SCHEDULE AND RESOURCES OPTIMIZATION USING PRIMAVERA IN METRO RAIL PROJECT

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Abstract— Proper Planning and scheduling is very important in Metro Rail construction projects for reducing and controlling delays of the project. Substantial amount of time, money, resources are wasted each year in a construction industry due to improper planning and scheduling. With globalization the construction project have become vast and complex. Planning of such requires huge amount of paper work, which can be reduced with the help of project planning software. Providing good planning, sufficient of flow of resources to a project can be automatically achieved desired result. This paper deals with some high potential parameters in Primavera software which significantly affect the project result.

Keywords— Planning, Scheduling, Resources, Primavera.

I. INTRODUCTION

Now a days Metro Rail plays virtual role in India. Because of growing traffic congestion, unprecedented growth of personal vehicles, to avoid congestion at peak hours, time saving of transporting passengers and fuel consumption. Construction industry is an integral component of a nation’s infrastructure and industrial growth. This industry is the second largest industry in India still its growth has been differential across the nation. There is a vast difference of development in the rural and urban areas. Here arises the need for effective project management. Many problems and issues are being faced by the construction industry, major of them are cost overruns and time overruns due to inadequate project formulation, poor planning for implementation and improper management during execution. Many analysts state that average cost of project goes up by 30% as of the budgeted cost due to improper planning and scheduling. Observations show that proper skillful management is essential for a project to complete within time, estimated budget and with allocated resources. Providing good planning, proper organization, sufficient flow of resources to project can automatically achieve the desired result. Primavera Project Planner is specialized in managing all types of projects, small, medium and large; throughout the world it has sufficient functions to help the user plan for the time, resources and cost and then later monitor them. It is used handle very large and complex projects, especially in the engineering and construction business.

CASE STUDY: KOCHI METRO RAIL STATION WORK PROJECT

Kochi metro rail project is the one of the lading project undertaken by Delhi Metro. It involves construction of station work at various locations across Cochin. Considered one station work for case study.

Main steps involves in station construction project are

1. Road winding, barricading and temp street lighting
2. Piling
3. Pile caps
4. Construction of main column (stage1)
5. Longitudinal and precast beam
6. Construction of main column (stage2)
7. Construction of Transvers Beam
8. RCC work for Track Slab
9. Construction of Outer Column up to Platform Beam
10. Erection of Roof
11. Finishing.

II. METHODOLOGY

Well-known methods of project planning
Gantt chart: - The technique was developed by Henry Gantt and Fredric Tailor and can be identified as the scientific method of project planning. The method uses horizontal rods representing time length of a task accomplishment for planning and tasks' names are written vertically in separate columns. Every rod is place in front of every task and the chart shows the starting date, accomplishment time length and finishing date of tasks (Berch & Grad nitzki,1992).

Advantage of Gantt Chart:- Gantt charts have gained wide acceptance and popularity mainly because of their simplicity of and ease of preparation and understanding. No —theoryl or complicated calculations are involved. Anyone can understand them. Gantt charts particularly appeal to persons who do not have a technical background. For example, some clients and upper-level managers may better understand the plan for carrying out a construction project by looking at a bar chart than by looking at a schematic of logic network. The advent of the critical path method (CPM) and the evolution of powerful computers, Gantt chart did not perish or lose importance. Instead, they evolved to a different supporting role that made them more valuable and
One of the major network scheduling methods which have been used in the construction industry is CPM (critical path method). This method involves the use of a geometric representation of flow chart which depicts the precedence between activities. The critical path method (CPM) is a duration-driven technique in which the basic inputs are project activities, their durations, and dependence relationships. Activity durations are functions of the resources required (rather than available) to complete each activity. The CPM formulation assumes that resources are not restricted in any sense. The use of network techniques and CPM by construction companies has reached a steady level after the enthusiastic boom of the early 1960's. Computer programmers eliminate the need to prepare a network, but the network notation provides an easily understood output format for management personnel. (Lutz and Hijazi, 1993)

Advantages of Network Scheduling Method:-When comparing bar charts with networks, three advantages over bar charts (Mubarak, 2003):

- Network show logic, the relationships among the activities. Bar charts do not
- Networks can better represent large and complicated projects.
- Networks can estimate, or predict, the completion date of the project, or other dates, on the basis of mathematical calculations of the CPM

