

Assessment of Influencing Factors in Construction Project Scheduling

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Abstract

Construction industry is blended with uncertainty risk in many projects. The vital part of the project is to complete within the stimated times, cost with expected quality is the predominant goals of the project management. However in reality a number of attributes of various types and a variety of constraints involve from time to time which have to be managed successfully by overcoming various obstacles. Completion of the construction project involves several factors and attributes of various types contribute to their extent of impact on the project. These factors were identified by consultations with experts and practising engineers apart from reviewing literatures and carrying out a pilot study. Questionnaire was designed for the experiment and administered on selected construction professionals of varying capacities. The obtained responses were factored. Using the data, statistical model has been constructed. The model was analyzed using SPSS and the outcome such as frequency, mean variations and deviations and other statistical parameters were obtained. The variations mean and deviations were considered and represented in the bar chart and pie charts for the possible interpretation of the results quantitatively. It was evident from the results of analysis that the resource management and supportive management of the project play a key role in making the successful completion of the project. In next level factors such as the technical competence, financial management and management efficiency were found dominant as per the analysis. However the factors related to social and environmental and safety were given least importance by the respondents. This study is limited by the number of respondents, however the same has been carried out on a larger experiment with large number of respondents to get the outcome more accurate. The detailed analysis, interpretations and the summary of the findings were discussed and elaborated in this article.

Keywords: Construction Scheduling, Scheduling concepts, Critical Attributes

INTRODUCTION

Construction project planning and execution involves which is complexity of tasks unique and specific to the nature of the project. The function of planning and scheduling involves a lot of expertise and experience in making the successful execution of the project. However, the various types of attributes and factors related to the project, such as resources, construction, finances have to be carefully considered for

their likely impact on the completion, which are to be accounted in the making of the schedule.

In reality, though a number of assumptions were made during the planning and scheduling they were altered and modified during the execution times. These were to be accounted and the changes had to be managed appropriately with the least variations and their likely impact shall be minimized.

However, there was limited information of quantified knowledge available for the planner, making the task scheduling complex. Hence the assumptions made were to be accurate or else it were lead to erroneous and inappropriate schedule which makes the project unsuccessful. A large number of failed projects were of this category showing the lack of knowledge.

An insight into the execution of projects and scheduling their planning methods had revealed and that a large number of attributes and factors were contributing with their varying impacts for the successful completion. These were qualitative by nature often utilized by the planner for their scheduling.

An effort has been made to understand these factors by identifying their nature and trying to quantify their likely impact on the project by involving expert consultations and identifying the root cause.

REVIEW OF LITERATURE

Many researchers have done research on causes of delay and the identification of factors responsible for that delay in the construction projects. Such literature was collected from various sources such as construction management books, journals, articles, web sources etc. The relevant papers were studied in detail and reviewed to identify the reasons for rescheduling the projects. The following topic defines the various issues in scheduling the causes for rescheduling the factors that affect the planned duration and uses of its application in construction industry. Every individual paper has given information about the schedule overrun of the projects in construction industry.

Iyer and Jha (2006) stated that fifty five factors influenced the performance of the project. They were two success factors after carried out the two stages of questionnaire survey among the stakeholders. They made the conclusion for significant contribution for enhancing the current level of performance of the project or success factor was "commitment of the project participants" and "owner's of the project or success factor was "commitment of the project participants" the "owner's competences".

Sweis et.al (2008) revealed that reason for residential project delay in Jordan was “financial difficulties faced by contractor”. They suggested that the terminology of the drawing and open conversion system which helps to argue the suggested that the terminology of the drawing and open conversion system which helped to argue the major delays occurring in the project.

Baya and Song (2016) stated that managerial capability of project managers should be enhanced for the curtailing the delay in projects. 140 experts were asked to give their opinion about the delay in scheduling of the public construction projects in burkrinafaso. Finally they concluded that top five factors such as i) financial capability of contractor, ii) financial difficulties of owner, iii) delay payment, iv) equipment availability of the contractor and v) poor performance using quantitative statistical method in schedule delay. However, the financial capability of contractor found the sever impact in the project delay.

Hwang et al. (2015), studied the reason for delay in 98 green building project and 51 retrofitting project in Singapore. They found 22% of green building delayed and retrofitting had more than green building delay. They conclude that consultant cooperation issue impact the performance of the schedule in the both type of projects.

