

Analysis and monitoring of highway project – a case study of Seoni Mohagaon project

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Abstract: The role of construction industry in the country's economy is increasing by each passing day and that is the reason why construction industry has become the second largest industry of this country. But our construction industry is lacking by the advancements and technologies in project planning and management which is the major reason for the delays and the cost overruns in the project completion. The time duration of any project can be optimized by proper planning, scheduling and resource allocation, and not only the time duration it also affects the cost of the whole project.

In this study, '**Seoni Mohagaon stretch**' is the ongoing project which is running delayed by its pre-scheduled duration. Here I am planning a scheduling of this project considering all the flaws observed in the project and providing a proper solution to this work considering manual resources analysis and assigning lag to individual activity.

The main aim of this study is to explore the use of project management software called Oracle Primavera P6 in the construction field because the proper project management and planning has a vital role in the execution of construction works. With the help of **Oracle's Primavera P6** software, a comparative study of this project is carried out in between the actual site work progress and the software scheduling with the standard data. And also the resource allocation of this project is done on the basis of the coefficients from **IS: 7272 part-1** central region.

Index Terms-Planning, Scheduling, Resource allocation, Controlling, Primavera, Lagging, Tracking, and Construction.

I. INTRODUCTION

Construction schedule management includes the process required to complete a construction project on time by meeting the major project milestones. Creating the project schedule is one of the most important processes in construction schedule management. The case study helped in deeper understanding of the program of construction the main pillars of a any construction project are planning scheduling and execution.

In India, construction is a labour intensive process, while in developed countries the construction process is mostly mechanized. The degree of mechanization however depends on the nature of the construction work involved and the time schedule. Construction activities are now being increasingly mechanized all over the world, including India, to ensure the timely completion of projects. High capacity machines with better output and greater efficiency have made the construction process less stressful. Nevertheless, the construction process in India still involves a huge labour force because of the easy availability of cheap labour of all categories.

Infrastructure development is the need of the hour to ensure overall growth. Building infrastructure in India has now become a formidable challenge which can only be met by adopting innovative construction technology. Earlier, development projects mostly in the public sector were ploughed with financial constraints. The scenario has changed now there is no dearth of funds anymore. The projects are now being financed by the central and state government, private enterprises and foreign direct investment. However, the timely completion of projects is still a problem and this is where construction technology becomes relevant. We can no more rely on manual efforts as the same is beset with the problem of fatigue. Therefore it becomes necessary to switch to more reliable technology to attend desired results.

Introduction of Project

About the project:- The project selected for study is a site of four lane divided median project highway that includes land, building structures and road work.

in which the actual site work duration exceeds the limit of the predicted schedule. The project is running delayed by its scheduled duration because of the lack of proper project management i.e. improper planning, scheduling and inappropriate allocation of the resources to the project activities. The delaying of the project not only increasing the time of the project but also affects the cost of the project. The study considered the various causes of delays encountered during the work execution. Since the project is running delayed, therefore its proper project management is required as the project can be finished on time and under allotted budget. So to prevent the project from the further delay, I have done a comparative study of its actual schedule with the standard data for which I have used a project management tool named '**Oracle's Primavera P6**' software for managing the project.

The main reason for the cost overruns of the project is the over allocation of the resources to the project activities, for which I have used **IS: 7272 part-1** through which the actual requirement of the labour resources is carried out. Primavera enables to track the percentage of activity completion which shows how much of the work has been completed.

In this project, the scheduling is done from the standard data and after comparing this schedule with the actual site progress, the number of days saved is optimized with the help of primavera. The activities of the project maintain a relationship with their predecessor and successor on the basis of the interdependencies in between them which results in to find out the total project duration during the planning phase. In this study, the sequence of the project work is being split into four major categories--- **preconstruction, substructure, superstructure, finishing works.**

Primavera Introduction

The Oracle's Primavera P6 software is a project management tool which has been employed in small scale and large scale projects as well across every industry. The P6 software has wide applications in monitoring IT process, define and control risk in aerospace engineering, determine the rate of execution and completion of telecom projects, and a wide advantage to enable stronger control in manufacturing processes.

Primavera P3 was first launched in 1983 with DOS oriented program by PRIMAVERA systems, then it becomes Windows operated in 1984. In 2008 it is acquired by Oracle Corporation with the upgraded version as Primavera P6. In the year 2006, the Primavera P6 upgraded its version as P6 8.3. Now its latest version available in project management market is Primavera P6 18.4.

Primavera is a time redeemable tool with proper resource optimization so as to provide improvement in construction management, whenever we encounter difficulties.

II. LITERATURE SURVEY

John B. Dalton - emphasized that the design process itself is the key ingredient to built-in- quality. The purpose of Quality Assurance in the design process is to ensure that there are effective and documented procedures to control the quality of management at these critical points and that these procedures are infact carried out without any shortcuts being taken.

