700/ sq.m. which is considerably very much less compared to insulated structural glass glazing which is Rs. 5860/sq.m. as per scheduled rates book. Conventionally it is being seen that the cost of the project is Rs. 50,657,057.83/-, by applying crashing the cost again got increased due to reduction of work time which is Rs. 52,416,091.44/-. Again, by applying the alternative material cost the overall cost of the building is reduced by Rs. 48,879,432.36/-. So this method of cost optimisation majorly decrease the conventional cost of the project up to Rs. 17,77,625.47/-

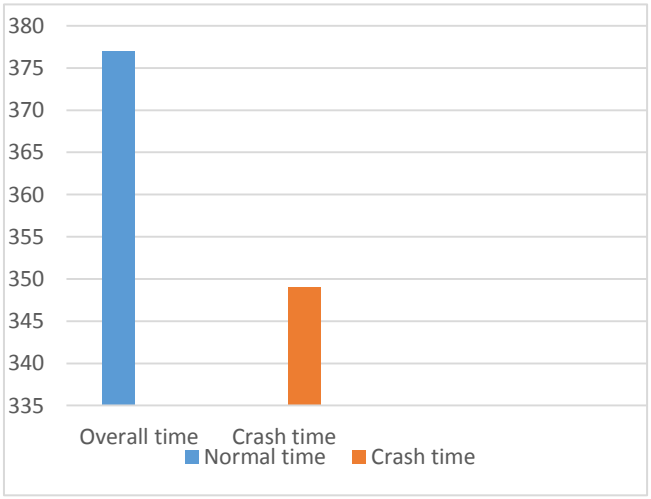

Chart -1: Reduction in Time

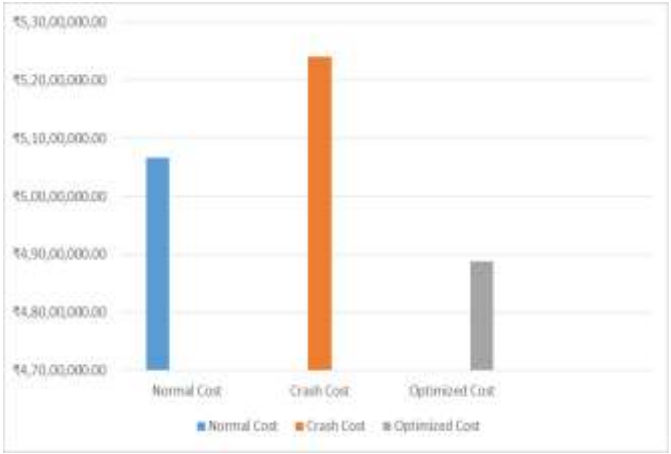

Chart -2: Reduction in Cost

6. CONCLUSION

As we had reduced the overall cost by 6.98 % and the overall duration by 7.71 %. This project concludes that any relative construction project mainly depends on the Time and Cost constraints which gives a proper economical weightage to any project. Moreover, it also depends on the project manager and types of resources which is involved in the project. Consequently, how the overtime will influence the project duration by simultaneously decreasing the slack time. A proper planning and scheduling will also make a huge difference in construction project considering the labour management. This project also concludes that the project effectively depends on the seasonal variations and the location such that it will be either advantageous or disadvantageous to the owner. It also concludes that proper maintained work ethics will also helpful to make a project more time and cost bound i.e. economical.

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