



## PLANNING AND DELAY ANALYSIS IN CONSTRUCTION PROJECT: A MANAGERIAL APPROACH

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*Abstract* : The construction industry, a cornerstone of global development, faces the perennial challenge of completing projects within stipulated time frames. Delays in construction projects can lead to cost overruns, contractual disputes, and compromised quality, necessitating a thorough understanding of the planning and delay dynamics. This research delves into the intricate fabric of construction project management, with a specific focus on planning methodologies and delay analysis from a managerial perspective.

The primary objective of this study is to explore the nexus between project planning, delays, and managerial interventions. Employing a mixed-methods research design, the investigation integrates quantitative data collection, statistical analysis, and qualitative insights to unravel the complexities associated with planning and delays in construction projects.

Quantitative analysis forms the backbone of this research, involving the examination of project planning documentation, schedules, and historical data from a diverse set of construction projects. A stratified sampling approach will be employed to select projects representing various scales, complexities, and construction types. Key parameters such as project duration, budget, and the effectiveness of planning methodologies will be scrutinized to identify patterns and correlations.

The research will employ advanced statistical tools to analyse the quantitative data, with a focus on identifying the key factors influencing project delays. Various planning parameters, including the accuracy of initial project schedules, resource allocation, risk management, and contingency planning, will be assessed for their impact on project timelines. The quantitative findings will contribute empirical evidence to the existing body of knowledge, facilitating a deeper understanding of the quantitative aspects of planning and delays in construction projects.

*Index Terms* – Qualitative Analysis, Quantitative analysis, stratified sampling, Project planning , Delay analysis

### I. INTRODUCTION

#### General

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 marc in restraining the development of construction industry.

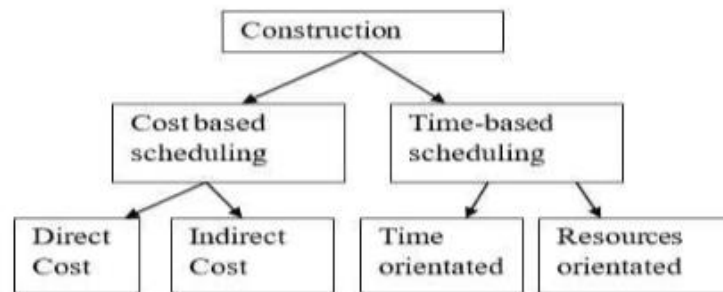
Scheduling is an unavoidable event to cramp the success of any production process in any industry. It is well known that the scheduling under the indoor environment (Manufacturing industry) industries is more successful than the outdoor environment industry like construction industry (building construction, 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.

## 1.1 IMPORTANCE OF CONSTRUCTION PLANNING

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. Fig.1.1 shows the different stages or phases involved in construction planning.



**Figure 1.1 Different phases of Construction Planning**

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 Marosszky 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 major aspects; determining how long each activity will take to complete and determining who is responsible for completing each activity.

## 1.2 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 labours, 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.

1.2.1 Social Relevance effect

1.2.2 Work Environment and Health and Safety in Project

1.2.3 Client /Owner Related Issue

1.2.4 Technical support and Competence Related Issue

1.2.5 Management Efficiency

1.2.6 Financial Capability and Support

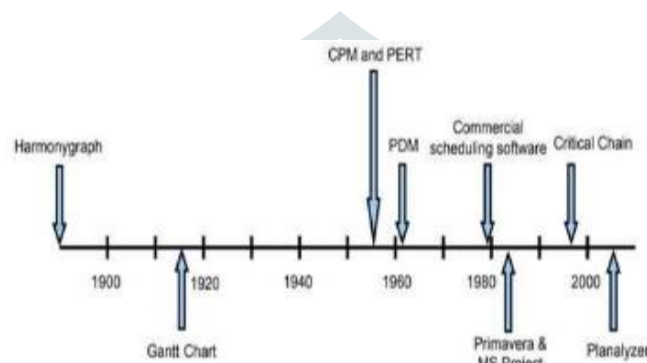
1.2.7 Resource Management

### 1.3 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. Fig. 1.2 shows the history of scheduling methods used in the construction industry.



**Figure 1.2 History of scheduling methods**

### 1.4 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 overruns factors and evaluation of preventive measures to avoid or minimize the same has 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.

The study is bringing out the issues related to the scheduling concept in construction industry. The following are some of research question arises and insists to do this research for finding the solution of schedule related problem often occurring in the construction industry.

