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Delay Analysis of Road Projects by RII Method

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Abstract: *The purpose of this study is to develop and recommend a tool for contractors to use prior to bidding to evaluate the impact of delays in road building projects using the relative significance index (RII) technique. 95 delay factors were detected and grouped into 9 major groups for this purpose after a thorough literature search and interviews with road construction specialists. To determine the relative importance of delay factors and groups, the relative importance index method was applied. The influence of various factors and groups on delay was indicated by rating them. The variables and groups most and least responsible for the delays were investigated.*

Keywords: *Delay, Road construction projects, RII, factors, groups.*

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I. INTRODUCTION

After agriculture, the construction industry is the second most important economic sector in India, playing a critical part in the country's social and economic growth. The construction business is critical to a country's social, economic, and political growth. Construction projects have a time limit. Each project has a predetermined length with start and end dates. When it comes to project time and cost, poor cost management and overruns are big concerns in both developed and developing countries. Delays are common in many different construction projects, and they can result in severe losses for project participants. The construction business has a terrible reputation for dealing with delays. Delay analysis is either disregarded or performed subjectively by simply including a contingency. As a result, several large projects go behind schedule. In a road construction project where time genuinely equals money, time management is crucial (Duran, O. (2006)), and forecasting the possibility of delay may play a major role in project success (Luu, et al. (2009). Delay denotes that the project was not completed within the agreed-upon time frame. According to Kaming (1997), a delay is a prolonged period of time beyond the contractors' scheduled completion dates within the contract. According to Trigunarsyah, B. (2004), in Indonesia, just 47% of projects were completed on time, 15% were completed ahead of schedule, and 38% were delayed.

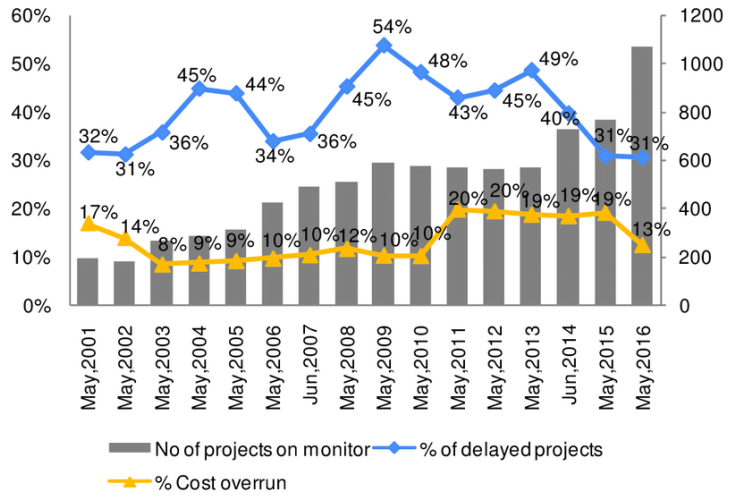

Figure 1: Cost Overrun in Construction projects in India (Source: MoSPI)

1.1.1 Need of Study

The road construction business accounts for a sizable portion of the Indian economy. Nonetheless, very few studies have used project management methods to address delays. A big contributor to this problem is the failure to use project management methods to address these delays. This has resulted in poor work quality, decreased productivity, project delays, an increase in overall project costs, unemployment, the dissolution of construction enterprises, disagreements, and litigation.

1.1.2 Objectives

i. To identify the factors that cause delays in road construction projects.
ii. To figure out the corresponding importance of delay factors and groups, as well as to present the factors and group ranking depending on their relevance level.
iii. Address the most significant contributing factors and groups that create delay.

II. REVIEW OF LITERATURE

The following literature review presents some theoretical and analytical studies conducted in this topic.

[1]. El Razek (2008) performed a study to determine the primary reasons of delays in Egyptian construction projects as seen by owners, consultants, and contractors. They classified the thirty-two (32) reasons for schedule delays into nine (9) categories to meet the Egyptian building industry. Funding, materials, contractual ties, changes, rules and regulations, staff, scheduling and control, tools, and environmental considerations were among these categories. The most significant contributing factors, according to their findings, were a lack of professional construction/contractual management and the following: financing provided by the contractor during construction, delays in the owner paying the contractor, and design changes made by the owner or consultant during the construction phase.

