

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: www.ijirset.com

Vol. 8, Issue 4, April 2019

Forensic Schedule Delay Analysis in Construction Projects Using Primavera

Tooba Batool¹, Prof. M.C. Paliwal², Prof. Subrat Roy³

M.Tech Student (C.T.M.), Department of Civil and Environmental Engineering, NITTTR, Bhopal, India¹

Associate Professor, Department of Civil and Environmental Engineering, NITTTR, Bhopal, India²

Professor, Department of Civil and Environmental Engineering, NITTTR, Bhopal, India³

ABSTRACT: In major construction projects, Forensic schedule delay analysis is a method to study and investigate the activities/events that cause delays. Delays lead to unwanted disputes and claims between the owner, contractor and other involved parties. If disputes and claims do not settle down amongst the parties themselves, then arbitrator needs to get involved. Therefore, proper analysis and documentation of the project is necessary as it forms the basis on which disputes and claims are sorted out by the arbitrator/ jury. In real time execution of projects, delays are inevitable and that affects the financial budget of the project. Causes of delays, their impact on the construction progress and liability of involved people is a debatable issue. Proper analysing and examination of construction progress in different stages however helps to find out reasons and responsibility of delays being caused. Arbitrators, boards, Courts and agencies in many jurisdictions prefer the use of forensic schedule analysis in determining legal claims for delays caused during the course of construction. Also with use of management softwares like MS PROJECT and PRIMAVERA etc., it becomes easier to monitor the different construction stages and find out delay causing events which can be brought to the notice of concerned parties. This leads to much needed transparency amongst different organizations involved in the same project. Furthermore, forensic analysis involves delay analysis techniques like time impact analysis, window analysis, impacted as planned analysis etc. Which makes it all the more convenient to find out critical activities/ events causing delays and the party/ parties responsible for causing them. This helps in settlement of claims and disputes.

KEYWORDS: Forensic, Project, Management, Activities, Construction, Delays, Analysis.

I. INTRODUCTION

In construction projects, delays are inevitable. Delay is the variation between the planned duration and realistic duration of a construction project. Big projects are susceptible to numerous changes throughout the construction phases. This leads to arguments, controversies, debates between the concerned parties often leading to costly disputes and claims. Knowing the origin, reason and cause of delay becomes important. The involved parties get involved in conflicting issues as to who owns the responsibility for delay. Hence, it is obligatory to have proper detailed documentation of each activity of the project. Proper analysis and record keeping is proof of what went wrong, when, where and by whom. This leads to clearance of doubts and also becomes easier for the arbitrator to give wise judgement. Time, money, scope and quality are major forms of disputes and claims in construction projects. If proper forensic analysis is not available, it leads to issues which otherwise could have been avoided. Lot of money and time is put on stake by merely ignoring the importance of a good, detailed forensic delay analysis. A detailed, informative delay analysis can help resolve many disputes timely and appropriately. Whenever a project delay causes a project to complete late, someone spends money; the Contractor pays liquidated damages costs or the Owner pays extended general conditions costs. The large values associated with these fees combined with the complexity of analysis makes forensic schedule delay analysis very important.

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: www.ijirset.com

Vol. 8, Issue 4, April 2019

The objectives of this paper are:

- To investigate the delay factors by revealing problems that affect construction project performance.
- To determine general causes of construction delays through a literature survey.
- To identify 'types of delays' and adopting proper 'delay analysis techniques' in forensic schedule analysis of a project.
- To improve planning strategy, control and study the delay factor of construction projects by using smart Current programming software like Primavera.

II. LITERATURE REVIEW

Sadi A. Assaf, Member, Mohammed Al-Khalil ,Muhammad Al-Hazmi in their paper (**Large Building Construction Projects Delay causes**), chose samples of projects from different contractors. A study was undertaken and after monitoring and discussions with individual personnel, finances were found out to be leading cause of disputes and environment as least. Architects, engineers, managers, labourers were asked to rate different causes according to their on field experience.

