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Systematic Study of Factors Causing Cost Overrun and Delay in Pune Metro Line Project by using Relative Importance Index (RII) Method

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ABSTRACT

To sketchily identify the major causes of delays on construction of Pune metro line I project; the major causes of delays from this research study were investigated following data collection carried out through a questionnaire survey with a wide range of construction professionals based in Metro Projects. The findings from this research determined the major causes of delays based on an relative importance index, and the main conclusions from output of the data could help the construction sector to better assess not only the major causes of delays on construction of metro projects but also how to minimize and mitigate the risks involved. The construction industry which supplements the second largest job in India after agriculture industry is also generates construction waste which impacts environment in the form of soil contamination, water contamination, and deterioration of landscape. It is well well-known fact that most railway construction projects showing the delay in timeline or cost overrun or both of them. This phenomenon may distress the progress of infrastructure in the country as well as may risk many contracting firms profit margin. This study was supported out based on literature review and a semi-structured survey that was acquired from competent people from contracting companies, consultants and stakeholders of Pune metro project, and to understand the top factors delaying the time line of railway metro projects analysis has been carried out by RII method. By analysis it has been find out that top three factors responsible for delay are Land Acquisition, Covid 19 pandemic and Shortage of skilled workforce which clearly represent the importance of land acquisition role in infrastructure projects like metro projects and the scarcity of skilled workforce also plays a substantial role in delay of project.

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KEYWORDS: *Railway project, Pune Metro, Material Wastage, Relative Importance Index*

1. INTRODUCTION

1.1. General

The construction industry in India is growing with rapid speed and investment which accounts for nearly 8% of India's GDP in 2021. The construction industry is one of the industries through which the physical expansion of the nation is accomplished. It is truly the locomotive of the national economy, at the same time the impact due to construction activities on the natural environment is immeasurable.

The construction industry is considered as one of the most important industries in India. It is well known fact that most construction projects in India are getting delayed or cost overrun. The study area of Pune metro phase I project is one of the prominent projects of the country which make this ideal to understand the time delay and cost overrun. The study carried out in this research paper will be beneficial for other metro line construction projects as well as give enrich exposure to the various factors influence the timeline in construction of metro line projects.[1]

1.2. Problem Statement

Management of construction and demolition waste is a serious concern in the country given the high phenomenal growth in the construction industry; the market size is expected to increase at a Compound

Annual Growth Rate (CAGR) of about11 percent considering 2020-21.

Transportation infrastructure projects like metro projects which will be nerve for many cities of India faces delays in construction. This study is carried out with an objective to specifically identify the critical delay factors in the commissioning of Pune metro line I project.

2. LITERATURE REVIEW

Investigation of Pune strip development projects presented to time invades and material wastage or both. This wonder may influence the advancement of the development business just as may uncover numerous organizations of development to be destroyed.[2]

The charging which is determined in super ventures can be co-related with uses of CAD utilizing 5 measurements and a geographic data system.[3]

The creator in this exploration accentuation discovering the most ideal course for transportation lines regarding streets and rail routes, and this paper have helped in the metro passage course examination [4]. The creator has zeroed in on the appraisal of Mumbai city which falls under metropolitan region by utilizing 3D demonstrating methods [5]

This examination has utilized a fluffy characterization approach utilizing high-goal satellite pictures which have helped the creator for programmed street extraction.[6]

In this venture for quick development and limiting waste the creator has utilized E-squander as a fractional substitution in some rate, obviously, total to go after the material utilization.[7]

The creator do explore and has utilized 4D GIS during the time spent different development exercises alongside the quality, amount, and gauge of different underlying individuals like chunks, radiates sections, etc.[8] The very much dissected exploration including the labor regarding work and material administration is considered by the creator utilizing the RII technique by with the material administration is controlled.[9] The creator has applied the RMMM strategy for infrastructural projects for different asset management. [10]

The task accentuates discovering the best shorted conceivable course for RMC vehicles to move the solid to the site from different RMC plants.[11] The creator has taken Akola taluka as the examination territory wherein utilizing geological information alongside land drafting maps are utilized for the improvement of open or empty land space for endless suburbia. [12]

