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TIME AND COST OPTIMISATION IN CONSTRUCTION USING M.S PROJECT

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ABSTRACT -
Construction management is an important branch of civil engineering, which deals with effective and efficient management of any construction work. The essentials of construction management are functional utility, structural stability, economy, speed and quality of construction. In this work, estimation and costing of the physical education building is done in terms of optimization time and cost. For this particular building, analyses are performed in terms of optimizing time and cost. In analysis part, for this building scheduling will be performed by using MS PROJECT. Then factors are introduced to increase the duration of the project, then by schedule crunching and project crashing technique optimization of time and cost will befound ensured early completion of the project. The project also includes visiting of some construction companies and conducts questionary surveys, then analyses the difficulties due to cost and time and suggests improvement for the phase of the construction project.

Key Words: MS project, estimation, costing, crunching and crashing technique,scheduling

I INTRODUCTION

1.1 Background

The traditional time-cost trade-off problem has been the subject of intensive research since the development of the Critical Path Method (CPM) in the late 1950s. Construction planners face the challenge of optimum resource utilization to compromise between different aspects of projects, especially time and cost. Recent contracts consider the quality performance of projects in addition to time and cost. These new and emerging contracts impose an increasing pressure on decision makers in the construction industry to search for an optimal/near-optimal resource utilization plan that minimizes the construction cost and the time, while maximizing its quality. This creates new and pressing need for advanced resource utilization models that are capable of optimizing the multiple and conflicting objectives of construction time, cost and quality.Since its introduction in the late 1950s, the Critical Path Method (CPM) has proven to be a useful tool for planning and controlling construction projects. CPM enables project managers to evaluate the early and late times at which activities can start and finish, to calculate activity float (slack), to define critical activities, and to evaluate the impact of changes in duration and logical relations on the overall project duration.. In construction projects, CPM is very important because it enables the contractor to determine when and how many resources are needed, vendors to determine when to deliver materials, and subcontractors to determine when they can perform their work. A project is an organization of cost, time and risk and the maximal quality simultaneously. People dedicated to the deployment of a set of resources for a specific purpose or objective.

Total project costs include both direct costs and indirect costs of performing the activities of the project. Direct costs for the project include the costs of materials, labor, equipment, and subcontractors. Indirect costs, on the other hand, are the necessary costs of doing work which cannot be related to a particular activity, and in some cases cannot be related to a specific project. If each activity was scheduled for the duration that resulted in the minimum direct cost in this way, the time to complete the entire project might be too long and substantial penalties associated with the late project completion might be incurred. Thus, planners perform what is called time-cost trade-off analysis to shorten the project duration. This can be done by selecting some activities on the critical path to shorten their duration.Construction managers need to develop a schedule for directing and controlling resources of workers, machines, and materials in a coordinated and timely fashion in order to deliver a project within the limited funding and time available. In addition to time and cost of activities, every resource utilization option will yield a specific performance quality. Trade-off between these conflicting aspects of project is a challenging job and as such planners are faced with numerous possible combinations for project delivery.

1.2 Research Motivation

If durations of the activities are compressed, the cost will increase due to more resources allocated to their rapid accomplishment. On the other hand, using fewer resources will result in extended duration of activities. In addition to time and cost of activities, every resource utilization option will yield a specific performance quality. Trade-off between these conflicting aspects of project is a challenging job and as such planners are faced with numerous possible combinations for project delivery.

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1.3 Objective

The objective of this project 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 a specific time to:

- Finish the project in a predefined deadline date.
- Recover early delays.
- Avoid liquidated damages

1.4 Need Of Study

Activity durations can often vary depending upon the type and amount of resources that are applied. Assigning more workers to a particular activity will normally result in a shorter duration. Greater speed may result in higher costs and lower quality, however. In this section, we shall consider the impacts of time and cost trade-offs in activities. Reducing both construction projects' cost and time is critical in today's market-driven economy. This relationship between construction projects' time and cost is called time cost trade-off decisions, which has been investigated extensively in the construction management literature. Time-cost trade-off, in fact, is an important management tool for overcoming one of the critical path method limitations of being unable to bring the project schedule to a specified duration.

