CHAPTER 45

Delay Analysis of Stadium Construction Projects using RII methodology and Formulating Mitigation Strategies

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ABSTRACT

The purpose of this research paper is to analyse delay factors of stadium construction projects using the Relative Importance Index (RII) methodologies and formulate efficient mitigation strategies. Methodology: The study uses a mixed-method approach that combines both quantitative and qualitative data collection techniques. A thorough literature review identifies common causes of delay in stadium construction. Purposive sampling is employed to select professionals with relevant experience and expertise in stadium construction projects. Surveys and interviews with industry professionals collect primary data on these causes and their perceived importance. RII analyses rank and prioritize the delay factors. Based on these findings, specific strategies to reduce delays are proposed and assessed for their potential effectiveness. Limitations and Gaps: The research is limited to stadium construction projects, which may not apply to other types of construction. The study depends on expert opinions, which can introduce personal bias. Moreover, the effectiveness of the proposed strategies is theoretical and needs practical application and long-term evaluation. Future research should tackle these gaps by broadening the focus to include various construction projects, using more objective methods to measure delays, and performing long-term studies on the application of the strategies.

Keywords: Delay Analysis, Stadium Construction, RII, Mitigation Strategies.

1.0 Introduction

1.1 Background of large-scale infrastructure and stadium construction projects

Major infrastructure projects are of great significance in the development of a nation as they contribute to the growth of the economy, social and urbanization.

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Among them, stadium construction projects are the kind of infrastructure that has its own peculiar category because of the magnitude of its construction, the technical complexity, and symbolic significance. Compared to the traditional building projects, modern stadiums incorporate elevated systems of structures, special playing fields, removable seats, broadcasting, and sustainability systems, which have significantly increased their complexity (Love et al., 2022). The number of stakeholders, involved in the projects, such as government agencies, sports authorities, designers, contractors, and event operators, also increases the complexity of the projects and the need to coordinate them (Doloi et al., 2012).

1.2 Significance of stadiums projects in economic growth, urban renewal and international sporting events

The boost of economic development and regeneration of cities is usually an idea behind stadium projects. They encourage employment, tourist attraction, city branding, and ancillary business like transport and hospitality (Baade and Matheson, 2016; Fashina et al., 2021). Within the framework of international sporting events, stadiums have to meet the highest international standards and set deadlines due to which the stadium finishing can lead to losing the right to host events and can be accompanied by serious financial and reputational losses (Flyvbjerg, 2021). This means that construction is not the only important concern regarding timely delivery of stadium projects but also in a more broad economic and political viewpoint.

1.3 Research gap in studies on stadium-specific delays

Despite the vast amount of literature on construction delays on general infrastructure and building projects, few studies on delays in the context of a stadium have been gathered. The majority of available studies consider the stadium projects in the context of more comprehensive infrastructure, ignoring unique technical, managerial, and political features (Love et al., 2022). Additionally, there is a paucity of studies combining delay ranking and action-oriented mitigation models designed to address stadium construction. The limitation of this gap to generalized delay results is that it limits the extrapolation of generalized results to construction projects in stadiums, and the focus of empirical research in this area is warranted.

1.4 Intention and importance of the research

The given study is aimed at identifying, ranking, and discussing the key issues that caused the delays in the stadium construction projects in a quantitative manner. Through the RII, the paper aims at ranking the causes of delays according to their perceived importance, frequency and severity. The results should help project managers, policymakers, and

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stakeholders to enhance planning, decision-making and mitigation strategies of risks. In the academic sphere, the research represents a small pool of literature on stadium-specific construction delay, whereas in practical terms, it can provide evidence-based suggestions on improving how timely and efficiently the project is delivered.

2.0 Literature Review

2.1 Concept of construction delays

Construction delay refers to the time overrun beyond the project completion date ageed upon by contracting parties. It is a persistent global issue particularly in complex and uncertain infrastructure projects (Enshassi et al., 2009). Delays not only affect schedules but also increase costs, compromise quality and create conflicts among stakeholders. Prolonged delays often damage trust and may lead to claims, disputes or project abandonment (Fashina et al., 2021).

