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Resources, Cost Planning and Time Delay in Assembly Buildings

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Abstract – *Construction industry is ever upfront for the development and advancement. Therefore there is a requirement of a certain techniques such as software applications for the total management of projects. Planning is a general term in construction management which refers to attain the expected goals and destinations. It involves the breakdown of whole project work into small tasks. Scheduling refers to slotting out the time duration with respect to resources by analysis along with estimations. Delays are a major concern in such projects even after a perfect planning. It is loss of time and money. This study also identify the factors of delays and a model for future construction.*

Key Words: **planning, scheduling, primavera, factors of delay, SPSS software.**

1. INTRODUCTION

Project is an endeavor to achieve a desired goal. The achievement of this goal requires careful planning and management. Project is an activity that is limited by time and resources such as cost, materials, equipment and people, so it requires good project management. Planning and scheduling is very important in construction projects because of the increasing complexities in this domain. The benefits of effective planning, scheduling and control of construction projects are reduced construction time, reduced cost overruns. Planning is the process of identifying all the activities necessary to successfully complete the project. Scheduling is the process of determining the sequential order of the planned activities, assigning realistic durations to each activity and determining the start and finish dates of each activity. Major constructions projects are so complex in the nature there are various things involved in the project to be managed in order to complete the project successfully. Project management software which helps to give a structured approach. This study involves planning, monitoring, controlling, scheduling and estimating the project of assembly building using Primavera P6.

Construction technology has a great potential to improve productivity and decrease project duration. Delay happens in many construction projects. It is beneficial for the construction parties to recognize the project current situation and identify the delay causes at its early stages. This will help them a lot to take the necessary precautions in order to minimize the effect of those causes when they occur. The SPSS part involves preparation of a regression model by evaluating the factors of delay in view of various assembly buildings.

1.1 Objective

The overall objective is to plan, schedule and estimate and to evaluate the factors affecting performance of construction projects. To understand the planning and schedule the list of the planned activities using computer applications. The construction sequence for the building construction can be found out. Calculating the practical durations required to carry out the activities. Developing scheduling and estimations using primavera project planner's software. The effect of delay in construction can be evaluated. Analyze most affecting factor of delay in construction and preparing regression model to predict the delay in new projects.

1.2 Scope

Estimation of quantities of material, manpower and machinery according to the given plan and for further ease in scheduling the project. Through primavera, resource allocation and resource leveling can be applied for calculating the total budget of the project. The primary goal of this thesis is not to list out the factors that cause delay in construction but to find out the critical factors by ranking that can significantly influence delay and to prepare regression model.

2. METHODOLOGY

Collection of data is a detailed analysis of the materials, man power, machinery, other resources used and the sequence of activities executed from the beginning of the construction to its completion. Collection of raw data from visiting various sites. Studied the data. On the basis of it, prepared the plan and scheduled by using project management software Primavera and understood the ease, sufficiency & flexibility that the project management software offers us. The study also include to identify, evaluate by ranking, factors that influence the duration of a construction. A questionnaire was developed in order to evaluate the frequency of occurrence and

importance of the identified causes. A preliminary survey was conducted in order to know the factors affecting the delays in projects.

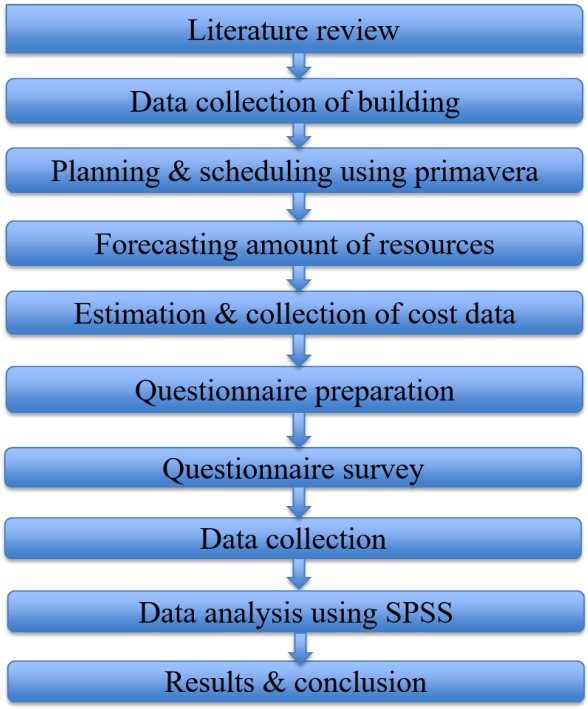

Fig-1: Research methodology

2.1 Primavera

The Primavera is an enterprise project portfolio management software. It includes project management, scheduling, risk analysis, resources management, collaboration and control capabilities and integrates. It also monitor, track and schedule the progress of the project. It is the most common critical path based planning software used in planning and executing large engineering projects. Primavera also supports estimating in making the project fit the budget.

