

ASSESSMENT OF TIME DELAY ANALYSIS IN CONSTRUCTION PROJECTS

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ABSTRACT

Time delay is one of the biggest problems facing in many construction buildings in India. Completing projects on time is the key factor of the project, but the construction process is subject to many variables and unpredictable factors, which result from many sources such as availability of resources, external factors, performance of parties and type of building. If there is a delay in project it leads to loss of productivity, increased cost, contract termination and disputes between contractor and owner. Construction site delays arise from the systematic accumulation of time surplus in numerous tasks inherent to the construction process. Time delay refers to the unproductive use of time that could have been utilized for beneficial purposes. Each activity has distinct factors that contribute to the inefficiency of that specific activity.

The aim of this project is to examine the causes and effects of delay on building construction project during construction phase and to provide control measures for time overrun in the project. A study carried out on construction schedule delays and various delay analysis techniques and methods in order to evaluate the causes of delay and their impacts in the construction project. Then a questionnaire survey is done to find the major causes of delay.

Key words: Schedule delays, external factors, Time delay, construction project and delay analysis techniques.

INTRODUCTION

Construction is a perilous business. And while today's construction projects may be safer than they were in the past, the financial risks persist to be great. Today's construction projects are bid under stern competition with little margin and require the synchronization of many trades under demanding conditions and challenging time frames. Often, the whole lot does not go according to plan, and the parties to the construction Contract find themselves at odds. Many of the risks that Owners and Contractors face can impinge on construction time and the cost of a lost day on a construction Project may be confounding. Unfortunately, the effects on construction time can be difficult to isolate, identify, and enumerate. This is true despite the fact that the construction process has employed modern scheduling techniques for almost half a century. More surprisingly, even though the power and capabilities of scheduling software have increased significantly in recent years, identifying and accurately quantifying construction delays continues to confront even the best Project Managers.

While the parties' management teams are able to analyze and assess most factors associated to a change, the effect on construction time remains difficult to comprehend and accurately measure. And

so, even though the parties can often reach compromises related to most aspects of a change, it is the delay factor that often prevents settlement. As a result, most construction claims incorporate a component related to delays. Because the expertise required to reliably and convincingly evaluate delays and delay damages often goes beyond that of the participants, experts are hired to analyze delays for mediation and trial.

The financial implication of delays demands that the Project Owner, General Contractor, Construction Manager, Designer, and Subcontractors educate themselves regarding delays and the associated added costs. This study is intended as a practical, hands-on guide to an area of construction that is not well understood.

All construction industry professionals should make out the basic types of delays and understand the situations that give rise to entitlement to additional compensation. Most important, they should recognize how a Project schedule and Project documentation can be used to determine whether a delay occurred, quantify the delay, and assess the cause of the delay. Furthermore, construction professionals must be able to assess the delay's effects on the Project and quantify any costs or damages.

Many techniques are used to evaluate delays. Some of these methods have in built weaknesses and should be avoided. This study points out the shortcomings of these faulty methods and explains how a delay analysis should be performed. It then describes—explicitly—how the analysis is done with CPM schedules. The study will cover the subtleties of the process, such as shifts in the critical path and noncritical delays.

The subject matter of damages is covered in detail, including the major categories of extended field overhead and unabsorbed home office overhead costs. Likewise, the damages undergone by the Owner, either actual or liquidated, are also explained. Today, India is one of the foremost outsourcing hubs in the world. However, the world judges us not just by the skills that have to offer, but also on the basis of our infrastructure capabilities. India has set a determined target of investing USD 1 trillion in infrastructure during the Twelfth Five Year Plan period. Given this factor, infrastructure progress has been a key focus area in every Indian state more so in the recent past. At the center as well, big budgets have been allocated for infrastructure development in all Five Year plans. However, the country has over and over again fallen short of meeting such targets over the last few years. These projects have been customarily riddled with issues of time reasons for such schedule and cost overruns, Ministry of Statistics and Programme implementation (MoSPI) recommended PMI to conduct a Study, in consultation with KPMG to highlight the key reasons for the time and cost overruns across major sectors in infrastructure projects. Infrastructure plays a vital role in the economic growth of a country.

Infrastructure investments in India have been mounting on a constant basis. In each five year plan, the government sets an grand target which is higher than the previous one. The 12th five year plan also promises significant investment in infrastructure sector to bridge the huge infrastructure shortfall. The plan is twice over the spending to USD 1 trillion through 2016-17 with 50 percent of the funding to be met by private sector. Although, the sector is considered to be a key driver of economic growth, time and cost overruns threaten to limit the sector's latent to help achieve the desired growth and ensure efficient capital expenditure.