Bon Gang HWANG and Lay Peng LEONG (2013) identified the degree of project delay in 220 traditional and 96 green construction projects in Singapore. They established that 15.91% of the traditional projects was delayed while 32.92% of the green Construction projects was completed behind schedule. The top 5 factors causing delay in green projects were (1) Speed of decision making of the client; (2) speed of decision making involving all of the project teams; (3) Communication/coordination between key parties; (4) level of experience of consultants; and (5) difficulties in financing the project by contractors.

SCHEDULING CONCEPTS

In the practice of the construction industry planning and scheduling is a significant task to be performed by the experienced planners. However, the scheduling is generally carried out either based on time or cost and accordingly termed to be cost oriented schedule and time oriented schedule depending on the type of project. Most of the time, the resources and their availability play a vital role and thus cost oriented scheduling is most widely used and when circumstances warranted for the completion of the project within the time, then all activities are back worked to meet the completion time. Accordingly the resources are allocated, leveled and optimized for the best utilization of resources as well as project time duration.

However, in practice the scheduling is a complex task involving varying attributes and the assessment of their impact on the project. The general attributes that are having major impact on the project are grouped and given in Figure 1.

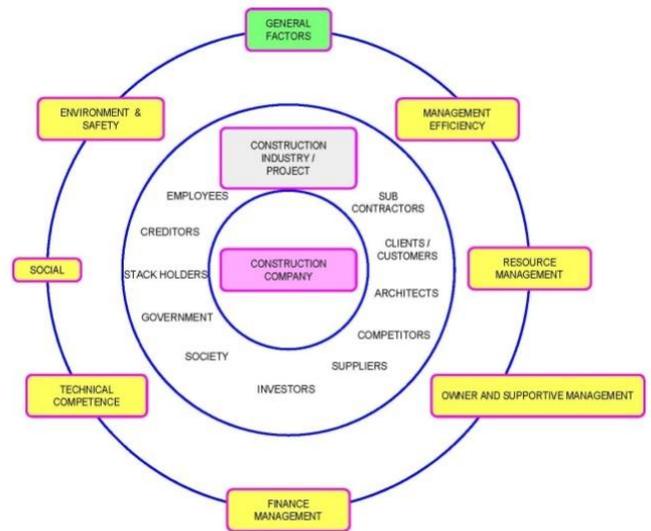


Figure 1. Typical Complexity Involved In a Construction Project.

General Factors affecting Construction Project

As the construction is involving many attributes which are grouped as in general viz social related factors, safety and environmental, technical competence, supportive management, management efficiency, financial management and resource management are shown in the figure 2.

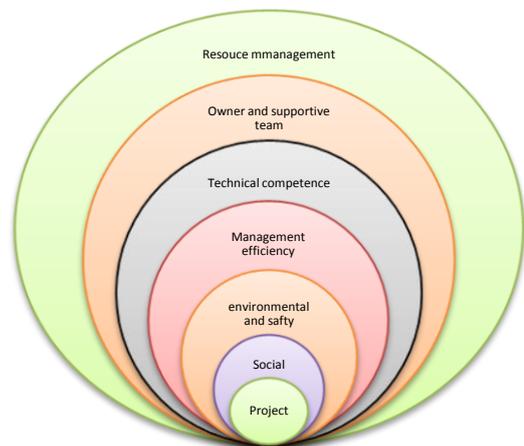


Figure 2. Typical representations of factors.

1) Social Factors affecting Project:

After completion of the project the user will be either public or private in general. The society comprises users as well as project participants. The support of the society is very critical in the project completion. The society as a whole may object, protest and obstruct the construction process in getting clearances and moving the men, materials and machinery. In the case of the public projects the land acquisition and their cooperation is very much required. The level of contribution and significance the construction project is examined and it is accounted in this research.

2) Environmental Clearance Safety:

Safety is a predominant and foremost requirement in construction project. There were a lot of standards and stringent implementation is ensured towards safety. A slippage on the safety not only affects the project duration, but also the progress of the project itself becomes tough. However due to budget provisions and other reasons these were generally given the least importance and to know exactly a survey has been carried out and the results are discussed.

Environmental clearances for the larger project have become mandatory. Also the terrain is important in moving machinery and materials for the construction. Water ways, rivers, black top roads, and electricity are all significant in shaping the constructible project.

3) Supportive role of owner and management:

Since the project itself is a team work and the cooperation of all the participants is very much required. The contribution of the owner and his support are the driving force for the completion. An efficient project management team and its willingness and working will take the project ahead towards the completion targets.

4). Technical competence of the project:

Construction projects involving technical complexity are to be addressed by the technical team. Solving these issues will be based on the efficiency of the engineers and technical team handling the issues. How much importance has been generally given to these factors is being examined and carried out in the survey. The findings are discussed and given detail in this work.

