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Studying Project Management System for Mumbai Metro

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Abstract: As the city of Mumbai is undergoing tremendous infrastructural development and Mumbai Metro is going to be an iconic project being undertaken by the government. We intend to work on studying some important aspects of Construction Management such as Studying Project Management System, Risk and Value Analysis. Further we also intend to do a risk assessment and measures taken for risk mitigation of Mumbai metro and also the cost assessment and overheads caused due to delays and the measures taken to minimize the impact of such delays so that project is completed on scheduled time. As the project is under construction right now there would have been many such delays and steps would already have been taken to mitigate the impact of such delays caused due to unforeseen factors like rains. Mumbai Metro is a rapid transit system serving the city of Mumbai Maharashtra. The system is designed to reduce traffic congestion in the city, and supplement the overcrowded Mumbai suburban Railway network. It is being built in three phases over a 15-year period, with overall completion expected in2021. When completed, the core system will comprise eight high-capacity metro railway lines, spanning a total of 200 kilometers (120 mi) (20% underground, the rest elevated, with a minuscule portion built at-grade), and serviced by 169 stations.

Keywords: EVM, CPM, EAC, NCC.

I. INTRODUCTION

Metro 7 of the Mumbai Metro is part of the metro system for the city of Mumbai, India. The 33.5 km (20.8 mi) line is elevated partially. (16.475 km (10.237 mi) section under construction, and 13.5 km (8.4 mi) section approved) and partially underground (3.5 km (2.2 mi) underground section approved), and consists of 29 (14 elevated under construction, 12 elevated approved and 3 underground approved) stations, stretching from Golden Nest, Bhayander in the north to CSIA T2 in the south. Contracts for Line 7. The following is the division of construction work according to area.

Table 1

Package	Contractor
Mahanand	Simplex Infrastructure Ltd
JVLR Junction	
Shankarwadi	
Andheri (East)	
Mahindra & Mahindra	JKumarInfraprojects Ltd
Bandongri	
Pushpa Park	
PathanWadi	
Aarey	
Dahisar (East)	NCC Ltd
Ovripada	
National Park	
Devipada	
Magathane	

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Metro line 7 is a mega construction project with an expected budget of 6208 cr. It is not possible that a project of this magnitude takes place without the proper management. Construction management is therefore an important tool for successful management of any project. This leads to safety of the workers involved, efficient use of the money, faster revenue generation and timely completion of the project.

II. NEED TO STUDY

Construction Management- Proper management of construction work can be done by giving importance to Risk, Cost and Schedule. The study of this professional service with the help of specialized management technique will help to oversee the planning, design, and construction of a project from start to end.

III.METHODOLOGY

Risk Assessment:

The risk is a measurable part of uncertainty, for which we are able to estimate the occurrence probability and the size of damage. The risk is assumed as a deviation from the desired level. It can be positive or, which most often happens, it can be negative. Therefore, the risks analysis is so important for project selection and coordination of construction work. The risk analysis is regarded as the analysis of adverse events even at the stage of planning and programming of a construction project.

Risk Analysis aims to answer three main questions:

What is the worst thing that can happen? Likelihood of the occurrence Impact of the occurrence.

Risk analysis involves three main steps

1) Identification of risk: This is the frist step in risk analysis.

In order to tackle or mitigate the impact of any future adversity, it is important to first identify that risk. There are many types of risks in a construction project. Some of them are political risk, market risk, economical risk, contractual risk, environmental risk, technical risk etc. Once identified, steps can then be taken to mitigate the impact.

2) Assesment of risk: This step involves analysing the impact of all the risk. It helps to identify more severe and important risks.

3) Allotment of risk: After the firs two steps, risk are then alloted to respective parties which can tackle a particular risk.