To build Infrastructure, construction plays a paramount role in the economic growth of a country. Infrastructure investments in India have been growing on a steady basis. Although, the sector is considered to be a key driver of economic Growth, time and cost overruns warn to limit the sector's potential to help achieve the desired growth and ensure efficient capital expenditure. Dearth of skilled project managers has the utmost influence on project delivery. Lack of skilled project managers emerges as the root cause for time and cost overruns in a project lifecycle. It has been pragmatic that the inflow of talent in the infrastructure sector has been declining – as resources are going for alternative, more lucrative options. This concern is felt across diverse stages of project lifecycle.

One of the reasons for inefficient project delivery is the paucity of skilled project managers in the construction sector. This turn down in the inflow of talent in the sector has emerged as the embryonic cause for time and cost overruns in the project life cycle. Resources are being seen to deflect away from the construction sector towards alternative, more lucrative options. This growing concern which has been felt across various stages of the project life cycle has been supported by this insufficiency further leads to issues such as protracted finalization of design, scope creep and contractual disputes. An explanation of delays and delay damages have been presented in a straight forward, accessible manner, should be beneficial to public and private Owners, Construction Managers, General Contractors, Subcontractors, Designers, suppliers, and attorneys whose work involves them in the construction industry.

TIME DELAY IN CONSTRUCTION PROJECTS

Construction delays are seen as significant risks and can lead to disputes. It is crucial to have knowledge and understanding of the causes of delays in order to identify and effectively manage the risks associated with exceeding project timelines, disputes, arbitration, project abandonment, and litigation. (Ogunlana 1996; Aibinu & Jagboro 2002). Bassioni & El-Razek (2008) asserted that time overrun in construction projects is a prevalent issue that leads to many detrimental consequences for the project and its

stakeholders. Hence, it is imperative to ascertain the precise factors responsible for time overrun to effectively reduce and prevent such delays and their associated costs.

Arditi & Pattanakitchamrorn (2008) asserted that construction delays can lead to several consequences in a project, including delayed completion, reduced productivity, expedited work, escalated expenses, and contract termination. Typically, circumstances that result in delay are intricate in their characteristics. The extent to which a delay in one activity affects the whole project timeline may vary depending on the specific circumstances. The project may or may not be impacted by a time overrun induced by a party.

The completion date may or may not result in harm to a third party. A time overrun might happen simultaneously with other time overruns, and all of them can have an impact on the project's completion date. Timely project completion is a measure of efficiency, however, the construction process is influenced by numerous unknown elements stemming from various sources.

The sources encompass the project partners' performance, resource and financial availability, environmental conditions, and contractual interactions. The time overrun undoubtedly has adverse effects on the project's performance. Hence, the issue of time overrun holds significant importance within the building sector. The task at hand is to precisely quantify the overall effect of the construction time delay. An inquiry into this problematic area is necessary to effectively handle instances of time overrun and minimize their repercussions. There is a lack of research on the impact of resource limitations on time delays in the building industry in India. Evaluating the occurrence rate of time delays, the magnitude of potential time delays, and the variables that impact time delays can offer valuable information for enhancing the scheduling of a construction project, managing these variables, and enhancing project efficiency.

RESOURCE CONSTRAINTS CAUSING TIME DELAY

A significant challenge in the Indian building sector is the limited availability of resources. Resource constraints are prevalent in the majority of building projects. The primary resources in building projects include labor, materials, equipment, and finances. The time overrun of a construction project during the construction stage can be attributed to various variables, including labor shortage, unavailability of equipment and materials in the market, price

fluctuations, and cash flow issues. Therefore, it is crucial to undertake research in order to detect and assess the impact of resource constraints on time delays and their significance. These insights can assist project managers in the resource scheduling and allocation process for building projects.

1.4 IMPACTS OF TIME DELAY

Exceeding the allotted time can result in several adverse consequences, including exceeding the budget, conflicts, legal arbitration, litigation, and complete abandonment of the project (Aibinu & Jagboro 2002, Sambasivan & Soon 2007). These repercussions will hinder the overall progress of the construction industry. Therefore, it is imperative to implement measures to address and resolve delays in the timeline of a building project.

