Causes of Delays in Transportation Infrastructure Projects in India

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***Abstract*— Infrastructure projects worth Rs. 1.50 billion and above, 578 projects have reported time escalations (or, in other words, delays), 400 projects reported cost overruns and 202 projects reported both time and cost overruns with respect to their original project implementation schedules, while 374 are on schedule, as in November 2021, according to the Ministry of Statistics and Programme Implementation (MoSPI). About 93 projects have reported additional delays vis-à-vis their date of completion reported in the previous month (October 2021). Of these 93 projects, 26 are mega projects worth Rs. 10 billion. This review also discussed the groups causing delay based on the source of delay. The top five delay factors related to contractor, owner and consultant have been discussed within each category. This study covers the various causes of delays in detail, as well as delays which are caused at various stages of the project. For this study only the transportation infrastructure projects are considered. The various issues plaguing these projects are studied. The study also includes an in-depth literature review of the subject and the various works carried out on the subject. As a part of data collection, the study includes the random sample of road, railway, civilian airport and sea ports. The delays and the time and cost overruns that they have caused have been studied. Also, the locations of the projects need to be considered for drawing certain conclusions. The study basically carries a qualitative and quantitative assessment of the causes of the delays. It establishes a link to the analysis of the delays in order to quantify the severity of each type of delay with respect to the time overruns.**

Index Terms: **Questionnaire Survey; Construction Delays, Transportation infrastructure projects.**

INTRODUCTION

A project delay is typically an issue that can take companies over budget, cause them to miss deadlines, and sometimes derail projects. Its impact on costs and timings can be significant, so project managers must pay special attention to its occurrence. In most cases, the failure of project is mainly related to the influence of consultants, contractors and owner on project performance. Effect of delays are costly to all parties concerned and very often it will result in disagreement, cost overrun, arbitration, litigation, total abandonment, and project infeasibility.

NEED FOR STUDY

Delays are an integral part of any construction project; they may be insignificant or otherwise. However considering the Indian scenario, the later i.e. the significant delays are almost universally associated with the word ‘delay’. Almost every other Infrastructure project in the country gets delayed, barring Pune Metro.

India being a rapidly developing country needs an equally rapidly developing infrastructure. The infrastructural development is indeed the backbone of the country’s economic progress and constitutes a great extent of the fiscal spending. India is no different to this exception and the government has duly increased spending on the infrastructure projects. According to the 11th five year plan, the government has planned a spending to the tune of $500 million on infrastructure projects. This comes to about 7.5% to 8% of the GDP India.

PROBLEMSTATEMENT

This study has been carried out for the partial completion and has some limitations. These are mentioned as follows:

1 The study is primarily based on questionnaire analysis and hence the feedback from

respondents. However the views of the respondents can be inaccurate.

2 The sample size is very small (10 in number).

3 The case study was conducted from information available from various sources such media reports, journals, and internet sources. No information could be gathered from personnel working on actual project.

OBJECTIVES

The main objectives of this study include the following:

1 To identify the causes of delays in construction of metro rail.

2 To test the importance of the causes of delay between parties involved in project.

3 To study the differences in perceptions of the three major parties in any constructions, namely, owners, contractors and consultants

Basically the main objective of the project is to effectively rank the various causes of delays and identify the most salient causes as well as the different project stages in which the project can get delayed.

The ranking of the projects would help the project management to concentrate more on how to avoid the most salient causes of delays. The study would also give us an idea about the stages in a project which are most likely to get delayed.

Concisely the scope of the study is as follows:

1 To study available literature.

2 To identify the various causes of the delays of Metro projects.

3 To carry out a questionnaire survey and rank the causes of delays in Metro projects.

4 To carry out a survey of Metro Project pertaining to the transport sector.

5 To identify solutions on the salient causes of delays.

LITERATURE REVIEW

Mohammad Al-Mohammad [1]attempts towards reviewing past literature on causes of delay in different types of construction. The most common methods adopted by researchers for causes of delay identification were presented. Time is one of the keys by which project success can be measured. However, delay in construction projects remains a common occurrence.

Sanjay Nimbalkar[2] have investigated the constructions of urban infrastructure are an important sector that provides remarkable ingredients for the economic development of modern cities. However, a large number of transportation infrastructure construction projects are delayed; therefore, those projects always exceed their original time and cost estimates. So construction delay has been considered as a recurring problem in the construction projects.

