Effective Tactics for Delay Analysis [1, 2]

Pratyush K. Chaturvedi

ABSTRACT

This study aims at investigating the main cause of delays within Oil & Gas & Construction EPC Projects. TIA (Time Impact Analysis) is a schedule delay analysis technique to claim the contract time extension and cost due to the delays which are not the responsibilities of the contractor. The time for performance (Plan vs Actual) of a project is usually important for both the contractor and Employer (Owner/Client). The purpose of project delays is making right decisions on potential times and cost claims for both parties. This study shows the impact of delays within FEED (Front End Engineering Design) and execution phase on overall duration of the project. The requirement for performing TIA is that schedule must have recently updated and approved Critical Path method schedule.

Keywords: Oil & Gas Projects, EPC Projects, Delay Analysis, Cost Claims, Extension of Time, Scheduling, Critical Path Method (CPM), Extension of Time (EOT), Owner & Contractor, Vendor, Claim, Baseline Schedule

INTRODUCTION

A Time Impact Analysis (TIA) is a modeled method of analysis to aid in supporting a request for an extension of contract time. As defined by AACE RP 52R-06, "TIME Effect Examination is connected in Oil and Gas and Development Industry. The TIA id 'forward-looking' planned timetable investigation procedure that adds a displayed delay to an acknowledged contract calendar to decide the conceivable effect of that deferral to the undertaking culmination." On the other hand, "ACE RP 29R-03, FORENSIC SCHEDULE ANALYSIS-2011[3] (29R- 03), endeavors to characterize and portray review investigations." This demonstrates some 'Observational examination's Method Implementation Protocols (MIP 3.3, 3.4, 3.5) are every so often called 'Time Impact Analysis' (TIA). Be that as it may, most investigators think about TIA as a 'Demonstrated' examination (MIP 3.6, 3.7) [Figure 1]. Under the portrayal of MIP 3.6, ordinarily

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referred to as 'Affected As-Planned', RP 29R-03 states: 'MIP 3.6 can be utilized tentatively or reflectively'.

Taxonomy	1	RETROSPECTIVE															
	2	OBSERVATIONAL							MODELED								
	3	Static Logic			Dynamic Logic				Additive				Subtractive				
	4	3.1 Gross	3.2 Periodic		Contemporaneous Updates (3.3 As-Is or 3.4 Split)		3.5 Modified / Reconstructed Updates		3.6 Single Base		3.7 Multi Base		3.8 Single Simulation		3.9 Multi Simulation		
	5		Fix Periods	Variable Windows	All Periods	Grouped Periods	Fixed Periods	Variable Windows	Global Insertion	Stepped Insertion	Fixed Periods	Variable Windows or Grouped	Global Extraction	Stepped Extraction	Fixed Periods	Stepped Extraction	
Common Names		As-Planned vs As-Built	Window Analysis		Contemporaneous Periods Analysis, Time Impact Analysis, Window	Contemporaneous Periods Analysis, Time Impact Analysis, Window Analysis	Contemporaneous Periods Analysis, Time Impact Analysis	Time Impact Analysis, Window Analysis	Impacted As Planned, What-If	Time Impact Analysis, Impacted As Planned	Time Impact Analysis	Window Analysis, Impacted As-Planned	Collapsed As-Built	Time Impact Analysis, Collapsed As-Built	Time Impact Analysis, Collapsed As-Built	Time Impact Analysis, Window Analysis, Collapsed As Built	

Figure 1. AACE RP29R-03 Forensic Schedule Analysis

What is PROSPECTIVE and RETROSPECTIVE analysis?[4]

PROSPECTIVE ANALYSIS	RETROSPECTIVE ANALYSIS
RP 29R-03 defines prospective analyses as: "Prospective analyses are performed in real-time prior to the delay event or in real-time, contemporaneous with the delay event. In all cases prospective analysis consists of the analyst's best estimate of future events. Prospective analysis occurs while the project is still underway and may not evolve into a forensic context."	RP 29R-03 defines Retrospective analyses as: "Retrospective analyses are performed after the delay event has occurred and the impacts are known. The timing may be soon after the delay event but prior to the completion of the overall project, or after the completion of the entire project... In other words, even forward-looking analysis methods implemented retrospectively have the full benefit of hindsight at the option of the analyst."

The Time Impact Analysis is performed while a venture is in running stage. The Time Impact Analysis additionally a procedure to be utilized by the Contractor as an inward strategy to assess changes to recuperate or enhance venture consummation for delays caused by the Contractor. According to individual late experience, many contracts concur that TIA ought to be arranged and submitted to quantitatively approve the Contractor's ask for time augmentation.

[4] *THE USE (OR MISUSE) OF A PROSPECTIVE TIME IMPACT ANALYSIS PROVISION IN A FORENSIC ARENA: A CASE STUDY*. (2017). *Navigant.com*. Retrieved 26 November 2017, from https://www.navigant.com/-/media/www/site/insights/construction/2017/gcon_ifh_theuseormisuseoftias_tl_0617.pdf

Once the span of time has been settled upon, at that point the additional time-related expenses of such a deferral can be resolved regarding the agreement.

Delay claims are presently a noteworthy wellspring of contention in the Oil and Gas and development industry and it is likewise exceptionally hard to determine. The temporary worker is regularly pardoned from the outcomes and additionally is permitted remuneration for any expenses due to delays coming about because of occasions or conditions that are outside its ability to control like power majeure. Legally binding arrangements additionally permit the proprietor/Employer to recoup sold harms (LD) from the contractual worker for inability to convey the undertaking inside the agreement execution period. In both case, a point by point plan is required to look at the occasions that have made the undertakings surpass. Businesses/Owner and contractual workers have utilized many Delay Analysis Techniques (DATs) to achieve this.

To summarize this paper is written to answer the question,

i. What are different types of TIA methods?

ii. Why we use Time Impact Analysis and how to analyze the delay?

iii. Which one is preferable under what circumstances and why?

METHODOLOGY

STEP 1: Problem recognition

Every project starts with a plan: the what, when, how, where and in what order of the matter in which work will be completed. The plan is given in a greater detail, the who and when that develops the baseline schedule for the project, or the contractor's original understanding and plan of action for the project. Once the project starts, schedule updates and revisions, whether at scheduled intervals or as result of a change, creates a new schedule of record that shall meet the owner's approval. Eventually, the final schedule of record will be the as-built schedule of the project, a final documentation of actual start and finish of activities, any delays, change orders, extra work and other factors that affected project completion.