- How the schedule is affecting the cost and time of the project?
- What are factors which contribute the schedule overrun in the construction industry?
- Did the qualitative method alone give the better solution?
- Did the quantitative method alone give the better solution?
- How the qualitative method and quantitative method can give the better solution?
- What statistical approach can be proposed for identifying critical factors?
- What are all the variables are interconnected the schedule overrun?
- Which statistical model gives the prediction model for schedule overrun?
- Which scheduling method can reduce the scheduling issue?

### 1.5 OBJECTIVES AND SCOPE OF THE PRESENT STUDY

1. To extract and identify the critical factors influencing schedule overrun from literature survey, Professionals in construction industry and case studies.
2. To study the influencing range of the individual factors that lead to the schedule overrun using the qualitative and quantitative analysis.
3. To develop the index equation for estimating the probability of schedule delay in the construction project by Linear regression modelling

4. To develop an algorithm in order to optimize the hierarchy scheduling method using Ant colony optimization technique (ACO).
5. Finally, to provide suggestions and recommendations to control the schedule overrun in the construction projects of Mumbai.

## 2. LITERATURE REVIEW

### 2.1 GENERAL

A detailed survey about the components impacting the scheduling of construction presented in this chapter. Now a day's construction scheduling in the complex and challenging task. Various research works carried out in the field of scheduling and planning for determining influencing factors since the 1990s'. Various attributes have been clarified and differentiated into various forms such as critically important and reliant one using different approaches and methodologies.

### 2.2 REVIEWS ON CAUSES OF DELAY

**Odeh and Battaineh, (2002)** studied the reasons of construction delay at traditional contracts in Jordan, they used questionnaire method on this study; the questionnaire became circulated to 100 contractors and 50 experts arbitrarily. The authors decided that insufficient contractor experience, owner interfering, and funding of work have been the various top 5 important factors.

**Aibinu and Jagboro, (2002)** explored the developing problem of construction delay in Nigeria and tested the results of delay on delivery of construction works in the country. Using an information gathered on sixty one projects, the authors recognized and evaluated the consequences of delay in the construction. Time and price hikes were considered as general reasons of delay.

**Frimpong et al. (2003)** done a survey to discover and study the relative significance of considerable factors contributing to delay and fee overruns in Ghana groundwater construction works. The questionnaires become directed towards 3 groups in both public and private agencies: proprietors of the groundwater projects, consulting offices, and contractors involved in the underground water works. From the study the major causes of time and price overruns have been identified.

**Long et al. (2004)** reviewed the problems of huge construction works using a case study in Vietnam, one of the growing countries. The authors grouped the problems under 5 major heads; incompetent designers/contractors; poor estimation and alternate of control; social and technological issues; site related issues; and incorrect techniques and tools.

**Wiguna and Scott, (2005)** studied the risk affecting construction delays and price overruns in Indonesia. The study established the following as important factors: excessive inflation/accelerated material charge; design change by the client; defective design; climate conditions; behind schedule payment on contracts and defective construction work.

**Meeampol and Ogunlana, (2006)** explored the price and time routine of highway assignments from the perspective of the public vendor. Thirteen fulfillment factors were diagnosed from literature and the evaluations of skilled engineers. Data were accumulated from 99 projects controlled by the Department of Highways (DOH) in Thailand. Discriminant analysis was used to build the price and time predictive models. The results convey that achievement in price overall performance depends on the supervision of construction resources, finances control, construction approach and conversation. By means of assessment, timetable control and manpower control inhibit price overall performance.

**Lo et al. (2006)** explored thirty delay reasons in Hong Kong construction works grouped below seven classes particularly client associated, an engineer associated, contractor associated, the human behaviour associated, a project associated, external factors and resource associated. The authors mentioned that the percentage agreement (PA) became 74% among the owner and consultant institution with numerous significant reasons.

**Sambasivan and Soon, (2007)** reviewed an incorporated method and tried to examine the effect of particular causes and the follow up of delays in Malaysian construction works. The authors recognized 10 vital factors out of twenty-eight factors and six predominant results of delays using relative significance index.

**Abd El-Razek et al. (2008)** in his work identified that the distinctive construction parties have no relative significance to various factors of delay in Egyptian construction projects.

**Al-Kharashi and Skitmore, (2009)** recognized the frequency, extent, and reasons for delay of private in addition to public construction work in Saudi Arabia. They highlighted the persistent environment of the issue and disparity within the views of the project stakeholders. They observed that the most manipulating current source of the delay is the shortage of qualified and experienced employees credited to the significant amount of big, revolutionary, construction works and insufficiency of manpower within the industry.