Nuhu Braimah, in his paper (delay analysis techniques – application issues review and need for improvement), has aimed at explaining delay analysis techniques. He has explained each delay analysis technique with help of a case study project. He also explains that although delay analysis techniques help in analysing delays but practically their use is limited due to lack of knowledge and awareness of these techniques amongst the involved personnel. This is a prime reason for these techniques not being used and the claims and disputes remain on hold. Proper knowledge of these techniques is of utmost importance. He uses delay analysis techniques on a case study project and cite out issues often not addressed by these techniques and hence scope for improvement prevails.

In the paper (**Critical path effect based delay analysis method for construction projects**) the authors (**Jyh-BinYang, Chih-KueiKao**) have put forward the fact that existing analysis techniques have certain advantages and disadvantages. So they have devised their own analysis techniques based on amalgamation of existing techniques and used critical path method as basic scheduling tool. The new technique proposed by them is "EDAM- effect based delay analysis technique. In this analysis activities affecting critical path are taken into account.

Nuhu Braimah and Issaka Ndekugri in their paper "**Consultants' Perceptions on Construction Delay Analysis Methodologies**" have explained that delay claims settlement remain unresolved efficiently because of :

- insufficient record keeping ,
- improper use of critical path method
- Lack of knowledge regarding delay analysis techniques.
- Internal politics

In this study , the author also create awareness regarding violation of engineering ethics wherein subsidiaries tend to favour their own boss. For example, the quantity surveyor tends to favour the owner. So internal politics makes it all the more difficult for analysis to be done accurately.

Norbert J. Delatte Jr., in his paper titled (**Beyond Failure: Forensic Case Studies for Civil Engineers**) has stated that Forensic analysis comes into action when there is an engineering fail. Any kind of engineering fail leads to

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: www.ijirset.com

Vol. 8, Issue 4, April 2019

speculation. These failures are widely propagated but they do tell what should be done and what should be avoided to prevent repetition of existing failures to a considerable extent.

Steve Scott; Richard Anthony Harris; and David Greenwood in their paper titled (**Assessing the New United Kingdom Protocol for Dealing with Delay and Disruption**)

have given details and benefits of society of construction law protocol. After analyzing that forensic analysis are not being carried out properly, and existing delay analysis techniques not being implemented efficiently, the engineering society of United Kingdom has come up with a protocol called society of construction law protocol. This protocol hands out rules which are fair concerning all parties. It also gives guidelines on how the project should be handled, how finances and personnel should be managed. It helps the jury to take favourable decisions regarding claims, disputes and extension of time requests.

Vishal Annappa Nimbale, Prof. Balasaheb Jamadar in their paper (**Planning, Scheduling and Allocation of Resources for Multi-Storied Structure using Oracle's Primavera P6 software**) have emphasised using of modern developing technologies in all construction projects, big or small. The author used Primavera software to show construction progress of a multinational (8 storey) building in Pune. The authors have recommended use of advance softwares like primavera for planning, scheduling, and resource allocation of the project. They explained how proper use of software can help in efficient management of projects. They also emphasised that in India, computer based management is often discouraged especially in small projects and in big projects, it is not used effectively leading to uprising of contentious issues.

III.METHODOLOGY

The project considered is a gulf based project. The delays have been analyzed using Time Impact analysis wherein a stop-action picture of the project is developed each time it experiences a major delay situation. The schedule is then updated at this delay period and the effect of the delay is analyzed to establish a new completion date. The difference between the new completion date and the date prior to the exercise gives the delay caused by that particular impact. A "fragnet" or sub networks are sometimes prepared to depict the impact of the delay event, e.g., change orders on the schedule. It is an effective technique because the delays are analyzed using real time CPM (critical path model). With help of primavera as planned schedule, as planned finish dates were considered and compared to as built completion dates. From this, duration of delays was calculated of major delay events. The event with maximum duration of delay was presented for claiming extension of time by the contractor.

Forensic analysis methodology

- Construction delay background and claims information should be available.
- Identification of delays (excusable, compensable, non excusable, non compensable)
- Mitigation of delays
- Project information source and software used should be taken into account.
- AACE Recommended Practice review and applied wherever needed.
- Choosing of Delay analysis methodology
 - As-Planned vs. As-Built method

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: www.ijirset.com

Vol. 8, Issue 4, April 2019

- Impacted As-Planned method
 - As planned but for method
 - Collapsed As-Built method
 - Window Analysis method
 - Time impact method
- Delay analysis for exploring the cause, duration and responsibility of the delay
 - Settling of disputes and claims using rules set up by SCL protocol and clauses mentioned in the contract.