As mentioned in Figure 1. AACE RP29R-03 Forensic Schedule Analysis, by using fixed periods 'Time Impact Analysis', the time impact analysis method is the most comprehensive, integrating the actual project history into a dynamic plan. Any change, delay or interruption to the schedule calls for time impact analysis to detach and quantify the event. For this, a "S-Curve" of the CPM network is taken when the event occurs followed by inserting the delays into the network. All variations that may impact the schedule such as, the critical path may shift; float may be consumed; or new links between activities may be required; are analyzed to determine what the effect of the event will be. Any additional or revised activities will be reflected in the revised schedule. In the example below, the Delay is the owner's failure:

- To slow process in taking decision

- Freezing engineering issues and finalization of project specifications
- CMS (Construction Management System) activity has contributed significantly for such slow progress
- Conflict in tender spec and unit rate contract
- Balance ordering is delayed due to unresolved engineering issues.

STEP 2: Feasible alternatives

There are mainly 9 type of Time impact analysis approaches. amongst the 9, only four are commonly used. In this paper will discussed 4 types of TIM which are commonly used:

1) As-Planned-As Built
2) Impacted As-Planned
3) Time Impact Analysis
4) Collapsed As-Built

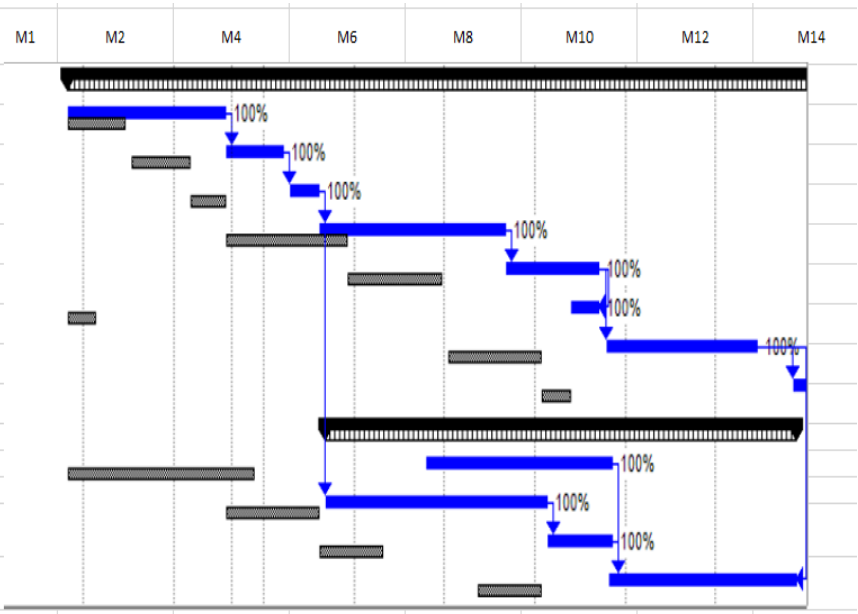
STEP 3: Development of the outcome for alternatives

1) As-Planned-As Built:

The As-planned versus As-built schedule delay analysis is retrospective method. Using this method involves comparison against the baseline or as-planned, as-built schedule against the project schedule, or a schedule that reflects through a particular point of time. This analysis is typically performed when approved baseline and as-built schedule data exists.

The implementation of the As-built schedule versus As-planned analysis methodology compares the duration, start and finish date, and relative sequences of the activities and tries to determine the root cause of each variance. The main difference between as-built completion dates and as-planned is the total of time for which the claimant will request for compensation.

ID	Task Name	Baseline Duration	Duration
1	**PART-1**	**112 days**	**413 days**
2	Basic Engineering	14 days	81 days
3	Detail Engineering	14 days	31 days
4	Procurement	7 days	27 days
5	Mechanical	28 days	79 days
6	Piping	21 days	65 days
7	Civil	7 days	21 days
8	Electrical	21 days	83 days
9	Instrumentation	7 days	26 days
10	**PART - 2 -Commissioning**	**41 days**	**249 days**
11	Boiler	42 days	76 days
12	Turbo-Generator	21 days	68 days
13	Sychronization & Start Up of Unit	14 days	34 days
14	Performance Gaurantee Trial of Unit	14 days	71 days



Benefits:

- **Simple to Prepare:**

  413 Actual delays - 168 planned delays = 245 delays days

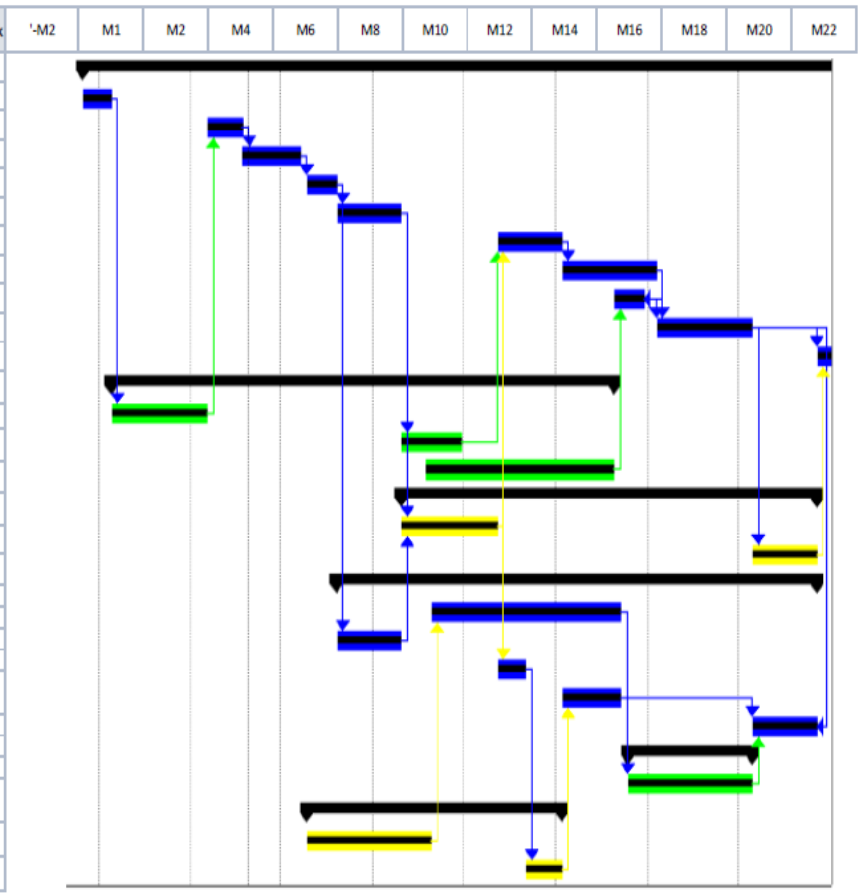
- **Drawback:** Exact delays event no information.