Arun Solanki[3] has studied different factors like power failure, weather, rider load, festive season, etc. which are responsible for the delay of Delhi Metro. Due to these factors, Metro got delayed and run at a reduced speed causing much inconvenience to the people, who are hoping to reach their offices on time. Delhi Metro data are received from different sources which may be structured (timings, speed, traffic), semi-structured (images and video) and unstructured (maintenance records) form. So, there is heterogeneity in data. Except for this data, the feedback or suggestion of a rider is vital to the system. Nowadays riders are using social media like Facebook and Twitter very frequently. Three-tier architecture is proposed for the delay analysis of Delhi Metro. Different implementation techniques are studied and proposed for the social media module and delay prediction modules for the proposed system.

Yash Kumar Mittal [4], et al. had studied with an objective to specifically identify the critical delay factors in the commissioning of metro rail projects in India.

Ahsan &Gunawan[5]studied the time performance of projects in a selectedgroup of countries in Asia and found the time performance of Indian construction projects to be the poorest, with an average schedule overrun of 55%.

Vijayamohan Pillai & K P [6]studied 24 power projects in India and analysed the extent of time and cost overruns. The projects were reported with an average time overrun of more than 150%.

Sambasavin, et.al[7] had studied the factors of project delay and its repercussions on project completion in the Malaysian construction industry. The ten most significant causes of delay identified from a set of twenty eight different causes were (1) contractor's improper planning, (2) contractor's poor site

management, (3) inadequate contractor experience, (4) inadequate client's finance and payments for completed work, (5) problems with subcontractors, (6) shortage in material, (7) labor supply, (8) equipment availability and failure, (9) lack of communication between parties, and (10) mistakes during the construction stage.

METHODOLOGY

a. Problem Identification:

The thesis would primarily consist studying the various causes of delays and their relative degree of importance. Hence we have conducted a fair deal of literature review and studied a number of projects which have got delayed. Further data collection was also done with the help of a questionnaire. The problem identification was also based on the mini thesis which we conducted earlier.

We aimed to basically have a better understanding of the causes of delays which occur in the transportation infrastructure projects. Further the main problem of the study was identified as the ranking of the various causes of the delays. This ranking would be on a relative basis to clearly understand which causes are more significant and which are not so significant.

b. Data Collection:

For the purpose of literature review, we have carried out a survey of 4 infrastructure projects, which are in various stages of completion. These projects basically belong to the Pune Metro infrastructure sector. This study involves the collection of information regarding each project on the following basis:

1 The type of project, i.e. to which sector it belongs.
2 The size of the project in terms of its cost.
3 The location of the project.
4 The quantum of time overruns and cost overruns involved before or during the execution of the work.
5 The causes attributed to the delays.

The sources of data are as follows:

1 Collection of data through questionnaire survey.
2 The collection of data from scholarly articles, research papers and academic studies.
3 The collection of primary data from sources like Ministry of Statistics and Programme Implementation (MoSPI)
4 The collection of data from media reports.

c. Design of the Questionnaire:

A questionnaire is an analytical tool consisting of a set of questions in order to collect information from respondents. They are designed for statistical analysis of responses. Questionnaires should be prepared in one way those respondents need to be able to read and answer questions.

The analysis was used using a four-point Likert scale and the weight is given as follows:

1 - Severe
2 – Less Severe
3 - Moderate
4 - Mild
5 – Negligible

d. Calculation of relative importance factor:

To assess the perception of various categories of respondents, this study followed the approach of calculation of RII as discussed in the literature review. The opinion of these groups was taken on a five-point Likert scale and relative importance indices (RII) were calculated for each factor as follows:

$RII = \sum W/A \times N$

W Weightage for each factor by respondent (ranging from 0 to 5)

A Maximum Weightage (i.e. 5 in this case)

N Total Number of respondents

Higher value of RII indicates the importance of the factor under consideration. The calculated value of RII is used to rank the factors for the delay. The group-wise and aggregated ranking enabled to compare the importance of factors as comprehended from the opinion of various groups.

CASE STUDY ON PUNE METRO :

Name Of The Project :Pune Metro
Client : Maha - Metro
Location : Pcmc-Swargate,
Vanaz – Ramvadi ,
Maharashtra.
Cost Of The Project :Inr 10,700 Crores.
Alignment Map : Line 1{Pcmc - Swargate}

Line 2 {VANAZ - RAMWADI}

CAUSES OF DELAYS IN PROJECT:

1.Delay Caused Due To Covid:

PUNE, INDIA (Metro Rail News): Prime Minister Narendra Modi laid the foundation stone for the much-delayed Pune Metro project on December 18, 2016. However, the project has encountered a few roadblocks while attempting to travel its many paths since then. As the may 2022 deadline approaches, the two metro lines are still not finished after five years.Covid-imposed limitations, which resulted in a major departure of workers, caused the work to be delayed, according to officials. The project has been on and off the rails several times, due to a variety of issues ranging from political wrangling among parties to land acquisition issues.The work at Sambhaji bridge, commonly known as LakdiPul, has been halted, adding to the growing list of roadblocks. The Congress, Nationalist Congress Party (NCP), and Shiv Sena, the three Maha Vikas Aghadi (MVA) partners, have opposed the height of the viaduct at Lakdipul because it will hinder Ganesh's emersion process.