**Pourroostam and Ismail, (2011)** recognized the enormous factors causing and consequences of delay in projects in Iran. A survey was performed to implore the reasons and results of delay from experts and contractors' point of view. This study explored 10 maximum crucial reasons from a list of 27 extraordinary causes of delay and six different results of delay. The results showed delay can lead to many bad results including time and price overrun, differences, adjudication, general abandonment and litigation.

### 2.3 REVIEW ON TIME OVERRUNS

#### 2.3.1 MATERIAL RELATED FACTORS CAUSING TIME OVERRUNS

Chan and Kumaraswamy, (1995 and 1997) presented the study to enumerate the reasons affecting works in Hong Kong. The authors mounted relationships among different project characteristic variables with the construction period, construction cost, overall gross floor area and many stores in the buildings. Furthermore, in this study on plant usage level and site labour productivity were offered to discover the micro-factors that have an effect on construction periods. Results specify that the 5 most important and common causes of delays are: slow in decision making, bad ground conditions, worst management and supervision of site, variations created by client and other needed variations of works.

## 2.4 MANPOWER RELATED FACTORS CAUSING TIME OVERRUNS

**Majid and McCaffer, (1998)** identified that the factors including deficiency in labor supply, absenteeism, strike, and occasional motivation and morale are the important factors that make contributions to delay.

**Ogunlana et al. (1996)** diagnosed the factors including a shortage of professional labor and labour safety has a high influence on the causes of delays. Manpower related issues causing time overrun were recognized and are presented in Table 2.1.

**Odeh and Bataineh, (2002)** in their studies recognized labour productivity and labour as important delay factors. Chan and Kumaraswamy, (1996) diagnosed that scarcity of professional labour is the maximum essential issue that contributes delay.

**Table 2.1 Manpower related factors causing time overruns**

Groups	Factors
Manpower	<ul style="list-style-type: none"> <li>• Shortage of labour</li> <li>• Lack of skilled labour</li> <li>• Migrant labour</li> <li>• Labour injuries, disputes and strikes</li> <li>• Unqualified work force team</li> <li>• Personal conflicts among labour</li> <li>• Obtaining permits for migrant labour</li> <li>• Lack of motivation</li> <li>• Lack of communication</li> <li>• Lack of Mobilization</li> <li>• Absenteeism of labour</li> </ul>

### 2.4.1 EQUIPMENT RELATED FACTORS CAUSING TIME OVERRUNS

**Chan and Kumaraswamy, (1996)** mentioned that a lack of equipment and incorrect equipment are the factors contributing delay. Odeh and Bataineh, (2002) diagnosed that equipment allocation problem is the primary cause for construction delay.

**Long et al. (2004)** diagnosed the issue of insufficient modern equipment as a reason causing time overrun of construction works. Table.2.4 lists the equipment related factors causing time overruns.

**Ogunlana et al. (1998)** described the factors including inadequate numbers of equipment; frequent equipment breakdown, and equipment allocation problem are the considerable issues focusing delay.

**Majid and McCaffer, (1998)** provided that the delay factors are equipment breakdown, unsuitable equipment, slow deployment of equipment, and equipment allocation problem.

**Table 2.2 Equipment related factors causing time overruns**

Groups	Factors
Equipment	<ul style="list-style-type: none"> <li>• Availability of equipment</li> <li>• Complication of advanced technology equipment</li> <li>• Transportation of equipment</li> <li>• Idle time of equipment</li> <li>• Complication of hire</li> <li>• Disruption of accessories</li> <li>• Poor maintenance of equipment</li> <li>• Idle time of equipment</li> </ul>

### 2.4.2 FINANCE RELATED FACTORS CAUSING TIME OVERRUNS

**Majid and McCaffer, (1998)** recognized that the factors such as insufficient fund distribution and late payment to subcontractor/suppliers are producing delays in construction work.

**Ogun Lana et al. (1996)** identified that the contractor's economic difficulties have a high influence on the causes of delays. Long et al. (2004) pronounced that the high-interest rate as an issue causing delays.

**Koushki et al. (2005)** discussed the unreasonable constraints to the customer have an excessive effect on putting off. Frimpong et al. (2003) diagnosed that monthly payment problems are the most serious issue that contributes to delay. Finance related issues causing time overrun are provided in Table 2.3.