2) Impacted As-Planned:

The impacted as-planned method measures the impacted delays on the contractor's as-planned Critical Path Method Schedule (CPM). The delay analysis technique includes the inclusion of new exercises or expansion of exercises speaking to postponements or changes into the pattern timetable to distinguish the effect of defers exercises. Utilizing the affected as-arranged calendar investigation strategy gauges the venture's culmination date and demand for extension of time (EOT).

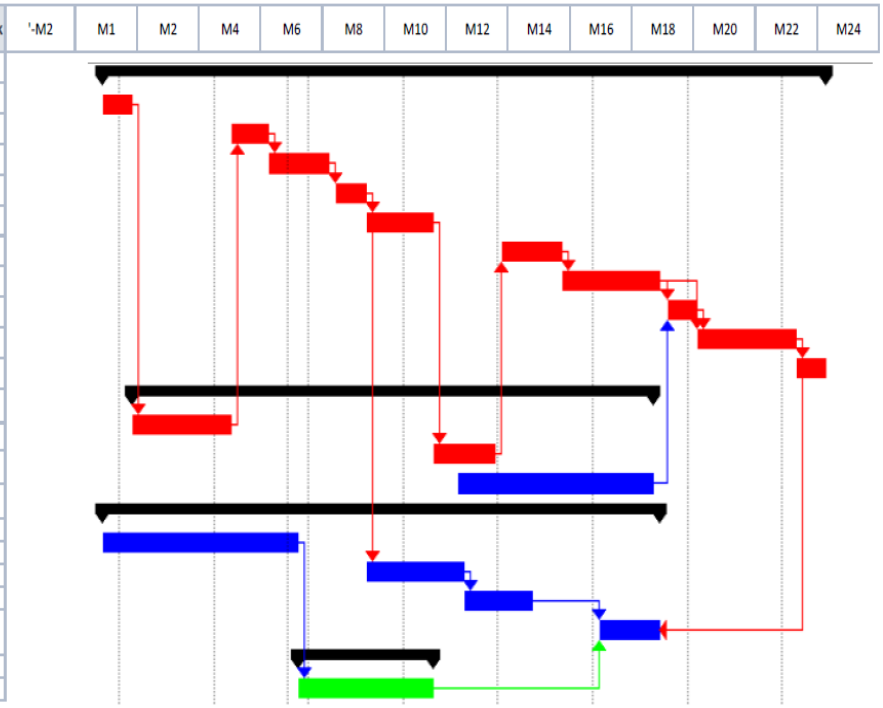
As-Built with Delays

ID	Task Name	Duration	Total Slack
1	**PART-1**	**413 days**	**0 days**
2	Basic Engineering	81 days	0 days
3	Detail Engineering	31 days	0 days
4	Procurement	27 days	0 days
5	Mechanical	79 days	0 days
6	Piping	65 days	0 days
7	Civil	21 days	0 days
8	Electrical	83 days	0 days
9	Instrumentation	26 days	0 days
10	Manufacturing	97 days	0 days
11	Delivery	10 days	0 days
12	**Owner Delays**	**280 days**	**0 days**
13	Engineering Design Change	120 Days	0 days
14	Document Clearance Delays	90 Days	0 days
15	Design Basis Delays	78 Days	0 days
16	**Contractor Delays**	**145 days**	**0 days**
17	Procurement Order Delays	90 Days	0 days
18	Civil Subcontractor Delays	58 Days	0 days
19	**PART - 2 -Commissioning**	**41 days**	**0 days**
20	Boiler	42 days	0 days
21	Turbo-Generator	21 days	0 days
22	Sychronization & Start Up of Unit	14 days	0 days
23	Performance Gaurantee Trial of Unit	14 days	0 days
24	Final Completion	2 days	0 days
25	**Owner Delays**	**96 days**	**0 days**
26	Site Clearance Delays	96 days	0 days
27	**Contractor Delays**	**110 days**	**0 days**
28	Civil Works Delays	70 days	0 days
29	Mechanical Works Delays	68 days	0 days



As-Planned with Owner Delays

ID	Task Name	Duration	Total Slack
1	**PART-1**	**334 days**	**0 days**
2	Basic Engineering	81 days	0 days
3	Detail Engineering	31 days	0 days
4	Procurement	27 days	0 days
5	Mechanical	79 days	0 days
6	Piping	65 days	0 days
7	Civil	21 days	0 days
8	Electrical	83 days	0 days
9	Instrumentation	26 days	0 days
10	Manufacturing	97 days	0 days
11	Delivery	10 days	0 days
12	**Owner Delays**	**280 days**	**0 days**
13	Engineering Design Change	120 Days	0 days
14	Document Clearance Delays	90 Days	0 days
15	Design Basis Delays	78 Days	0 days
16	**PART - 2 -Commissioning**	**81 days**	**45 days**
17	Boiler	42 days	59 days
18	Turbo-Generator	21 days	59 days
19	Sychronization & Start Up of Unit	14 days	27 days
20	Performance Gaurantee Trial of Unit	14 days	27 days
21	**Owner Delays**	**96 days**	**81 days**
22	Site Clearance Delays	96 days	81 days



Total duration of As-Built = 413 Days
Total duration of As Planned with Owner Delays = 334 days
Total duration of original As Planned = 168 days
The Difference: 334-168 = 166 days (Owner)
Contractor's Delays: 413-334 = 79 Days
Benefits: Allows for mitigation of Delays

Drawback: Very much subjective.