Brief description about the project

The project is divided into two stages which are further divided into four phases.



Figure 1 – Phasing Layout

Stage	Description	Contract completion
Stage 1	Phase 1 – 7 Buildings	31-08-2016
	Phase 2 – Zone B, C & D – 14 Buildings	
	Phase 4 – Multi Storey Car Park	
Stage 2	Phase 2 – Zone A – 5 Buildings	28-02-2017
	Phase 3 – Hotels, canal works etc.	
	Phase 4 – Hotels, Arcade Buildings, Water Pavilion	

Table 1 - Stage Completion Dates as per Primavera Schedule of Contract

IV. RESULT ANALYSIS

The purpose of this submission is to particularise the cause and effect of the Events experienced by the Contractor during the Contract, and demonstrate the Contractor's entitlement to extension of time under the Conditions of the

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: www.ijirset.com

Vol. 8, Issue 4, April 2019

Contract. The document is issued as a Claim for an Extension of Time for Project Completion. Reimbursement of Prolongation, Disruption and Acceleration Costs will be addressed separately. This document will demonstrate the:

- Cause of delays to progress;
- Effect of delays upon progress of the Works,
- Claim justification through reasoned argument,
- Entitlement under the Contract.

DELAY EVENT	DESCRIPTION	STAGE MILESTONE	BASELINE COMPLETION	IMPACTED COMPLETION	DELAY (CD)
DE04	Delay to PH3 Shoring	Stage 2	28-Feb-17	11-Mar-18	376
DE 03	Delay in PH4 works due to service diversion	Stage 1	31-Aug-16	09-Apr-17	222
		Stage 2	28-Feb-17	04-Oct-17	219
DE 08	Delay to Phase 2 & 3 due to Concrete Walkway decks	Stage 1	31-Aug-16	04-Apr-17	217
		Stage 2	28-Feb-17	28-Sep-17	213
DE-11	Delay due to Hybrid wall	Stage 1	31-Aug-16	07-Jun-17	281
		Stage 2	28-Feb-17	02-Dec-17	278
DE-12	Delay due to Structural Steel Decking	Stage 1	31-Aug-16	08-Aug-17	343
		Stage 2	18-Feb-17	28-Feb-18	376
DE-14	Delay due to Cathodic Protection	Stage 1	31-Aug-16	29-Mar-17	211
		Stage 2	28-Feb-17	14-Sep-17	199
DE-10	Delay in infrastructure due to Design NOC's	Stage 1	31-Aug-16	28-Jan-17	150
		Stage 2	28-Feb-17	05-Apr-17	36
DE-09	Delay to Phase 4 due to late issue of GFC DD	Stage 1	31-Aug-16	04-Jan-17	126
		Stage 2	28-Feb-17	27-Jun-17	119
DE-13	Delay due to Precast beam and hollow core slabs	Stage 1	31-Aug-16	01-Apr-17	214
		Stage 2	28-Feb-17	05-Oct-17	220
DE-15	Delay due to late issue of Design Information & Design NOC's	Stage 1	31-Aug-16	06-Mar-17	188
		Stage 2	28-Feb-17	24-Aug-17	178

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: www.ijirset.com

Vol. 8, Issue 4, April 2019

Liability for the event:

The liability for the above delay events belongs to the Engineer/Client as the event triggered due to design change.

Contract Provisions:

The Contractor has notified the Engineer and sought Extension of Time for the Completion of Works based on the following provisions of Contract:

The Contractor is entitled to an extension of Time for the Completion of Works pursuant to the Conditions of Contract.

Statement of the claim :

Contractor hereby claims an Extension of Time and associated prolongation costs as follows:

- 343 calendar days on Stage 01 completion extending the baseline date from 31st August 2016 to 08th August 2017.
- 376 calendar days on Stage 02 completion extending the baseline date from 28th February 2017 to 11th March 2018.

V. CONCLUSION

Failure to provide good forensic schedule delay analysis is a leading cause of disputes, creating problems to resolve claims in a timely manner.