2.2 Delay factor in large infrastructure projects

Infrastructure projects are highly prone to delays due to their large scale, long durations and involvement of multiple stakeholders. Contractor-related delays often arise from poor planning, weak site management, shortage of skilled labour and poor subcontractor coordination (Fashina et al., 2021). Financial mismanagement and lack of equipment further contribute to time overruns. External and political factors such as policy changes, regulatory constraints, economic instability and force majeure events also significantly affect project timelines particularly in government-funded projects in developing countries (Singh, 2022). Additionally, land acquisition and multi-level regulatory approvals frequently delay stadium and infrastructure projects (Enshassi et al., 2009).

2.3 Research gap

Although mass literature and surveys were carried on the causes of construction delays in infrastructure projects, the available empirical research on the cause of construction delays in stadiums is still scarce. Existing studies consider stadiums as members of larger infrastructure or public construction groups, which does not consider the unique technical, managerial, and political challenges (Love et al., 2022). More so, most of the studies define and prioritize delay factors, but few combine delay ranking with a structured mitigation planning specific to the stadium projects. A major gap in research is the absence of empirical proof of the connection between quantitative delay analysis and practical mitigation strategy. To close this gap, it is necessary to make the delay studies more relevant to practitioners working on the stadium construction project (Fashina et al., 2021; Singh, 2022).

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3.0 Research Methodology

3.1 Research design

The current research will take the quantitative research design which is descriptive in nature in an effort to study delays in stadium construction projects in a scientific and objective way. Quantitative approach is also an appropriate method of conducting the construction delay studies because it makes it possible to measure, compare, and rank various delay factors, guided by numerical data provided by industry professionals (Doloi et al., 2012). The research method considered was based on a survey to get the perceptions and experiences of professionals working on the construction of stadium projects directly. The reason why survey methods are popular in construction management research is that they are efficient in capturing standardized information of a variety of stakeholders and provide an opportunity to statistically analyze complex issues surrounding a project (Doloi et al., 2012).

3.2 Questionnaire design

The questionnaire was constructed based on a thorough analysis of the peer-reviewed literature on construction delays, especially focusing on the large infrastructure and sport facilities projects. Delay factors which were found during past research have been thoroughly modified to suit the context which exists in stadium construction. The respondents were asked to rate the delay factors on a Likert scale of five points with 1 indicating very low perception and 5 very high perception. Likert scale was chosen based on the fact that it is reliable and is widely used in construction management studies to measure subjective judgments on a quantitative basis (Doloi et al., 2012). The delay factors included in the questionnaire were categorized into the following five groups to ensure structured analysis:

- Technical factors
- Management-related factors
- Design-related factors
- Logistics and procurement factors
- Other external factors, including political and regulatory influences

This categorization facilitates clearer interpretation and comparison of delay causes across different functional domains within stadium construction projects.

3.3 Sampling and data collection

The population of the study was set to be professionals working in the area of stadium and large infrastructural projects, such as project managers, site engineers, consultants, and contractors. These respondents were chosen because they have first-hand experience with the project planning, execution and decision-making process. Purposive sampling method was

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employed to make sure that the respondents involved in the study had contributed to the study through relevant experience. Purposive sampling can be employed in construction research when specialized information and industry contacts play an important role in acquiring significant and dependable information (Doloi et al., 2012). The online questionnaire was used to gather the data, thus, making it possible to distribute and collect the responses effectively due to the geographical distribution of the professionals. The final analysis was based on inclusion of complete and valid responses only to ensure the accuracy and consistency of the data.

3.4 Reliability and validity test

The internal consistency of the questionnaire was checked using Cronbach's Alpha reliability analysis. This method is commonly used in social science and construction management studies to assess whether survey items measure the same underlying concept (Walker, 2015). An alpha value of 0.70 or higher is considered acceptable, indicating good reliability. The results obtained in this study confirms that the questionnaire data are reliable and appropriate for further statistical analysis of delay factors in Stadium construction projects.