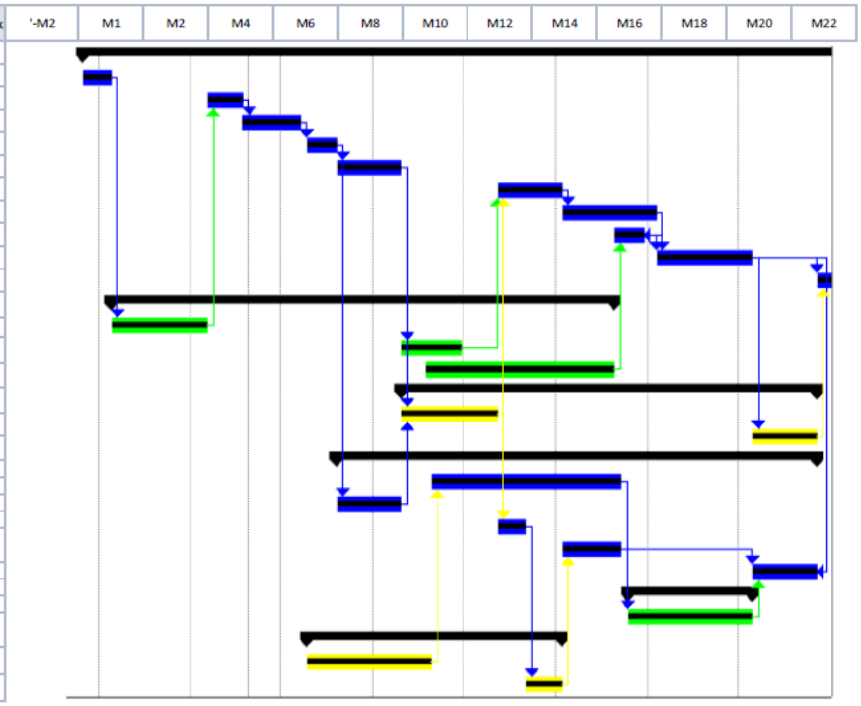
3) Collapsed As-Built:

The collapsed as built delay analysis methodology looks into the past events/projects. The method starts with the As-built schedule and then it removes the activities which represents the project delays or project changes from both contractor's and Owner's side which in turn demonstrate the effect on the project's completion date.

Implementation of collapsed as-built delay analysis usually involves detection of the project delays or project changes, after that removing the activities which represents these delays or changes which are from the as-built project schedule. The collapsed as built schedule demonstrates the date of completion of the project but it demonstrates the effects of the delays or changes which are made on a project's completion date, if there is any delay or change.

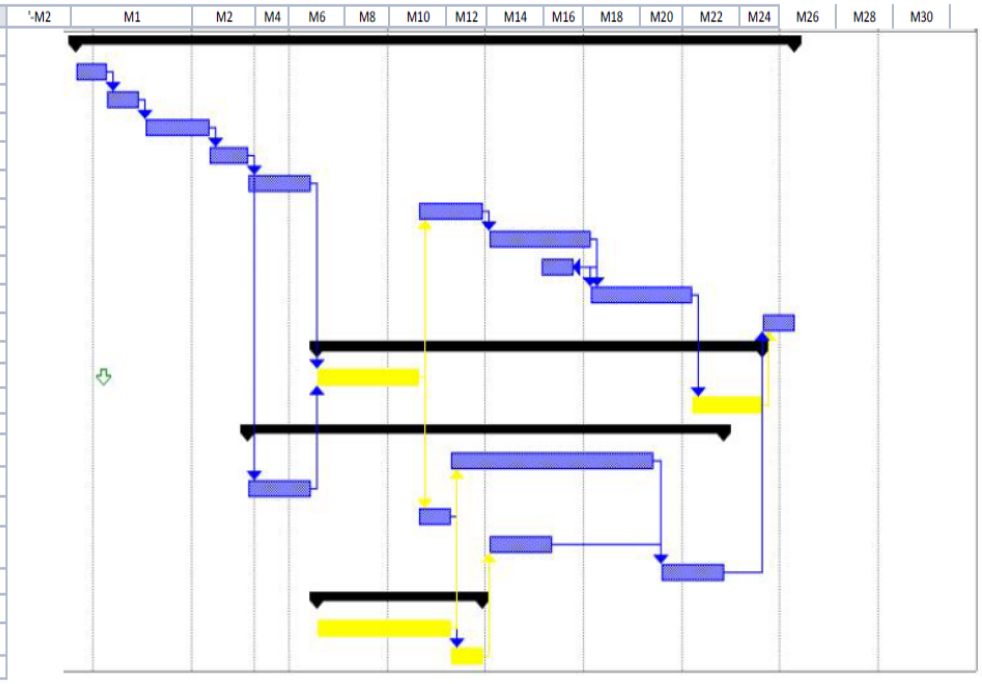
As-Built with Delays

ID	Task Name	Duration	Total Slack
1	**PART-1**	**413 days**	**0 days**
2	Basic Engineering	81 days	0 days
3	Detail Engineering	31 days	0 days
4	Procurement	27 days	0 days
5	Mechanical	79 days	0 days
6	Piping	65 days	0 days
7	Civil	21 days	0 days
8	Electrical	83 days	0 days
9	Instrumentation	26 days	0 days
10	Manufacturing	97 days	0 days
11	Delivery	10 days	0 days
12	**Owner Delays**	**280 days**	**0 days**
13	Engineering Design Change	120 Days	0 days
14	Document Clearance Delays	90 Days	0 days
15	Design Basis Delays	78 Days	0 days
16	**Contractor Delays**	**145 days**	**0 days**
17	Procurement Order Delays	90 Days	0 days
18	Civil Subcontractor Delays	58 Days	0 days
19	**PART - 2 -Commissioning**	**41 days**	**0 days**
20	Boiler	42 days	0 days
21	Turbo-Generator	21 days	0 days
22	Sychronization & Start Up of Unit	14 days	0 days
23	Performance Gaurantee Trial of Unit	14 days	0 days
24	Final Completion	2 days	0 days
25	**Owner Delays**	**96 days**	**0 days**
26	Site Clearance Delays	96 days	0 days
27	**Contractor Delays**	**110 days**	**0 days**
28	Civil Works Delays	70 days	0 days
29	Mechanical Works Delays	68 days	0 days