Gould & Joyce in 2009 said that the beginning of a project, when the amount of money spent in the project is at its low point, the possibilities of influencing the design and the direction of the project is at its highest. This is illustrated in Figure 1, which also shows that the ability to influence the project decreases with time while the amount of money spent increases. Once the project has initiated the construction phase, changes made can become very costly both in time and in actual money spent.

Kang Sik Wei in 2010 tried to figure out the reasons, impact and methods of minimizing delays in construction projects with the help of a Interactive Data Collection constituting 52 different aspects responsible for the construction delays that lead to 6 impact of delays. He finally sought possible solutions for the same from a list of 15 different actions/methods.

The top ten most important aspects that contributed to the reasons of delays include: late in revising and approving design documents, delays in sub-contractors work, poor communication and coordination, change orders by client during construction, inadequate contractor's work, delay in approving major changes in the scope of work, shortage of labors, ineffective planning and scheduling of project, conflicts in subcontractors schedule in execution of project, and mistakes and discrepancies in design documents.

He identified time overrun and cost overrun as the most common effect of delays, among others which were dispute, total abandonment, arbitration and litigation. He finally suggested the most effective methods of minimizing delays. They were: site management and supervision; effective strategic planning; clear information and communication channels; collaborative working in construction; proper project planning and scheduling; frequent coordination between the parties involved; finish and proper design at the right time; use appropriate construction methods; accurate initial cost estimates; proper material procurement; and proper emphasis on past experience.

III. METHODOLOGY

General

In the methodology, first of all to identify what the project is all about and what is the scope of the work. So basically in this study the planning and scheduling of the highway project is done with the help of given data and duration. The data I got from the site consists of the drawings of the plans and elevations and sections of the structures found on the alignment. The information consists of the reasons of the delays or the problems raised during the work execution. The information also consists of the allocation of the manpower i.e. the resource allocation. The data consists of the quantity of work for the particular activity along with the time it will take for completion. The completion time of the particular activity is carried out in two ways- the first one is according to the site work progress i.e. the actual time of completion and the other is the standard duration which is known from the experienced engineer that how much time should the particular activity takes.

Project Case Study

Following are some basic details of the project to get an idea about the project-

Name of work	highway project
Name of Agency	NHAI
LAND	30 KM.
Amount of Project	600 Crore
Date of start	20-10-2019
Structure	
Project Awarded to	BRISK construction



Picture of a under construction MNB on the alignment

Primavera Scheduling

The Primavera scheduling using the project data is explained step by step:-

Step 1 Create a Enterprise project-For creating enterprise project structure, firstly I have create a company profile in enterprise project structure under which the whole project executes, further I will assign job profiles to the designation using organization breakdown tool.

Step 2 Assign roles and responsibilities-In this step, the responsibilities being assigned to the deserving EPS company profiles. The proper roles assignment is necessary to execute the project as per the schedule.

Step 3 Create a project-In this step, the project is started under the company profile. For starting the project, the project ID and project name is provided along with the starting time of the project.

Step 4 Create company calendar-The company calendar is created as per the working hours and shifts to be assigned in this project. Each company has its own time schedule and shifts as per work duration.

Step 5 Generate the work breakdown structure-The process of breaking the project into easily identifiable major systems, their sub-systems and discrete activities is called the work breakdown structure. So this project is divided into four major parts i.e. Preconstruction – Substructure – Superstructure – Finishing works.

Step 6 Create a baseline-The baseline is created with respect to the start date and finish date of the project and it can be viewed in the Gantt chart. The baseline is created to control the project according to the schedule which enables to know the deviation of the project from the original schedule during execution.

Step 7 Generate the resources to be used-In this step, the resources are generated which are used in the project works. The resources consist of the skilled and unskilled labour, technical and supporting staff, materials, machinery or equipment's and money.

Step 8 Assign manpower to each activity-Resource allocation simply means deciding what resources each activity of the project requires. For computing labour or resource requirement of each activity I have prepared an excel sheet in which the quantity of the labour resources calculated from the labour constants provided in IS : 7272 code part-1.

Step 9 Prepare a schedule with data as per actual site work progress-In this step, firstly assign the activities to WBS in order to define the working to be done in each breakdown structure. Gantt chart is prepared with the proper link in a continuous manner to show the predecessor and successor of each activity assigned. This schedule is prepared with actual data of site work progress while considering the causes of delays.

Step 10 Prepare the schedule with the standard data-In this step the schedule is prepared by putting the standard data from the standard books, IS standards and from the knowledge of experienced engineers. The schedule is prepared after resolving the causes of delays considered and providing the appropriate lagging in number of days to the particular activity.

Step 11 Tracking of the project-The tracking regulates with respect to the baseline created and mention when the project deviates from the schedule. Tracking helps in the resource leveling as it shows the over allocation of resources if occurs in any activity.

IV. RESULTS DISCUSSION

So the results are the outcome of my deskwork analysis, in which I have divided the whole data of the structure into floor wise and split it in the manner of particular activity with its quantity and its original time to complete.