5). Management efficiency:

The project management is the driving force for the completion of the project. State of the art methods and the efficiency of using latest tools and techniques, competence of the management. Key factors to improve the success and completing within the duration of the project. However, in practically it's very crucial for completion of project with the efficiency of management.

6). Financial management capability:

Financing of the project is complex and very critical. Efficient management of finances is the key factor in controlling the overrun of the project. A disciplined approach need to be adopted in the control of the budget and cost of activities to check the project cost overrun. How effectively this is being managed and to what extent these are contributing to the successful execution of the schedule are studied and reported here.

7).Resource management:

Construction involves material resources, machinery, labour and staff which are all to be scheduled properly and to be used appropriately. An optimized use of resources will lead to reduction in the project cost with effective resource management program. In the absence of resource management or poor programme the project will slip from its scheduled targets and pose number of issues like cost escalation, material and labour wastages, idling of machinery timings

ASSESSMENT OF IMPACT ON THE FACTORS AFFECTING SCHEDULE.

The survey is carried out in two parts consisting of demographic and questionnaire survey. The statistical model using SPSS is being developed and analyzed,. In each category the factors are identified and grouped and accounted for analysis, since analyzing each and every factor might consume a lot of time and to be a laborious task. A number of attributes pertaining to the factors of social, environmental and safety were consolidated and grouped. The factors responsible for finance were grouped and titled as finance management. Likewise these groups were formed and used for the analysis as category wise.

Factor Rating

Factor rating is used as 1-5 point likert scale method. It's a type of psychometric responses for surveying and this type of likert scale is widely used in the market research. Likert scale method is allowed by the respondents to responses of their level agreement of the questionnaire survey. In this study the likert scale was used to rate their opinion about the schedule overrun in the project.

Demographical analysis and results

The semi structured questionnaire was circulated among the construction professionals in various projects and retrieved their responses of the questionnaire about the present project. The data were collected with various techniques such as face interview, mail and friends of friends through questionnaire.

The questionnaire were split into two parts such as Part A and Part B. the Part A consists of personal details of respondents and project characteristics like designation, Type of organization, type of project, type of scheduling etc., The second Part B consist of fifty three factors which are influencing the construction project scheduling. Later, The Part B was grouped under seven categories namely.

The survey method is useful to collect wide range of information and large amount of participants to refer any kind of issue in the research. The questionnaire was designed based on literature study and experts opinions in the pilot study. The questionnaire was constructed by using semi structured form where the participants can freely express their opinion. In this study the questionnaire was distributed to two hundred and seventy projects and retrieved only two hundred and ten hundred responded were filled completely. The percent of

responses of questionnaire is 82% and it could be consider as good response to proceed the analysis.

Data were collected from various construction professionals such as Project managers, project engineers and site engineers etc., through face to face interviews and mail in case the difficult to meet face to face. The descriptive statistics was considered to know about the respondents details. From table 1, Designation and other project parameters were analysed and presented.

When the respondents' profile is considered, the highest contribution was from Site Engineers 32%, followed by Planning Engineers and Project Manager 27% and 21% respectively (Table 1) shows that the highest contribution of company profile was from private limited and that is 81.4% which shows the maximum responses were obtained from private limited companies only.

The Project responses were obtained covering major cities in southern part of India and they were categorized under five heads such as residential, commercial, industrial and

infrastructural projects and others as shown in Table 1. It is found that the samples collected are a well balanced mix having all types of projects, proving the consistency in the outcome of the research.

When the project scheduling is considered, the highest contribution was from Time based 67.1%, followed by resource based 21.4%.

In order to derive the best possible outcome of the survey, the questionnaire and research objectives were explained to the professionals during data collection.

Ranking of factors Impact

The SPSS (Statistical Packages of Social Studies) tools used to find the impact of factors in the schedule overrun. The 5 point likert scale was used to distinguish the range of responses for nil(0) to severity (5) of the schedule overrun in the project. The mean and mode value were calculated to tank the top most critical factors for schedule overrun.