Collapsed As-Built without Owner Delays

ID	Task Name	Duration
1	**PART-1**	**210 days**
2	Basic Engineering	81 days
3	Detail Engineering	31 days
4	Procurement	27 days
5	Mechanical	79 days
6	Piping	65 days
7	Civil	21 days
8	Electrical	83 days
9	Instrumentation	26 days
10	Manufacturing	97 days
11	Delivery	10 days
12	**Contractor Delays**	**145 days**
13	Procurement Order Delays	90 Days
14	Civil Subcontractor Delays	58 Days
15	**PART - 2 -Commissioning**	**41 days**
16	Boiler	42 days
17	Turbo-Generator	21 days
18	Sychronization & Start Up of Unit	14 days
19	Performance Gaurantee Trial of Unit	14 days
20	Final Completion	2 days
21	**Contractor Delays**	**110 days**
22	Civil Works Delays	70 days
23	Mechanical Works Delays	68 days



Total duration of As-Built = 413 days

- Total duration of Collapsed As-Built without Owner's Delays = 210 days
- Total duration of original As Planned = 168 days
- The difference between collapsed as built and the as built schedules: 413 – 210 = 203 days (Owner's Responsibility)
- The remaining difference between collapsed as built and as planned:
- 210 – 168 = 42 days (Contractor's Responsibility)

Benefits: Very good accuracy

Drawback: No allowance for mitigation of Delays

4) Time Impact Analysis:

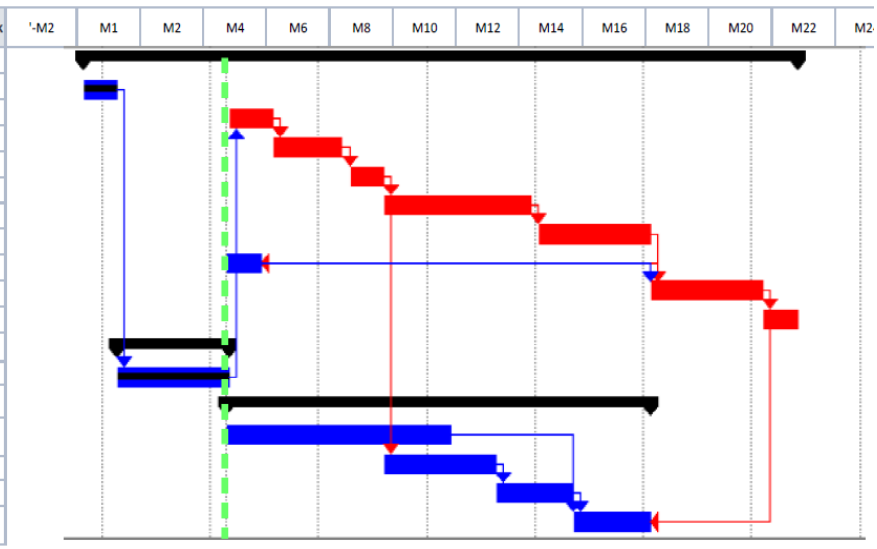
The time impact analysis (TIA) is almost same as the impacted as-planned analysis. Implementation of a Time impact delay analysis involves identifying project changes or any project delay first, and then adding new activities to the project schedule that represent that delays or change. This new schedule represents the project progress just before the occurrence of delay or change. Thus, the Impact of delay or changes affect the project completion date.

The delay is determined by the difference between the new project date and the scheduled baseline date which is caused by the particular impact. This technique is better because it analyses the delays using actual critical path method (CPM). This technique is also appropriate to use in different project phases like project execution and after completion.

Contemporaneous Period Analysis Method (Window Analysis):

CPA Method - Window Analysis 1 - Using first window 1 analysis method compared to the baseline schedule and first update becomes the new baseline for following window and evaluate the non-excusable, compensable and non-compensable delays performed at each update.

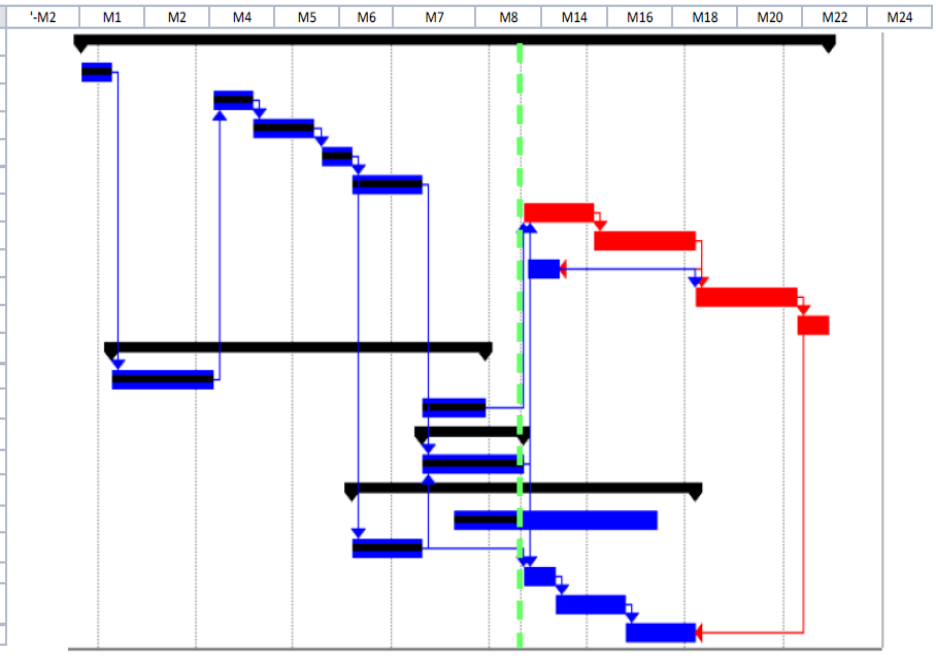
ID	Task Name	Duration	Total Slack
1	**PART-1**	**244 days**	**0 days**
2	Basic Engineering	81 days	0 days
3	Detail Engineering	31 days	0 days
4	Procurement	27 days	0 days
5	Mechanical	79 days	0 days
6	Piping	65 days	0 days
7	Civil	21 days	0 days
8	Electrical	83 days	0 days
9	Instrumentation	26 days	0 days
10	Manufacturing	97 days	0 days
11	Delivery	10 days	0 days
12	**Owner Delays**	**280 days**	**0 days**
13	Engineering Design Change	120 Days	0 days
16	**PART - 2 -Commissioning**	**81 days**	**45 days**
17	Boiler	42 days	59 days
18	Turbo-Generator	21 days	59 days
19	Sychronization & Start Up of Unit	14 days	27 days
20	Performance Gaurantee Trial of Unit	14 days	27 days