Table 2.3 Finance related factors causing time overruns

Groups	Factors
Finance	<ul style="list-style-type: none"> <li>• Cash Flow (Inflow and Outflow)</li> <li>• Slab of payment during construction</li> <li>• Financing by contractor during construction</li> <li>• Financing between the owner and contractor</li> <li>• Unavailability of financial incentive</li> </ul>

**Swesis, (2013)** studied the main issues causing time overruns in the Jordan construction industry. The overrun variables have been extracted from the literature and from an intensive exam of the belief of 30 engineers, and then ranked in keeping with their severity index. The top ten issues are recognized and handled with the use of principal component and factor analysis (PCFA).

**Mulla and Wagmare, (2015)** analysed the time and cost overrun factors and recommended the correct remedial solutions. The relevant information has been collected and studied by evaluating the real and planned schedule to understand the causes and implications of overruns. The result exhibits that poor planning, operation and management are the primary reasons. Finally it has been concluded that the use and implementation of better project management and its strategies, proper planning, controlling can be used to manage the issues.

## 2.5 REVIEW ON SCHEDULE OVERRUNS

**Olwale and sun, (2010)** recognized the leading five factors constraining time and cost manipulate in construction practice in the UK as; risks and doubts; inaccurate assessment of project time/period; the complexity of works; and non-performance of subcontractors. The design change is mainly considered through practitioners as hindering the capacity to manipulate the not only time of construction projects but also cost. Findings of this study resolved that there's an excessive level of correlation between the inhibiting factors for cost manipulate and time control.

**Bhatia and Apte, (2016)** determined the issues initiating project schedule and cost overruns, in Pune province of India through evaluating the planned and finished schedule of the project and by evaluating the real and planned expenditure of the project.

**Borse and Khare, (2016)** analysed the construction projects to fix money to be spent and exact schedule in numerous kinds and dimensions of the projects. It was observed that maximum considerable issues initiating time and cost overruns in Indian construction are the material rate, loss of planning, slow decision making, raising of the fund, agreement amendment and change in material specification, increase of material price.

**Abu El-Maaty et al. (2017)** determined the fundamental reasons of schedule overrun in highway projects in Egypt using cost increase as independent variable in mathematical models. Contractor's technical staff becomes inadequate and ineligible to attain the project was the maximum crucial cause of schedule overrun, and the inadequate instruction of the project about planning and implementation was the major reason of cost increase. Four models have been created using linear regression evaluation technique and statistical fuzzy theory and it has been observed that the linear regression-based model predicts more accurately than the other one.

## 2.6 REVIEWS ON SCHEDULE PERFORMANCE

**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 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. She 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.

**Hwang and Yang, (2014)** assessed the reconstruction within the construction industry and its impact on schedule overall performance. The remedies for this issue are discussed and presented. Hwang et al. (2015) carried out his research on ninety-eight green building and fifty one retrofitting projects in Singapore. They expressed the consultant non-cooperation issue impacts the performance of the schedule in both kinds of projects.

## 2.7 REVIEW ON SCHEDULING METHODS AND TECHNIQUES

**Iyer and Jha, (2006)** highlighted the status of project planning and recommended that project planning is done through skilled people. Many organizations knew the need to improve the level of knowledge and skills in the construction network by offering training using education, workshops, lunch and other learning programs (Buziak 2008). PMI has currently started an institution to learn scheduling besides the company (Galloway 2006). The difficulty of the project schedule shows the high interconnection

between activities. When the resources wanted for the project are widely spread, the project is considered complicated. Conversely the duration, cash flow and the excellence of the project will get affected; it is often required to make a perfect arrangement of activities of the project (Nassar and Hegab 2006).

**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 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. Also recommend measures are suggested to the company for enhancing their project planning abilities for similar projects in the future.

**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 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. Like this a number of researches have analyzed a particular reason which influences the construction scheduling and have reported the significance of that reason. Thus, the various studies accomplished by the authors like schedule Specification, lack of experience and knowledge, lack of communication among project members, poor management, incorrect planning, wrong handling of scheduling methods and tools and worst use of software program had been reviewed and presented as follows.

### 2.7.1 SCHEDULE SPECIFICATION

An essential step in the construction is the choice of planning and scheduling specification clauses to be covered in the construction agreement (**Ballast and Popescu, 2001**). According to the **PMI (2007)**, Specification tells about an entire, specific, verifiable way, the requirements, design, behaviour, or different characteristics of a system, component, product, result or service and, frequently the approaches for determining whether those provisions were satisfied.