2.Delay Caused Due To Permission:

The of Sambhaji bridge is five-and-a-half meters, which is the same along Karve Road," Maha-Metro (Maharashtra Metro Rail Corporation Limited) executive director Atul Gadgil said. The level of all PMC flyovers is also the same. We've requested police protection so that we can resume work on the viaduct at Sambhaji Bridge in Deccan. Vanaz to Ramwadi and Pimpri-Chinchwad to Swargate are the two metro routes being built by Maha-Metro.The first roadblock was deciding whether to build an elevated or underground metro; it wasn't until union minister Nitin Gadkari got involved that the authorities decided on an elevated metro. Another stumbling block was the Pataleshwar caves on JM road; despite calls for it to be built parallel to the city, the metro was diverted from Karve Road to riverfront road instead of JM road.The project was later contested before the National Green Tribunal (NGT), but it was ultimately approved. The metro route was challenged again at Aga Khan Palace, and the court-ordered Maha-Metro to amend the route because it was a monument. The corridor was subsequently changed to Kalyaninagar. At KamgarPutala and Budhear Peth, there was also a dispute over land acquisition.

PROJECT FEATURES:

- The Metro Rail System has proven to be most efficient in terms of energy consumption, space occupancy and numbers transported.
- High-capacity carriers – very high volumes of peak hour peak direction trips.
- Eco-friendly – causes no air pollution, much less sound pollution.
- Low energy consumption – 20% per passenger km in comparison to road-based systems.
- Greater traffic capacity – carries as much traffic as 7 lanes of bus traffic or 24 lanes of car traffic (either way).
- Very low ground space occupation – 2 meter width only for elevated rail.
- Faster – reduces journey time by 50% to 75%

DATA ANALYSIS AND FINDINGS:

Respondent's profile

The respondents' profile including Sex represented, occupational level and working experience are compiled in Table 5.1.

Demographic characteristic	Frequency	Percent
Sex		
Male	10	100
Female	0	0
Occupational Level		
Senior Engineer	5	50
Manager	2	20
Project Manager	1	10
Safety Engineer	2	20
Working experience		
Less than 5 years	3	30
5-10 years	2	20
10-20 years	4	40
More than 20 years	1	10

Table5.1.Respondents Profile

Questionnaire Survey And Finding Of RII

The number of Respondent scoring were given on the basis of numbers (0 to 5) as follows-

1 - Negligible

2 - Mild

3 - Moderate
4 - Less Severe
5 - Severe

To assess the perception of various categoriesof respondents, this study followed the approach of calculation of RII as discussed in the literature review. The opinion of these groups was taken on a five-point Likert scale and relative importance indices (RII) were calculated for each factor as follows:

$RII = \sum W/A \times N$

W Weightage for each factor by respondent (ranging from 0 to 5)

A Maximum Weightage (i.e. 5 in this case)

N Total Number of respondents

Ranking of Factors:

RII value for all the factors was calculated for the identification of the most critical factors of delay in metro rail projects. The factors were listed in the decreasing order of their value of RII and ranked. The factors were listed in the decreasing order of their value of RII and ranked. The five most critical factors of delay from the perspective of respondents were: (1) Delay in Land Acquisation (RII = 0.88); (2) Effect of Covid (RII = 0.62); (3) Effect of Traffic during Work (RII = 0.56); (4) Delay in Design Approval (RII = 0.54); (5) Shortage of Labours (RII = 0.52).

The analysis of the critical factors from the perspective of client, contractors and consultants/designers indicates that delay in land acquisition and site handover to contractor is the most critical factor in delay. The opinion of respondents suggests that effect of COVID is the second most responsible factor for delays. These all tend to have a negative impact on the schedule compliance of the project and intensify delays. Metro rail projects are also prone to the effect of unforeseen subsurface and changing ground condition. At times, a difference in the expected and actual subsurface and ground conditions is observed, which requires necessary course correction and results in delays.