2.2 Project management

Planning a project the first step in project management is to define the project. To ensure that the project goals are met within the stipulated time and cost, effective project planning is needed. Planning ensures that the project manager gets the opportunity to analyze the work required and determine the appropriate strategies based on resource availability, construction methodology, constructability, cost and time. The result of this analysis is documented in a plan. Before implementing primavera to schedule projects, should understand the processes involved in project management. More than likely would take the time to plan and estimate. It is the process of achieving set goals within the constraints of time, budget and staffing restrictions. It allows to get the most out of available resources like people, material, money, equipment.

2.3 Work breakdown structure

The work breakdown structure (WBS) is a hierarchical system that represents the construction project in increasing levels of detail to define, organize and display the project work in measurable and manageable components. One of the first steps in planning a project is to break down the project into its major deliverables. After created the WBS, then can create the activities required to achieve those deliverables.

2.4 Project calendar

Before assign activities firstly have to create a calendar for the project. Can create and assign calendars to each resource and each activity. These calendars define the number of available work hours in each calendar day. It can also specify national holidays, organization's holidays, project-specific work/ non work days, and resource vacation days. The module uses calendar assignments for scheduling and tracking activities, and leveling resources.

2.5 Activities and resources

An activity is an element of every project and its schedule, the number of such activities together forms a complete project. Every particular activity has its specific descriptions about activity duration, start date and finish date. Basically there are four types of relationships to tie the activities. They are finish to start, start to start, finish to finish and start to finish.

The Critical Path Method (CPM) is one of several related techniques for doing project planning. If some of the activities require other activities to finish before they can start, then the project becomes a complex web of activities. CPM can help to figure out: how long the complex project will take to complete and which activities are critical, The essential technique for using CPM is to construct a model of the project that includes a list of all activities required to complete the project, the time that each activity will take to complete and the dependencies between the activities.

Resources are the personnel and equipment that perform the work across all projects. It can set up a resource hierarchy that reflects the organization's resource structure and supports the assignment of resources to activities. We can allot the resources to activities by creating resources which will be require for our project. Then assign the proper resource type i.e. labor, non-labor and materials and also assign default

resource calendar and default units/time and price/unit. Finally start assigning the resources to the activities.

2.6 Scheduling

Scheduling is the process of determining the sequential order of the planned activities, assigning realistic durations to each activity and determining the start and finish dates of each activity. The scheduling model should be general and flexible in order to capture the actual operation conditions on site. It is all finalysed with the management software primavera.

2.7 Cost estimation

Time and cost estimates are the building blocks of project planning and management. Estimates are used to ascertain project feasibility and to develop and maintain detailed schedules and plans. In current industry practice, time and cost estimates are determined. As we all know that if a project is delayed the cost of the project would increase. So time and cost has a strong and a very important relationship with each other. Cost estimating is one of the most important steps in project management. A cost estimate establishes the base line of the project cost at different stages of development of the project and can be done with primavera.

2.8 Questionnaire design

Questionnaire preparation was based on relative important index & spearman rank correlation coefficient in the importance index. Delay causes and effects were identified from extensive literature review of several previous studies related to building projects. Data were gathered through a questionnaire which consists of a list of the causes of delay in construction projects. These causes are classified into six groups according to the sources of delay: Causes related to contractor, owner, consultant, services and utilities, Government regulations, and external environment. Each group subdivided into several factors.

For each cause there are two main questions, one for determining the frequency of occurrence and the other one for measuring the degree of severity. Both the frequency and severity are based on a five point scale.

The Likert Scale is an ordered, one- dimensional scale from which respondents choose one option that best aligns with their view. In scoring, numbers are usually assigned to each option (such as 1 to 5). A benefit is that questions used are usually easy to understand and so lead to consistent answers.

Table-1: Likert scale

1 No effect at all	2 Fairly important	3 Important	4 Very important	5 Critically Important

2.9 Data collection

The questionnaire was distributed by hand and sent by e-mail to 15 members. Data collection is the most critical part of the study since the accuracy of the data will determine the success or failure of the research. Data obtained through these questionnaires will be analyzed accordingly using appropriate analysis techniques. Responses from questionnaires will then be compiled and analyzed. Data collected from different questions will be gathered to answer different objectives.