1.5 Scope of Work

The main goal of the project is to finish the project with minimum cost and within the time. This model will better handle in areas such as resource constraints, time and cost overrun during the construction. It gives clear idea how to finish the project within the predefined deadline.

II MATERIALS AND METHODS

2.1 RESEARCHMETHODOLOGY

In order to achieve the objectives of the research the following tasks were performed:

1. Site investigation initial plans for the project. The main aim of site investigation is to study factors affecting the project.
2. Questionnaire Survey is done in order to studythe factors affecting the project in terms of time and cost by survey from owners and engineers.
3. From the survey, factors affecting time and cost is studied.
4. Once the factors are studied then analysis is done for a school building by including those factors.
5. In this area, analysis of building starts with preparation of detailed estimate, like estimation of resources of a building.
6. Using the Microsoft project, scheduling is done
7. Once the factors are introduced into the scheduled project, crunching and crashing technique is used to find out the effective technique in terms of optimization of time and cost.

III RESULTS AND DISCUSSIONS

3.1 STUDY FACTORS AFFECTING PROJECT

3.1.1SITE INVESTIGATION

Delays happen in most construction projects, both simple and complex. The causes of project delays include: design changes, poor weather conditions, labor actions, and mistiming of deliveries. To recover the damage caused by delays, both the delays and the parties responsible for them should be identified. For this purpose site investigation is very important. Nearly 7 sites where investigated and factors affecting the project in terms of time and cost is studied. The seven sites investigated are as follows:

- **P.V.R Apartment, Manjeri, Kerala**
- **Brigade Cosmopolis, Whitefield, Bangalore**
- **IB School, Kelambakkam, Chennai**
- **JK Tyre Industry, Sriperamputhur, Chennai**
- **Ruby Apartment, East Thambaram, Chennai**
- **Foundation One Apartment, RS Puram, Coimbatore**
- **AVK CBSE Residential school, Sankarankovil**
- **Emami Galraj Project Site, Navalur, Chennai**

3.1.2QUESTIONNAIRE SURVEY

Sites are visited to perform questionnaire survey.Usually, a questionnaire consists of a number of questions that the respondent has to answer in a set format.While questionnaires are inexpensive, quick, and easy to analyze. The main aim of this survey is to find out factors affecting the project in terms of time and cost. Survey was actually conducted in newly constructed buildings. Survey was conducted to engineers and owners.

Site 1: P.V.R Apartment work, Manjeri, Kerala
Survey was conducted in newly constructed (G+8 FLOOR) building.

Date of Start : 03-01-2013
To be completed : 21-12-2015
Completed on : not yet completed

Nearly 25 factors were collected from literature survey and listed, and survey conducted for this factors. Star indicates factor affected this project.

Site 2:JK Tyre Industry, Chennai
Survey was conducted in newly constructing (G+2 FLOOR) building.

Date of Start :15-08-2014
To be completed on:08-12-2015

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Not yet Completed.

In this particular project there are many factors plays an role in it. It got delayed by more than 2 years.

Site 3:Brigade Cosmopilis, Bangalore

Survey was conducted in ongoing residential project. Even though the project is not completed, By survey the project will be delayed for more than one year was the result**.**

No.of Towers : 3
No.of Floors : G+15
Date of Start : 14-01-2011
Completed Date : 30-11-2014

Site 4:IB School, Chennai

GRN is a residential project located in Camp road East Tambaram.

