Title:- "IDENTIFY RISK FACTORS IN INFRASTRUCTURE PROJECTS FOR DELAYING THE CONSTRUCTION WORK – A CASE STUDY"

Ankitkumar P. Patel[1]
PG student of Transportation Engineering & Planning, Department of Civil Engineering, Sandip University, Nashik 422213. Email: ankitpatel231196@gmail.com

Asst. Prof. Girish Gadve[2]
Professor,Transportation Engineering & Planning, Department of Civil Engineering, Sandip University, Nashik, 422213. Email: girish.gadve@sandipuniversity.edu.in

ABSTRACT

This research project focuses on delay analysis in a mountainous area NH project with a 1.72 km long tunnel. The primary objective is to identify the main causes of delays in the project and provide recommendations for overcoming these delays.

The study begins with a comprehensive case study of the Kashedi ghat 8.957km long NH project, where interviews were conducted with project personnel to gather insights into the delay events faced by the contractor. These delay events were analyzed in detail, and recommendations were proposed on how the contractor, client, and consultant can effectively address these delays.

To further investigate the reasons for delays in NH projects, a questionnaire survey was conducted using the Likert scale method. The survey included 30 delay reasons, with 10 each from the contractor, consultant, and client perspectives. The survey was distributed to engineers who had worked on similar projects or had relevant experience.

By applying the Relative Importance Index (RII) and Likert method, the ranking of delay causes was determined. The results revealed that the majority of delays occur from the contractor's side, followed by delays from the client. This finding emphasizes the importance of effective planning by contractors and close coordination between the contractor, client, and consultant throughout the project lifecycle.

Based on the findings, it is recommended that contractors prioritize project planning, ensure adequate experience and knowledge, and employ skilled manpower. Project managers should analyze the project thoroughly to anticipate potential delays and take early actions to mitigate their impact. By implementing these recommendations, it is expected that NH projects in mountainous areas can be completed within the specified timelines, ensuring successful project delivery.

Keywords: - Primavera software, RII Method, Likert Method, Risk management.

INTRODUCTION

1. General:

Highway and National Highway (NH) projects play a vital role in connecting cities, regions, and countries, facilitating efficient transportation and promoting economic growth. However, the construction phase of these projects often faces significant delays, leading to cost overruns, extended project timelines,

and potential disruptions to traffic flow. To ensure the successful completion of NH and highway projects, it is crucial to identify and address the key factors that contribute to delays.

Delay events in NH and highway projects can arise from various sources, including approval processes, land acquisition challenges, weather conditions, coordination issues, and unexpected ground conditions. These delays can have far-reaching implications, impacting the project budget, quality, and public perception. It is imperative for project stakeholders, including contractors, clients, and consultants, to proactively address these delays and implement effective strategies to minimize their impact.

Cost consumption is a significant concern in NH and highway projects, as delays can result in increased material and labor costs, extended equipment rentals, and additional administrative expenses. Moreover, prolonged construction periods can disrupt traffic flow, leading to increased congestion, accidents, and environmental implications. Therefore, finding ways to optimize project timelines and mitigate delays is essential for minimizing cost overruns and ensuring efficient project delivery.

Robust project management practices should be implemented to monitor progress, identify potential delays, and promptly address them. Regular communication and collaboration between stakeholders, such as contractors, clients, and consultants, are essential for proactive problem-solving and timely decision-making.

Public engagement and community involvement are also vital in NH and highway projects. Clear communication channels should be established with local communities to address concerns, minimize disruptions, and ensure smooth project implementation.

Through effective project planning, proactive management practices, resource allocation, advanced technologies, and community engagement, project stakeholders can navigate the challenges posed by delays and ensure the successful completion of NH and highway projects. By doing so, we can realize the full potential of these vital infrastructure projects in facilitating connectivity, economic growth, and safe and efficient transportation networks.

Literature Review:

i. INTERNATIONAL JOURNAL OF INNOVATIONS IN ENGINEERING RESEARCH AND TECHNOLOGY [IJIERT]

CAUSES OF DELAY IN INDIAN TRANSPORTATION INFRASTRUCTURE PROJECTS

S. K. PATIL[1,] A. K. GUPTA[2], D. B. DESAI[3], A. S. SAJANE[4]

A survey was conducted in Western Maharashtra to assess the time performance of various construction projects and identify the causes of delay according to different project participants: owners, consultants, and contractors. A total of 64 delay causes were identified during the research. The study revealed a significant problem, with 72% of infrastructure projects reported as being delivered late, while only 28% were completed on time. Clients reported that 59% of public projects experienced delays, consultants reported 62% of projects were completed late, and contractors stated that 77% of projects exceeded the planned duration.

