

ARTICLE

Analysis on Factors Causing Project Delays in Road and Highways Sector in India Using Relative Ranking Index Technique

Siddesh K. Pai^{1*} Neeraj Anand² Ankur Mittal²

1. National Institute of Construction Management and Research (NICMAR), India

2. University of Petroleum and Energy Studies (UPES), India

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ABSTRACT

On-time completion of road infrastructure projects is a critical goal. When projects were not completed on schedule and real construction progress is slower than expected, the inconvenience and disruption to business access increases. On time completion is linked to economic and social welfare, as well as safety. Construction delays continue to be a typical occurrence, despite the need of prompt completion.

A literature study is conducted in this context in order to learn more about the causes and factors that contribute to delays. Following a thorough review of the literature, it was determined that a questionnaire survey is the most effective and trustworthy way for gathering information about the causes and quantifying delays caused by emergent factors. The Relative Importance Index (RII) method was used to analyze the data, and the reasons for the delay were prioritized according to their importance. This study focuses on the emergent concerns/causes and reasons of concern in road infrastructure projects, as well as how to priorities these issues sequentially during the planning stage. This study survey can assist construction companies doing business in India in understanding the essential or sensitive issues that require special attention in order to conduct their businesses smoothly in this country while employing appropriate project management practices.

1. Background of the Study

Delay is the most serious issue that construction companies confront. Emerging concerns that can result in a variety of negative consequences, including owner-contractor disputes, increased costs, lost productivity and revenue, and contract cancellation. In many nations around the world, construction enterprises was experiencing major delays. Scope, time, quality, and

budget were the key restrictions. The second and more difficult task is to optimize the allocation and integration of necessary inputs in order to accomplish set objectives and produce the intended result. Delay problems, on the other hand, are tough to work on in nature because several delays might occur at the same time and can be caused by multiple parties or none of the major parties. One of the new difficulties could be the source of additional delays.

**Corresponding Author:*

Siddesh K. Pai,

National Institute of Construction Management and Research (NICMAR), India;

Email: siddeshp@nicmar.ac.in

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Because documenting individual activity schedules is impossible in complex and large projects with multiple activities, delays was only examined using the two key metrics of time and cost. Because delays in infrastructure projects have a negative impact on the country's economy, it is critical to complete the project on time and under budget ^[1].

2. Need for Study

Time is one of the three mainstays of construction project management (cost, time, and quality). A study of project delays will help researchers better understand the causes of road building project inefficiency. In the context of India, the study of road development is critical since roads contribute to economic growth and poverty alleviation. Construction project, from inception to closure, encounter numerous risk that may affect the completion time of project. These risks may relate from initiation phase of project and probability of occurrence may be throughout project life cycle. These risks are unique in nature and their occurrence may vary from project to project. Man-aging the risk in construction project is considered as a very crucial process in order to minimize the risk throughout project life cycle. The occurrence of risk will be enhanced in two manner probability or likelihood of occurrence and their consequences or impacts if it does. Management of risk is an integral part of achievement of good business and successfully completion of project which directly affects the cost. Risk management provides a structured way of dealing and forecasting with uncertainty.

3. Literature Review

Several studies have been done to determine the causes of project delays in the construction industry. Frimpong undertook a survey that identified and assessed the relative importance of vital factors that contributed to groundwater construction project delays and cost overruns in Ghana. The delays in public water and sewage projects was discussed by Al-Ghafly in terms of sixty causes and further categorized ^[2]. He concluded that the delays were common in medium and large projects, and severe in small projects. There were a number of significant reasons for delays, including owner engagement, contractor performance, financial issues, delays in the owner's decisions and approvals, changes in the design and scope, challenges in acquiring a construction permit were all major factors. Al-Momani considered at the reasons for delays in 130 government projects in Jordan. According to the report, paying close attention to certain characteristics

will aid industry practitioners in reducing contract conflicts. It was concluded that the delays have a strong link to contractor failure and ineffective performance ^[3].

