Study of Project Monitoring System for Mumbai Metro Line-3

[1]Rohit Parkar, [2]Mitesh Waghela, [3]Rishabh Madhani, [4]Parth Mithawala, ,[5]Keyush Shah, [6]Swapnil Raut

[1]UG Student, [2]UG Student, [3]UG Student, [4]UG Student, [5]UG Student, [6]Assistant Professor
Department of Civil Engineering,
Thakur College of Engineering and Technology, Mumbai, India

Abstract: Development in infrastructure demands an increase in transportation facilities that's why the Mumbai Metro Rail Corporation Limited (MMRCL) decided to construct the first underground metro in Mumbai. The main aim of this article is to study the aspects of Construction Management such as the Delay Analysis, Project Management and Monitoring System. The article covers the methods to assess the delays and the measures taken to minimize the impact of such delays so that project is completed on scheduled time. The processes involved use of Primavera P6 software to analyze the delay and time overrun. As the project is under construction, many such delays and steps would already have been taken to mitigate the impact of such delays caused due to unforeseen factors.

IndexTerms **- Project Monitoring system, Primavera, Delay, Time overrun**

I. INTRODUCTION

Mumbai Metro line 3, which is also known as Colaba-Bandra-Seepz line is the first underground metro line in Mumbai having a length of 33.5km. The metro line will connect the trading region of Cuff Parade in the south of the city to Seepz which is located in the north central region of the city. It consists of 26 underground stations and one at-grade station. The track width is standard gauge and the estimated cost of the project is ₹23,136 crore.The proposed metro shall increase mobility and accessibility to facilitate, increase in economic stimulation in the region, increase in business opportunities, improve aesthetics and image of the city.It only describes techniques and prioritizes the time impact analysis technique.The choice of technique also depends on but not limited to the complexity of the project, the records available and the purpose of analysis. The delay analysis plays a crucial role in this thesis. Thus a separate literature study is performed for the delay analysis.

II. LITERATURE REVIEW

A. Delay Analysis (Prof. Siddhesh Pai, Mr.J Raj Bharath)

The following paper discusses the causes which critically affects the delay of infrastructure projects in India with a few examples. It takes into account examples of modern

construction projects, various methods adopted for surveying industries to find the causes mainly responsible for the delay in projects, the possible solutions for minimizing delay and to reduce cost overruns. The processes involved in completing a project were found out along with the ones which are responsible for causing delay.

B. Delay Analysis (Mr. Yash Mittal, Mr. Virendra Paul)

Probably every infrastructure project around the world faces delaysbut the present paper specifically deals with a study carried out to find out the critical delay factors in the commissioning of metro rail projects in India. A questionnaire was prepared as a survey to collect opinions of clients, contractors and consultants to find out the major causes of delay and with the help of those factors the Relative Importance Index (RII) was calculated.The RII gave the delay factors certain rankings which were later analysed using Spearman's rank coefficient**.** The delay factors were identified and suitable course correction measures targeting the critical delay factors were suggested for application which could mitigate such issues. Since metro's are helpful in augmentation of public transport infrastructure and the main hindrances in their completion are time and cost overruns it became necessary to conduct a research about these issues and with the help of RII and spearman's rank coefficient the issues were helped to resolve. The delay factors could be taken for further future research for finding other causes of delay and their mitigation strategies.

III. METHODOLOGY

The nature of proof required for the demonstrating delays is explained less in the delay and disruption protocol. It only describes techniques and prioritizes the time impact analysis technique. In addition, it does not tell how these techniques should be applied. Firstly, the delay analysis is not merely limited to four techniques and every technique has its own pros and cons. The choice of technique also depends on but not limited to the complexity of the project, the records available and the purpose of analysis. The delay analysis plays a crucial role in this thesis. Thus a separate literature study is performed for the delay analysis.

The two main methods which we have referred in order to perform delay analysis are As Built and As Planned.

As Built vs As Planned: This method does not involve explicit use of CPM logic. Hence, they are called observational static methods. In this As-planned vs As-built method, there is a comparison made between the as-built schedule and the as-planned schedule. All the delay events are present in the as-built schedule. The difference between the as-planned and the as-built completion dates gives the delayed time. The claimant can ask for compensation in time and monetary terms for this delayed time.