The top five major causes of construction delays in transportation infrastructure projects were identified as land acquisition, environmental impact assessment, financial closure, client change orders, and poor site management and supervision by contractors. According to the survey respondents, 50% attributed the delays primarily to contractors, 40% held clients responsible, and only 10% felt that consultants played a significant role in the delays. This indicates that consultants, serving as intermediaries, have less responsibility for construction delays.

This abstract highlight the prevalent issue of project delays in Western Maharashtra, emphasizing the

high percentage of projects experiencing delays and the key factors contributing to these delays. The findings underscore the need for improved coordination and management among project stakeholders, with particular attention to addressing land acquisition challenges, conducting thorough environmental impact assessments, ensuring timely financial closure, and enhancing site management and supervision practices.

ii. International Research Journal of Engineering and Technology (IRJET)

Delay in Construction of Highway and Expressway Projects

Vijay Kumar (June 2020)

He studied One of the key industries that contributes crucial components to the growth of an economy is the Road construction sector. But numerous projects suffer significant delays, which cause them to take longer than expected and spend more money. One of the most frequent issues in the construction sector, construction delays have a negative impact on the timeliness, cost, quality, and safety of projects. India's highway and motorway projects are suffering from significant delays. It is crucial to thoroughly study the causes of delays and to develop a clear understanding among highway and motorway specialists because of the paradigm shift in the volume and capacity of the highway construction sector over the past ten years. The research identified the significant factors affecting the delays in the Indian highway and motorway construction industry by adopting a thorough analysis of the project stakeholders, including the client, consultant, and contractor, and then establishing the association between factors to develop prediction models to evaluate the impact of these delay factors.

Aim of study

"The aim of this study is to identify the risk factors that contribute to delays in infrastructure projects, and to differentiate the delay causes among contractors, consultants, and clients. Using case studies, data analysis, and a questionnaire survey, this research seeks to develop effective strategies for mitigating the risks of delay and improving the performance of infrastructure projects.''

What is delay?

Delay is a situation when the actual progress of a construction project is slower than the planned schedule or late completion of the project. However, delay situations are complex in nature because multiple delays can occur concurrently and because they can be caused by more than one party, or by none of the principal parties.

Below is the list of type of Delays: -

- Critical and Non-Critical.
- Excusable and Non-Excusable
- Compensable and Non-Compensable
- Concurrent and Non-Concurrent.

Research Methodology: -

i. Likert Scale Method: -

The Likert scale method is a commonly used survey technique for measuring attitudes, beliefs, opinions, and perceptions. It involves asking respondents to indicate their level of agreement or disagreement with a series of statements or questions. The Likert scale typically

consists of a range of response options, such as:

- Strongly Agree (5)
- Agree (4)
- Neither Agree nor Disagree (3)
- Disagree (2)
- Strongly Disagree (1)

Several researchers employed the study instrument that was created utilizing a variety of measures that were incorporated from existing literature and several new measures generated for this research project to examine the data. Five-point Likert scales were the tools employed in the field survey questionnaires. The questionnaire was carefully created so that respondents could contribute information about the frequency and significance of delays in the projects based on their personal experiences. The sample was made up of engineers who worked for the three main construction stakeholders, the Client, consultant, and contractor. In this investigation, there was no rational or mathematical method of sampling used.

ii. Relative Importance Index: -

Relative Importance Index (RII) is a numerical scale used to rank factors based on their importance in a study. It is commonly used in survey-based research to analyze responses from participants and identify the most significant factors. The RII ranges from 0 to 1 and is calculated using the following formula:

Below is the formula of Relative Important Index: -

$$\text{Relative Important Index} = \frac{5n_5 + 4n_4 + 3n_3 + 2n_2 + 1n_1}{A*N}$$

Where,
n_1 = Number of Respondent for Strongly Disagree
n_2 = Number of Respondent for Disagree
n_3 = Number of Respondent for Neutral
n_4 = Number of Respondent for Agree
n_5 = Number of Respondent for Strongly agree
A (Highest Weight) = 5
N (Total No. of respondent) = 35

RII is a simple and widely used method for analyzing survey data and identifying important factors. However, it does not consider the interrelationships between factors or the potential interactions between them. Therefore, it is important to use RII in conjunction with other analytical methods to gain a comprehensive understanding of the factors that contribute to a particular phenomenon.

Data Analysis and Result: -

i. Data Collection as per Likert scale method: -

This section presents the data collected through a Likert scale-based questionnaire survey conducted via Google Forms. The survey aimed to identify and evaluate the causes of delay in construction projects using a structured questionnaire. Participants were asked to rate their level of agreement or disagreement with various delay reasons using a five-point Likert scale: strongly disagree, disagree, neutral, agree, and strongly agree.