The number of Respondent scoring were given on the basis of numbers
(0 to 5) as follows-
1 - Negligible
2 – Mild
3 - Moderate
4 - Less Severe
5 - Severe

Sr. No	Causes of Delay	Number of respondents scoring (Occurrence)					RII	Ranking
		1	2	3	4	5		
1.	Environmental Impact Of The Project	2	5	3	0	0	0.42	8
2.	Difficulties in Financing Projects	5	5	0	0	0	0.3	12
3.	Shortage of Labours	1	3	5	1	0	0.52	5
4.	Delay in Land Acquisation	0	1	5	3	1	0.88	1
5.	Political Instability	4	3	2	0	1	0.42	9
6.	Shortage of Construction material	4	2	3	0	1	0.44	7
7.	Effect of COVID	1	2	4	1	2	0.62	2
8.	Delay in Design Approval	1	5	1	2	1	0.54	4
9.	Unqualified Workforce/Low skilled Labours	5	1	3	1	0	0.40	10
10.	Delay in Obtaining Permits From Local Bodies	1	5	2	2	0	0.50	6
11.	Effect Of Traffic During Work	1	2	5	2	0	0.56	3
12.	Delays due to Improper Execution Of Work	7	1	0	1	1	0.36	11

Table5.3. Ranking of Causes (based on respondents)

CONCLUSION AND RESULTS

Discussion of Results

The ten most critical factors of delays (based on all respondents) as shown in the Table 5.3 are: (1) Delay in Land Acquisation (RII = 0.88); (2) Effect of Covid (RII = 0.62); (3) Effect of Traffic during Work (RII = 0.56); (4) Delay in Design Approval(RII = 0.54); (5) Shortage of Labours(RII = 0.52). This section discusses the details of the critical factors of delay in metro rail projects.

Delay in land acquisition

Unavailability of land affects the timely implementation of construction projects. The issues of land scarcity and difficulty in land acquisition have affected metro rail projects.

Effect of Covid

Prime Minister Narendra Modi laid the foundation stone for the much-delayed Pune Metro project on December 18, 2016. However, the project has encountered a few roadblocks while attempting to travel its many paths since then. As the may 2022 deadline approaches, the two metro lines are still not finished after five years. Covid-imposed limitations, which resulted in a major departure of workers, caused the work to be delayed, according to officials.

Effect of Traffic during Work

Traffic congestion increases vehicle emissions and degrades ambient air quality, and recent studies have shown excess morbidity and mortality for drivers,

commuters and individuals living near major roadways. Presently, our understanding of the air pollution impacts from congestion on roads is very limited.

Delay in Design Approval

Delay in design approval is the fourth cause of delay of metro according to the respondents.

Shortage of Labours

Construction of projects is frequently struck by shortage in labour. In agriculture based economies, migrant seasonal workers lead to unavailability of labour in the harvesting season. They are a major cause of delay for most of the construction based projects in India. Labour crisis also occurs due to the low number of new entrants, low wages, skill mismatch and geographic location based issues. Shortage of skilled labour also contributes to project delays in the construction industry. Metro rail projects are more affected by the shortage of unskilled labour.

Conclusion:

Metro rail projects are helpful for public transport . These projects are frequently characterized by time and cost overruns. The aspect of time overrun is undertaken for investigation in this research. Progress of a metro rail project is typically influenced by multiple impediments. These impediments can be an outcome of factors related to owner, contractor, consultant, materials issues, labour issues, technology related aspects and external agents. The paper presents the results of a study on causes of delay , their importance, and ranking for the case of metro rail projects in Pune. Based on a total of 12 causes, a questionnaire was designed to gather the opinion of professionals with experience in Metro Rail based projects. Data from the survey was analysed using the Relative Importance Index (RII) and factors of delay were ranked and causes of delay were ranked. The RII of 12 causes of delay factors suggests that 1) Delay in land acquisition; (2) Effect of Covid ; (3) Effect of Traffic during Work ; (4) Delay in Design Approval; (5) Shortage of Labours are the five top causes for the delay in metro rail projects. A ranking based on the category of causes was also derived.

Limitation:

This study has been carried out for the partial completion of Under Graduate Programme and as such has some limitations. These are mentioned as follows:

a. The study is primarily based on questionnaire analysis and hence the feedback from respondents. However the views of the respondents can be inaccurate.

b. The sample size is very small (10 in number).

c. The case study was conducted from information available from various sources such media reports, journals, and internet sources. No information could be gathered from personnel working on actual project.

FUTURE WORK

As a recommendation for future studies, We strongly recommend to future researchersto make one step further and investigate the exact contribution of each cause to the delay in metro rail project. The recognition of this will help both private and public sectors in the provision of Infrastructures. Further, the analysis of the identified factors of delay can be taken up in future research from the view-point of identification of project risks. Also, projects pertaining to the other sectors of infrastructure can be investigated to find out the causes of delay and their mitigation strategies.

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