[2]. Wiguna and Scott (2005) investigated the risks of building schedule delays in the Indonesian cities of Surabaya and Denpasar. According to their investigation, the most critical variables were: high inflation/increased material prices; client-driven design modifications; bad design; weather conditions; late payments on contracts; and poor construction performance.

[3]. Odeh, A. M. (2002) performed a study to identify the primary causes of delays in traditional building projects. They classified delay factors into seven categories: contract-related, client-related, consultant-related, material-related, labor-related, equipment-related, and external-related. Interference, insufficient contractor experience, money and payments, labour productivity, slow decision-making, poor planning, and subcontractors were identified as the top ten (10) most crucial causes in the survey findings.

[4]. Frimpong, Y. et al. (2003) conducted a survey to evaluate the factors causing cost and schedule overruns in Ghanaian groundwater development projects. Twenty-six (26) factors that led to project delays and cost overruns were reviewed and graded. According to the study's findings, the primary causes of schedule delays and cost overruns in groundwater project development are problems with monthly contractor payments from agencies, poor contractor management, problems regarding materials, poor technical performance, and a rise in material costs.

[5]. Koushki, P. A. et al. (2005) conducted a survey on building schedule delays in private residential developments in Kuwait. They found three (3) significant causes of timetable delays: order revisions, owner financial constraints, and owners' lack of building industry competence.

[6]. T. Subramani, P. S. Sruthi, and M. Kavitha (2014) finished a study on Indian road building projects. They discovered that inadequate project formulation, poor field investigation, poor cost estimates, poor planning during the execution stage, insufficient equipment supply plan, lack of project management during the execution stage, insufficient working, changes in scope of work, and changes in law and order were the main contributing factors to the cost overruns of road construction projects in India.

[7]. Abdullah Alhomidan (2013) conducted an analysis based on the 41 key reasons of cost overruns in road projects, as well as a poll, to establish the factors that had the most effect. He observed that internal administrative difficulties, payment delays, poor communication among project partners, and decision-making delays were the most significant contributors to cost overruns.

[8]. Ibrahim Mahamid (2013) conducted research on the 45 elements that may cause development projects in the West Bank of Palestine to be postponed. He used a questionnaire to conduct a survey and discovered that the main causes of time overrun in Palestine were the contractors' financial standing, owner payment delays, the political climate and Western Bank's segmentation, a lack of communication between project parties, ineffective equipment, and intense bidding competition.

[9]. Wijekoon (2011) proposed doing research on the elements that have the greatest impact on cost overruns in Sri Lanka's northern and eastern regions. He created a questionnaire based on 19 criteria and performed a thorough nationwide poll. He observed that issues with site acquisition, cost inflation,

payment delays, delays in transferring existing utilities, and design alterations made during construction were the leading causes of cost overruns in Sri Lankan projects.

[10]. Han and Dikmen (2007) developed a framework for implementing the suggested strategy and provided a fuzzy risk assessment methodology to analyse cost delay risk in construction projects. They anticipated that cost overruns will be caused by a total of twenty-three (23) risk factors originating at the project and national levels. According to their risk model, nine (9) factors influence national risk and fourteen (14) aspects generate project risk. A global construction firm developed a computer software, and real company and project data were utilised to illustrate the system's applicability during the bidding stage risk assessment.

[11]. Al-Momani (2000) conducted a quantitative assessment of the construction schedule delays of Jordan's 130 public building projects. According to the study's conclusions, the key causes of schedule delays in construction projects include designers, user modifications, weather, site circumstances, late delivery, economic problems, and increases in quantity.

[12]. According to Dinesh Bhatia (2016), the main factors and reasons for schedule and cost overruns in the construction of residential projects are delays in decision-making, poor time estimation of project tasks and activities, unexpected events, internal disagreements within the project team, inadequate work organisation and planning, and a lack of aggressive action by any of the parties involved.