The creator has utilized the open patio territory for water assortment by with the water waste isn't captured with the Mumbai transportation frameworks and subsequently a turnpike is kept up.[13] The creator has worked out the development of the material and primary components utilizing Etabs and Staad to actualize the time and cost factors with the pre- and post-development of intercultural projects. [14]

This investigation was done dependent on writing audit and a poll review that was acquired from contracting organizations, specialists and proprietors in Pune Strip. The examination explained that "late in modifying and supporting plan reports "was the most basic factor that impacts project length. The study demonstrates that "material - related components "involved the second position in significance". The absence of materials on the lookout" and "postponement in material conveyance to the site" is likewise the main components influencing project duration. [15]

According to the investigation by creator, cost overwhelm is a difficult which influences 90% of finished tasks on the planet. In this paper creator, embraced the work area methodological methodology which includes contrasting the reasons for material waste and those of cost invades from the writing to decide the conceivable relationship.[16]

According to the aftereffect of examination paper, 96.88% and 81.81% of the reasons for cost overwhelm likewise because material waste at the pre-agreement and post-contract organizes individually. There is a 86.74% cover between the reasons for material waste and those of cost overwhelms at all phases of a project.[17]

The investigation suggests that development project administrators, just as the development specialists, ought to empower the administration of material-squander causes, as it can possibly limit the reasons for cost invade for a project.[17]

Creator has conveyed the examination included progressing building development projects inside Abuja, Nigeria, from which an example of 31 public and private activities was intentionally chosen. The creator utilized Pearson second connection and the engaging technique to dissect the gathered information and the outcomes uncovered a measurably critical connection between material waste and cost overrun.[18]

The outcomes showed material waste to project-cost overwhelm goes from 1.96% to 8.01%, with a normal commitment of 4.0% to project-cost overruns.[18]

In this paper, the creator contemplated five limited scope private development projects in Nasik where odds of waste age are more because of absence of appropriate administration. [19]

The development material waste situation of every one of the 5 private, medium to little building locales discovered to be significant in cost-adequacy and necessities the executives. The increasing expense on development project emerging because of development material wastage which is in the middle of 5% to 10 % of task according to the examination and investigation by author. [19]

In this investigation, the creator intends to set up connection between times invade and work profitability on building site in India. The information result show that deficient asset for the venture, lacking arranging before project departure, insufficient devices and gear and postponement in conveyance material are the rundown of the significant reasons for time invade while the utilization of wrong development strategy, deficient development material, and off base drawing particular are the key factor causing low work profitability building site. The huge negative relationship figured out between time invade and work profitability at building site.

The creator closed by suggesting that the early arrangement of the venture chief could guarantee appropriate administration of both human and material assets that could ensure improved profitability and eventually save project from time overcome.[20]

3. AIM AND OBJECTIVE

"The eventual aim of this research paper is, to systematically identify the various factors influence the cost and time overrun of Pune metro project".

1. To study various factors causing delay of Pune metro Line I project.
2. To study various factors causing cost overrun of Pune metro Line I project.

4. METHODOLOGY

Initially, the data will be collected from literature review and Pune metro line I project and a roadmap of research work will be prepared in form of various factors may influence the time and cost overrun of metro project and evaluate the factors by RII method.

Figure No. 1: Research Methodology

5. DATA COLLECTION AND ANALYSIS

5.1. Survey

a. Type of Survey: Close-ended Question and using Likert Scale.

b. Participants

A. Nature of Organization: In this study, the participants that is contractor, consultant and owner are 60%, 23% and 17% respectively.

