

STUDY AND STATISTICAL ANALYSIS BY SPSS ON THE FACTORS AFFECTING CONSTRUCTION PROJECT SCHEDULING FOR COMMERCIAL PROJECTS IN TAMILNADU

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ABSTRACT: The construction industry is leading as the topmost contributor to India's GDP (Gross Domestic Product). The Project Management Institute (PMI, 2008) defines a construction project as "a temporary endeavor addressed to create a distinctive product, service, or result". It provides a greatest employment provision beyond supporting economic potential. According to the reports of the Government, the construction sector has been travelling continuously on a constant growth path, even though innumerable challenges are forwarding march in restraining the development of construction industry. Scheduling is an unavoidable event to cramp the success of any production process in any industry. It is well known that the scheduling under the indoor environment (Manufacturing industry) industries is more successful than the outdoor environment industry like construction industry (building construction, road works, railways, and civil engineering structures etc.). The reason behind is the abundant complex nature of scheduling in the construction industry because it involves varieties of entities like clients, contractors, consultants, stakeholders, shareholders and regulators. To complete a construction project successfully as per the schedule, a long list of activities should be carried out within the précised time. Men, material, equipment, cost and time estimation are mandatory in planning and scheduling. Even after the tremendous growth in construction industry, scheduling of the projects remains a challenging activity during the execution of construction projects. Developing a good construction planning and scheduling becomes an enigmatic task due to the involvement of different project participants and the organizations. The present study is hence carried out to study in depth the affecting factors of construction scheduling. The factors are identified using the reported literatures, questionnaire survey and the case studies.

INTRODUCTION

A construction schedule is defined as a calendar which connects the assigned tasks with the resources required to perform the tasks. It is used to determine the time and sequence of operations of the construction projects. It calculates the start or end of a specific activity and it assembles the various operations or tasks throughout the project to present a clear picture from the beginning to the completion of the project. A well planned construction schedule guides in outlining the assigned jobs and also defines the methods and sequence in which the materials are going to be put in place. A scheduler must take care in designing the right schedule by considering all the important factors in mind. Scheduling evaluates the sequence of activities to allocate various resources required for the tasks. The scheduler is the key person involved in making the schedules in a typical construction project. The start and end date of an activity depend on its duration, predecessor activity, predecessor relationships, resource availability, and finishing date of the project. Construction planning is considered as two ways of approach, first cost oriented scheduling and second is time oriented

scheduling method. Cost orientated scheduling is based on the budget and availability of cash flow in the project. Time oriented scheduling is based on time or resource orientated scheduling. Nowadays most of the projects follow time based scheduling. According to Saleh Mubarak, (2010) scheduling is necessary to estimate the approximate date of completion of the project; to coordinate between the suppliers of raw materials and execution team; to avoid conflicts during execution; to improve work efficiency; to examine the advancement of the project; to determine the effect of changes during execution and to prove delay claims. Similarly, (Okuwoga 1998) examined that the construction industries are more concerned on all types (private and public) of clients. (Karim and Marosszeky 1999) studied construction performance measurement using Key performance indicators (KPIs) such as time, cost, quality, client fulfillment; client changes, business performance and safety in order to enable measurement of project and organizational performance throughout the construction industry. Strictly speaking, Construction schedules focus on two Construction Planning Cost based scheduling

Time-based scheduling Direct Cost Indirect Cost
Time orientated Resources orientated 4 major
aspects; determining how long each activity will take
to complete and determining who is responsible for
completing each activity.

SCHEDULING ISSUES

The success of the construction project occurs when the project is performed within a limited or expected time and also completed to the estimated cost and with expected quality. However sometimes some issues can bog down projects and derail their timely completion. So the analysis of such issues should be given priority in the project management. In India, last three decades many number projects have been proposed and executed. Cost and time overruns affect most of the Indian construction projects as per the report of the Ministry of Statistics and Programme Implementation (Infrastructure and project monitoring division), Government of India, (<http://www.mospi.gov.in>). It was noted that more than 90% of these projects had registered with very high cost overrun and time over run ranging from 5% to 500% (<http://www.mospi.gov.in>). These were due to inappropriate methods of scheduling and their inaccurate schedule project input parameters. Over these years due to intensive research activities, many more advanced technologies and methods have been developed covering almost all aspects of construction in optimization, risk, resource utilization, machineries, manpower, skill metrics etc. So far planning engineers use their heuristics coupled with available expertise and in house data generated on their projects made the scheduling as successful. A planned duration fixes the achievement of the project. But it is a rare scene in Indian construction industry, that a project is executed within the stipulated duration. The root cause for such delay is treating the task duration as decisive but in actual condition it is more uncertain and affected by more critical factors and activities. In addition of that, many numbers of factors govern each and every project; creating a common template of data becomes laborious and difficult task.