Table 1. Demographic Information of Respondents

Designation	Percentage
Construction Manager	9.5
Project Manager	21.0
Project Engineer	15.0
Planning Engineer	27.5
Site Engineer	32.0
Organization type	
Sole Proprietor	5.7
Partnership	1.9
Private Limited	81.4
Public Limited	9.5
Others	1.4
Project type	
Residential	19.5
Commercial	44.8
Industrial	11.9
Infrastructure	21
Others	2.9
Type of scheduling	
Resource	21.4
Time	67.1
Line of Balance	11
Others	0.5

Table 2. Factor influencing construction project schedule

Sl. No.	Factor influencing construction project schedule	Mean	Std. Deviation	Mode
1.	Whether local / social hurdles affect the schedule of project?	2.42	1.096	3
2.	Whether local people co-operate for the work progress?	2.70	1.021	3
3.	Whether work was affecting local / government policies?	2.24	1.077	1
4.	Whether project was affected by change of Government?	2.09	1.116	1
5.	Is there any local disturbance by the political members?	2.18	1.168	1
6.	How far the project was affected due to any payment of stakeholders?	2.48	1.207	3
7.	Whether the project was to complete the target based on payment systems by contract?	2.90	1.124	4
8.	Whether the schedule is being affected due to lack of finance?	2.61	1.286	3
9.	How far the project has a sufficient technical support by the workers/engineer in the project?	3.72	0.955	3
10.	Whether you classify the project in the technical aspects at the time of scheduling	3.55	0.988	3
11.	Do you have a separate consultant team for the technical support?	3.17	1.337	3
12.	How far the project was inspected at the time of major activities?	3.80	0.964	2
13.	How far the planned resources can be obtained at the time of work?	3.57	0.937	4
14.	How far the project has faced problems by the neighborhood issues?	2.56	1.039	3
15.	How far the planning of housekeeping was implemented in your project?	3.54	1.072	4
16.	Whether any specific Measurement is followed to maintain good environment?	3.52	1.081	4
17.	How far their project is run by hierarchical process?	3.38	1.011	4
18.	Whether the designation / category is followed based on experience or education system of employee?	3.70	0.987	4
19.	How far the project faced internal dissatisfaction among the workers?	2.54	1.076	4
20.	How far the project is using advanced technological methods?	3.46	0.934	3
21.	How far the project follows resources documentation systems?	3.60	0.908	4
22.	How far the project identifies the waste of resources?	2.94	1.061	3
23.	How far is the co-operation among the stakeholder in the project?	3.10	1.066	2
24.	Whether the project scheduling was developed based on earlier project parameter/ information?	3.23	0.951	4
25.	Whether the project has faced unavailability of materials?	2.49	1.090	3
26.	Whether the project is affected due to increase in materials prices?	2.74	1.099	4
27.	Whether the project was centralized procurement system?	3.22	1.206	2
28.	Whether the project has sufficient vendors?	3.49	1.082	3
29.	Are there any shortage of materials, labour and Machinery as planned in the schedule?	2.64	1.112	3
30.	Whether the project was affected due to interrelationship with the craft / crew?	2.33	1.059	4
31.	Whether the project was rectified based on review system?	3.03	0.980	4
32.	How far the project is being affected by contractors or sub-contractors?	2.70	1.071	4
33.	How far decision will be taken if any issues occur on the project?	3.37	0.970	2
34.	How far the client interference with in making changes in the project?	3.37	1.109	3
35.	How far the recruitment and evaluating the status of contractors and sub-Contractor in the project?	3.27	0.992	4
36.	How adequate the project is implementing new methods and technology?	3.26	1.013	2
37.	How adequate is training and knowledge sharing about new method & New technology to the concern team/crew in the project?	3.45	1.007	3
38.	Whether you satisfy the communication between the owner consultant and contractor?	3.72	0.837	2
39.	How far is project affected in the conceptual/preliminary approvals by the authority?	2.98	1.053	3
40.	How far is project contractual made with conditions towards the scheduling?	3.15	0.971	2
41.	How far is project delayed due to rework and repair in the project?	2.58	1.056	3

42.	How far is availability of labour as per scheduling of the project?	3.34	0.879	4
43.	How far is availability of plant, & Machinery as per scheduling ?	3.40	0.940	3
44.	How far is availability of supply of material as per scheduling in this project?	3.45	0.891	3
45.	Whether the scheduling has allotted shutdowns in the project? (Equipment maintenance, weekday leave)	2.61	1.186	4
46.	How far the leave, and holidays maintained in the scheduling? (Type of calendar 5,7 days, day and night Shift.)	2.91	1.108	3
47.	How far the project was affected due to natural calamities?	2.77	1.047	2
48.	How the scheduling can be prepared according to the climatic conditions?	2.73	1.113	2
49.	How the geological parameters in the projects can be anticipated?	2.84	1.046	3
50.	How far the project has been scheduled based on geographical/topographical data?	2.98	1.104	4
51.	How far the project was affected due to site preparation?	2.53	1.017	3
52.	What is the impact of major or minor accident in the project scheduling?	2.37	1.113	4
53.	How much is the welfare of the society (pollution, safety, indirect labour market, legal aspects) considered in the project scheduling?	3.51	1.041	4