SCOPE OF THIS STUDY

- ❖ Time delay analysis in construction projects holds significant importance in assessing project performance and identifying areas for improvement.
- ❖ It helps project managers and stakeholders understand the reasons behind delays, whether they are due to unforeseen circumstances, changes in scope, or other factors.
- ❖ This analysis allows for the development of effective mitigation strategies, optimizing resource allocation, and enhancing overall project efficiency. Moreover, it plays a crucial role in dispute resolution by providing a detailed chronology of events and their impact on the project timeline.
- ❖ As construction projects continue to grow in complexity, the scope for time delay analysis becomes increasingly valuable in ensuring successful project delivery and minimizing financial and reputational risks.
- ❖ Time delay analysis begins with the identification of delays. This includes recognizing both critical and non-critical delays, understanding their root causes, and categorizing them based on their impact on project timelines.
- ❖ Delays can result from various factors, such as design changes, unforeseen site conditions, weather, or resource shortages. A comprehensive time delay analysis involves a detailed examination of these factors to pinpoint the root causes. Understanding the reasons behind delays is

crucial for developing effective strategies to mitigate them in future projects.

- ❖ Analyzing the impact of delays is essential for evaluating their consequences on the overall project schedule and budget. This involves assessing the ripple effects of delays on subsequent activities, project milestones, and contractual obligations.

OBJECTIVES OF THIS STUDY

- To identify the core issues affecting completion of construction projects
- To examine the major reasons for the time overruns in construction projects.
- To chalk out initiatives requisite for short term as well as long term to reduce time.
- To analyze how professional project management practices can bring about a positive change in the completion of construction projects on time and within budget.
- To offer suggestive frame work for the actions to be taken for expediting construction projects
- To identify delay factors in construction projects
- To rank the delay factors according to the importance level on delays in project
- To find the tools to analysis and evaluate the time delay factors in the construction.

METHODOLOGY OF THE PRESENT STUDY

Figure 1.1 provides a description of the methodology that was utilized in the present work.

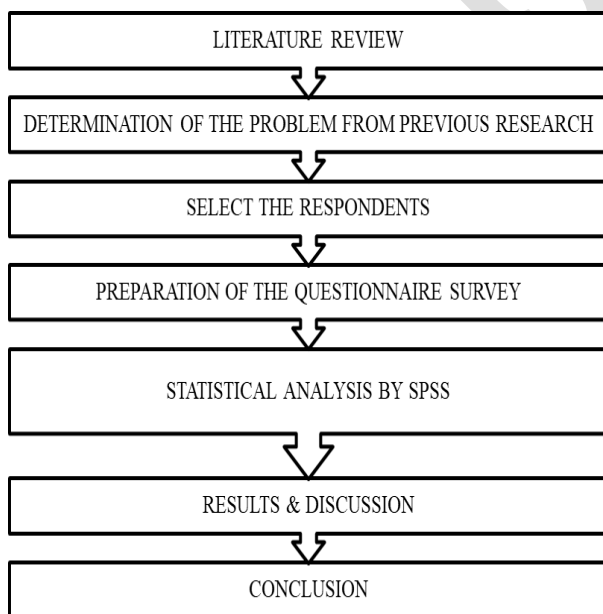


Figure 1.1 Methodology of the present research

LITERATURE SURVEY

Diana Binti Musa (2012) worked on “causes and effects of delay in construction industry projects”. According to her research projects can be delayed due to number of reasons that may due to client, contractor, acts of God or third party. According to the study delays can be minimized when causes are identified. The study was carried out on literature review and questionnaire survey. The serious causes which contributed to the delay includes insufficient number of equipments , poor site management and supervision, shortage of materials, improper project planning and scheduling, incompetent project team, contractors financial difficulties mentioned manner will help to reduce the delays in projects.