Presently the scheduling specifications have emerged as overstressed with the challenge of addressing the entire range of roles now encompassed by the activity of scheduling.

As a result, scheduling specification advancements through the years have been extremely uneven, resulting in agreement specification with schedule provision in short or long sentences. This lack of standards and methodologies are the reasons for establishing requirements and best practices (**Levin 2006**).

The dynamic and unique nature of construction projects makes it tough to plan, schedule and manage. Most of the studies in “factors affecting scheduling” have been made in developed countries. The difference in context, the applicability in developing countries won't be identical and is consequently in need of exploration (**Iyer and Jha 2006**).

**Kuruoglu and Ergen, (2002)** defined that countries that are developing may not adopt the approaches handled by developed countries.

### 2.7.2 LACK OF EXPERIENCE AND KNOWLEDGE

**Nima et al. (2002)** People with construction knowledge and experience ought to carry out the early project planning so that interference among design and construction may be avoided **Hartley, (1993)** stated skilled and experienced personnel only can adhere with the scheduling. Due to the inexperienced organizations there occur unrealistic planning (**Nima et al. 2002**) and unrealistic base-lined schedules (**Son and Rojas 2011**). Nowadays the planned scheduling can be ignored and instead a mechanized method of schedule has been adopted (**Ponce de Leon 2008**).

### 2.7.3 LACK OF COMMUNICATION

Amongst project participants, Lack of communication is usually indexed as one among the shortcomings for poor project schedule performance. Communicating includes the exchange of data. A clear, unambiguous and complete diffusion of data should be there in between the persons involved (**PMBOK 2004**).

Projects schedules are the medium via which information is presented for the clear particulars of the project. To achieve maximum benefits, the continual use of the project schedule by all project members is important.

#### 2.7.4 POOR MANAGEMENT

Members often experience some kind of schedule pressure which often causes out-of-order work to be corrected (Nepal et al. 2006). PM solutions want to be flexible in order that schedules can weather out those and different turbulences. Poor management fails to combine and respond to problems that can arise.

#### 2.7.5 FLAWED PLANNING

Ponce de Leon (2008) declared that the failure of schedule is due to inadequate collaborative planning. Planning is used to achieve a described objective within described temporal and financial constraints (Long et al. 2004). Glen wright, (2004) stated that the scheduling, planning does not provide always the needed particulars of the agreement execution.

#### 2.7.6 IMPROPER USE OF SCHEDULING METHODS AND TOOLS

The best usage of tools and methods available drives the project in a success path (Griffith 2006). When properly used, scheduling techniques and tools force the project team to break down the assignment into discrete activities, estimate the period of each, and assume through the possible and preferable sequencing of the activities.

#### 2.7.7 INCOMPETENT USE OF SOFTWARE

Herroleon, (2005) According to several authors' soft wares are meant only for representation purposes and not fruitful in delivering the project in time even though more number of programs is being invented in this regard.

### 2.8 Reviews on Schedule Delays

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 is 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.

Aibinu and Odeyinka, (2006) Al-Kharashi and Skitmore, (2009); Kazaz et al. (2012) all studied the reasons for schedule delays and outcomes to the time concept. Upadhyay et al. (2016) quantified the top most schedule issues in Gwalior area and nearby areas by using Relative Significance Index (R.I.I.) approach. The top most important elements causing delay were useless planning and scheduling, errors and late in producing design papers, late in progress outflows, less information about proprietor in construction and reluctant in supplying the materials.

According to Ousseni Bagaya and Jinbo Song, (2016) Managerial capability of project managers curtails the delay in projects. One hundred and forty experts have been requested to put forth their ideas of schedule delay reasons in Burkina Faso. Financial functionality of contractor; monetary difficulties of proprietor; delay price; getting the needed equipment's very fast and poor performance in using quantitative statistical approach are determined as causes of schedule delay. The financial capability of contractor was found to cause a severe impact in the project delay.

Bilgin et al. (2017) proposed to delay analysis an ontology to make easier the improvised databases, data sharing in addition to retrieval for delay evaluation within construction companies. An in-depth literature overview on construction delays was performed during the improvement of the ontology and it is evaluated by the use of 5 case research. The delay evaluation ontology can be used for different purposes specifically to support decision-making during risk and claim management tactics. It may allow companies to create their own databases, corporate memories and develop decision support structures for better analysis of delays.