METHODOLOGY

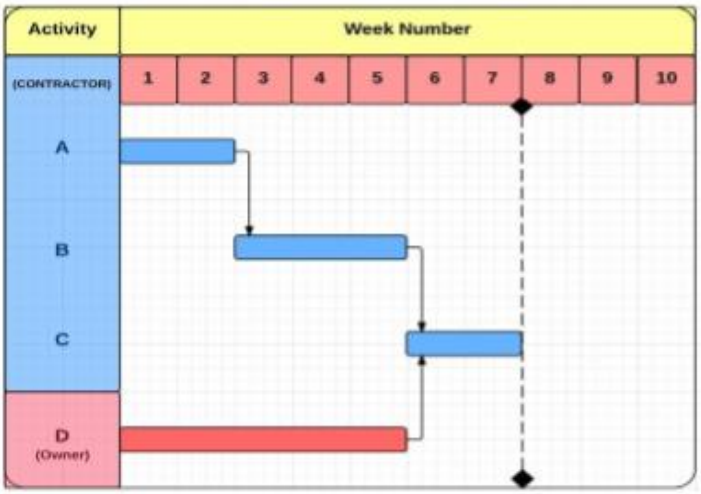

Fig1. As Planned Schedule

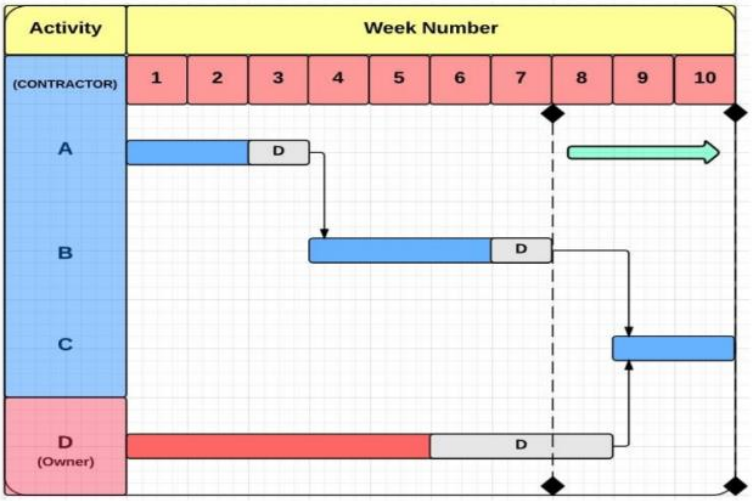

Fig. 2. As Built Schedule

Consider an as-planned and as-built schedule as shown in figures. An as-planned schedule is a schedule by which the contractor intends to work. The as-built schedule is a schedule by which the contractor actually performed on site. The following illustrates the methodology of a sample project:
Sum of contractor caused delays = 1+1 = 2 weeks
Sum of Owner Caused Delays = 3 weeks
Therefore the concurrent delay for both parties is 2 weeks.
The net project delay the owner is responsible is = 3 – 2 = 1 week delay.
The total project delay is 10 – 7 = 3 weeks.
The balance after owner's delay is the contractor's responsibility which is = 3 – 1 = 2 weeks delay.
Thus, the result of the as-planned vs as-built schedule analysis is that owner is responsible for 1 week delay and contractor is responsible for 2 weeks delay.

A. Creating Project in Primavera P6

Study was done by analyzing the progress reports on a set of activities in execution of MML3 using Primavera P6 software.

- Step 1 - Several activities from the progress report are compiled and Work Breakdown Structure (WBS) is created as per the group of stations.

Layout: WBS

WBS Code	WBS Name	Total Activities
NEWPROJ	Metro Tracking	20
NEWPROJ.1	Cuff Parade	7
NEWPROJ.1.1	Temporary Retaining Structure	4
NEWPROJ.1.2	Exavation Works	3
NEWPROJ.2	Vidhan Bhavan	5
NEWPROJ.2.1	Temporary Retaining Structure	3
NEWPROJ.2.2	Excavation Works	2
NEWPROJ.3	Churchgate	4
NEWPROJ.3.1	Temporary Retaining Structure	3
NEWPROJ.3.2	Excavation Works	1
NEWPROJ.4	Hutatma Chowk	4
NEWPROJ.4.1	Temporary Retaining Structure	3
NEWPROJ.4.2	Excavation Works	1

Fig.3. Work Breakdown Structure Layout

- Step 2 – The activities are listed in the WBS and their planned start and duration are entered.