Questions: -							
Sr. No.	Questions Ask for	Delay by	Options				
			Strongly Agree (5)	Agree (4)	Neutral (3)	Disagree (2)	Strongly Disagree (1)
Delays Due to Contractor side							
1	Delay due to Poor site management and supervision by contractor during the construction period!	Contractor	0	0	3	17	15
2	Inadequate planning & scheduling of contractor for construction of project.	Contractor	0	1	5	17	12
3	Lack of high-technology mechanical equipment on site (lack of machineries on site).	Contractor	0	0	7	17	11
4	Shortage of manpower and sub contractors (skilled, semi-skilled, unskilled labour).	Contractor	0	1	6	15	13
5	Delays due to Improper Execution and unplanned activities of the work by contractor.	Contractor	0	0	8	17	10
6	Delay in ordering main equipment by contractor or procurement process.	Contractor	0	1	9	17	8
7	Rework due to errors during construction by contractor.	Contractor	0	0	5	18	12
8	Delays in contractor's payments to subcontractors and other suppliers.	Contractor	0	0	6	20	9
9	Inadequate equipment (Formwork, labour tools, electrical tools) for the works.	Contractor	0	0	6	19	10
10	Safety rules and regulations are not followed within the contractor's organization.	Contractor	0	1	9	20	6
	Total		**0**	**4**	**64**	**177**	**106**
	Average of Total		**0**	**0.4**	**6.4**	**17.7**	**10.6**
Delays Due to Consultant side							
1	Delay in progress payments approvals from consultants to the Contractor.	Engineers	0	0	6	17	12
2	Slow response from the consultant (Authority Engineer) to Contractor inquiries.	Engineers	0	2	10	11	12
3	Delay in approving major changes in the scope of work and approval of variations by consultant.	Engineers	0	0	4	19	12
4	Delay in performing inspection and testing by consultant (Authority Engineer's) during the construction.	Engineers	0	3	8	16	8
5	Delays in drawings and other approvals from consultant (Authority Engineer's).	Engineers	0	1	6	21	7
6	Inadequate design-team experience for review of Designs and drawings.	Engineers	0	2	9	20	4
7	Late in reviewing and approving design documents during construction by consultant.	Engineers	0	0	6	20	9
8	Delay in reviewing and approving initial design documents by consultant.	Engineers	0	0	5	20	10
9	Inadequate NCR raised by the Consultant for any particular activity or event.	Engineers	0	3	9	21	2

Questions: -							
Sr. No.	Questions Ask for	Delay by	Options				
			Strongly Agree (5)	Agree (4)	Neutral (3)	Disagree (2)	Strongly Disagree (1)
10	Delay in work on particular activity as inadequate SOR or HSE report raised by consultant for Quality, Safety and Environment.	Engineers	0	1	8	16	10
	Total		**0**	**12**	**71**	**181**	**86**
	Average of Total		**0**	**1.2**	**7.1**	**18.1**	**8.6**
Delays Due to Client side							
1	Delay Due to Land Acquisition in Ghat project.	Client	0	1	5	11	18
2	Environmental issues related with project location (Ghat area).	Client	0	0	6	21	8
3	Delay occurs due to Change orders by the client or change of scope in project.	Client	0	0	13	11	11
4	Difficulties in obtaining work permits from client side.	Client	0	2	10	12	11
5	Insufficient data collection and survey before design and drawing of project.	Client	0	0	4	23	8
6	Delay due to subsurface site conditions materially differing from contract documents.	Client	0	3	10	16	6
7	Ambiguities, mistakes, and inconsistencies in contract specifications and drawings.	Client	0	0	8	16	11
8	Changes in material types and specifications during construction by client.	Client	0	1	11	20	3
9	Unrealistic imposed initial contract duration (More work scope in short term contract).	Client	0	2	5	18	10
10	Delay in providing services from utilities (such as water, electricity).	Client	0	0	7	12	16
	Total		**0**	**9**	**79**	**160**	**102**
	Average of Total		**0**	**0.9**	**7.9**	**16**	**10.2**

Table no. 1 Data Collection

ii. Data Analysis as per RII method: -

Below is the formula of Relative Important Index: -

$$\text{Relative Important Index} = \frac{5n_5 + 4n_4 + 3n_3 + 2n_2 + 1n_1}{A*N}$$

Where,
n_1 = Number of Respondent for Strongly Disagree
n_2 = Number of Respondent for Disagree
n_3 = Number of Respondent for Neutral
n_4 = Number of Respondent for Agree
n_5 = Number of Respondent for Strongly agree
A (Highest Weight) = 5
N (Total No. of respondent) = 35