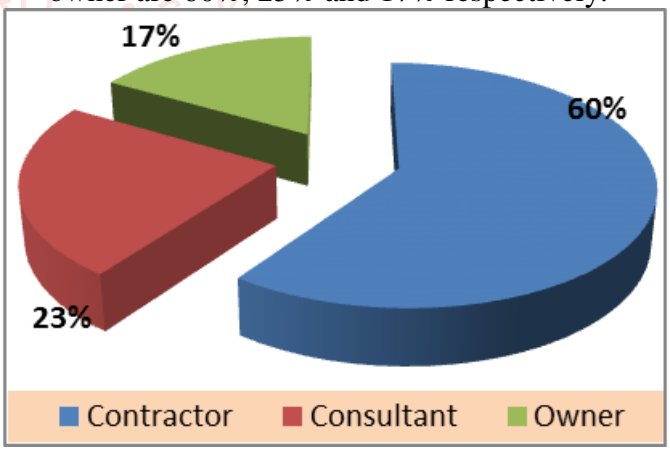

Figure No. 2: Types of Participants Nature of Organization

B. Types of Projects handled by Participants:

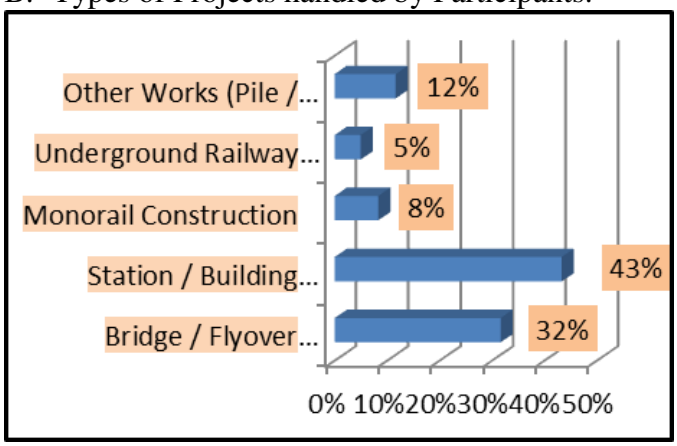

Figure No. 3: Type of Projects Handled by Participants

C. Participants Designation:

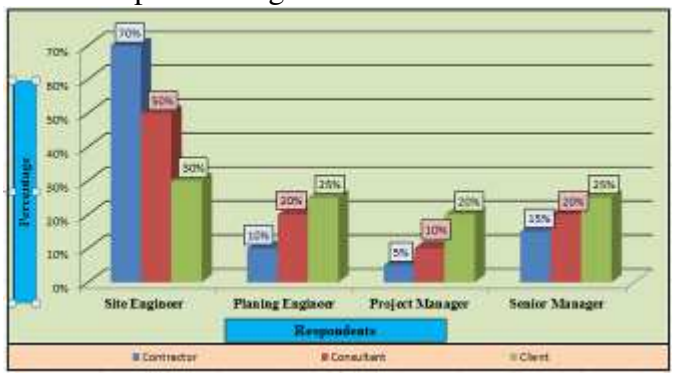

Figure No. 4: Participants Designation

D. Participants Professional Trades:

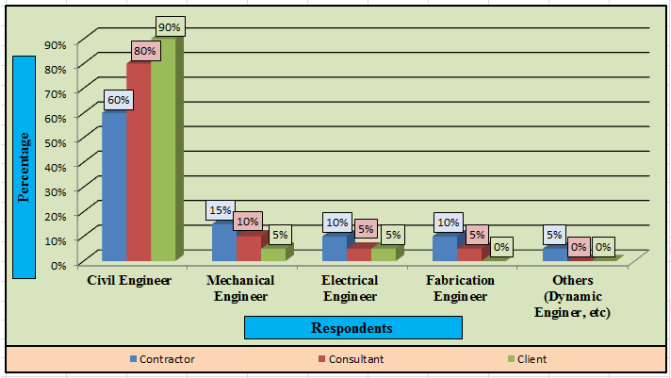

Figure No. 5: Participants Professional Trades

5.2. Relative Importance Index

The process used in examining of data was aimed at forming the relative importance of the various factors that contribute to causes of delays in metro line construction project particularly in Pune Metro.

The contribution of each of the factors to overall delays was examined and the ranking of the attributes in terms of their criticality as perceived by the respondents was done by use of Relative Importance Index (RII) which was computed using equation and the results of the analysis are presented in following section.

$$RII = \frac{\sum W}{A \times N}$$

Simply for understanding, formula can be written in the following way

$$RII = \frac{5(N5) + 4(N4) + 3(N3) + 2(N2) + 1(N1)}{A \times N}$$

Where, N5 = Nos. of respondents for great impact
N4 = Nos. of respondents for considerable impact
N3 = Nos. of respondents for average impact
N2 = Nos. of respondents for slight impact
N1 = Nos. of respondents for least impact

5.3. Skewness and Kurtosis of Survey

The summary of the collected data from survey is given below. In this datasheet, total sixty respondents have given their ratings on all thirty factors by using Likert's scale of 5 points. The data has been collected in form of physical sheets and all the respondents are the competent persons to avoid error in result analysis.