NEWPROJ Metro Tracking		07-Dec-16 08:00 AM	05-Jan-19 12:00 AM	759	13-Oct-16 12:00 AM A	19-Mar-19 02:24 PM
NEWPROJ.1 Cuff Parade		07-Dec-16 08:00 AM	08-Dec-18 12:00 AM	731	13-Oct-16 12:00 AM A	08-Dec-18 12:00 AM
NEWPROJ.1.1 Temporary Retaining Structure		07-Dec-16 08:00 AM	08-Dec-18 12:00 AM	731	13-Oct-16 12:00 AM A	08-Dec-18 12:00 AM
A1020	Balance of Station Box	23-Jan-17 12:00 AM	20-Jul-17 12:00 AM	178	13-Oct-16 12:00 AM A	04-Mar-18 12:00 AM A
A1010	LS for NATM tunnel works	23-Jan-17 08:00 AM	15-Apr-17 08:00 AM	82	10-Feb-17 12:00 AM A	11-Jan-18 12:00 AM A
A1000	Launching Shaft for TBM1 & TBM2	07-Dec-16 08:00 AM	01-Feb-17 08:00 AM	56	16-Feb-17 12:00 AM A	05-Feb-18 12:00 AM A
A1030	Entry/Exit	02-Aug-18 12:00 AM	08-Dec-18 12:00 AM	128	02-Aug-18 12:00 AM	08-Dec-18 12:00 AM
NEWPROJ.1.2 Exavation Works		01-Feb-17 12:00 AM	24-Feb-18 12:00 AM	388	04-Sep-17 12:00 AM A	13-Jul-18 10:05 PM
A1130	TBM Launching Area	01-Feb-17 12:00 AM	02-Jun-17 12:00 AM	121	04-Sep-17 12:00 AM A	08-Sep-17 08:10 PM
A1140	NATM area	06-Apr-17 12:00 AM	30-Aug-17 12:00 AM	146	21-Oct-17 12:00 AM A	01-Nov-17 04:19 PM
A1150	Station box	05-Jun-17 12:00 AM	24-Feb-18 12:00 AM	264	01-Nov-17 12:00 AM A	13-Jul-18 10:05 PM
NEWPROJ.2 Vidhan Bhavan		27-Jan-17 12:00 AM	29-Aug-18 12:00 AM	579	25-Mar-17 12:00 AM A	19-Mar-19 02:24 PM
NEWPROJ.2.1 Temporary Retaining Structure		27-Jan-17 12:00 AM	29-Aug-18 12:00 AM	579	25-Mar-17 12:00 AM A	15-Nov-18 06:14 PM
A1040	Station box [off raod south side (grid 1-8)]	27-Jan-17 12:00 AM	01-Jul-17 12:00 AM	155	25-Mar-17 12:00 AM A	02-Feb-18 12:00 AM A
A1050	Station box [off raod north side (grid 9-13)]	27-Jan-17 12:00 AM	31-Jul-17 12:00 AM	185	26-Aug-17 12:00 AM A	30-Aug-17 03:00 PM
A1060	Entry/Exit	03-Mar-18 12:00 AM	29-Aug-18 12:00 AM	179	07-Jan-18 12:00 AM A	15-Nov-18 06:14 PM
NEWPROJ.2.2 Excavation Works		21-Feb-17 12:00 AM	16-Mar-18 12:00 AM	388	25-Sep-17 12:00 AM A	19-Mar-19 02:24 PM
A1160	Off road	14-Apr-17 12:00 AM	02-Mar-18 12:00 AM	322	25-Sep-17 12:00 AM A	22-Apr-18 12:29 PM
A1170	On road	21-Feb-17 12:00 AM	16-Mar-18 12:00 AM	388	15-Jan-18 12:00 AM A	19-Mar-19 02:24 PM
NEWPROJ.3 Churchgate		24-Feb-17 12:00 AM	09-Nov-18 12:00 AM	623	20-Jul-17 12:00 AM A	04-Feb-19 09:36 AM
NEWPROJ.3.1 Temporary Retaining Structure		24-Feb-17 12:00 AM	09-Nov-18 12:00 AM	623	20-Jul-17 12:00 AM A	17-Nov-18 02:24 PM
A1070	Station box (west side)	24-Feb-17 12:00 AM	19-May-17 12:00 AM	84	20-Jul-17 12:00 AM A	27-Jul-17 09:30 PM
A1080	Station box (east side)	23-Jun-17 12:00 AM	07-Oct-17 12:00 AM	106	14-Jan-18 12:00 AM A	16-Jan-18 02:53 AM
A1090	Entry/Exit	24-Jul-18 12:00 AM	09-Nov-18 12:00 AM	108	13-Feb-18 12:00 AM A	17-Nov-18 02:24 PM
NEWPROJ.3.2 Excavation Works		24-Apr-17 12:00 AM	19-Jan-18 12:00 AM	270	01-Jun-18 12:00 AM A	04-Feb-19 09:36 AM
A1190	Station box	24-Apr-17 12:00 AM	19-Jan-18 12:00 AM	270	01-Jun-18 12:00 AM A	04-Feb-19 09:36 AM
NEWPROJ.4 Hutatma Chowk		21-Feb-17 12:00 AM	05-Jan-19 12:00 AM	683	25-May-17 12:00 AM A	28-Nov-18 09:36 AM
NEWPROJ.4.1 Temporary Retaining Structure		21-Feb-17 12:00 AM	05-Jan-19 12:00 AM	683	25-May-17 12:00 AM A	28-Nov-18 09:36 AM
A1100	Station box (west side)	21-Feb-17 12:00 AM	17-May-17 12:00 AM	85	25-May-17 12:00 AM A	25-May-17 08:24 PM
A1110	Station box (east side)	29-Jul-17 12:00 AM	01-Nov-17 12:00 AM	95	03-Feb-18 12:00 AM A	04-Feb-18 09:36 PM
A1120	Entry/Exit	30-May-18 12:00 AM	05-Jan-19 12:00 AM	220	06-Sep-18 12:00 AM A	28-Nov-18 09:36 AM
NEWPROJ.4.2 Excavation Works		25-Oct-17 12:00 AM	31-May-18 12:00 AM	218	28-Apr-18 12:00 AM A	25-Nov-18 06:14 PM
A1180	Station Box	25-Oct-17 12:00 AM	31-May-18 12:00 AM	218	28-Apr-18 12:00 AM A	25-Nov-18 06:14 PM