Shruti and Dinish (2014), According to this study delays can minimized only when there causes are identified .The causes of delay where categorized into different groups to make a questionnaire survey on account of owner, contactor, labor, equipment, material respectively .The paper also reports about the effects of delay as: Time overrun, Profit reduction for contractors, Distrust within the parties, Delay in the work progress payments, Disputes between the owner and contractor. The study tells about the following two techniques for analyzing the impacts of delay:

Ankush C. Khona, Ashish (2018) studied reduction of delays in infrastructure projects”. In this paper they explained the proper way to reduce the delays to greater extent. They give following steps: Perform advocate initial planning, Script out a well defined WBS, Proper vendor evaluation selection, Regular tracking and monitoring, Clear and continuous communication .Thus executing the project in above

Assaf, Al- Khalil& Al – Hazmi (1995) in their research titled —Causes of Delay in large building construction projects| studies a variety of reasons for delay in construction of large building projects in Saudi Arabia from three viewpoints such as contractors, owner and architect / Engineers. The study was done with 56 questions that cover all three categories in the study. The study identifie d that preparation of shop drawings, Delays in contractor’s progress, payment by owners are believed to be the major reasons for time delays according to the contractors. The study also identified that cash flow, subcontractors’ schedules, tardiness in owner decision making are main reasons for delay according to architects/engineers. The third

category owners believed that Design errors, extreme bureaucracy in project organization, and labour shortages are the key reasons for time delays in construction of large building projects in Saudi Arabia.

Shreyash (2013) studied the effect of project cost and time monitoring on progress of construction project in India. The author collected data on Roads & Highways, Bridges & Stadiums, Real Estate and Oil & Gas projects and investigated the relation between project control, monitoring and project progress and concluded that the project monitoring decreases as the project progresses and thus project monitoring could be a major reason for project delays, cost and time overruns.

Sriprasert (2000) found that inefficient management of construction practices and ineffective design control system led to the issue of cost overrun in construction projects. The company management could make changes in project schedule, cost and time estimate based on changes or problems that could occur during the implementation of construction projects.

Ram Singh (2015) in his article titled —Delays and Cost Overruns in Infrastructure Projects: An Enquiry into Extents, Causes and Remedies. The study is based on 894 projects from 17 infrastructure sectors. The study revealed the following facts. Only a small number of projects get delivered in time and within the budget. Examples of successful project implementation, like construction of the Delhi Metro Rail, are few and appear only far in between. Indeed, the problem of time and cost overruns in India is widespread and stern. Yet, very few empirical studies subsist on the subject. Even rarer are the studies based on projects which are completed. As a result, the extents as well as the causes behind delays and cost overruns have remained under researched. This study examines the various issues related to delays and cost overruns in publically funded infrastructure projects

Ramanathan Chidambaram and Narayanan SambuPotty(2018) in their article Qualitative analysis of Time delay and Cost overrun in Multiple Design and Build Projects recognized that Projects are more complicated involving huge contract values, participants from multi-discipline, more specialized works, tighter schedule, stringent quality standards, etc. Ultimately, cost and time are the two key parameters that plays considerable role in a

project success. The study focuses on multiple Design and Build project which has complex risk and is governed by fixed contract sum (Lump sum). As such, there is no such specific study to address this difficulty faced in Malaysia construction industry.

Mr.SalimS.Mulla and Prof.AshishP.Waghmare (2019) in their study — A study of factors caused for time and cost overruns in Construction Project & their remedial measures identified diverse factors causing the overruns of time and cost in a construction project. The study used interview method to gather the data from officials working in 17 real estate construction projects. The study concluded that many projects are facing challenges in controlling time and cost overrun in construction industry due to delay from client in supplying materials as a part of contractual agreement further leads to delay in clearing the accounting bills. The study also discovered that further these main problems are supplemented by other problems in delaying the construction of projects. The study suggested that usage of better project management techniques help in controlling the overruns and helps in improving the productivity as planned

Sai Murali Krishna Reddy Raya and S.S Bhanu Prakash (2022) in their article titled cost and time overruns in Indian construction industry| tried to make out the main cause for time over run and cost overrun in construction industry in India. The study revealed that regular changes in design, weak project management, inappropriate contractors, unskilled manpower, inaccuracy of material estimate, complication of works, and usage of poor software are main reasons for time overrun and cost overrun in the Indian construction industry. The study recommended that better inventory control management, usage of appropriate software, thorough focus on activity based control can be used as techniques to prevail over the problems arising due to time overrun and cost overruns.

Sai Murali et al (2020) in their article Cost and Time Overrun in Indian Construction Industry| conducted an extensive research to identify the root cause of time and cost overruns in construction projects that lead to the delays in the project completion. Time and cost are the crucial elements of any project. It is of supreme importance to study, analyse and evaluate the significant factors leading to these constraints and recommend the best measures to overcome time and

cost overrun constraints. The study identified repeated design changes, poor project management, inappropriate contractors, unskilled manpower, inaccuracy of material estimate, lack of appropriate software, difficulty of works as the main causes for time and cost overruns in Indian construction industry. The study suggested that time and cost overruns can be controlled with the help of improved inventory control, usage of adequate software and focus on activity based control.