Table No. 1: Skewness and Kurtosis of Survey

Sr. No	Factors	Skewness	Kurtosis
1	Effects of subsurface and ground conditions	0.5	-0.7
2	Poor site management	-0.6	-0.5
3	Poor site layout	-0.3	-1.0
4	Delay of materials approved by a consultant	0.0	-0.8
5	Escalation of material prices	0.3	-0.7
6	Low Productivity level of labor	-0.5	-0.8
7	Shortage of skilled workforce	-0.1	0.9
8	Insufficient number of staffs	-1.0	-1.1
9	Frequent change in Contractor	0.5	0.4
10	Low level of equipment operator skills	0.1	-0.9
11	Labor injuries on site	0.4	0.6
12	Insufficient number of Equipment	0.5	0.4
13	Shortage of good conditioned equipment at a site	-0.1	-0.6
14	Inadequate contractor work experience	-0.5	-0.7
15	Delay of material delivery to site	0.1	-0.7
16	Complexity of the project	0.5	0.4
17	Suspension of work by owner or contractor	0.8	-1.4
18	Poor communication and coordination by owner	-0.4	-1.0
19	Poor communication& coordination by contractor	0.0	0.5
20	Slowness in decision making process by owner	-1.0	0.8
21	Original contract duration is too short	0.3	-1.0

22	Delay in Payment	0.1	0.9
23	Shortage of construction material at the site	0.3	1.0
24	Disputes between the parties regarding legal issues	0.5	-0.7
25	Changes in government regulation and laws	-1.0	-0.1
26	National or Global Pandemic (Covid 19)	-1.0	0.1
27	Ineffective planning & scheduling of project	0.2	-1.0
28	Ineffective planning and scheduling by Agency	-0.6	-0.5
29	Land Acquisition	-1.0	-0.7
30	Local issues	-0.5	-0.7

First the data collected from the semi-structured survey, will be checked by Skewness and Kurtosis method of analysis to validate the collected data.