Fig.4. Activity Tracking Table

- Step 3 – The predecessor and successors are assigned for each activity and their relationship is established.

B. Creating Baseline

- Baseline – A baseline is a copy of original schedule which gives a reference for the project schedule and for tracking the progress.
- After establishing the relationship and entering the start dates and duration, baseline is created.

C. Tracking

- The created baseline is assigned to the project.
- After assigning the baseline actuals are entered for each activity.
- After entering the actuals the time overrun for each activities can be analysed.

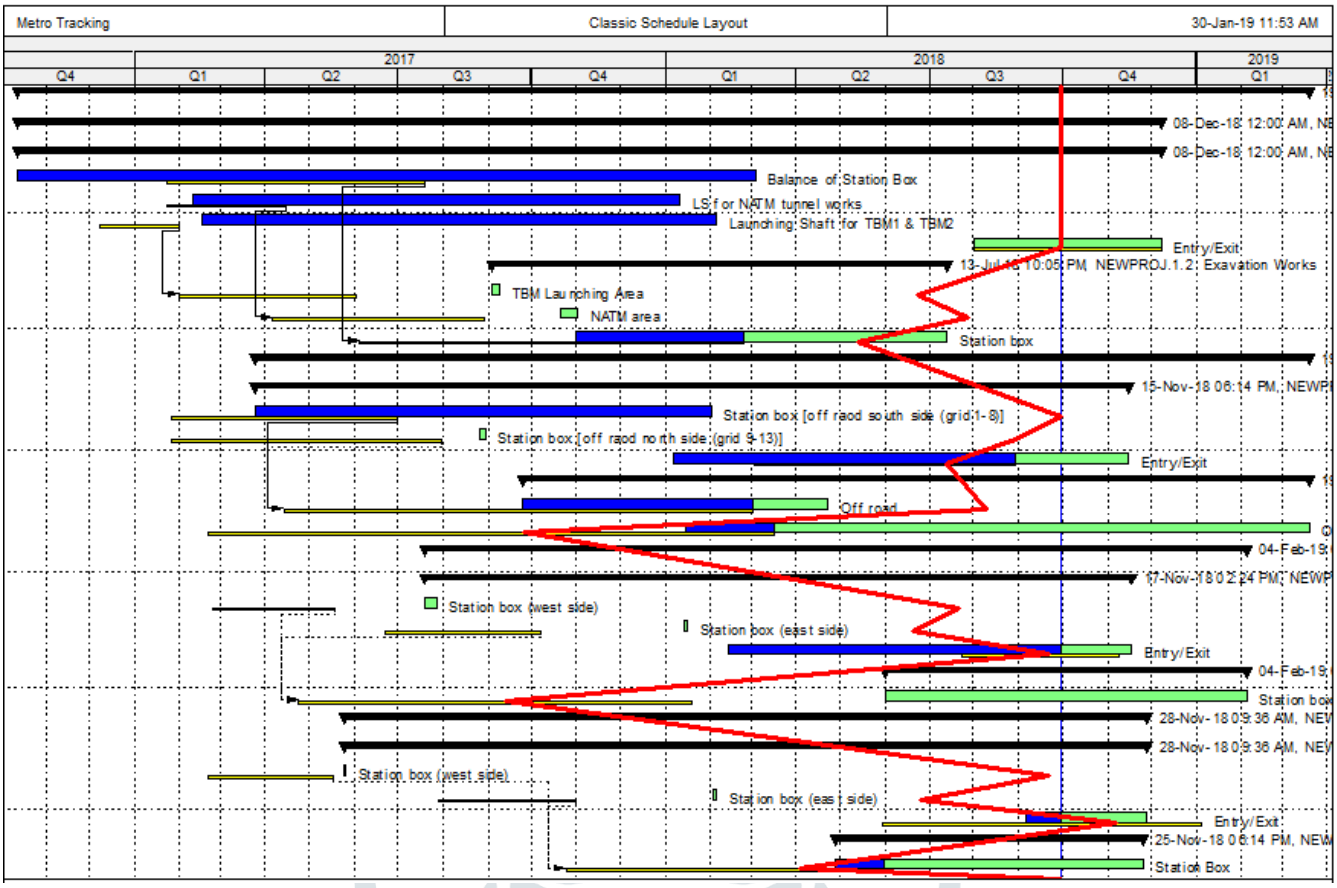

Fig.5. Tracking Gant Chart

IV. RESULTS

After tracking the following results were achieved.
Following tables shows the variance of activities from the finish date.

Activity Name	Variance - BL1 Finish Date
NEWPROJ Metro Tracking	-74
NEWPROJ.1 Cuff Parade	0
NEWPROJ.1.1 Temporary Retaining Structure	0
Balance of Station Box	-227
LS for NATM tunnel works	-271
Launching Shaft for TBM1 & TBM2	-369
Entry/Exit	0
NEWPROJ.1.2 Exavation Works	-140
TBM Launching Area	-99
NATM area	-64
Station box	-140
NEWPROJ.2 Vidhan Bhavan	-203
NEWPROJ.2.1 Temporary Retaining Structure	-79
Station box [off raod south side (grid 1-8)]	-216
Station box [off raod north side (grid 9-13)]	-31
Entry/Exit	-79
NEWPROJ.2.2 Excavation Works	-369
Off road	-52
On road	-369
NEWPROJ.3 Churchgate	-87
NEWPROJ.3.1 Temporary Retaining Structure	-9
Station box (west side)	-70
Station box (east side)	-101