No.of Floors : G+3
Date of Start : 25-01-2014
Completed date : 25-09-2015

Table 1 :Factors Affecting Time And Cost in site 1,2,3,4 in %

S.NO	CAUSES	AFFECTED			
		Site 1	Site 2	Site 3	Site 4
1	Improper allocation of skilled man power and timeline by the contractor	10	10	10	10
2	Too many change orders from owner	20	15	30	30
3	Frequent design changes	15	25	20	20
4	Unforeseen ground conditions	20	20	10	10
5	Shortages of materials	30	30	45	45
6	Delay in decisions making	10	10	25	25
7	Cash flow and financial difficulties faced by owner	20	20	15	15
8	Inadequate contractor experience	15	10	10	10
9	Workmen productivity	25	20	10	10
10	Equipment availability and failure	5	20	15	15
11	Slow payment to the vendors	30	40	40	40
12	Underestimate project duration	15	15	20	20
13	Mistakes during construction/Repeated works	25	25	25	25
14	Lack of communication among parties	10	5	5	5
15	High cost of equipments	10	5	20	20
16	Severe weather conditions	30	30	10	10
17	Fluctuation in prices of materials	15	20	30	30
18	Poor design reading by inexperienced engineers	5	10	5	5
19	Clearance from Owner for excavation	20	10	10	10
20	Frequent unauthorized absence of workmen	40	15	30	35

Similarly questionnaire survey was conducted for remaining projects. Factors affecting the projects were studied. Factors are ranked in decreasing order in terms of affecting time and cost.Twelve factors affected the project taken from the survey are ranked in bar chart in terms of decreasing order. These factors are very useful in scheduling of projects. While scheduling the project, we can predict the weather condition and schedule the project according to it. It has found that fluctuation in price of materials affected all the eight projects. From the studies it has been found that optimization of time and cost is very important in order to overcome the loss.

3.2 ANALYSIS OF BUILDING

3.2.1 Details of building

Top 12 factors affecting time and cost from above projects are taken into an account for Emami Tejomaya Project in terms of optimizing time and cost.

No.of Floors : S+27
Total Plinth Area : 7 laks SQ.FT

For this particular building, analyzes is going to be performed in terms of optimizing time and cost. In analysis part, for this building scheduling will be performed using Microsoft project. Then factors are introduced to increase the duration of the project, then by schedule crunching and project crashing technique optimization of time and cost will be found.

3.2.2 PREPARATION OF DETAILED ESTIMATE

Estimation means calculating the materials, labor, and equipment needed to complete a construction project. The resources required for this project is obtained from detailed estimate. By estimation, resources are fed into the Microsoft project and scheduled. Total cost and duration required for the project is estimated.Estimation is the first step in optimization of time and cost. Estimation is done by calculating each grid, not as a whole. Since resources based on estimation, Estimator should be very careful in calculations.

3.2.3 Cost Estimate

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Before undertaking the construction of a project it is necessary to know it probable cost. The main objective of this estimate is to enable one to know beforehand, the cost of work. So while preparing the estimate very carefully the calculations should be carried out. The actual cost of a work is known at the completion of the work. Account of all expenditure is maintained day to day during the execution of work. At the end of completion of work the actual cost is known. The actual cost should not differ much from estimated cost. The cost of each item of work is estimated from quantities already computed.

Here the estimation of cost starts from excavation till painting. for every item of work cost is estimated. Estimated cost and actual cost should not vary much, otherwise it will leads to a major loss. So calculations should be carried out very carefully in estimation of cost. The success of a project depends upon cost so cost plays an important role in every project. Therefore maintaining a cash flow is very important for a project. The detailed estimate of every work is calculated and cost is found out in this section.

3.2.4 Scheduling the project

Project is scheduled according to the resources derived from the detailed estimate. Using the Microsoft project scheduling is done. Project is scheduled to start on 01/01/13 and to end on 10/08/13.

Fig 1 Project Task Schedule

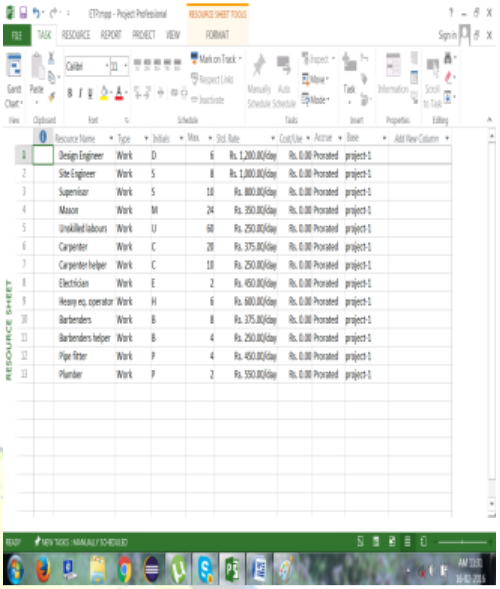
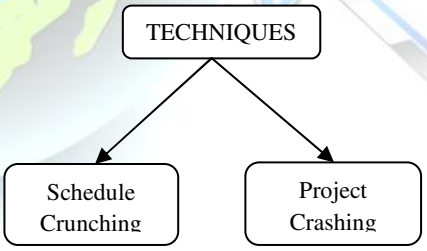