The causes were examined and the ranking of their attributes was done using the Relative Importance Index. The relative importance index is

$$Rii = \frac{\sum W}{A \times N}$$

Where,
Rii = Relative Important Index
W = Weighting given to each factor by the respondents (ranging from 1 to 5)
A = Highest weight (here 5)
N = Total number of respondents

2.10 Data analysis with SPSS

The data collected from survey was subjected to the descriptive Statistical analysis to rank the problems and regression was used in order to prepare model that predict the delay for a new project. The analysis is done by using SPSS software. The Statistical Package for the Social Sciences (SPSS) is a package of programs for manipulating, analyzing, and presenting data; the package is widely used in the social and behavioral sciences.

3. RESULTS

The Report Wizard in Primavera P6 allows for the inclusion of detailed information about the schedule. Its shows some of the reports generated in the project including the start and finish dates of the activities. The generated logic report of the project is shown in Table 2.

Gantt chart is a type of bar chart that illustrates a project schedule. It is used for planning projects of all sizes and they

Table-2: Activity report

Activity ID	Activity Name	Original Duration	Planned Start	Planned Finish	Budgeted Labor Cost	Budgeted Material Cost	Budgeted Non labor	Budgeted Total Cost
A1000	Start of project	0	22-Feb-20		0	0	0	0
A1010	site clearance	2	22-Feb-20	24-Feb-20	0	0	18,618.18	18,618.18
A1020	earth work excavation in soft soil	3	25-Feb-20	27-Feb-20	5,550.00	0	19,200.00	24,750.00
A1030	RRM for foundation	10	28-Feb-20	10-Mar-20	19,642.74	87,000.00	10,500.00	1,17,142.74
A1040	laterite masonry	18	11-Mar-20	31-Mar-20	39,675.00	1,78,800.00	4,500.00	2,22,975.00
A1050	hollow brick masonry	40	01-Apr-20	20-May-20	1,03,500.00	4,63,700.00	60,000.00	6,27,200.00
A1060	rcc	15	21-May-20	06-Jun-20	54,750.00	2,02,500.00	22,500.00	2,79,750.00
A1070	plastering	35	08-Jun-20	17-Jul-20	1,62,750.00	3,20,000.00	52,500.00	5,35,250.00
A1080	flooring	7	18-Jul-20	25-Jul-20	17,337.50	85,720.00	0	1,03,057.50
A1090	fixing openings	1	18-Jul-20	18-Jul-20	1,375.00	18,000.00	0	19,375.00
A1100	fixing main door	1	18-Jul-20	18-Jul-20	1,750.00	26,000.00	0	27,750.00
A1110	fixing D	1	20-Jul-20	20-Jul-20	2,325.00	23,200.00	0	25,525.00
A1120	fixing D1	1	20-Jul-20	20-Jul-20	1,900.00	39,000.00	0	40,900.00
A1130	fixing D2	1	20-Jul-20	20-Jul-20	1,225.00	7,000.00	0	8,225.00
A1140	W3. 8000	2	21-Jul-20	22-Jul-20	2,850.00	1,08,500.00	0	1,11,350.00
A1150	W3. 5000	1	21-Jul-20	21-Jul-20	1,750.00	9,000.00	0	10,750.00
A1160	V	1	22-Jul-20	22-Jul-20	2,850.00	9,000.00	0	11,850.00
A1170	plumbing work	5	23-Jul-20	28-Jul-20	1,86,000.00	1,00,000.00	0	2,86,000.00
A1180	electrical work	5	23-Jul-20	28-Jul-20	1,44,000.00	2,55,000.00	0	3,99,000.00
A1190	painting	10	29-Jul-20	08-Aug-20	2,36,000.00	60,000.00	0	2,96,000.00
A1200	ACP work	4	10-Aug-20	13-Aug-20	72,000.00	1,92,000.00	0	2,64,000.00
A1210	truss work	26	18-Jul-20	18-Aug-20	7,60,000.00	1,382,500.00	0	2,142,500.00
A1220	interior	10	10-Aug-20	21-Aug-20	2,40,000.00	4,08,000.00	0	6,48,000.00
A1230	finish	0		21-Aug-20	0	0	0	0
Total		**152**	**22-Feb-20**	**21-Aug-20**	**2,057,230.24**	**3,974,920.00**	**187,818.18**	**6,219,968.00**