[13]. Abd El-Razek (2008) investigated construction project delays in Egypt. A total of 32 delay causes were selected and classified into nine groups, including financing, manpower, changes, contractual relationships, environment, equipment, rules and regulations, materials, scheduling, and control, depending on who was responsible (contractor, consultant, owner, and shared responsibility). Each delay cause was rated using a Likert scale with four categories: extremely significant, important, slightly important, and not important. They came to the conclusion that the following factors contributed most significantly: lack of use of skilled construction/contractual management; delays by the owner for payment to the contractor; design modifications done by the owner or his agent during construction phase; partial payments done during construction; and financing provided by the contractor during construction.

[14]. Bent Flyvbjerg (2004) conducted research on 258 road and rail infrastructure projects totaling US$90 billion. They focused on three major sources of cost overruns. They concentrated on characteristics such as project size, project ownership structure, and project execution phase time. They determined that the size and duration of the project were the key sources of cost overruns and related risks. They came to the conclusion that public ownership played a larger effect in the kind of ownership.

[15]. Rahman, Memon and Karim (2013) attempted to identify and categorise significant elements influencing schedule and cost overruns in ground water projects. The components were classified into numerous categories. Based on these rankings, the order of relevance of the factors was determined. These data suggest that cost overruns in underdeveloped countries like Ghana are influenced by a range of factors. The owners, contractors, and specialists have reached an agreement on five crucial elements. They include regular payment troubles with agencies, poor contractor management, material procurement, mediocre technical performance, and material cost budget hikes.

III. METHODOLOGY

This section describes the technique that was employed in this study to achieve the study's aims. This research project is divided into four distinct sections. The first part of research involves a review of the literature. The second step of study is the creation of a framework of acquired data for assessing delays in road building projects. The third step of study comprises data analysis and a discussion of the results of ranking using RII approach. Based on a questionnaire survey of respondents from various construction enterprises in India, the relative significance index (RII) is generated for each reason using a 5 Likert rating scale.

$$\mathbf{RII = \sum W / (A \times N) \ldots\ldots\ldots\ldots\ldots\ (1)}$$

where W = the weights assigned by the respondents to each element (ranging from 1 to 5, with 1 being the least severe and 5 being the most severe), A = the greatest weight on the rating scale (i.e., 5 in this example), and N = the total number of replies. The fourth phase of research focuses on the conclusion and recommendations.

Figure 2: Delay factors and groups

Table 1 displays a tabular list of delay factors organised by their linked groups.

Table 1: Base input factors and groups of delay factors

Code	Categories
(A) Project Owner related delay factors	
PO1	Change of scope order during construction
PO2	Conflicts between joint ownership of the project
PO3	Late in approval design document by the owner
PO4	Delay in progress payment by the owner
PO5	Owner's failure to furnish and deliver the site to the contractor on time
PO6	Improper feasibility study before project design
PO7	Poor owner's representative
PO8	Lack of owner experience in construction projects
PO9	Unavailability of incentives to the contractor for early finish of project
PO10	Poor communication and coordination between consultant and contractor
PO11	Decision-making process is too slow
PO12	Suspension of work by owner
PO13	Inadequate planning
PO14	Inappropriate contractual procedure
PO15	Land Acquisition
PO16	Delay in approving shop drawings and sample material
PO17	Selecting inappropriate contractors
PO18	Changing specifications of material after project progress is started
(B) Contractor related delay factors	
C1	Subcontractors are frequently changed because of their poor performance
C2	Less experience of the contractor
C3	Improper construction method implemented by contractor
C4	Incompetent project team
C5	Ineffective project planning and scheduling