The responsibility of such schedule overrun is distributed over several critical factors such as natural disasters, sudden strike of labors, unavailability of materials, lack of experience of participants,

contractual relations, inefficient scheduling before and during implementation of the project etc., (Sweis 2013; Shanmugapriya 2013). Hence, these critical activities and factors are the important reasons for the time overrun of individual activity. The overrun of each activity will affect the entire project. As a result the project duration and cost increases whereas the quality of the project decreases. Earlier anticipation of such problem is very important because the problem can be controlled or even corrected to get the project back on track. These factors of varying degree of impacts on the project and their assessment also are to be made unique based on the expertise available with the practicing engineers. In order to explore the relevant practice a unique approach has been developed for this research, which are detailed in the thesis. The following areas are essential to minimize the schedule overrun in the project and to enchant the corrective framework for scheduling.

RESOURCE PLANNING

Resource planning are prime important in any construction projects. Resources are categorized under three types such as materials, manpower and equipment / plant and machineries. In a typical project, material costs around 60% to 70% of total budget. Consequently, material planning includes quantifying, ordering, and scheduling. Productivity will be affected if the material planning is not done properly causing the time overrun in the project at a higher level. There has been a terrible lack of specialized persons to manage with the rapid growth in construction projects. In view of that skilled manpower are not really skillful, but gained their experience from job 9 site and learn skills through trial and error (Azlan Shah Ali 2015). Hence, it is quite difficult to assign the proper specialized persons in a particular task which leads to the insufficient number of labors. Requirement of more labors becomes essential to produce high quality work. However, implementation of Training institutions are limited even though that could produce construction workers in India (Iyer 2006).

SCHEDULING METHODS

Many options have been resolved by the builders and contractors to represent and create construction

schedule techniques. Scheduling can be executed using the following procedure;

1. Listing of Activities
2. Development of framework indicating the relationship between various activities/Stages
3. Estimating the timeline of each activity, preparing a schedule and evaluating the start /finish time for each activity, along with the float.
4. Assessing the required resources

creating a construction schedule is influential whether a project is big or small. Once construction begins, everyone discharges their duties with the same information and expectations. Since 1900 several methods have been followed by the builders to make the project successful.

NEED FOR THE STUDY

Improper Scheduling is the main problem in the construction industry which results in cost and time overrun. Constructors are prone to see the most of the schedule overrun in responsibility of the client, while client usually want to blame on the constructor or third parties. In order to bypass this situation, the identification, quantification and analysis of schedule overrun becomes essential. Hence identification of schedule overrun factors and evaluation of preventive measures to avoid or minimize the same have been carried out in the present study. The findings of this research will enhance the scheduling strategy and project performance of construction industry to schedule the project activities properly and to complete the project in time.

LITERATURE REVIEW

This chapter presents an in-depth examination of the factors influencing construction scheduling. Construction scheduling nowadays is complex and hard. Research in the subject of scheduling and planning has been conducted to identify influential elements. Various traits have been categorized and distinguished into different forms based on their crucial importance and reliance utilizing various ways and methodologies. Chan et al. (2004) categorized the issues affecting project fulfillment into 4 groups: project-associated, procurement-related, project management and project participant-associated factors. Dos Santos, (2002) exhibits that only a small portion of the issue stems from the