As metro is a big government project, all this would already have been done and our objective is to study the same and learn different ways of identifying and mitigating the impact of risk

Scheduling:

To make sure that a project is completed on time, it is necessary to prepare a schedule. First step for preparing a schedule is to identify all the activities involved. Then, a precedence relationship based on these activities is prepared. Once that is done, we can find out a critical path which is singularly responsible for determining the duration of a project. It is also necessary to allocate all the resources (manpower, equipment and materials) and determining the cost required for each day. Once the schedule is prepared, it is handed over to the execution team or to the contractor (in case a different company is given the job for construction management) so that the actual work starts. We can identify if there is any delay by looking at the schedule and determining the work that should have been completed according to the schedule. For Metro Line 7, construction management work has been handed over to three consultancy companies: AICA, Italferr and Ayesa. We plan to study the method and software by which schedule for Line 7 has been prepared and also to compare the same with the modern and recent softwares used around the world for the same.

Cost assessment:

Construction cost assessment during bid preparation is the most tedious and responsible stage.Evaluators have to take into account a multitude of various factors affecting construction cost. They include the following in case of the conventional construction pattern: the chosen methods and technologies of facility construction; options of construction provision with machinery and mechanisms, labour and material resources; conditions of payment for executed works and supplied resources, which affect the formation of financial flows during construction. We intend to study the same in metro project and also applying Earned Value Management technique if possible.

Evm:

It is a powerful tool for monitoring and controlling the project, It is one tool which can be used to determine the performance of the project and to check the progress made by the construction project. Frequent generation of EVM reports results in better controlling of the project and compels a construction manager to think about path to be chosen

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to minimize the impact in case of a delay. EVM also tells us whether the project is overrun by cost or not. This technique compares the actual work performed with the value of work scheduled to be performed at a particular stage of the project. Here all the values are in terms of one basic unit that is money. Since, the unit of all the activities is not same, it is necessary to convert the scheduled work and work performed in terms of money. EVM is an important tool and is already used extensively in developed countries like USA, UK and Japan. Success of a project is determined by the cost used and cost used also depends on the amount of delay. If there is a delay in a project, additional cost will be used up to minimize the impact of the same. Thus, EVM is an important tool which tells about the same and steps can then be taken to avoid huge overheads or delay.

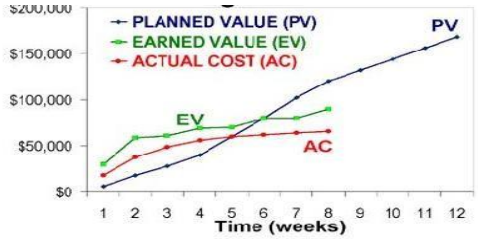

FIG 1

IV. DATA ANALYSIS

Scheduling:

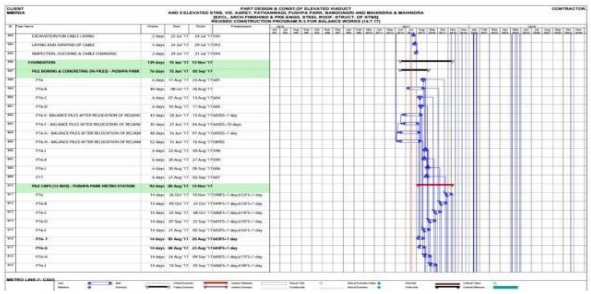

FIG 2-Scheduling

The above is a part of the schedule for metro line 7. It shows duration of each activity performed and it also shows the location of each pile.

Gantt Bar Chart:

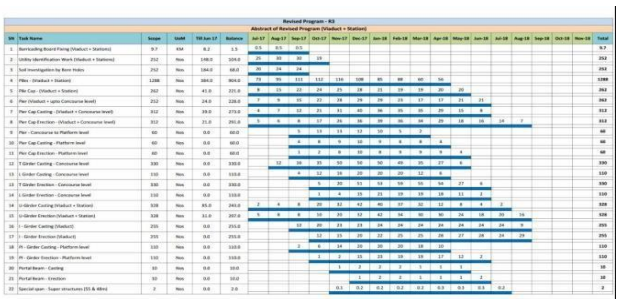

FIG 3-Gantt Bar Chart

A Gantt chart is a type of bar chart that illustrates a project schedule. Gantt charts illustrate the start and finish dates of the terminal elements and summary elements of a project. Figure above is the gantt bar chart for metro line 7. It tells us about the work remaining after june 2017.First column tells us about all the activities or task name. second column tells us about the scope or the total unites of that particular activity. third column tells us about the unit for the activity. Fourth column tells us about the work already completed till June 17 and the following column tells us about the balance of work remaining. From the data above we can say that casting of the piles is the activity which has most number of units to be completed after june 17 and this is very important as all the following activity depends on this. Extent of the Blue line against an activity indicates the month till which therespective activity is to be completed and the number above the blue line in each month indicates the units scheduled to be completed in that month.

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S Curve:

It is defined as curve of cumulative project cost plotted against time, which typically follows the shape of the letter "S": the beginning represents a slow, but accelerating start, while the end represents a deceleration as the project approaches to an end. The S curve can be considered as an indicator of goals achieved, baseline, cost, time etc. The above graph is based on the schedule of metro line 7. Y axis indicates the money spent in crores and x axis is represented by the months in 2017. This graph tells us about the cost to be used in each month based on schedule

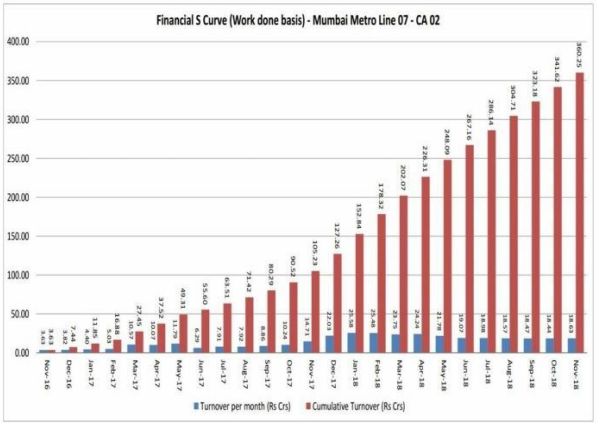

FIG4-SCURVE

Resource allocation chart :