Timely and comprehensive forensic schedule delay analysis, accessible in a lucid and persuasive approach can offer thorough calculated evaluation of quantum and accountability which helps resolve conflicts & issues in early discussions/negotiations.

Forensic schedule delay analysis is not only imperative just in claims on concluded projects, but just as vital to resolve delays that have been engrossed into the schedule during the course of the project.

At whatever time a project delay causes a project to finish behind schedule, somebody spends funds; the Contractor pays liquidated damages expenses or the Owner pays extended conditions costs. The hefty values allied with these fees pooled with the complication of analysis makes forensic schedule delay analysis very essential.

The Challenges

Schedulers / Planners are often asked to classify and analyze delays and perform forensic schedule delay analysis devoid of having appropriate understanding of analysis methodologies and techniques.

Most Project Control professionals do not have prescribed training in forensic delay analysis.

Construction industry deals with complex projects which include large schedules & need powerful monitoring & controlling of the project. It is preferable to use Primavera software in construction projects. However this software requires an extensive training to understand & practical use.

Pro active advice for professionals associated with project management:

- Insist on a CPM schedule.
- Involve all parties in development of schedule.

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: www.ijirset.com

Vol. 8, Issue 4, April 2019

- Establish systems to ensure schedule is updated accurately.
- Integrate schedule into day to day operation of project.
- Integrate schedule review into project meetings.
- Act immediately to halt source of delay and search for ways to mitigate while it is still possible.
- Make sure you accurately report status of activity, if incomplete, as of update to allow detection of inefficiency or productivity issues.
- Make use of free float effectively.
- Support all your work with evidence and exact citations from software used preferably PRIMAVERA.
- Ascertain the Delay analysis methodologies to be used with approval of all the involved parties in case of claims and delay disputes.
- All data, records, reports (manual and software based) should be accurately preserved for forensic delay analysis experts.

REFERENCES

1. Levy, S. M. (2006) —Project Management in Construction, McGrawHill, USA.
2. NuhuBraimah, (2013) —construction delay analysis techniques—A review of application Issues and improvement needs, Buildings 2013, civil engineering department, Brunel University.
3. Assaf, S., Al-Khalil, M., and Al-Hazmi, M. (1995). Causes of Delay in Large Building Construction
4. Ashley & Jaselskis (1987), Determinants of construction project success, Project Management Journal, Vol. 18
5. Wells J. (1986), The Construction Industry in Developing Countries: Alternative Strategies for Development. Croom Helm Ltd, London
6. Ruben I.M. & Seeling W. (1967), Experience as a factor in the selection and performance of project managers. IEEE Trans Eng Management, Vol. 14 (3), pp. 131 – 134.
7. David B. Ashley, Clive S. Lurie, and Edward J. Jaselskis —Determinants of construction project success — Project management Journal, Vol. 9, No.2 June 1987.
8. Alkass, S., Mazerolle, M., and Harris, F. (1996). —Construction delay analysis techniques, Constr. Manage. Econom., 14, 375–394.
9. Winter, R. MS Project for Construction Schedulers. In Proceedings of the AACE International 55th Annual Meeting, Anaheim, CA, USA, 19–22 June 2011.
10. Kim, Y., Kim, K., and Shin, D. (2005). —Delay analysis method using delay section, Journal of Construction Engineering and Management, ASCE, 131(11), 1155–1164.
11. McCredie, J. (2002). Resolving Construction Disputes, The Forensic Accountant, Available: <http://www.eotprotocol.com/press.shtml> (Accessed 2004, May 20).
12. AACE International. (2007). Recommended Practice No 29R-03: Forensic Schedule Analysis, TCM Framework: 6.4 – Forensic Performance Assessment, AACE International, Inc.
13. Australian Government (2007). National Statement on Ethical Conduct in Human Research, October 2007 reprint. Australian Government, National Health and Medical Research Council, Australian Research Council.
14. Ward, P. (2006). “Suitability of the SOCL’s Protocol’s Provisions for Dealing with Concurrency on Australian Construction Projects”. Proceedings of the CIB W89 International Conference on Building Education and Research. Hong Kong, 10th – 13th April 2006
15. Society of Construction Law, (2002) The Society of Construction Law Delay and Disruption Protocol, March 2003 reprint, The Society of Construction Law.