Update Number	Schedule Date (Month No.)	Project Completion (In Days)	Delay During Period	Delays			Comments
				Non Excusable	Excusable Noncompensable	Excusable Compensable	
0	0	168	0	0	0	0	
1	3	244	76	0	0	76	Engineering Design & Site Clearance

CPA Method - Window Analysis 2

ID	Task Name	Duration
1	**PART-1**	**334 days**
2	Basic Engineering	81 days
3	Detail Engineering	31 days
4	Procurement	27 days
5	Mechanical	79 days
6	Piping	65 days
7	Civil	21 days
8	Electrical	83 days
9	Instrumentation	26 days
10	Manufacturing	97 days
11	Delivery	10 days
12	**Owner Delays**	**240 days**
13	Engineering Design Change	120 Days
14	Document Clearance Delays	90 Days
15	**Contractor Delays**	**90 days**
16	Procurement Order Delays	90 Days
17	**PART - 2 -Commissioning**	**81 days**
18	Boiler	42 days
19	Turbo-Generator	21 days
20	Sychronization & Start Up of Unit	14 days
21	Performance Gaurantee Trial of Unit	14 days
22	Final Completion	2 days

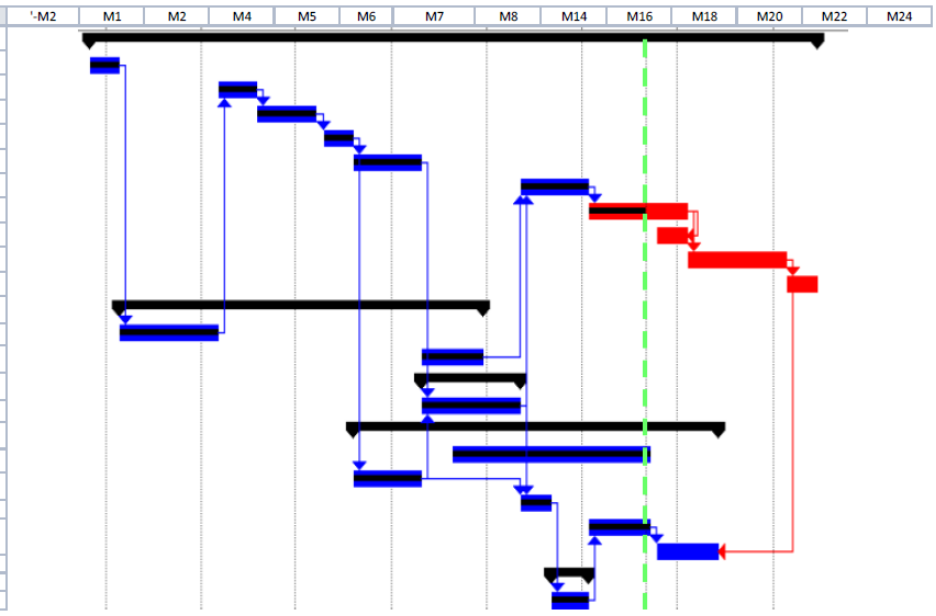


Update Number	Schedule Date (Month No.)	Project Completion (In Days)	Delay During Period	Delays			Comments
				Non Excusable	Excusable Noncompensable	Excusable Compensable	
0	0	168	0	0	0	0	
1	3	244	76	0	0	76	Engineering Design & Site Clearance
2	8	334	90	11	14	65	Document Clearance & Procuremnt order

Using window 2 analysis the impact of delays from both parties, Owner and Contractor due to the Document clearance from Owner side this is because the contractor is not able to procurement order to the vendor.

CPA Method - Window Analysis 3

ID	Task Name	Duration
1	**PART-1**	**360 days**
2	Basic Engineering	81 days
3	Detail Engineering	31 days
4	Procurement	27 days
5	Mechanical	79 days
6	Piping	65 days
7	Civil	21 days
8	Electrical	83 days
9	Instrumentation	26 days
10	Manufacturing	97 days
11	Delivery	10 days
12	**Owner Delays**	**240 days**
13	Engineering Design Change	120 Days
14	Document Clearance Delays	90 Days
15	**Contractor Delays**	**90 days**
16	Procurement Order Delays	90 Days
17	**PART - 2 -Commissioning**	**81 days**
18	Boiler	42 days
19	Turbo-Generator	21 days
20	Sychronization & Start Up of Unit	14 days
21	Performance Gaurantee Trial of Unit	14 days
22	Final Completion	2 days
23	**Contractor Delays**	**110 days**
24	Civil Works Delays	70 days

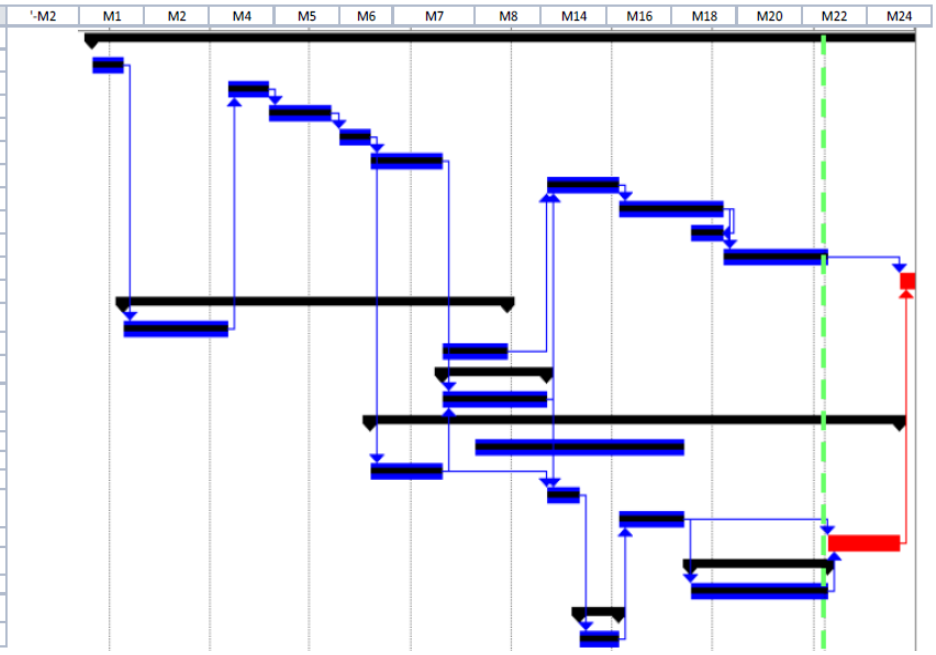


Update Number	Schedule Date (Month No.)	Project Completion (In Days)	Delay During Period	Delays			Comments
				Non Excusable	Excusable Noncompensable	Excusable Compensable	
0	0	168	0	0	0	0	
1	3	244	76	0	0	76	Engineering Design & Site Clearance
2	8	334	90	11	14	65	Document Clearance & Procuremnt order
3	16	360	26	0	0	26	Civil Works