Fig 2 Project Resource Schedule

3.2.5 INCREASED PROJECT SCHEDULE

Now the factors affecting the project are introduced. Due to some factors like shortage of materials, cash flow project duration is increased and new schedule is formed. Tower C should start on 10/11/15 but started on 16/01/16.Later crunching and crashing technique will be used for optimizing the construction time and cost.

3.3 TECHNIQUES TO OVERCOME FACTORS



3.3.1 Schedule Crunching

Crunching is a period of time in which one must make a effort quickly in order to finish the project. In this technique increased duration and cost of a project can be reduced. But Crunching should be of optimum; otherwise it leads to poor in quality. By using this crunching technique the duration of project reduced from 219 days to 182 days.

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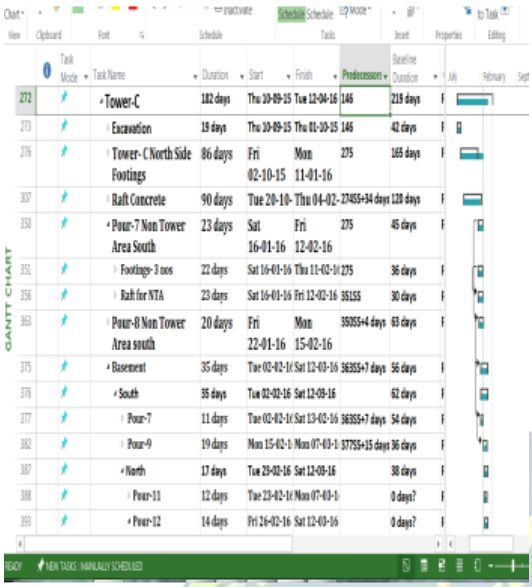

Fig 3 Project Schedule - Crunching

Table 2: Cost analysis using Schedule - Crunching

Genre	Tower C	Savings
Original	Rs 622000	
Crashing	Rs 524800	Rs 98200

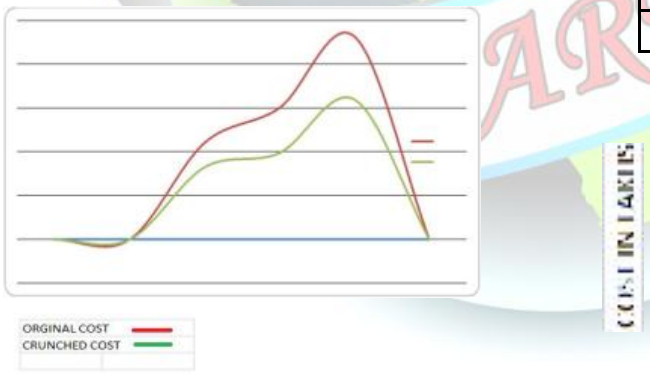

Fig 4 Graph of Scheduled and Crunched

3.3.2Project Crashing

Crashing means adding of additional resources to a project in order to finish the project in a specific deadline. But adding of resources should be optimum it should not affect the cost of the project. By using this crashing technique the duration of project reduced from 219 days to 166 days .There are a number of standard and typical approaches to attempting to crash a project schedule. One of the most commonly utilized methods involves increasing the assignment of resources on schedule activities. This essentially means decreasing the time it takes to perform individual activities by increasing the number of people working on those activities.