Ananth Narayan Shete and Vaibhav DurvasKothawade (2016) in their study *An Analysis of Cost Overruns and Time Overruns of Construction Projects in India* tried to recognize the causes and effects of cost and time overruns in construction projects. The major purpose of the study is to identify the key reasons for cost overruns in construction projects in India as well as the critical success factors that are helping to avoid the cost overruns. Two distinguished Indian construction companies with similar characteristics were chosen for the study. Interview method and questionnaire survey were selected to collect data from the respondents. The respondents are project managers, contractors, consultants, construction managers, and representatives of clients. The study revealed that cost overrun in building construction projects are political situation, fluctuation in the prices of materials, level of competitors, currency exchange, and economic volatility. The study suggested paying a lot of thought to project planning, Material prices and labour rates should be updated continuously, sufficient time should be given for preparing feasibility studies, planning, design, information documentation and tender submission.

Vaibhav and Ghaitidak (2016) studied the elements of cost and Schedule Overrun in Construction Projects studied about the factors that influences schedule overruns and cost overruns of a project. The study presented that Low productivity of labour, delaying in bill settlement, lack of maintenance of the equipment, poor procurement programming of materials, Strikes, riots and other external factors was the most serious factor that influence project delay. The study highlighted that delay in preliminary handing over the site was one of the most considerable factors that may lead to cost overrun. The study also presented that contractor's delay of material delivery and equipment lead to cost overrun. The study also revealed inflation of prices also adds to cost overrun.

Reshma Mary Johnson and Robin Itty Ipe Babu (2018) in their article *Time and Cost overruns in the UAE construction industry: a critical analysis* recognized the major causes construction delays and cost overruns in the UAE construction sector. The study identified that performance of the industry mainly determined by the timely completion of project within the anticipated budget and at the same time not compromising in quality. The research revealed that design variations from clients and consultants, unrealistic schedules and completion dates projected by clients, delays in getting permissions as well as approvals from governments, inaccurate time estimations by the consultants, and change orders from clients are rated as top five time overrun causes in UAE construction industry. The study also highlighted that design variations, poor cost estimation, delay in client's decision making process, financial constraints of the client and unsuitable methods of procurement are rated as five major causes of cost overruns in UAE construction industry.

Doloi et al. (2012) carried out research to analyze the factors affecting the construction delay project in India. They chose a set of 45 elements. Their study initially identified critical factors that influence the delay in the Indian construction industry and established relationships between key attributes to develop predictive models to assess the impact of these factors on the delay. Questionnaires and personal interviews form the basis of their research. The study investigated the importance of delay factors using factor analysis and regression modeling. From the factor analysis, the main elements of the construction delay were the lack of commitment, the subsequent inefficient site management and the poor site coordination in third place.

Ghulam and Kassim Gidado (2013) reported that contracts under months contributed to the delay. They concluded that there were two reasons for the delay between all parties of "security" and "corruption". Inadequacy of security is the most difficult task for implementation of construction project. It led to project delay and increased cost. Corruption has a serious impact on construction delay, which poses a serious threat to the improvement of the construction industry.

Anu and Sudhakumar (2014) reported that the results of the questionnaire survey resulted in delays in productivity due to productivity decline to identify factors affecting the labor productivity

of project managers, site engineers, inspectors and craftsmen in Kerala. There are timely acquisitions of materials on the site, delayed delivery of materials by suppliers' blows and blows by political parties, frequent revision of drawings and designs productivity.

NitinChaphalkar and KC Iyer (2014) says that when inappropriate handling is done, the parties' time and funds are in conflict, and conflicts may create stakeholder concerns at the construction stage leading the project for a long stay.

Prakash Rao and Joseph CamronCulas (2014) concludes that poor project planning and planning, delays in on-site transfers and delays in the work of subcontractors are the three most critical factors that the contractor causes, which has an impact on project performance, followed by delays on delivery and delivery. Factors that occurred too late when changing and approving design documents. The survey found that 51% of the delays were caused by customers, followed by 36% of contractors and 13% of consultants. Research from ARC File Solutions (2015) shows that file management issues are the main cause of delays and timeouts on construction projects.