Sr. No.	Delay Due to	Total Number (N)	Responses					Total	A*N	RII	Ranks
			[1] Strongly Disagree	[2] Disagree	[3] Neutral	[4] Agree	[5] Strongly Agree				
1	Contractor	35	0	0.8	18.9	70.8	53	143.5	175	0.820	1
2	Consultant	35	0	2.4	21.3	72.4	43	139.1	175	0.795	3
3	Client	35	0	1.8	23.7	64	51	140.5	175	0.803	2

Table No. 2 Data analysis by RII method

iii. Result: -

Based on the data in Table no. 2, an analysis has been conducted using the RII method formula to calculate the values. The results are presented in the following table, which ranks the components based on the occurrence of delays. This ranking provides valuable insights into the relative contribution of each component towards the occurrence of delays in the project, helping to identify areas that require attention and improvement.

Sr. No.	Delay Due to	Relative important index value	Ranks
1	Contractor	0.820	1
2	Consultant	0.795	3
3	Client	0.803	2

Table no. 3 Result

CONCLUSION

Based on the results obtained through the RII method, it is evident that most of the delay events in mountainous region road construction projects are attributed to the contractor. The contractor obtained the highest rank, indicating a significant role in causing delays during the construction phase. This finding emphasizes the need for contractors to enhance their project planning, communication, and monitoring practices.

To address these delays, the contractor should prioritize effective project planning by considering factors such as weather conditions, availability of resources, and site-specific challenges. Close coordination with the client and consultant is essential to ensure timely decision-making and resolve any issues that may arise during the project.

Furthermore, the contractor should focus on improving communication channels with workers and various departments involved in the project. Clear instructions, regular progress meetings, and efficient monitoring mechanisms can help streamline construction activities and minimize delays.

Additionally, implementing a robust quality control system can ensure that the construction work meets the required standards, reducing the chances of rework and associated delays. Regular inspections, quality assurance checks, and prompt resolution of non-conformities are crucial in this regard.

By adopting these measures, the contractor can mitigate delays and enhance the overall

efficiency of the construction process. It is important for the contractor to acknowledge their role in delaying events and take proactive steps to improve project management practices. The findings also highlight the importance of ongoing collaboration between the client, consultant, and contractor to achieve timely project completion and meet stakeholders' expectations.

REFERENCES

1) **Mr. Prashant Kachare, Prof. V. R. Payghan and Dr. Navnath. V. Khadke** International Journal of Creative Research Thoughts (IJCRT) on IDENTIFICATION AND ANALYSIS OF ROOT CAUSES OF DELAY IN MUMBAI METRO LINE 4

2) **Mr. Kartik bagrecha and Ms. Ayushi bais** from international journal of innovations in engineering research and technology [IJIERT] on STUDY ON DELAY CONSTRUCTION PROJECT IN INDIA

3) **Subhav Singh**, **Anju Bala**, **Saurav Dixit and Deekshant Varshney** from International Research Journal of Engineering and Technology (IRJET) on CRITICAL ANALYSIS OF CAUSES OF DELAY IN RESIDENTIAL CONSTRUCTION PROJECTS IN INDIA

4) **C. Devika Mohan and S. Yukesh** from The Asian Review of Civil Engineering on Analysis and Modelling of Factors Causing Delay in Road Construction Projects

5) **Shitaw Tafesse (Feb 2021)** from International Research Journal of Engineering and Technology (IRJET) on A Review on the Critical Factors Causing Delay of Delivery Time in Construction Projects.

6) **Vijay Kumar (June 2020)** from International Research Journal of Engineering and Technology (IRJET) on Delay in Construction of Highway and Expressway Projects

7) **Asish Ram, Dr. Pratheeba Paul (April 2015),** from IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE) on Study on Construction Sequence Delay for Road Infrastructure Project.

8) **Zayyanu Mohammed, Umar Bello** from International Journal of Engineering Research & Technology (IJERT) on Causes of Delay in Construction Projects: A Systematic Review.

9) **N. Hamzaha*, M.A. Khoirya, I. Arshada, N. M. Tawilb and A. I. Che Anib from 2011** Published by Elsevier Ltd. On Cause of Construction Delay - Theoretical Framework.

10) **Mr Ashish Chandu Pawar1. Mrs. Sheetal.D. Marawar2, Mr. Nikhil.V. Bhalerao** from International Research Journal of Engineering and Technology (IRJET) on A Methodology for Ranking of Causes of Delay for Residential Projects

11) **Raut S. P.1, Gohatre V. S. 2, Nistane H.P.3 Assistant Professor1,** 2, 3 Department of Civil

Engineering on Causes of Delays in Construction Projects.