Using window 3 analysis the impact of delays from both parties but due to delay in site clearance and finalization of plot plan. So, this is the excusable compensable delay for the contractor.

CPA Method - Window Analysis 4

ID	Task Name	Duration
1	**PART-1**	**413 days**
2	Basic Engineering	81 days
3	Detail Engineering	31 days
4	Procurement	27 days
5	Mechanical	79 days
6	Piping	65 days
7	Civil	21 days
8	Electrical	83 days
9	Instrumentation	26 days
10	Manufacturing	97 days
11	Delivery	10 days
12	**Owner Delays**	**280 days**
13	Engineering Design Change	120 Days
14	Design Basis Delays	78 Days
15	**Contractor Delays**	**145 days**
16	Civil Subcontractor Delays	58 Days
17	**PART - 2 -Commissioning**	**41 days**
18	Boiler	42 days
19	Turbo-Generator	21 days
20	Sychronization & Start Up of Unit	14 days
21	Performance Gaurantee Trial of Unit	14 days
22	Final Completion	2 days
23	**Owner Delays**	**96 days**
24	Site Clearance Delays	96 days
25	**Contractor Delays**	**110 days**
26	Civil & Mechanical Works Delays	70 days



Update Number	Schedule Date (Month No.)	Project Completion (In Days)	Delay During Period	Delays			Comments
				Non Excusable	Excusable Noncompensable	Excusable Compensable	
0	0	168	0	0	0	0	
1	3	244	76	0	0	76	Engineering Design & Site Clearance
2	8	334	90	11	14	65	Document Clearance & Procuremnt order
3	16	360	26	0	0	26	Civil Works
4	21	413	53	0	0	53	Site Clearance, Civil & Mechanical Works Delays
Total			**245**	**11**	**14**	**220**	

Benefits: Most accurate results with comparison to other methods.

Drawback: Time consuming and critical analysis

STEP 4: Selection Criteria

To understand which criteria affects the selection of our alternatives, we will take a look at all the criteria first:

- Information Availability
- Type of information
- Competency
- Time Cost Effort

ID	Type	As-Planned vs As-Built	Impacted As-Built	Collapsed As-Built	Time Impact Analysis
A	INFORMATION AVAILABILITY				
A1	Schedule Type				
A1.1	As-Planned Schedule	√	√		√
A1.2	As-Built Schedule	√		√	√
A1.3	Updated Schedule				√
A1.4	Adjusted Schedule		√	√	√
B	TYPE OF INFORMATION				
B1	CPM Approved but not updated	√	√		
B2	CPM Approved and updated	√	√	√	√
C	COMPETENCY				
C1	Time Extension	√	√	√	√
C2	Cost Claim/Compensation	Depends	Depends	Depends	√
D	TIME/COST/EFFORT				
D1	Type of Analysis	Observative	Additive	Subtractive	Additive
D2	Level of effort	Low	Low	Moderate	High

Table 2: Comparison of Delay Analysis Techniques

FINDINGS

STEP 5: The analysis of alternatives

In order to decide which technique between As-planned versus as-Built, impacted as-built, collapsed as-built, and Time impact analysis gives the best accurate results for the project in respect to above mentioned criteria.

METHOD	DATA REQUIRED	EFFORT/COST	ACCURACY EXPECTED
As-Planned vs As-Built	Low	-$-	Poor
Impacted As-Planned	Moderate	-$$-	Good
Collapsed As-Built	Above Moderate	-$$$-	Very Good
Time Impact Analysis	Comprehensive	-$$$$-	Excellent

Table 2: Analysis of Alternatives

The above table and analysis of each method or technique states that the As-Planned versus As-Built, Impacted As-Planned, Collapsed As-Built, and Time Impact Analysis is the most accurate approach.

However, with this we cannot be sure that TIA is excellent. So that to be sure we will analyze the alternatives with additive weighting technique.

QUALITY	
Excellent	3
Good	2
Fair	1
Poor	0

CRITERIA	As-Planned vs As-Built	Impacted As-Planned	Collapsed As-Built	Time Impact Analysis
INFORMATION AVAILABILITY	2	2	3	3
TYPE OF IMFORMATION	1	1	2	3
COMPETENCY	1	2	2	2
TIME/COST	1	1	2	2
EFFORT	2	2	2	3
ACCURACY	0	0	1	3
AVERAGE	1.16	1.33	2.0	2.66

Table 3

CRITERIA	RELATIVE RANK	NORMALIZED WEIGHT (A)			As-Planned vs As-Built		Impacted As-Planned		Collapsed As-Built		Time Impact Analysis	
					B	A*B	C	A*C	D	A*D	E	A*E
INFORMATION AVAILABILITY	0	0/15	=	0	2	0	2	0	3	0	3	0
TYPE OF IMFORMATION	1	1/15	=	0.07	1	0.07	1	0.07	2	0.14	3	0.21
COMPETENCY	2	2/15	=	0.13	1	0.13	2	0.26	2	0.26	2	0.26
TIME/COST	3	3/15	=	0.2	1	0.2	1	0.2	2	0.4	2	0.4
EFFORT	4	4/15	=	0.27	2	0.54	2	0.54	2	0.54	3	0.81
ACCURACY	5	5/15	=	0.33	0	0	0	0	1	0.33	3	0.99
SUM	15	SUM		1	SUM	0.94		1.07		1.67		2.67