Durdyev et al. (2017) fulfilled an essential knowledge gap by identifying the various attributes for construction project delay with the residential building projects in Cambodia. Relative significance Index (RII) was used in ranking the factors delivered from the survey conducted with the contractors and consultants. Outcomes of the study are listed as limited number of professional labours; limited amount of supplied materials and its delayed delivery; fake project scheduling; Project complexity; worst handling of site; dereliction in duties by subcontractor; irregularity of labours; delay payment of owners; site protection to avoid accidents by the contractors and experts.

### 2.9 SUMMARY OF LITERATURE SURVEY

From the Literature survey, the importance of scheduling and its utility in the construction industry has been found. The elements which impact the schedule overrun are critical elements, the importance of time, cost and quality, the importance of critical and non-critical activities. Most of the researchers discovered that general project duration increases due to the time overrun of every single activity of the projects. Researchers found the reasons for the delay, varieties of delay and their impact of delay in usual project duration and the assigned works for members of the projects to avoid the delay. The purpose of research, in general, earned out "how can avoid the rescheduling, chances to finish the project in planned schedule" and also helps to monitor the project performance. The methods like MS Project, Primavera, Genetic algorithm, Time impact analysis approach, Gene Hunter software, Crashing approach, ANOVA, Earned value analysis, resource levelling and various schedule delay analysis are often adopted to find the construction schedule overrun. The studies focused to discover the reasons for rescheduling and also helped to find the crucial elements that affect the planned duration of the projects. Maximum of the researchers recommended some guidelines to minimize the schedule overrun like avoid rescheduling, ending the task in planned duration and within the budget affordable by each owner and contractors. Many researchers only focused on the qualitative technique by getting ideas from skilled civil construction practitioners, which include clients, consultants, and contractors to determine the delay reasons. The present study therefore focused on bringing out the critical activities causing delay in construction projects by conducting quantitative method using information's obtained through the case studies to know the actual effect of delay in the scheduling of the projects. This chapter presents in detail the studies carried out by the researchers around the globe on the various factors influencing construction project scheduling. Remedial measures have been provided by number of researchers for the picked out factors. But still the problem of construction project scheduling prevails in India. Hence in Mumbai which is a part of India, this study of focusing on the schedule delay factors in construction sector has been conducted. An improvisation is required in

adopting the technique for quantifying the factors considering the uncertainties involved in scheduling. From the literature, it can be seen that statistical model development is a well-proven technique for assessing the factors that influence scheduling. Hence this research focuses on developing simple statistical models for assessing those factors by considering small and medium-sized projects only in Mumbai. Based on the research carried out suitable recommendations have also been given for successful scheduling of construction projects.

### 3 CONCLUSIONS

The study comprises identification of schedule overrun factors in the construction projects. First and second stages are identifying the critical factors through questionnaire survey and using Qualitative method and Quantitative method. Fifty three factors related to schedule overrun are extracted through an extensive literature Survey and are used as a base for the questionnaire preparation. The questionnaires are distributed to several personal those who are working in the construction process and the major reasons causing schedule overrun are identified. Using qualitative approach the factors have been analyzed. A questionnaire comprising fifty three factors has been distributed to 420 respondents. A five point Likert scale (nil, low, moderate, high or very high) is used to represent the degree of influence. A value of 5 is given, if a particular reason influences highly and a value of 1 is given if it is not an influencing factor. Twenty seven factors out of these fifty three factors has a mean value higher than 3 indicating that these twenty seven factors had a greater importance for schedule overrun in the construction project. None of the reasons has a mean value above 4, (the maximum mean value was 3.80) and so that it is clearly seen that the reasons influencing the schedule overrun differs according to the project. Further it is concluded that no universal solution prevails to avoid this problem. The topmost reason for schedule overrun in the building project is "Inspection of project at the time of major activities", having a mean of 3.8, followed closely by the reason "Technical support from the workers and Engineers" having a mean of 3.72. By looking at these reasons, it is concluded that the topmost reason that would influence the schedule overrun of any project is the controlling and monitoring system of the project by technical team. This shows that importance should be given by companies in recruiting and assigning the technical team selection for the project. The next part of study is finding the critical activity, most critical milestones, activity and factors prolonging to schedule overrun in the project. This study has been carried out with the help of details collected from thirty numbers of construction projects. There are around 224 activities in all 30 projects. The retrieved data were analyzed and the top influencing critical activities and factors have been evaluated and ranked.

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