Abdalla M. Odeh & Hussien T. Battaineh (2022), In Jordan, contractors and labor productivity was the most important delaying factor. Delays are costly and often argument and claims, damages the feasibility for the project owners and progress of the construction industry

Sadi A. Assaf, Sadiq Al-Hejji (2006) Causes of delay in large construction. In this paper, 73 causes of delay were identified by field survey. Three parties were participated in it. The common causes of delay arose from all parties were change order by the owners during construction to avoid delay, Delay in progress payment, ineffective planning and scheduling, shortage of labors, difficulties in financing on the part of the contractor.

Hoai et al. (2008) studied time delay and cost overrun of 87 construction projects in Vietnam. Based on a questionnaire survey, they identified five most important causes of time delay and cost overrun of Vietnamese construction projects: (i) Poor site management and supervision, (ii) Poor project management assistance, (iii) Financial difficulties of owner, (iv) Financial difficulties of contractor, and (v)

Design changes. Based on factor analysis, they further concluded that the slowness and lack of constraint, incompetence, design, market and estimate, financial capability, the government and the worker were the principal factors contributing to the time delay and cost overrun of construction projects in Vietnam.

SUMMARY FROM LITERATURE

This chapter presented the literature review on the past studies carried out in India and in other countries. It also listed the inferences from the literature review. The delays experienced in construction projects can be ascribed to many sources. The factors contributing to delays in construction projects encompass change orders initiated by the owners to mitigate delays, delays in progress payments, insufficient planning and scheduling, scarcity of labor, and issues in contractor finance.

DELAY ANALYSIS IN CONSTRUCTION

In construction, delay could be defined as the time overrun either beyond completion date specified in a contract or beyond the date that the parties agreed upon for delivery of a project. It is a project slipping over its planned schedule. The delay in the project has an adverse effect on project success in terms of time, cost and quality.

Time delay analysis in construction management is a critical process aimed at identifying, assessing, and mitigating the causes and impacts of delays in a construction project. It involves a comprehensive evaluation of the factors contributing to project timeline disruptions, such as unforeseen site conditions, design changes, material shortages, weather conditions, and contractual disputes. The analysis typically begins with the identification of the root causes of delays and their categorization into excusable and non-excusable delays. Excusable delays are often beyond the control of the contractor and may warrant extensions to the project schedule, while non-excusable delays may lead to penalties or liquidated damages.

Time delay analysis utilizes various methodologies, including critical path method (CPM), project schedules, and retrospective or prospective approaches, to assess the extent of delays and their impact on project completion. It plays a crucial role in dispute resolution and can help in the fair allocation of responsibilities and liabilities among project stakeholders. Effective time delay analysis enables

construction managers to enhance project planning, risk management, and ultimately contribute to the successful and timely completion of construction projects.

STUDIES ON DELAY ANALYSIS

Construction project planning

Planning explains “what” is going to be done, “how”, “where”, by “whom”, and “when” for effective monitoring and control of complex projects. The objective of project planning is to complete the construction within the specified time and budget. In construction project planning the steps need to be identified are as follows.

- ✓ Feasibility of the project
- ✓ Project management plan
- ✓ Identifying the constraints in the project (time, cost, resources)
- ✓ Project delivery method, stakeholders, funding sources
- ✓ Construction method
- ✓ Identifying risk in project
- ✓ Milestone, duration and budget
- ✓ Roles and responsibility
- ✓ Preparation of contract documentation

Project scheduling

Project scheduling covers only the issue of when? I.e. when works need to be done and completed. By doing project scheduling it helps to control and measure the project duration and provides information for timely decisions to be taken when there is a change in schedule. The results of doing a detailed project schedule are duration of the project and completion date can be easily tracked, helps to calculate the start or end of a specific activity, evaluate the effect of changes, improves work efficiency, predict and calculate the cash flow, resolve delay claims and it serves as an effective project control tool.

Types of project scheduling

Selection of the most appropriate scheduling technique depends on the size and complexity of the construction Project, the preferences of the entity preparing the schedule, and the scheduling requirements of the Contract. The most common scheduling techniques used for construction projects are Gantt Charts or bar charts, linear schedules, program evaluation and review technique and Critical Path Method (CPM) schedules.

Progress monitoring

When updating a project, actual progress is recorded for each activity relative to the date of each update. This regular update will include progress on values for: dates on which activities started or finished actual percent of work completed within each task, actual resources expended on each task and actual cost expended on each task. There are six basic techniques for measuring the progress of a task in a CPM network as follows: Unit Measure, Incremental Milestones, Start/finish, Observational Assessment, Level of Effort/Cost Ratio and Equivalent Units.