As an example of a developing economy, Ogunlana looked into the delays in construction projects in Thailand and concluded that the construction industry's challenges in developing nations were divided into three layers: (1) shortfalls or shortcomings in industrial infrastructure, primarily resource supply; (2) issues produced by clients and consultants and (3) issues caused by contractor ineptitude. Poor risk management and supervision, unanticipated site conditions, sluggish decision-making, client-initiated changes, and task variance were discovered as five major factors in a survey conducted by Chan and Kumaraswamy to assess the relative relevance of 83 potential delays in Hong Kong building projects ^[4]. They also discovered that different groups of participants in building and civil engineering projects had diverse perspectives of the causes of delays. They suggested that different industrial groups' biases might blame other organizations for delays.

Mahamid et al. recommend that government should give attention to conduct a training program to improve the managerial skills of various construction parties. Risk assessment is done to have control over project-related threats. Various risk factors affect road construction activities separately and it becomes very important to determine the activities which are vulnerable to various risk factors so that risk can be minimized to a certain level.

Various studies were conducted to identify the causes of delays in highway construction projects. Mahamid et al. conducted a study to investigate the time performance of road construction projects to determine delay causes and their severity according to contractor and consultant. In his study, 52 causes of delay were identified and combined into 8 groups. Aziz et al. proposed a model for predicting actual road project durations and indicate that findings can helpful for the project manager to mitigate delay in the road construction project ^[11]. A list of 293 delay causes from the literature review was identified and a questionnaire was distributed among various professionals to rank the importance of delay causes. Mahamid et al. recommend that government should give attention to conduct a training program to improve the managerial skills of various construction parties. Risk assessment is done to have control over project-related threats ^[5]. Rachid et al. collect data through a questionnaire survey and conducted direct interviews with experts to identify the causes of delay. Results showed that owner related problems are the source of delay in construction projects.

Alsuliman categorized the delay factors according to the different stages of the construction project. The study developed a formula to calculate the effect of delay caused on the project site and provide appropriate solutions to reduce any delays. Prasad et al. identified root causes of delay in a different project. 60 delay factors are identified and an important index was used to rank delay factors. Delay in settlement of claims and late payment from contractor identified as major delay factors. Edison and Singla developed a scale that measures the factors affecting delay in construction projects. 45 delay factors were identified and subjected to Exploratory and confirmatory factor analysis. Six factors were identified by the study which creates a delay in construction projects^[6]. Kog identified eight of the top delay factor attributed to the contractor. Delay factors according to each party are identified as a result of the research. Various risk factors affect road construction activities separately and it becomes very important to determine the activities which are vulnerable to various risk factors so that risk can be minimized to a certain level.

4. Objectives of the Study

The research methodology will explain how the objectives of this study can be achieved. Construction delays and its substantial research and literature review available for study, are classified into delay groups, and sub classified into a number of causes. Some of these causes are adopted in this paper while considering the Indian scenario and its stakeholder's perspective. This was achieved by personal interaction with stakeholder to check the extent of association of the adopted causes for this study with the current scenario Indian construction sector. The selected causes were chosen by reviewing international books and papers. Subsequently, with more personal interviews the attributes, along with the questionnaire, honed with time. The questionnaires were distributed and collected majorly via personal interviews. The respondents in locations which were non-viable due to time or accessibility constraint were in touch via e-mails. The results thus obtained by the survey as per the responses were given by stakeholders were used to perform Descriptive Analysis. Such an analysis is used to rank the causes of delays as per the acquired responses. Ambiguity is a by-default property of such obtained results and gives no precise understanding. To overcome this, advanced statistical analysis is essential and has been carried out.

a) To identify the emerging issues in construction industry in India through extensive literature review and questionnaire survey.

b) To focus on the prominent emerging issues impacting the road construction industry through principle component factor analysis.

c) To rank the critical emerging issues as per relative importance index rating.

5. Research Gap

A literature review of around 30 research papers was done in relevant area. The research papers covered up as a part of reference for literature review in this research has not identified the emerging issues in road construction management in India into its umbrella. Due to which there was huge time overrun and cost overrun.

6. Research Methodology

After assessing the scope of the objectives to be attained, the research approach was appropriately devised. The questionnaire survey was determined to be the most efficient technique of gathering the required data. The questionnaire was created and delivered to construction experts who was in charge of implementing public projects, as well as corporations, contractors, and consultants who oversee these projects. Thirty causes were found through expert interviews, word of mouth with professionals, literature reading, and conversation with certain professionals involved in the building sector in the research questionnaire. It is written to assess the severity and significance of the indicated causes. As part of a pilot survey to assess the reliability statistics, the questionnaire was forwarded to ten experts for review. Factored analysis, performed so as to reject the variables which gives a value less than one as initial Eigen value and accept those which was more than one^[6]. The last task performed was the Ranking based on Relative Importance Index. 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 Tables below.