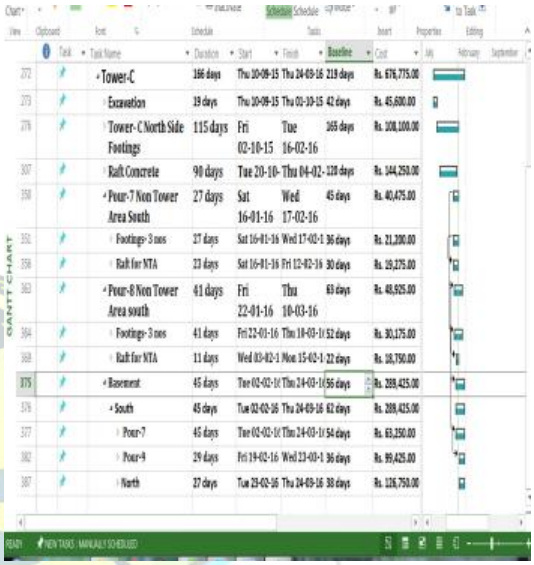

Fig 5Project Schedule - Crashing

Table 3: Cost analysis using Schedule - Crashing

Genre	Tower C	Exceeding
Original	Rs 622150	
Crashing	Rs 676775	Rs 54300

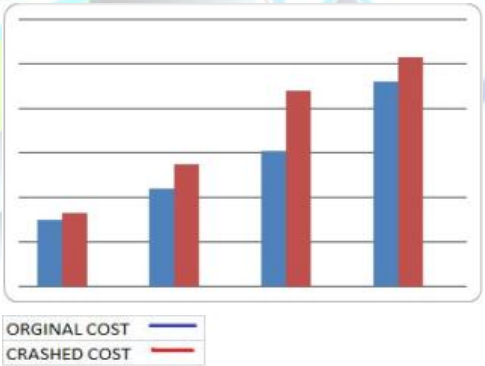

Fig 6 Graph of Scheduled and Crashed

3.3.3 Comparison of Technique

Table 4: Comparison of Techniques by cost

Cost	Saved & Increased
Estimated	Rs 622000
Crunching	Rs 524800

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Crashing	Rs 676775

Table 5: Comparison of Techniques by days

Actual	**219 Days**
Crunching	**182 Days**
Crashing	**166 Days**

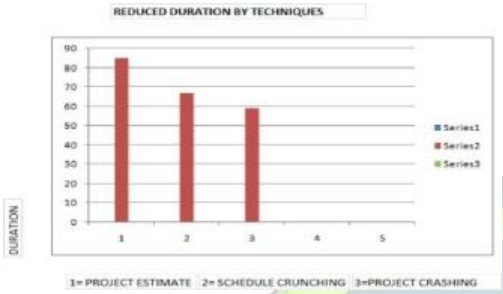

Fig 7Comparison of reduced duration

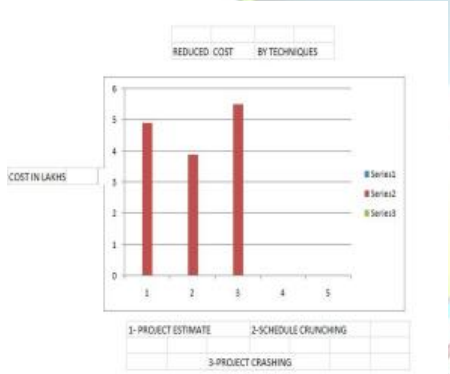

Fig 8 Comparison of reduced cost

IV CONCLUSION

Many project managers suffer to finish the project within the duration and estimated cost. They may add more resources to finish the project within the duration or they finish the project by delay. From the result,It is found schedule crunching is most effective technique in optimization of time and cost. But quality is not guaranteed in this technique. If project duration is decreased of optimum ,then we can achieve quality by this technique. In order to achieve more profit we should not reduce than optimum it may lead to collapse and to do rework. In order to achieve quality project crashing is a good technique. Thus optimization of time and cost is achieved.

In schedule crunching technique how far the duration can be reduced in terms of not reducing the quality of the project can be studied. Both schedule crunching and project crashing can be adopted in single project and studies can be carried out.

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