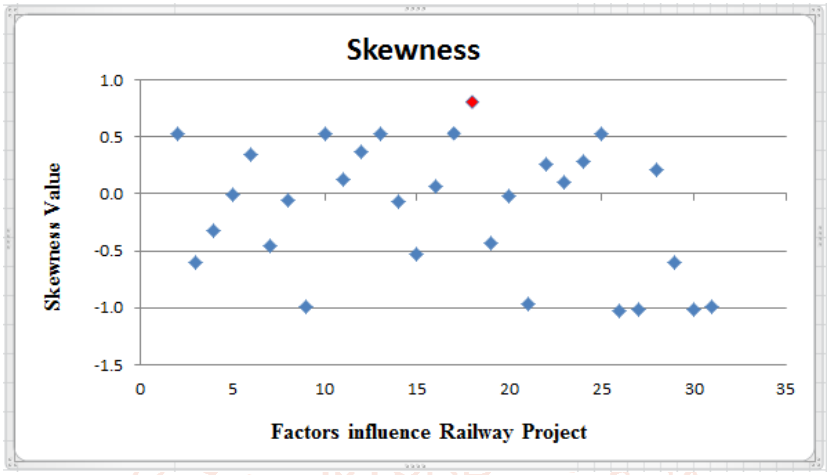

Figure No. 6: Graphical Representation of Skewness Value of Survey Data

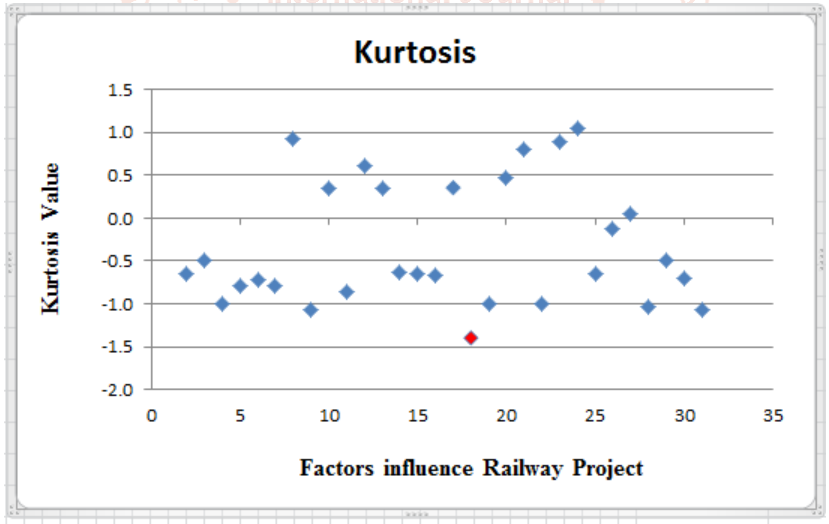

Figure No. 7: Graphical Representation of Kurtosis Value of Survey Data

5.4. Analysis of Survey

RII Technique is used in dissertation to determine the relative importance of the various causes of delays in railway project. The same method is going to be adopted in this study within various groups (i.e. contractors, consultants and clients). The five-point scale ranged from 1 (least impact) to 5 (great impact) is adopted and transformed to RII for each factor by using the formula specified in previous section.

Table No. 2: Critical Causes of delay to railway project by RII Method

Weighting given by each respondent					∑W	A	N	RII
5	4	3	2	1				
0	0	18	41	1	137	5	60	0.46
0	1	42	17	0	164	5	60	0.55
0	1	38	21	0	160	5	60	0.53
23	35	2	0	0	261	5	60	0.87
7	30	23	0	0	224	5	60	0.75

0	1	40	19	0	162	5	60	0.54
0	7	44	9	0	178	5	60	0.59
0	0	43	17	0	163	5	60	0.54
0	0	14	44	2	132	5	60	0.44
2	33	25	0	0	217	5	60	0.72
0	0	13	44	3	130	5	60	0.43
0	0	14	44	2	132	5	60	0.44
0	15	34	11	0	184	5	60	0.61
0	1	41	18	0	163	5	60	0.54
1	28	30	1	0	209	5	60	0.70
0	0	14	44	2	132	5	60	0.44
0	19	41	0	0	199	5	60	0.66
0	25	25	10	0	195	5	60	0.65
0	8	42	10	0	178	5	60	0.59
0	1	42	16	1	163	5	60	0.54
0	11	28	21	0	170	5	60	0.57
0	10	44	6	0	184	5	60	0.61
0	11	45	4	0	187	5	60	0.62
0	18	41	1	0	197	5	60	0.66
0	40	19	1	0	219	5	60	0.73
0	38	20	2	0	216	5	60	0.72
0	12	28	20	0	172	5	60	0.57
0	1	42	17	0	164	5	60	0.55
0	39	9	12	0	207	5	60	0.69
0	0	43	17	0	163	5	60	0.54

Base on the ranking, the 10 most important causes of material management by RII were as follows table:

Table No. 3: Rank of Factors Delaying Railway Project as per RII

Rank	Factors Delaying Railway Project
1	Land Acquisition
2	National or Global Pandemic (Covid 19)
3	Shortage of skilled workforce
4	Frequent change in Contractor
5	Local issues
6	Delay of material delivery to site
7	Shortage of construction material at the site
8	Inadequate contractor work experience
9	Suspension of work by owner or contractor
10	Ineffective planning & scheduling of project

6. CONCLUSION

As per the ranking on the bases of RII value, it can be observed that the top three factors responsible for delay in Pune project are Land Acquisition, Covid 19 pandemic and Shortage of skilled workforce which clearly represent the importance of land acquisition role in infrastructure projects like metro projects and the scarcity of skilled workforce also plays a substantial role in delay of project. Even in top 10 factors there are two factors related to material management i.e. delay of material delivery to site and shortage of construction materials at the site, which clearly reflects the role played by material in terms of cost overrun and delay in Pune metro project.

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