A five-point scale ranging from 1 (not important) to 5 (very important) will be utilized for each element, and the results will be translated to relative importance indices (RII) as shown in Figure 1. Kometa used the Relative Importance Index method to determine the relative importance of the many causes and effects of delays^[10]. The identical procedure will be applied in different groups in this study (i.e. clients, consultants or contractors).

$$RII(\text{Relative Importance Index}) = \frac{\sum W}{A \times N}$$

W Weight given to each attribute by respondent
 A Highest weight
 N Total number of respondents

Figure 1. RII calculation

7. Data Analysis

In order to satisfy the study objectives, the questionnaire is carefully designed to collect enough data from the respondent. The questionnaire was prepared utilizing the present status of construction management, as well as the conclusions of the literature review, and how developing challenges were addressed in the sector. Some surveys connected to the topic were studied, and some questions from them were extracted that were thought to be relevant to the construction sector. The key information needed for this study is divided into three areas. There were two areas of information about the respondent’s qualities and involvement in the building industry^[7]. Questions about the respondent’s involvement in projects that have proven successful. This section of the study identified the areas of concern for rising difficulties and their implications for the construction project management department in India. The third question concerns respondents’ perceptions of the severity of key emerging issues and their impact on the sector. Based on the literature review, a close ended questionnaire with 30 variables was designed considering the objective of the study.

8. Data Collection

Considering the high uncertainty related to variables associated with the construction industry, a questionnaire approach has been adopted which proved helpful in analyzing facts and concluding the results. A questionnaire survey was carried out in India involving professional stakeholders viz. contractors, consultants, and developers each of which has played crucial roles in their particular projects and had contributed to the industry in some way or the other. The profession and its respondents being surveyed have been kept heterogeneous to account for the big picture of the civil industry. The questionnaire is plotted at the most reliable way. As far as possible, the responses have been taken from respondents, who were competent of responding the best for purpose and answering it in the most appropriate way^[8]. The questionnaire was distributed to the respondents by

emailing them the link of online questionnaire personally. Total 140 responses were received. A 5-point Likerts Scale was used to determine the respondents view if they agreed or disagreed about the severity of these emerging issues based on their experience and expertise. The ratings of scale from 1 to 5 were based on percentage delay contributing factors:

- 5 - Extremely Significant: > 75 %
- 4 - Very Significant: 60 – 75 %
- 3 - Moderately Significant: 35 – 60%
- 2 - Slightly Significant: < 35 %
- 1 - Not Significant: 0%

The following were some of the benefits of adopting the Likert Scale: it is a universal approach with an easily quantifiable response; it makes question answering easy for the respondent; it was a quick, economical, and efficient way; and it has a lot of variety. The respondent had to rate on particular cause based upon the scale given. Validity of the questionnaire was check using Cronbach alpha which was found to be above 0.8 (Table 1). Cornbach’s Alpha is a scale that assesses reliability from 0 to 1. The values between 0.50 and 0.60 regarded as the lower limit of acceptability (Hair et, al; 1998). A sampling adequacy of more than 0.80 was considered outstanding. The value of less than 0.50 is considered undesirable. As the sampling adequacy via KMO and Bartlett’s Test came out was 0.632, hence PCFA method of factor analysis can be applied (Table 2). Variables were reduced from 30 to 18 via Principle component factor analysis (PCFA) (Table 3) and RII was conducted to find the top five critical factors causing project delays (Table 4).

Table 1. Reliability Statistics for questionnaire survey

Cronbach's Alpha	No. of Items
0.875	30

Table 2. Kaiser-Meyer-Olkin (KMO) and Bartlett’s Test validity for factor analysis

KMO and Bartlett's Test	
KMO Measure of Sampling Adequacy.	0.634
Approx. Chi-Square	951.707
Bartlett's Test of Sphericity	df 435
	Sig. .000

Principal Component Analysis is used mainly to reduce a data set to a more manageable size while maintaining as much of the original necessary information as possible^[11,12]. Primarily, adequacy of the surveyed data was successfully carried out using Kaiser-Meyer-Olkin (KMO) test and Bartlett’s Test of Sphericity^[9]. Amongst the 44 attributes mentioned, 30 were found to be significantly important based on correlation. These 30 attributes were further analyzed using Principal Component

Analysis. Here, the analysis derives linear components by decomposing the original sample data. The first component provides as much of the variability in the data as possible, and each component after that accounts for as much of the remaining variance as possible. This analysis is most concerned with finding out the linear components and establishing the capability of a particular variable to contribute its respective component.