Analysis of Individual activity with Lagging

The table below consists of the activity name, their quantity, unit of measuring quantity, actual duration of particular activity, and the lagging provided. The lagging is provided as how many days before the successor activity can be started with respect to its predecessor activity. Likewise the table below, the details of the whole project has been enlisted in the thesis.

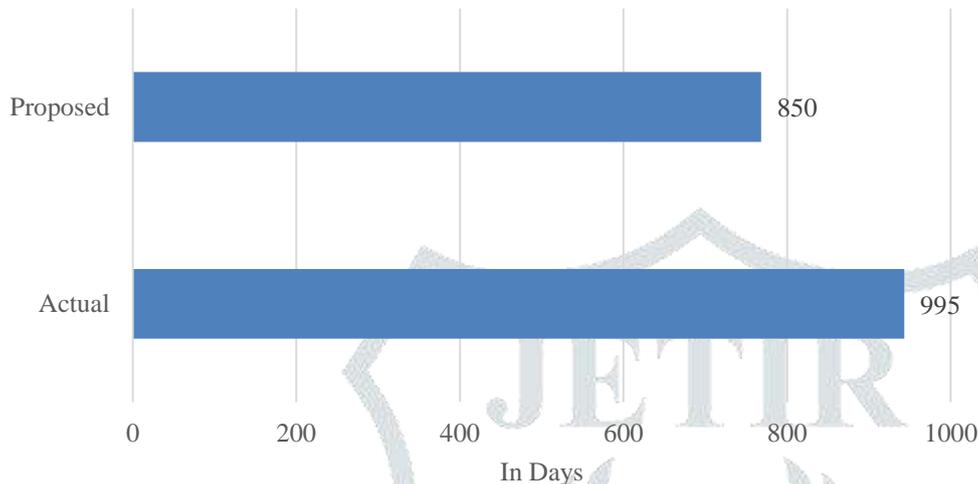
Scheduling of the project				
Activities	Quantity	Unit	Proposed Days	Lag
FOOTING				
P.C.C.	690	cum.	40	-20
reinforcement	285500	kg	60	-20
shuttering	2605	sqm	20	-15
concreting	1036	cum.	60	-8
de-shuttering	2605	sqm	10	-5

Duration for Project Completion

From the comparison in between the actual site work data scheduling and the Primavera scheduling with standard data, the following bar chart is plotted. Out of the two, the actual duration is the result of the original site work schedule whereas the proposed duration is the outcome of the standard data while considering lagging.

Project Duration in Days	
Actual	Proposed
995	850

Project Duration



Resource allocation as per IS. 7272 part-1

Formula for the computation of resources in each activity-

$$\text{No. of resources} = (\text{Quantity} \times \text{Resource Constant}) / \text{No. of days assigned}$$

This equation is utilized as per IS:7272 central region to assign resource as per durations. The resources once calculated for the whole project then plotted in the MS excel sheet in which each activity is analyzed for resources as per durations allotted. Likewise the table below, the resources for the whole project has been enlisted in the thesis.

S.No.	ACTIVITY	PROPOSED LABOUR REQUIRED FOR UPCOMING BLOCKS PER DAY					
		MASON	MAZDOOR	MATEVIBRATOR	BAR BINDER	CARPENTER	PAINTER
1	FOOTING						
a	P.C.C.	1.38	2.07	1.7	0	0	0
b	Reinforcement	0	47.6	0.0	47.6	0	0
c	Shuttering	0	26.1	0.0	0	32.6	0
d	Concreting	2.9	34.5	1.2	0	0.0	0
e	De-shuttering	0	13.0	0.0	0	15.6	0

V. CONCLUSION

In this study, an efficient new project management plan is brought with the help of Primavera P6 software by considering the drawbacks of present project management system. Project planned along with Resource allocation for delayed project is observed as a statement for removing flaws in the project. With the help of primavera tool this study is completed resulting in completion of project within time limit. So, the time duration of the project is reduced by about **four and half months**. And the time duration is directly proportional to the cost of the project, as the time duration reduces the cost of the project also decreases. After cost optimization of the labour resources for the reduced time, the overall cost of the project gets reduced to about 3-4%. Also, it can be concluded that:-

1. Individual activities linked to prepare a proper float for the project using lagging to promote speedy construction.
2. The Original scheduling duration with estimated data of the Project - 995 days.
3. Primavera scheduling duration with standard data of the Project - 850 days
4. The resource allocation is done on IS-7272 which gives optimum output of labour at construction site. This consideration of optimum output will also help in more cost reduction in each activity making positive effect on economy.
5. With the decreasing project duration, by the cost optimization the reduction in the cost of extra expenses and salary of reduced months comes around **3-4% i.e. about 75 lac-1 cr.** of the total project cost.
6. Total number of labour resources required for particular activity is plotted in M. S. Excel sheet attached.