Research Methodology Flow Chart

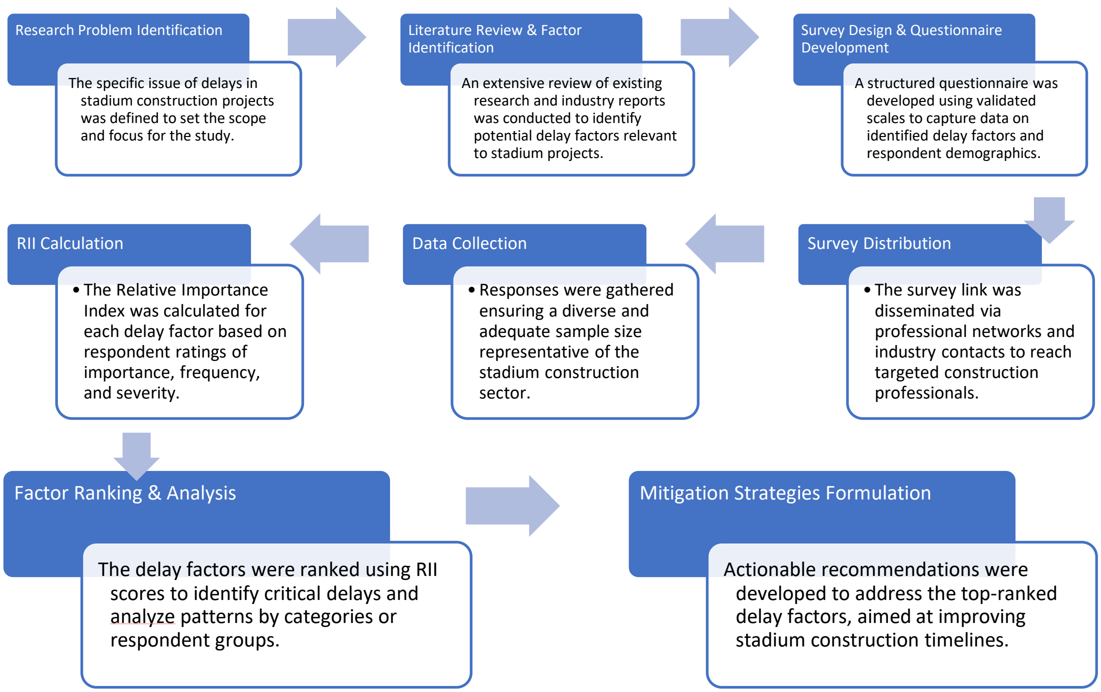

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Table 1: Survey Profile and Data Overview

Parameter	Description
Research approach	Quantitative, descriptive
Data collection method	Structured questionnaire survey
Survey mode	Online (Google Forms)
Sampling technique	Purposive sampling
Target respondents	Project managers, site engineers, consultants, contractors
Total responses received	34
Valid responses used	34
Measurement scale	5-point Likert scale (1–Very Low to 5–Very High)
Total delay factors analyzed	19

Source: Created by authors

Explanation: This table summarizes the basic structure of the dataset used in the analysis. Responses were collected from professionals involved in stadium and large infrastructure projects ensuring domain relevance. A five-point Likert scale was used to quantify perceptions of delay causes making the data suitable for RII analysis.

Table 2: Classification of Delay Factors Used in the Questionnaire

Category	Description
Technical factors	Issues related to construction methods, skilled labor, site execution, and technical complexity
Management factors	Planning inefficiencies, coordination problems, decision-making delays, supervision issues
Design factors	Design changes, incomplete drawings, late approvals, design revisions
Logistics factors	Material procurement delays, transportation issues, imported components
External / Other factors	Political influence, funding delays, land acquisition, regulatory approvals

Source: Created by authors

Explanation: The delay factors were grouped into five categories to facilitate structured analysis and interpretation. This categorization allows comparison across functional domains and helps identify which area contributes most significantly to project delays in stadium construction.