Table 3. Principle component factor analysis via SPSS V20

VARIABLE	1	2	3	4	5
27	.801				
22	.637				
17	.557				
23	.460				
30		.782			
18		.693			
29		.681			
16			.817		
12			.796		
15			.651		
10				.864	
06				.570	
07				.568	
11				.505	
09					.867
08					.606
19					.596
14					.420

Table 4. Critical Causes of delay by RII Method

Rank	Critical Causes of delay	RII
1	Inadequate planning prior to the commencing of the work	.84
2	Delay in Government correspondences.	.82
3	Bad cash flow or miss match of expenditure and income while executing the work.	.81
4	Acceptance to new technology by the any of the parties (Client, Consultant, Contractor, Sub-Contractor).	.78
5	Inadequate project monitoring without considering buffer for legal proceedings as well as recovery time for any unavoidable force majeure occurrences.	.77

9. Conclusions

A literature analysis and expert views were used to identify a number of relevant risk variables. A questionnaire was created and disseminated among several professionals with experience in the construction industry based on risk considerations. Site Engineers, Project Managers, Site Managers, and Site Supervisors were the target responses. Data was obtained from 140 people, and the most relevant information was chosen. The relative importance index and principal component factor

analysis were used to analyze the data. Using the ranking analysis technique, this research will propose a solution to a risk severity factor for budget allocation problems, such as allocating funds to competitive and deserving organizations. After giving weights to decision-making criteria, the evaluation technique aided in evaluating various severity factors according to their likelihood of occurrence.

As per data analysis the organizations must focus on the below listed emerging issues as per their rankings developed by extensive data collection and adequate analysis by using the software named SPSS. The research paper gives the following output on RII analysis.

Five most critical factors causing project delays are:

- (1) Inadequate planning prior to the commencing of the work.
- (2) Delay in Government correspondences.
- (3) Bad cash flow or miss match of expenditure and income while executing the work.
- (4) Acceptance to new technology by the any of the parties (Client, Consultant, Contractor, Sub-Contractor).
- (5) Inadequate project monitoring without considering buffer for legal proceedings as well as recovery time for any unavoidable force majeure occurrences.

10. Recommendations for Future Studies

This research has identified the hurdles that affect the Indian construction industry extensively. Research findings and conclusions, however, are useful to other developing countries as they may face the similar problem. Furthermore, the international literature displayed generic similarities that may benefit exhaustive comparative analysis worldwide. To study these project delays profoundly, future research needs approaches that include Casual Modelling. This would provide insight of the interrelatedness and complex interactions among the delay factors. More research on construction delays should be done in order to develop guidelines, or methods of minimizing construction delays. Furthermore, similar research should be performed in various provinces or cities of India. In order to providing more reliable data it is required to carry out studies for each specific type of construction projects, including metro rail, dam construction projects, utilities, etc. Surely, detailed surveys required to be performed to find out cash flow problems on delays in construction projects.

11. Limitations

Although the study concludes with tangible results regarding the road construction delays, the limitations

that abide them should also be accounted for in this research. First, the study was carried out for construction industry restricted to Indian roads and highway projects only. Although the methodology used in this research is standard, the result thus obtained cannot be generalized worldwide due to the dynamic nature of the industry. Second, the ranking of factors deduced from analysis in this research is relative to each other exclusively and is statistically significant; however, there is a possibility that exact ranking may not be statistically significant. Third, the response of the professionals having experience of 5 to 10 years may vary slightly as opposed to that of the response given by experts having experience more than 10 years. Even though the former may have great qualifications relevant to the Industry, the latter practically are more exposed to the construction field as they have managed numerous projects. Finally, this study attempts to see the road construction as a big picture, but, further classification such as small and large scale projects will definitely produce more specific results.

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