C6	Poor communication and coordination between owner and consultant
C7	Poor site management and supervision
C8	Rework due to errors
C9	Unreliable subcontractors
C10	Inadequate site investigation
C11	Inappropriate contractor's policies
C12	Poor financial control on site
(C) Consultants/Architects related delay factors	
CA1	Inadequate experience of consultant
CA2	Conflict between consultant and design engineer
CA3	Delay in approving major changes in the scope of work by consultant
CA4	Delay in performing inspection and testing by consultant
CA5	Inaccurate site investigation
CA6	Inadequate PM assistance
CA7	Late in reviewing and approving design documents
CA8	Poor communication between consultant & others
(D) Design related delay factors	
D1	Complexity of project design
D2	Design changes by owner or his agent during construction
D3	Design errors and omissions made by designers
D4	Insufficient data collection and survey before design
D5	Lack of design team experience in construction projects
D6	Mistakes and delays in producing design document
D7	Misunderstanding of owner's requirements by design engineer
D8	Poor use of advanced engineering design software
D9	Unclear and inadequate details in drawings
D10	Incomplete project design
D11	Defective design made by designers
(E) Project related delay factors	
P1	Complexity of project (project type, etc.)
P2	Original contract duration is too short
P3	Ineffective delay penalties
P4	Legal disputes between the project participants
P5	Unfavorable contract clauses
(F) Material related delay factors	
M1	Changes in material types and specifications during construction
M2	Damage of sorted materials
M3	Delay in manufacturing materials
M4	Escalation of material prices
M5	Late delivery of materials
M6	Late procurement of construction materials
M7	Poor quality of construction materials
M8	Shortage of construction materials
M9	Unreliable suppliers
(G) Labor related delay factors	
L1	Absenteeism of labors
L2	Low productivity level of labor
L3	Personal conflicts among labor

L4	Shortage of skilled labor
L5	Slow mobilization of labor
L6	Labor strikes
L7	Unqualified/Inadequate experienced labor
L8	Labor injuries at site
(H) Plant/Machinery/Equipments related delay factors	
PM1	Equipment allocation problem
PM2	Machinery/Equipment/Plant breakdown
PM3	Shortage of machinery & equipment
PM4	Availability of machinery & equipment
PM5	Low productivity of equipment
PM6	Lack of high technology mechanical equipment
PM7	Unskilled equipment operator
(I) External related delay factors	
E1	Accidents during construction
E2	Changes in government regulation and law
E3	Delay in obtaining Permits of plants
E4	Forest and Environment Clearances by Municipality/ Authority
E5	Delay in performing final inspection by third party
E6	Late certification from third party
E7	Unavailability of utilities at site (water, electricity, telephone)
E8	Global financial crisis
E9	Loss of time by traffic control at job site
E10	Price fluctuations
E11	Problem with neighbors
E12	Slow site clearance
E13	Unexpected surface & subsurface conditions
E14	Unexpected natural disasters/calamities
E15	Unfavorable weather conditions
E16	Inappropriate government policies
E17	Thefts at site

IV. CONCLUSION

"Land Acquisition", "Late in approval design document by the owner", and "Delay in approving shop drawings and sample material" had the highest recorded values of RII rank, with RII of 0.74, 0.72, and 0.71, respectively. The following groups depict the individual group-wise key delay considerations to consider in the future.

1. **Material:** The most important category of delay reasons was the material-related group. This was mostly due to factors such as "Late procurement of construction materials (RII=0.66)", "Late delivery of materials (RII=0.63)", and "Material price escalation (RII=0.62)".
2. **Plants/Machinery/Equipment:** The second most important category was the equipment-related group, which included the criteria "Shortage of machinery and equipment (RII=0.70)", "Low productivity of equipment (RII=0.54)", and "Machinery/Equipment/Plant breakdown (RII=0.50)".
3. **Project Owner:** Following the equipment, the project owner-related delay reasons were the next most important group. "Land Acquisition (RII=0.74)", "Late in approval design document by the owner (RII=0.71)", and "Delay in approving shop drawings and sample material (RII=0.71)" were the noteworthy causes.
4. **External:** After the project owner, the external factors group is the fourth most important category of delay factors. "Unfavourable climate conditions (RII=0.64)", "Changes in government rules and laws (RII=0.60)", and "Accidents while construction (RII=0.58)" were the most prominent factors.
5. **Labour:** The fifth most significant group was the labour group. "Labour strikes (RII=0.55)", "Low labour productivity (RII=0.54)", and "Shortage of skilled labour (RII=0.49)" were the most critical variables.