Limitation of Network Scheduling Method:- Comparing to bar charts, network scheduling is not time scaled. It requires practitioners to be trained to understand the CPM. From the authors' experiences the presentation of CPM is not as acceptable for field people as bar chart. And resource information cannot be loaded in CPM. Some scheduling software vendors tried to take the advantage of time-scaled feature of bar chart and impose it on network which some persons called time-scaled logic diagrams. On the other hand, there is evidence that contractors do not use networks in highly repetitive jobs because of their belief that high repetition would reduce the chances of successful scheduling and control by networks (Arditi and Albulak, 1986).

For example, network method presents complications in projects of repetitive nature such as high rise building construction. CPM-based techniques have been criticized widely in the literature for their inability to model repetitive projects (Russell and Wong, 1993). The first problem is the sheer size of the network. In a repetitive project of n units, the network prepared for one unit has to be repeated n times and linked to the others; this results in a huge network that is difficult to manage.

This may cause difficulties in communication among the members of the construction management team. The second problem is that the CPM algorithm is designed primarily for optimizing project duration rather than dealing adequately with the special resource constraints of repetitive projects. The CPM algorithm has no capability that would ensure a smooth procession of crews from unit to unit with no conflict and no idle time for workers and equipment. This leads to hiring and procurement problems in the flow of labor and material during construction (Arditi, Sikangwan, and Tokdemir, 2002). A new format was developed for work of a repetitive nature, such as work on floors in a high-rise project, or work on sections in underground pipe line or utility line project. In the pipe line or utility line instance, the use of basic CPM was laborious; the input for work on a typical section was duplicative and tedious. Further, once the schedule had reached the typical section, it was possible to predict a result through basic arithmetic without the use of a computer. This suggested that there were ways of graphing the result other than network presentation; this realization resulted in the development of some methods for use in linear and repetitive projects. Line of balance (LOB) method is one of them using a unit network to

Scheduling:- In a project management, a schedule is a listing of project milestones, activities and deliverables, usually with intended start and finish dates. A schedule is commonly used in the project planning and project portfolio management parts of project management. Elements of schedule closely relate to work breakdown structure (WBS), activities, calendar, duration.

Resources:- Required resources are those equipment's and devices needed for accomplishing a certain task. No task or activity is performed without human resources, machinery, equipment’s, materials and using various resources. Tasks required resources of a project are classified into three groups. One of the classifications is presented by Slovinksi by which resources are divided into these classes: renewable resources, non-renewable resources and resources with dual constraints. Beside, quasi renewable resources were also suggested. Implementation of every task requires allocation of needed resources. If available resources are in levels that cause no delay in implementation of those tasks which are to be accomplished in a simultaneous manner using uncommon resources, then no alteration occurs in project timing. But the situation is not usually like this. Hence, the way and time of resource allocation becomes important.

Steps involves in Scheduling and Resources allocation to the station work.
1) Creating an ideal schedule
To create an ideal schedule for any project, first step is to collect data available for the project. Subsequently the following steps can be followed in Primavera.
2) Enterprise Project Structure (EPS)
Create the structure of a company with its branches which is executing the project. This is known as Enterprise Project Structure.

3) Organizational breakdown structure (OBS)
After the EPS, OBS is created which is hierarchy that reflects the persons responsible for the project in the enterprise.

4) Calendar
The work is carried out in 6 days per week. So the standard 6 day workweek calendar is made with necessary holidays in it. A break of one hour is given in the afternoon.

5) Create a new project
A project is a set of activates and associated information that constitutes a plan for creating a product or service. The project is created under the respective division in the EPS and assigned in the person charged form OBS to it. The project can be given planned start and must finish dates. The project is assigned a calendar which can be global, resource or project calendar.

6) Work breakdown structure (WBS)
WBS is a hierarchy of work that must be accomplished to complete the project. Each project has its own hierarchy with top level WBS element begin equal to that EPS nodes or project. Each WBS element may contain more detailed WBS levels, activities, or both.

7) Define activities
Activities are the fundamental work elements of a project and form and from the lowest level of a WBS and, are the smallest subdivision of a project. An activity has the following characteristics like Activity ID, name, start and finish dates, activity calendar, activity type, activity codes, constrains, expense, successor and predecessor relationships, resources, roles etc.