Table-3: Delay occurred in different projects

GROUP OF CAUSES	SI No.	IDENTIFIED FACTORS THAT CAUSE DELAY IN CONSTRUCTION	DELAY (Days)					
			Prjt1	Prjt2	Prjt3	Prjt4	Prjt5	Prjt6
I. Causes related to contractor	1	Shortage of manpower	17	8	6	3	16	2
	2	Shortage of materials	7	5	9	14	5	5
	3	Poor site management and supervision by contractor	6	3	4	3	3	7
	4	Poor communication between contractor and other project parties	3	4	5	2	2	3
	5	Ineffective construction method implemented by contractor	11	3	14	13	6	13
	Total		**40**	**19**	**38**	**31**	**32**	**29**
II. Causes related to owner	1	Delay in decision making by the owner	12	3	10	20	7	12
	2	Budget availability for the project	10	7	19	15	19	5
	3	Delay in progress payments by the owner	8	5	12	3	9	7
	4	Interference by the owner during construction operation	3	8	3	10	4	3
	5	Change of project scope	1	0	2	2	1	2
	Total		**32**	**21**	**44**	**47**	**38**	**26**
III. Causes related to consultant	1	Insufficient experience by consultant	6	4	8	15	4	9
	2	Delay in performing testing and inspection by consultant	13	3	11	5	2	5
	3	Discrepancies between specifications and drawings prepared by consultant	6	2	6	3	1	2
	4	Missing dimensions in the drawings	7	5	2	4	2	6
	5	Lack of competent person to monitor the progress at site	5	6	1	2	0	2
	Total		**35**	**17**	**27**	**28**	**9**	**23**
IV. Causes related to services and utilities	1	Unclear or undefined positions of services networks in drawings	0	2	1	0	0	2
	2	Long response from utilities agencies	10	9	24	7	32	9
	3	Diversion of obstructing services	8	5	16	16	5	6
	Total		**16**	**15**	**38**	**20**	**35**	**16**
V. Causes related to Government regulations	1	Tendering system requirement of selecting the lowest bidder	7	2	9	11	2	7
	2	Weather restriction on time of work	17	6	25	14	6	4
	Total		**23**	**8**	**33**	**23**	**7**	**9**
VI. Causes related to external environment	1	Hot weather effect on construction activities	18	6	14	22	9	8
	2	Traffic diversion	15	9	12	12	5	5
	3	Effect of social and cultural conditions of inhabitants	5	2	10	8	0	2
	4	Accidents at construction site	7	4	7	5	2	9
	5	Political situation and security	8	3	11	2	0	3
	Total		**50**	**24**	**54**	**48**	**15**	**26**
Total Delay			**196**	**104**	**234**	**197**	**136**	**129**
Actual Duration			**2yr**	**1yr**	**2yr**	**2yr**	**1.5yr**	**1yr**

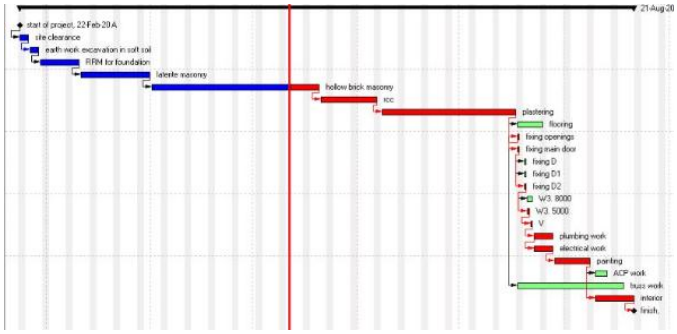

Figure-2: Gantt chart

All the questionnaire survey was done. Forty five problems related to the construction contractor, owner, consultant, services and utilities, Government regulations, and external environment are analysed. Critical factors are identified for each category by the process of ranking. Finding the Rii value of each cause, ranking done from highest to the least of each group of cause. High value of Rii value marked as 1 and as such. One's ranking is done, the regression model is prepared to predict the delay in duration of new construction project using regression coefficient by SPSS software. The coefficient of regression model is shown in Table 3. Thus the models thus created for each group of cause are shown below.

y1=2.8x11+2.5x12+.99x13+1.9x14+2.5x15-148
y2=0.74x21+0.51x22+.08x23+.25x24+0.16x25+43.28
y3=4.8x31+2.5x32+2.1x33+0.77x34+3.9x35-206.6
y4=1.5x41+0.14x43+68.04
y5=0.324x52+71.6
y6=1.8x61+2.1x62+2.2x63+1.8x64+1.6x65-93.6

4. CONCLUSIONS

Primavera serves as an effective tool for generating Gantt chart for the schedule of a construction. With the help of primavera a scheduler can effectively link all the activities involved in the construction of the project. It determine the total duration required for the construction of the different phases involved. It monitor and visualize project performances. Primavera allows project to carefully monitor resource availability and adjust such resources to meet project demands.

The objective was to identify the factors that cause delay in duration of construction projects. It quantify relative importance of the factors and the most and least important problems were also achieved according to the rankings. The project also helps to prepare regression model to predict delay in duration of new construction projects. To avoid delay causes develop human resources through continuous training programs, manage financial resources and plan cash flow by utilizing progress payment and work as a team, where every member feels that the project is his own and communicate effectively.

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