6. **Contractor:** Following labour, the contractor-related category of delay reasons was the sixth most important. "Ineffective project planning and scheduling (RII=0.55)" and "Poor financial control on site (RII=0.53)" were the standout causes.
7. **Consultants/Architects:** Following the contractor, the consultant-related category of delay reasons was placed seventh. "Delay in approving major changes in the scope of work by consultant (RII=0.56)", "Inadequate experience of consultant (RII=0.44)", and "Poor communication between consultant and others (RII=0.43)" were the notable factors.
8. **Design:** The design-related group was the eighth most significant group. "Complexity of project design (RII=0.53)" and "Design changes by owner or his agent during construction (RII=0.51)" were the most important variables.
9. **Project:** The final and least relevant group of delay reasons was project-related. "Original contract duration is too short (RII=0.44)" and "Complexity of project (project type, etc.) (RII=0.39)" were notable considerations.

The ***first*** goal was to identify the elements that cause delays in road building projects. A total of ninety-five (95) delay reasons were discovered through a rigorous literature analysis and interviews with experts from top construction companies.

The ***second*** goal was to quantify the relative impact of delay factors and provide the ranking of the variables and groups based on their importance level. This goal was achieved through interviews with a committee of professionals. All elements and categories were ordered in order of significance/severity using the estimated relative importance indices. The most and least significant aspect and group were also completed, according to these rankings.

The ***third*** goal was to target the most significant contributing causes and groups to the problem. The group with the greatest RII (0.519) was "Material related delay factors", whereas the group with the lowest RII (0.348) was "Project related delay factors". The three (3) most important contributing elements to induce delay were provided for each group.

REFERENCES

[1]. Abdelrassoul, H., and Rahim, Z. (2021). "Delay Impact of COVID-19 Pandemic on Malaysian's Oil and Gas Projects." IJIRMPS, Vol. 9, No. 4, pp. 40-65.

[2]. Daba, D., and Pitroda, J. (2018). "Assessment of delay of building construction project in Vadodara City." Int. J. of Creative Research Thoughts, Vol. 6, No. 2, pp. 211-224.

[3]. Desai, M., and Bhatt, R. (2013). "Critical Causes of Delay in Residential Construction Projects: Case Study of Central Gujarat Region of India", IJETT, Vol. 4, No. 4, pp. 762-768.

[4]. Desai, S., and Purohit, R. (2022). "Investigation on Causes of Delays in Residential Building Construction Project", Int. Re. J. of Engg. and Tech., Vol. 9, No. 7, pp. 1736-1745.

[5]. Ejem, A., Dike, D., Njoku, L., and Moneke, U. (2017). "Analysis of Factors of Delay in Road Construction and Other Projects in IMO State", IJESRT, Vol. 6, No. 2, pp. 454-460.

[6]. Jaiswal, S., and Kshirsagar, S. (2020). "Review Paper of Factors Affecting Cost Overrun in Real Estate Industry in India", IRJMETS, Vol. 2, No. 4, pp. 1238-1240.

[7]. Kadu, S., Narwade, R., and Nagarajan, K. (2021). "An Arithmetical Approach for Ranking of Factors Impacting the Timeline of Railway Project Using RII and IMPI Method." Strad Research, Vol. 8, No. 7, pp. 138-148.

[8]. Meena, V., and Babu, S. (2015). "Study on Time Delay Analysis for Construction Project Delay Analysis", IJERT, Vol. 4, No. 3, pp. 1076-1083.

[9]. Paray, W., and Kumar, C. (2020). "Delay Analysis in Construction Projects", Int. Re. J. of Engg. and Tech., Vol. 7, No. 10, pp. 477-479.

[10]. Rajgor, M., Paresh, C., and Bhavsar, D. (2016). "RII and IMPI: Effective Techniques for Finding Delay in Construction Project", IRJET, Vol. 3, No. 1, pp. 1173-1177.

[11]. Shikalgar, M., Ravi, K., and Patil, S. (2018). "Analysis of Material Wastage and Time Overruns in Construction Project Using Descriptive and Inferential Statistics", IJIRSET, Vol. 7, No. 5, pp. 5234-5242.

[12]. Tayade, A., Mahatme, P., and Sabihuddin, S. (2020). "Delay in bridge Construction and analysis by RII method", Int. Re. J. of Engg. and Tech., Vol. 7, No. 7, pp. 2040-2048.