partial utility of concept, the gap in knowledge amongst practitioners and the lack of support from the organizational structure. In case of the separation of arrangement of schedule and project operational reality, the expected reliable condition may not be reached (Son and Rojas 2011). The schedule can be improved to implement the project schedule by converting the project plan right into a logical arrangement and collection of activities. During the schedule improvement phase, the project activities are subtle, activity durations are determined, activity relationships and sequencing are specified, and key milestones are shown. Along with resources and estimation (AACE 2006). A schedule must be prepared by the construction managers for guiding and controlling resources (Lu and Lam 2000). Chester and Hendrickson, (2005) stated that construction mismanagement results in more than one problems that could cascade for the duration of the work pressure chain, affecting the schedule and main to damage more than one parties. To explain this a case study has been demonstrated with seven different mishandling scenarios. For decreasing the damages, the preventive measures are also submitted. Moneke, (2012) examined the schedule influencing factors and outlined a frame work to help managers to increase a reliable and cost-effective schedule important for successful implementation and control of projects in Nigeria. The outcomes of the analysis indicated that time, material and manpower have been the considerable factors. Author endorsed in-depth time forecasting and scenario analysis as well as apt management of materials and human capital development. Hwang, (2013) carried out a survey with 36 industry professionals and revealed that “site management”, “Co-ordination among various parties”, “Availability of laborers on site” had been the top 3 factors affecting scheduling of public housing projects carried out in Singapore.

Table 2.1 Factors affecting schedule performance (Hwang et al. 2013)

Researchers	Factors affecting schedule performance
Sullivan and Harris	Waiting for information from the client; Change orders, Ground problems/site inspection, Bad

(1986)	weather, Design complexity
Aibinu and Odeyinka (2006)	Contractors’ financial difficulties, Clients’ cash flow problem, Architects’ incomplete drawing, Equipment breakdown.
Assaf and Al-Hejji (2006)	Shortage of labors, Delay in progress payments by owner, Type of project Bidding and award, Unqualified work force, Late in reviewing and approving design documents by owner.
Enshassi et al. (2009)	Strikes, external or internal military action and border closures, Lack of materials in markets, Shortage of construction materials on site, Delay of material delivery to site, Cash problems during construction.
Ibrahim Mahamid et al. (2011)	Political situation Segmentation of the West Bank and limited movement between areas, Award project to lowest bid price, Progress payments delay by owner and Shortage in equipment.
Sweis et al. (2008)	Poor planning and scheduling of the project by the contractor, Financial difficulties faced by the contractor, Too many change orders from owner Shortage of manpower, Incompetent technical staff assigned to the project.

Iyer and Jha, (2009) stated that a capable project supervisor has the technical and monitoring skills for powerful leadership. Furthermore, the project supervisor has to be capable of delegate authority and duties to the project team and all other project individuals involved in the project execution. Project manager’s competence is associated with the skills, training and experience that he possesses. Every participant has abilities and knowledge that may be

beneficial in developing the project plan (PMBOK 2004).

Castro et al. (2009) evaluated the feasibility of the use of fuzzy mathematical models for evaluating construction schedules and the contingencies created via changes in scheduling because of an unexpected shortage of material. Networks have been analyzed the use of 3 strategies: manual critical path method scheduling calculations, Primavera project management software program and mathematical models using the Optimization Programming Language software. They inferred that allocation of material also affect project durations than a material shortage.

Laslo, (2010) attempted to develop and examine an alternative technique for resource planning and scheduling that is probably beneficial for project portfolio management. He used a simulation primarily based on a greedy priority dispatching rule and a cyclic coordinate descent search algorithm instead of the traditional optimization model to 39 create a job shop. Through the study it has been clearly stated that planning and scheduling is necessary for a good project management such as organizing project team and adopting the best construction practices.

Polekar and Salgude, (2015) said that a warning mechanism should be present which could alert the company approximately its viable success and failures during the project. The primary goals of this study are to plan, schedule, and track a residential project with the assist of Primavera software, observe the results generated, it is possible to signify which technique is appropriate for the selected residential project.

Devikamalam and Halena, (2013) used a genetic algorithm (GA) approach to evaluate the Resource Constraint project Scheduling problems (RCPSP) in the construction industry with the help of gene hunter software program. After a thorough analyzation GA finds the best schedule programme with minimal total project period and better-levelled resources with decreased cost and chances of closing the project within the planned schedule.

Deepika and Mariappan, (2013) accomplished research to improve time productivity in construction projects. That is carried out by using a scheduling algorithm called as a Genetic algorithm which is considered to be the best algorithm to get an optimized solution.

Agyei, (2015) performed studies on finding trade-off among the cost and minimum expected time with a purpose to be required to complete the building project. Angel Estates and Construction Ltd., in Ghana established a data base on the cost and 40 duration of activities. Critical Path Method (CPM) and Project Evaluation and Review Technique (PERT) has been used to crash the time and cost with linear programming identified in all activities. With this analysis the time prediction to finish project is reduced from 79 days to 40days.