Table 3: Reliability Analysis – Overall Questionnaire

Statistic	Value
Reliability test used	Cronbach's Alpha
Number of items	19
Cronbach's Alpha (overall)	0.953

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Explanation: Cronbach's Alpha value of 0.953 indicates excellent internal consistency among the 19 questionnaire items. This confirms that the survey instrument reliably measures delay factors and is suitable for further statistical analysis.

Table 4: Reliability by Measurement Dimension

Dimension	Cronbach's Alpha	Interpretation
Importance	0.964	Excellent reliability
Frequency	0.952	Excellent reliability
Severity	0.953	Excellent reliability

Source: Created by authors

Explanation: Separate reliability testing for importance, frequency, and severity dimensions shows consistently high alpha values (>0.95). This demonstrates that respondents rated delay factors consistently across all three dimensions, strengthening the credibility of the RII-based ranking results.

Table 5: Descriptive Statistics Summary of Delay Factors

Statistic	Observed Range
Mean values	3.15 – 3.88
Standard deviation	~1.03 – 1.42
Number of delay factors	19
Respondents	34

Source: Created by authors

Explanation: The mean scores indicate moderate to high perceived importance of the identified delay factors. The standard deviation values suggest acceptable variability in responses, reflecting diverse professional perspectives while maintaining overall consistency.

Table 6: Data Inputs Used for RII Analysis

Data Component	Description
Importance ratings	Respondent perception of how critical a delay factor is
Frequency ratings	How often the delay factor occurs
Severity ratings	Impact of the delay factor on project schedule
Rating scale	1 (Very Low) to 5 (Very High)
Analysis method	RII

Source: Created by authors

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Explanation: Each delay factor was evaluated across three dimensions—importance, frequency, and severity. These ratings formed the basis for computing RII values, allowing systematic ranking of delay causes according to their overall impact on stadium construction schedules.

Table 7: Key Qualitative Observations from Professionals

Recurrent Theme Identified
Political influence on decision-making
Delay in client approvals and absence of formal sign-offs
Frequent design revisions
Unskilled labor leading to rework
Imported materials causing procurement delays
Government funding interruptions
Land acquisition challenges
Market price fluctuations

Source: Created by authors

Explanation: In addition to quantitative ratings, respondents provided qualitative insights that helped contextualize the numerical findings. These recurring themes support the RII results and highlight real-world challenges specific to stadium construction projects, particularly in public sector and government-funded contexts.

5.0 Data Analysis and Results

5.1 RII analysis

The RII was employed to analyze and rank delay factors affecting stadium construction projects. RII is a well-established quantitative technique in construction management research, used to prioritize factors based on respondents' perceptions and to support objective decision-making (Assaf & Al-Hejji, 2006; Doloi et al., 2012).

5.1.1 RII formula and application

The Relative Importance Index is calculated using the following formula:

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

Where:

- $\sum W$ = weight assigned to each delay factor by respondents (1–5)
- A = highest possible weight (5)
- N = total number of respondents (34)

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In this experiment, the respondents ranked all of the 19 items that comprise delay factors on three scales namely-importance, frequency and severity. The RII values based on such ratings allowed the systematic ranking of delay causes based on their total effect to the project schedules. RII has wide applications in infrastructure delay studies that have been extensively validated with similar applications (Enshassi et al., 2009; Singh, 2022).

5.1.2 Ranking of delay factors

The calculated RII values displayed some observable difference amongst delay factors, meaning that there are causes that had a significant impact on project delays than the rest. The management inefficiencies, design modifications, and external factors had always reported higher RII values on the dimensions of importance, frequency, and severity. This result coincides with previous research that has highlighted the prevalence of organizational and external risks in the context of large-scale development projects of the public (Fashina et al., 2021).

5.2 Analysis of delay factors by categorical analysis

Delay factors were categorically analyzed according to their origin of function in order to make their interpretation more interpretable. It is a method of comparison of technical, managerial, design, logistics, and external areas, as suggested in earlier infrastructure research (Doloi et al., 2012).