Classification of construction delays

The classification of delays is dependent upon the type and magnitude of the effect that an activity will have on the project and who is responsible for the delay among the stake holders. Hence they are classified into four categories such as Critical or noncritical, Excusable or non-excusable, Compensable or Non-compensable and Concurrent or Non-concurrent. Construction delays can be classified into several categories based on their causes and impacts. One classification divides them into excusable delays, which are beyond the contractor's control, such as extreme weather conditions or unexpected site conditions, and inexcusable delays, which result from the contractor's actions or negligence. Another classification distinguishes between concurrent delays, which occur simultaneously with other delays and may complicate determining responsibility, and non-concurrent delays, which happen independently. Additionally, delays can be categorized as critical, meaning they affect the project's overall timeline significantly, or non-critical, with less impact on the completion date.

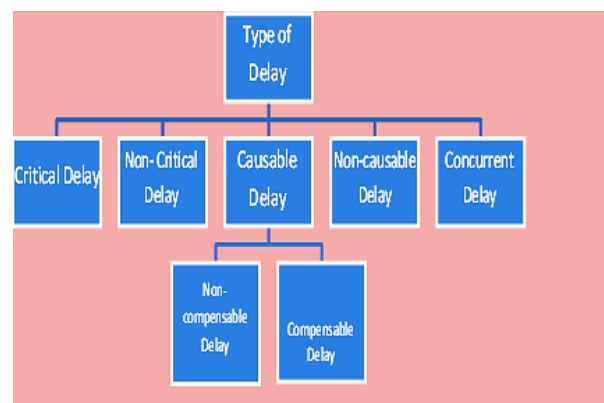


Figure 3.1 Types of delay in project

Critical Versus Non-Critical Delays

The delays that affect the project completion time or date are considered as critical delays. And the delays that do not affect the project completion time or date are noncritical delays. If certain activities are delayed in the construction project life cycle, the project completion date will be delayed. The determining which activities truly control the project completion date depends on the following: The project itself, the contractor's plan and schedule (particularly the critical path), the requirement of the contract for sequence and phasing and the physical constraint of the project.

Compensable and Non-Compensable Delays

Compensable delay is caused by the owner or the owner's agents. A compensable delay is a delay where the contractor is entitled to a time extension and to additional compensation such as payment for the delay. Non-compensable delay is caused by third parties or incidents beyond the control of both the owner and the contractor where the contractor is normally entitled to a time extension but no compensation for delay damages

Concurrent or Non-concurrent.

Concurrent delays are two or more parallel and independent delays to the critical path of a project. Concurrent delays can be on the same critical path or on a parallel critical path. Concurrent delay is when two or more delay events happen either at the same time or different times but their effects is felt simultaneously (Hastak, 2015).

“True concurrent delay is the occurrence of two or more delay events at the same time, one an Employer Risk Event and the other a Contractor Risk Event. The effects can be felt at the same time. For instance, the Owner fails to offer access to the site, and the Contractor has no resources mobilized to implement any work“(SCL, 2018).

The following figures are some situations of Gantt Chart Planned Vs Actual- of Concurrent delay at the same and different time from owner and contractor.

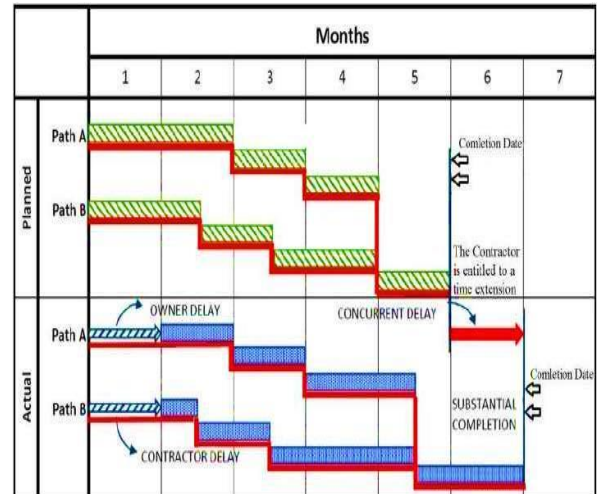


Figure 3.2 Gantt chart Planned Vs Actual- Delay at Same Time from Owner and Contractor

From Figure 3.2 above the owner delay and contractor delay happen and finish at the same time so the contractor is entitled to extension of time without any compensation.