8) Relationship between activities
To form a network the activities should be connected to each other, which is done by assigning preceding and succeeding activities with significant relation to the activities.
- Finish to start (FS) relationship.
- Finish to finish (FF) relationship.
- Start to start (SS) relationship.
- Start to finish (SF) relationship.

9) Determining activity duration
When planning the work, the duration is entered in the original duration field. The actual duration can only be entered for the activities, which are completed.

10) Activity dates.
The following are the types of activity dates available in the primavera; actual start, actual finish, planned start, planned finish.

11) Activity cost.
The activity cost is the sum of all the cost incurred to complete the activity.

12) Creating baselines
A simple baseline plan is a complete copy of the original schedule which provides a target against which a project’s performance is tracked.

13) Updating schedule
- If the project is progressing exactly as planned, then only needed to estimate progress.
- If the project is not progressing as planned many activities are starting out-of-sequence, actual resource use is exceeding planned use, and then update should be done for activities and resources individually.
- Most projects contain some activities that progress as planned and some which do not. In this case, the best method is to combine the two updating methods.

14) Tracking
Taking window is used for monitoring a project’s progress using different types of layouts such as labour costs, project cost, resource forecasting, resource allocation unit wise and cost wise.

15) Earned value
Earned value is a technique for measuring project performance according to both project cost and schedule. The technique compares the budgeted cost of the work to the actual cost.

16) Claim digger
The claim digger is a schedule analysis tool that enables a company to generate a report that compares selected data fields in a revised project and a corresponding baseline.

17) Project thresholds
Project thresholds consist of parameters assigned to WBS elements; they are used to monitor projects and generate issues.

18) Project issues
Project issues are the problems within a schedule that must be addressed before the project can be completed. They can either be created by thresholds or manually.

**Preliminary steps to be done in updating**
Choose project. Maintain baseline. Then add and save a copy of current project as a new baseline B1. Then choose project baseline as B1 and assign primary baseline as B1. Daily updates to be made:

a) Start date and end date
Choose the activity to be updated. Then in the activity details window, select status tab. Then tick mark started if the activity has been started and select the date. Tick mark finished if the activity has been finished and select the finish date.

b) Resource
In activity details window, select resource tab. Then select the resources which are to be added to the particular activity.

c) Code
In activity details window, select code tab. Then
select the activity code for each resource.

d) Notebook
In activity details window, select notebook tab. Select the topic which we want to note and write the details in notebook topic.

e) Steps
In activity details window, select steps tab. Then if the activity has any steps update the activity in percentage complete and put a tick mark if the activity has been completed.

f) Feedback
In activity details window, select feedback tab. Then the details for the resources have to be mentioned in feedback.

g) Work products and documents (WPs & Docs)
In activity details window, select the WPs & Docs tab. Then the drawings, documents, specifications have to be uploaded here.

Resource assignment and usage
The resource assignment window shows all the resource assignments, grouped by resource for the project. An approximate rate analysis was done to arrive at rates of individual resource groups, considering the various component resources. Most of the resources are taken as material. Machines are taken as non–labor and human involvement is listed as labor. The resource usage profile obtained using Primavera P6 shows that there has been a slight variation in the quantity of each resource used during the project life cycle.

CONCLUSION
The main objective of this study was to understand the role of scheduling and proper usage resources to timely completion of a construction project. This objective was achieved through methodologies involved in scheduling and resources allocation. The case study proved to be a guideline in understanding the progress of metro rail station construction work and also to identify the specific problems arising during the process. Results of this study show the drawbacks of the present project management system in station work project and the importance efficient planning, as well as the need and effectiveness of a project management software like Primavera P6 in a construction project.

The following reasons were observed during this thesis work, which can be held responsible for delays:

- Lack of knowledge about advanced tracking methods and software’s.
- Insufficiently skilled staff.
- Lack of proper fund flow throughout the project progress
- A major portion of labor force was from West Bengal and Orissa. Regional festivals in these areas cause sudden delays in work progress.
- Even though delay due to monsoon rain was already accounted in the baseline schedule, unexpected extension of monsoon caused further delay in project progress.
- Sand unavailability due to legal restrictions.
- Late delivery of resources.

REFERENCES