Nie and Gao, (2015) developed a model to integrate the resource levelling problem and resource-restricted time-cost tradeoff problem. This new multi-objective optimization approach, Strength Pareto Evolutionary Approach II (SPEA II) was implemented to evaluate the Pareto front of time and cost. According to this approach, the runtime of the algorithm has been polynomial times of the number of activities. The accuracy of the results seems to be moderate. Schedule delays are measurable always in construction projects. In order to avoid this so many methods have been developed and used to measure the schedule delay. Choosing a suitable evaluation method is a major project for resolving the schedule delay claims encountered.

Alkass et al. (1996) tested that construction projects retain to suffer delays. The authors mentioned different delay evaluation techniques that are presently utilized by practitioners. They also proposed a new delay analysis technique known as the isolated delay type (IDT). A case study has been thoroughly examined to highlight the strength and weakness of the technique. A Computerized Delay Claims analysis (CDCA) has been created to integrate the scheduling and management software known as spreadsheet.

Aibinu and Odeyinka, (2006) offered the key resources of construction projects delay in Iran

construction projects. The authors sorted out a comparison between new technology and delay. Skilled professionals from twenty-six agencies participated in this study. Seventy-three delay causes had been recognized in the sample projects, wherein 25 factors were associated with the new technology restrict. The end result 44 assists policy makers and practitioners to understand the actual elements causing delay.

Sadi A. Assaf et al. (2006) recognized seventy-three reasons of schedule delay exist in Saudi construction projects. They located that the maximum critical causes of schedule delay were: postponing the payment, late approving design files by using owner, change orders by the owner during construction.

Mohan and Al-Gahtani, (2006) mentioned ten schedule delay analysis and compared them in resolving the problems of real-time delay, concurrent delay and pacing delay. Based totally on study outcomes, Mohan and Al-Gahtani executed an applicable delay analysis system including 11 requirements, considering all delays and modifications in total floats. Complete schedule data approximately real-world cases related to construction schedule delays are clearly difficult to collect.

Abd El-Razek et al. (2008) explored the opinions of contractors, consultants and owners on the delay reasons in Egypt construction by conducting seven semi-structured interviews. The ensuing listing of delay causes changed into subjected to a questionnaire survey for quantitative affirmation and identity of the maximum essential causes of delay. The contractor and owner have opposing views, mainly blaming one another for delays. Finally, it has been concluded that unity and coordination is required to overlook the issue.

Kaliba et al. (2009) concluded from their examination that the time overrun in highway projects in Zambia are due to behind schedule payments, financial deficiencies at the a part of the client or contractor, settlement modification, financial problems, material procurement, adjustments in design drawings, staffing problems, lacking of proper management system, oversight in supervision, faulty

construction, 45 poor association of workers in site, frequent modifications in specification, labour problems.

Yang and Kao, (2009) differentiated the available delay analysis strategies with preferred schedule-related documents and distinct analysis strategies. The authors proposed six suggestions to expand a perfect delay evaluation technique, consisting of regarding of as-planned and as-built schedules, managing various delay types, supplying clear liability distribution, considering multiple critical paths and important path(s) exchange, defining total float in a clear position and incorporating the system into popular commercial scheduling software.

Dayi (2010) submitted in his study the evaluated delay reasons and the methods used in exploring them. A case study has been applied the “Time impact analysis technique” (TIA) which is kept running using PRIMAVERA software program in deciding the schedule delays; to evaluate the impacts of these delays towards the finishing period, and to allocate the duties of the persons involved in the project to avoid delay.

Perrenoud and Sullivan 2014). Contractors will be charged easily if anything goes wrong in the execution. Data was collected immediately from both 46 contractor and client project managers of 254 construction projects. Actual delays from contractors had been determined to be a small percentage of the general project schedule delays. For most of the delays contractors accused only the material providers.

Larsen et al. (2015) has taken the public construction projects to examine the schedule delay. It has been analysed that inexperienced project managers affects greatly the time, cost and quality. Questionnaires containing twenty six factors selected by conducting interviews were sent to the project managers. Relative Importance Index (RII) is used for ranking

and the Friedman’s test along with the Wilcoxon’s test are used for post-hoc evaluation. From the evaluation, the most affecting aspect associated with time became found to be unsettled or lack of project funding. For the price related aspect, mistakes or omissions in the representative material turned into the most important.