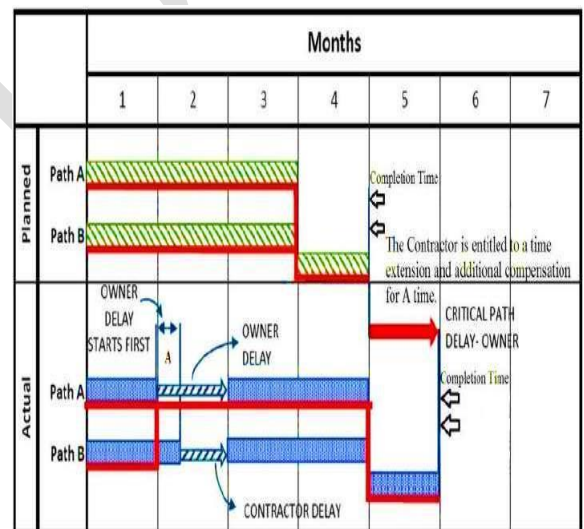


Figure 3.3 Gantt chart Planned Vs Actual Delay at different times from Owner and Contractor

Delay Analysis Techniques

Delay analysis is a analytical process that should be employed with project documentation along with collected data from project site. The selection of delay analysis depends on the variety of factors and the available records. There are five commonly used delay techniques.

1. Impacted as-planned method
2. Time impact analysis method
3. Collapsed as-built or but-for analysis method
4. Windows analysis method
5. As-planned versus as-built (Total time) method

Impacted as-planned method

According to Trauner et al. (2009), in this method the analyst specifies the as planned schedule, and inserts into this schedule the changes which caused project delays. These changes are the only determined delays recorded during construction process which may have affected the project duration. Trauner et al. (2009) point out the major weaknesses of this method as it does not reflect the dynamic nature of construction project and the critical path.

Time impact analysis method

The analyst determines the amount of project delay resulted from each of the delaying activity successively by calculating the difference between the project completion date of the schedule after the addition of each delay and that prior to the addition (Ndekugri, Braimah, and Gameson, 2008).

Collapsed as-built or ‘but-for’ analysis method

In this method, the analyst studies all contemporaneous project documentation and prepares a detailed as-built schedule instead of an as-planned schedule as mentioned in the what-if method. The analyst subtracts or removes activities which affected the project from the as-built schedule (Trauner et al. 2009).

Windows analysis method

Window analysis method is also called the contemporaneous period analysis and snapshot method. In this method, the basic concept is that the total project duration of CPM schedule is divided into digestible time periods or windows (e.g., monthly) and the delays that occurred in each windows of time are analyzed successively by focusing on the critical paths (Hegazy and Zhang, 2005).

As-planned versus as-built (Total time) method

Basically, the main concept is that the as-planned versus as-built method compares two schedules, which is why it is also called “the total time method or net impact method”. In this method the assumption is that one party (contractor) causes no delays and other party (owner) causes all delays.

Programme updates

It is used to document the performance of the employer, the professional team, designers, and the contractor and their ability to meet commitment dates. Programmes are updated to communicate actual project status from time to time, keep the programme relevant as a useful management tool, record actual performance of all parties alike, record changes to the original plan and support forensic or prospective delay analysis. When no frequency is specified, it is unlikely that a contractor will submit updated CPMs to the employer until extensions of time are granted or significant changes to scope or sequence are incorporated into the project. The minimum data required to properly update a programme would be percentage complete, remaining duration (%), actual start, and actual finish.

Records

Once the program update is done then changes need to be recorded. When good record keeping procedures are established and maintained, contract administrators are often able to access key information quickly and in a timely enough manner to respond to crises and manage problems at the time they arise. Many standard forms require contractors to provide notice of an intention to make a claim for time and/or money within a reasonable time after the event which gave rise to the claim. Records can be inspected by the employer’s representative from time to time. For each delay event an event analysis needs to be done.

CONCLUSIONS AND WORK SCHEDULE FOR PHASE 2

- ❖ Based on previous studies and on-site observations, several variables causing time delays have been identified.
- ❖ Various causes contributing to time delays are identified, including those related to project planning, scheduling, and other factors.
- ❖ The questionnaire survey questions are preformulated for later quantitative analysis.
- ❖ A statistical analysis will be performed on the collected and provided data. The time delay considerations will be listed based on the on-site observations

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