Entry/Exit	-9
NEWPROJ.3.2 Excavation Works	-381
Station box	-381
NEWPROJ.4 Hutatma Chowk	38
NEWPROJ.4.1 Temporary Retaining Structure	38
Station box (west side)	-9
Station box (east side)	-96
Entry/Exit	38
NEWPROJ.4.2 Excavation Works	-179
Station Box	-179

Fig.6. Finish Variance Table

By using As Planned vs As Performed method for finding the delay the actual progress of the project is known. As the project is a ongoing project the delay can be minimised by various methods such as increasing the recourses assigned, crunching the activity, crashing, etc.

V. CONCLUSION

Delays in the project can be problematic for both the contractor and the owner as it results in time overrun and cost overrun, issues and also affects the relation of project participants.

Some of the major causes of delay are:

- Contractor being inexperienced to handle work of given magnitude.
- Delay in obtaining the approvals from the required authorities.
- Unforeseen occurrences on the site resulting in delay.

Due to these delays the following set of activities are delayed by approximately 13 months.

REFERENCES

[1] Siddesh k Pai, J Raj Bharath on Analysis of Critical Causes of Delays in Indian Infrastructure Project, IJIRD, vol. 2. Issue 3

[2] Yash Kumar Mittal, Virendra Kumar Paul opn Identification of Critical factors for delay in metro rail projects in India, IJSRTM, vol. 6. No.1

[3] Varun Aasish Yerramareddy on schedule Quality – Delay Analysis

[4] https://www.mmrcl.com/en/package/package-1

[5] https://www.mmrcl.com/en/about-mmrc/quick-facts