Table 4

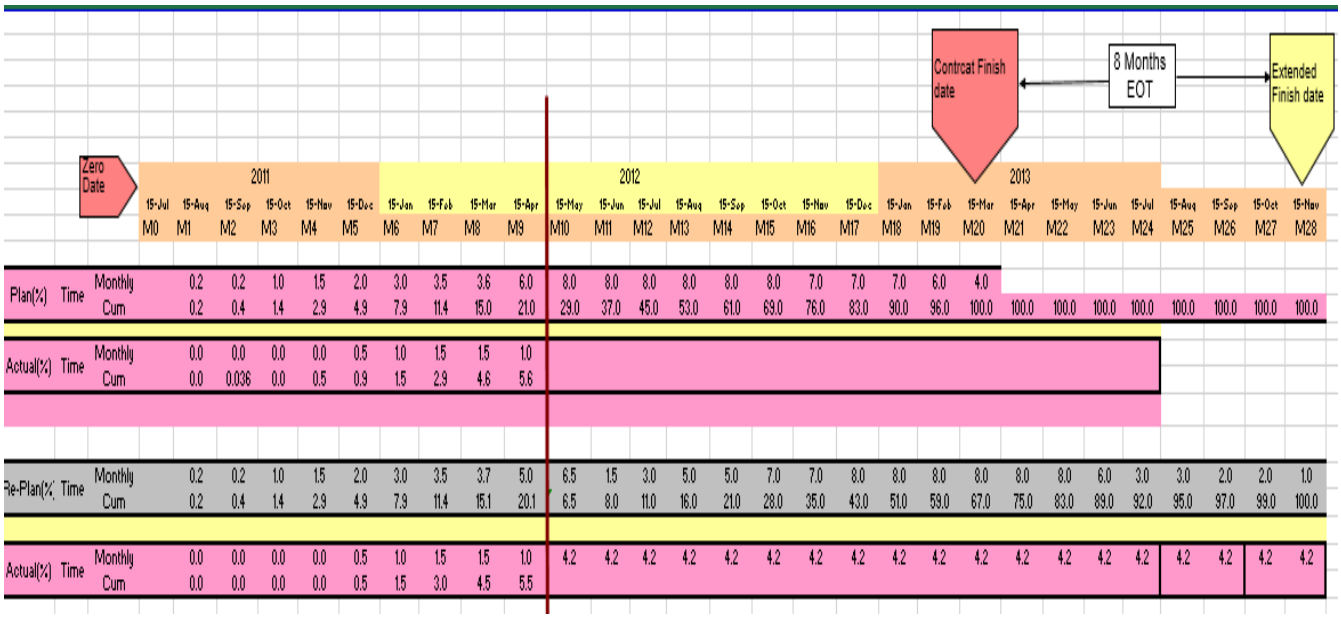
Based on above table number 1,2,3 and 4 and analysis, it is clearly visible that Time Impact Analysis is the best alternative to calculate the accurate delay and time for a project.

STEP 6: The Selection of alternatives:

In line with Table 3 and Table 4, We decided to categorize the best approach of delay analysis is time impact analysis because the time impact analysis technique is the most comprehensive and most sophisticated delay analysis method. In the project, any changes, delays to the schedule known as time impact analysis. In the schedule, the critical path method may shift or forward, reduce or consume the float or reduce the slack or new activities may be required, when analysis to determine the effect of the event. Any new or additional activities will be shown in the revised schedule.

STEP 7: Performance Monitoring & Post Evaluation of results

The aim of this method is examining the critical path and impact of delaying event on that path. Sometime time impact analysis is most time-consuming and most critical analysis methods compared to simpler methods such as the as-planned versus as-built, impact as-planned, and collapsed as-built method. It is also required specialized expertise and professionals to perform the analysis. However, it can be very accurate in terms of analysis of delays and changes, it least disputable and most logical technique.



This has resulted in delay causing finalizing sub-contracting ordering and activity for procurement. The above graph shows the impact of the delays approximate 8 months due to the owner's passive decision making.

CONCLUSION

In conclusion, Time impact analysis is most comprehensive and accurate analysis method to calculate the delays for a project as compared to other analysis techniques (As-Planned vs As-Built, Impacted As-Planned, and Collapsed As-Built). It is also important that if the project schedule is resource loaded in the right logical manner then the calculated delays are accurate. As a component of the more extensive research work, this paper tries to build up the information and comprehension of the defer investigation method. Current programming software like MS-Project and Primavera is a very good tool to calculate delays or we can say that they are one of the time saving tools.

Originally, this paper was written to answer the questions:

i. What are different types of TIA methods?

As per the above research, As-Planned vs As-built method gives less accurate result because of the lack availability of information and more data required and difficult to find attributable. Impacted As-Planned and Collapsed As-Built analysis is good analysis technique but as it can be seen from above result, Time impact analysis appears to be most appropriate technique.

ii. Why we use Time Impact Analysis and how to analyze the delay?

As we have already seen, Time impact analysis is the most accurate technique. Window analysis, which is updating the schedule.

iii. Which one is preferable under what circumstances and why?

To resolve the issues between Owner and contractor, Time impact analysis is more suitable technique when there is either compensable, non-compensable, excusable or non-excusable delay. From a Contractor's perspective, Compensable delay is considered to be the best as Contractor can claim time and cost both.

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About the Author

Pratyush Kumar Chaturvedi

Uttar Pradesh, India

Pratyush K Chaturvedi, is a certified holder of AgilePM Foundation and PRINCE2 Foundation with an extensive experience of over 9 years in Project Management and Project Controls as a planner, scheduler, budget & cost control in Oil & Gas, Power Plant and construction industry. At present, he is pursuing a Masters in Project and Programme Management and Business Development from SKEMA Business School, Paris. He originates from Uttar Pradesh, India where he completed his graduation with a Bachelor Degree in Information Technology (2006) from Uttar Pradesh Technical University. Previously, he has worked for Punj Lloyd Limited in India, Qatar and Indonesia as a planning engineer; followed by Corrtech International Pvt. Ltd., India as a senior engineer; after that he worked with PT. Timas Suplindo, Indonesia as a Lead Project Control Engineer; recently he worked with PT. Visacall Jaya Abadi, Indonesia as a Project Planner.

Pratyush can be contacted at mail pratyush.chaturvedi@gmail.com and at linked 5355b61a.