The factors are ranked based on the mean value and given in Table 2. The top 5 factors with high mean value are inspection of major activities at time of execution (3.80), technical support by workers and engineers (3.72), communication among the stakeholders (3.72), provision on proper designation based on education (3.70), and Resource documentation (3.6). However, In case of mode value the topmost factors opted by the engineers are provision on proper designation based on education (4), Recourse documentation

(4) and planned resources obtained at the time of project could influence the scheduling of the project.

Consequently the 53 critical factors were created as seven groups such as Socio Project Contribution, Environmental and Safety, Supportive Role of Owner and Management, Technical Competence of the Project, Management Efficiency, Financial Management Capability and Resource Management based on the questions on factors influencing the construction project scheduling in survey.

Table 3. Ranking of influencing factor

G.NO.	TYPE OF FACTOR	MEAN	RANKING
G1.	SOCIO PROJECT CONTRIBUTION	2.53	5
G2.	ENVIRONMENTAL AND SAFETY	2.87	6
G3.	SUPPORTIVE ROLE OF OWNER AND MANAGEMENT	3.41	7
G4.	TECHNICAL COMPETENCE OF THE PROJECT	2.94	3
G5.	MANAGEMENT EFFICIENCY	3.94	1
G6.	FINANCIAL MANAGEMENT CAPABILITY	2.89	4
G7.	RESOURCE MANAGEMENT	3.84	2

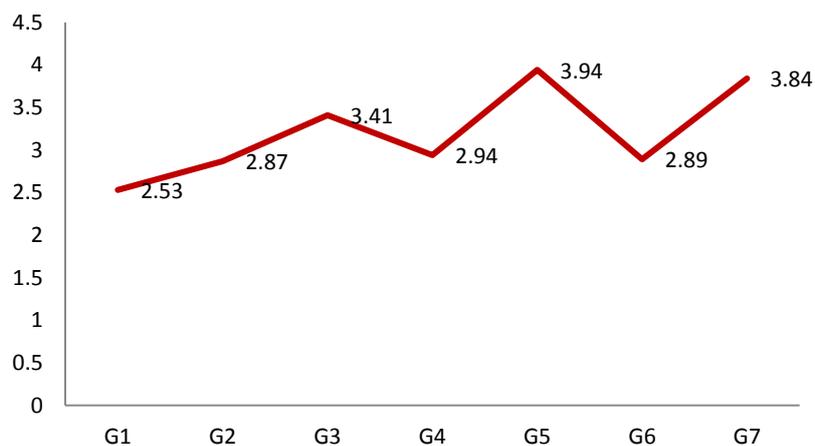


Figure 3. Ranking bar chart

Table 3 and Figure 3 show the mean value. The maximum mean value 3.94 has been for management efficiency group. Following that next recourse management having mean value of 3.84 and the least mean among the other groups 2.53 have socio project contribution.

CONCLUSIONS AND RECOMMENDATION

In India schedule based construction project management is still a new concept in and a new word in the Indian construction industry. It is expected that the trend will be changed as soon as possible. This study includes the identification of critical factors and the critical group in construction scheduling. A questionnaire survey comprising 53 identified critical factors was conducted with field experts. 210 responses were collected from professionals employed at various projects. The top 5 factors among 53 factors were identified by ranking the factors based on the mean value of the respondents. The most important factor was lack of Inspection of major activities at the time of execution with highest mean value of 3.80. However, the mode value suggests that the different opinions for scheduling issue, In provision on proper designation based on education or in charge of concerned activities are not qualified to handle the project and they are opted by most of responses as high value 4.

Later the 53 factors were synchronized as seven groups to focus on resolving the issue on scheduling. The topmost groups were identified based on mean value in management efficiency (3.94).

This study will assist the project planning and scheduling team to identify the activities which have varying impacts of different groups of factors that are governing the successful scheduling and execution of the projects. The quantitative evolution of the impact on the factors helps the management to take the right decision in construction projects. These findings shows the different aspects of pros and cons in the project success among the stakeholders to take the right decision. Evolution is much important for implementing to measure the effectiveness of the project. The data collected was subjected to 5-scale Impact of the factors with Scores. Those scores were used to check the scheduling in the perceived impact of the associated factors.

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