2.2 SUMMARY FROM LITERATURE STUDIES

The literature survey revealed the significance of scheduling and its practicality in the construction industry. Factors affecting schedule overrun include critical elements, the significance of time, cost, and quality, and the importance of critical and non-critical tasks. Researchers found that the overall project duration increases as a result of delays in individual project activities. Researchers identified the causes, types, and effects of delays in typical project durations, as well as the tasks allocated to project members to prevent delays. The primary aim of research is to determine methods to prevent rescheduling and increase the likelihood of completing a project according to the specified timetable. Research also aids in monitoring project performance. The study focused on identifying essential activities that cause delays in construction projects by using a quantitative method and information gathered from case studies to understand the impact of delays on project scheduling.

RESEARCH METHODOLOGY

METHODOLOGY

The approach provides a concise overview of the sequence of activities in the current investigation. Figure 3.1 displays a flow chart that outlines the different tasks in this research. The present study follows a series of steps, each of which is discussed in the ensuing titles of this chapter.

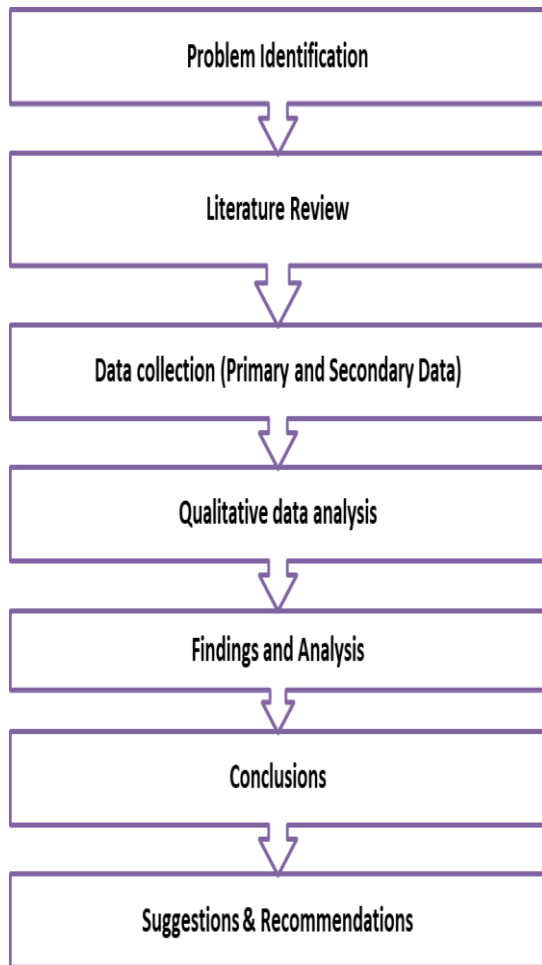


Figure 3.1 Methodology of present work

IDENTIFICATION OF PROBLEM

The main challenge in the construction industry is schedule overrun, caused by unpredictable critical activities and factors, cost overrun, conflicts among participants, loss of productivity, extensive resources needed for construction activities, supply chain disruptions, and natural disasters. Effective planning and scheduling are essential for the successful and meticulous execution of a construction project within the predetermined time, budget, and quality standards. It is crucial to concentrate on each building task before starting the project. For effective completion, an extensive literature review is required.

DATA COLLECTION

Data collecting significantly enhances the overall quality of study. The data was obtained in two stages for this investigation. The initial phase involves gathering data through a questionnaire survey, which is a key technique of data collection. The second stage involves gathering data through a case study.

CONCLUSIONS AND WORK SCHEDULE FOR PHASE 2

- ❖ In conclusion, several key factors significantly influence project scheduling within construction projects.
- ❖ Firstly, resource availability, encompassing labour, materials, and equipment, plays a pivotal role in determining the efficiency and timeliness of project completion.
- ❖ Clear project scope definition is essential to establish a solid foundation for scheduling, minimizing the likelihood of scope changes and their disruptive effects.
- ❖ A questionnaire survey will be conducted among various construction enterprises located in Tamil Nadu. Statistical analysis using the SPSS software package must be performed after data collection.

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