S. N.	Description	UOM	Productivity per month per unit		Max Qty	Jul-17	Aug-17	Sep-17	Oct-17	Nov-17	Dec-17	Jan-18	Feb-18	Mar-18	Apr-18	May-18	Jun-18	Jul-18	Aug-18	Sep-18	Oct-18
1	Piling rig	Nos	15	15	8	5	6	7	7	8	7	6	6	4	4	0	0	0	0	0	0
2	Pile cap shutter - Viaduct	Set	5	5	4	1	2	2	3	3	4	4	4	4	4	4	0	0	0	0	0
3	Pile cap shutter - Station	Set	4	4	3	0	2	3	3	3	3	1	0	0	0	0	0	0	0	0	0
4	Pier shutter - Viaduct	Set	5	5	4	1	1	2	2	3	4	4	3	3	3	4	4	0	0	0	0
5	Pier shutter - station	Set	4	4	3	0	1	2	3	3	3	2	2	0	0	0	0	0	0	0	0
6	Pier cap casting - Viaduct	Set	5	5	4	1	1	2	3	3	4	5	3	3	5	5	2	0	0	0	0
7	U girder casting	Beds	3nos	3	16	1	1	3	7	11	14	15	12	11	4	3	1	1	0	0	0
8	I girder casting - Viaduct	Beds	4nos	4	6	0	0	3	5	6	6	6	6	6	6	6	6	2	0	0	0
9	PI girder casting - station	Beds	4nos	4	5	0	0	1	2	4	5	5	5	5	3	0	0	0	0	0	0
10	T girder casting	Beds	4nos	4	13	0	3	4	9	13	13	13	12	9	7	2	0	0	0	0	0
10	U girder casting	Beds	4nos	4	5	0	0	1	3	4	5	5	5	3	2	0	0	0	0	0	0
11	Pier cap casting - Concourse level	Set	4nos	4	5	0	1	3	4	5	5	5	4	3	2	0	0	0	0	0	0
12	Pier cap casting - Platform level	Set	3nos	3	3	0	0	1	3	3	3	3	3	3	1	0	0	0	0	0	0
13	Cantilever pier cap shutter	Set	4nos	4	1	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0
14	Portal Beam	Set	2nos	2	1	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0
15	Cranes & Trailer for launching																				
	a) Pier cap erection (250MT + 1 Trailer)	Nos	25nos		1	0.2	0.2	0.2	0.4	0.5	0.6	0.0	0.6	0.6	0.6	0.6	0.6	0.6	0.3	0.0	0.0
	b) U girder - (400MT & 350MT + 2nos Trailer)	Nos	50nos		0	0.1	0.2	0.2	0.2	0.3	0.3	0.4	0.3	0.2	0.3	0.3	0.3	0.4	0.3	0.0	0.0
	c) Girder (2nos 180MT & 150MT + Trailer 2nos)	Nos	50nos		1	0.0	0.0	0.0	0.2	0.3	0.4	0.4	0.5	0.5	0.6	0.5	0.6	0.5	0.6	0.0	0.0
	d) Concourse Pier cap (400MT + 1 Trailer)	Nos	25nos		1	0.0	0.0	0.1	0.3	0.6	0.0	0.0	0.0	0.0	0.6	0.1	0.0	0.0	0.0	0.0	0.0
	e) Platform pier cap (2nos 400MT & 350MT +Trailer)	Nos	25nos		0	0.0	0.0	0.0	0.1	0.3	0.4	0.5	0.4	0.4	0.4	0.2	0.0	0.0	0.0	0.0	0.0
	f) T/L girder (2nos 300MT & 150MT + Trailer 2nos)	Nos	50nos		1	0.0	0.0	0.0	0.1	0.4	1.0	1.1	1.2	1.1	1.1	0.5	0.1	0.0	0.0	0.0	0.0
	g) PI girder (300MT & 250MT + Trailer)	Nos	25nos		1	0.0	0.0	0.0	0.0	0.1	0.6	0.9	0.8	0.8	0.7	0.5	0.1	0.0	0.0	0.0	0.0
	h) U girder (350MT & 250MT + Trailer)	Nos	25nos		1	0.0	0.0	0.0	0.1	0.2	0.6	0.0	0.0	0.0	0.6	0.4	0.1	0.0	0.0	0.0	0.0

The above chart tells us about the resource allocated for a particular activity each month. First column tells us about the activity. 2nd column indiactes unit of that activity. Third column indicates productivity per month per unit. And, the fifth column indicates max quantity in a particular month.

V. OUTCOME

Essential practical knowledge is needed for application of
Project Management System in this mega project. Risk mitigation is also an important tool for this project. In addition, application of the concept of Earned Value
Management which is fairly new in the industry. The use of Project Management System will help in minimizing the impact of delay in this project. To make the project efficient proper scheduling is required which was done is usually done by softwares like Microsoft Project and Primavera. Microsoft project has been used in extensively for planning Mumbai
Metro Phase 2.

FOR MMRDA
The Mumbai Metropolitan Region Development Authority is finding ways to deal with the increase of population in the financial capital of the country. The world is moving ahead with technological advancements and hence it is necessary to improve the transit systems for the citizens to save time and money . The growth in population has led to many difficulties for the authorities for efficient transport system in the island city. Thus, Mumbai Metro project will help in reduction of traffic on the Western Express Highway which is always busy with traffic. The project will also

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help in reduction of fuel emission and will help in conservation of energy and time. Services such as Mumbai Metro also help in reduction of pollution in a drastic manner. We as students are going to help the authorities in preparing a Risk register and are also going to suggest risk mitigation strategies.

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