5.2.1 Technical delays

Technical delays are mainly due to execution associated problems like design failure, insufficient technical monitoring and lack of skilled workers that result in rework. Technical factors in the current study had an average to high RII value with regard to the recurrent nature and the effect it has on the progress of construction. A large percentage of the time overruns was attributed to rework due to sub-optimal workmanship and ambiguity of drawings, which agrees with the results of Enshassi et al. (2009).

5.2.2 Management delays

In the analysis, some of the highest RII values were observed in the management related delays. Such delays were largely accredited to lack of decision-making speed, poor communication among the stakeholders, unrealistic time schedulings, and poor monitoring of the projects. Such delays are especially susceptible to stadium projects, which have several public and private participants. Other researchers have also made similar conclusions based on large infrastructure projects and managerial inefficiencies have been found to be the most common delay drivers (Doloi et al., 2012; Singh, 2022).

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5.2.3 Design-related delays

The delays related to design became a critical group since design finalisation was often delayed, revisions occurred, and there were no formal design sign-offs. The types of projects subject to change of design are specifically stadium projects because of modifications in international standards, broadcasting demands, and customer expectations. Their high values of RII in terms of design delays mean that they are seriously affecting the timelines of the projects, which supports prior results in mega sporting infrastructure projects (Love et al., 2022).

5.2.4 Logistics delays

The delays related to logistics entailed mainly the procurement delays, the supply chain interruptions, and the dependency on imported materials and specialized finishes in sports. International procurement and co-ordination with foreign suppliers took considerable time that impacted on the schedules of construction. These results align with the most current research stating complexity of procurement as one of the biggest risks of specialized infrastructure projects (Fashina et al., 2021).

5.2.5 External delays

The RII values were high in relation to these external delay factors namely political influence, government funding interruption, policy change, and land acquisition issue, especially in the aspect of severity. The projects involving stadiums, which are usually funded by the government, are sensitive to the political and regulatory climate. This has been the key focus of previous studies which have highlighted the disproportional influence of external and political elements on the delivery of public infrastructure (Flyvbjerg, 2021; Singh, 2022).

6.0 Discussion

6.1 Interpretation of major findings in relation to existing literature

The analysis of the current research indicates that the delay causes related to inefficiency in management, design-related factors, and external factors proved to be the most critical in construction projects on stadiums. The large RII, which was observed in the factors like delayed decision-making, regular revisions of the design and political interference, implies that they have the overriding factor in the project schedules. These findings are not new to the existing body of construction delay research, which highlights that factors related to organizations and governance tend to dominate in large infrastructure works rather than the technical ones (Sambasivan & Soon, 2007; Enshassi et al., 2009).

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In addition, the high internal consistency of the importance, frequency, and severity dimensions supports the reliability of the perceptions of the stakeholders on the causes of critical delays. The same methodological results have been reported in previous studies that apply RII-based analysis where managerial and client related factors always ranked higher than the contractor related issues (Sambasivan & Soon, 2007). This correspondence to literature supports the validity of the current results.

6.2 Comparing the delays in the construction of the stadiums with other infrastructural projects

Although delays are a common experience in infrastructure activities, the results are that the construction of stadium projects are more sensitive to design changes and the external pressures than the traditional infrastructure development, including roads, bridges and residential developments. Contrary to the linear infrastructure projects, stadiums must be adjusted to the international standards of safety, broadcasting, and experience of the spectators, which may cause the varying schedule and design changes at the final stages.

Earlier research on projects in general infrastructure projects identifies the poor performance of the contractors and shortage of the materials as the leading sources of delay (Enshassi et al., 2009). However, by contrast, the current research suggests that the changes and delays linked to stadium projects are more susceptible to its clients and the governance-related issues due to its openness and political importance. This difference highlights why there is a necessity to analyze delay in a project-specific manner and not in general terms of delay models in infrastructure (Sambasivan and Soon, 2007).

6.3 Effect of political influence and client-through transformations in the Indian case

The discussion identifies political interference and customer-oriented alterations as significant causes of delays in the building construction projects of stadiums in the Indian environment. Projects in stadiums are often publicly funded and linked with political goals, and thus they are vulnerable to the change of policies, the change of leaders, and the stop of funding sources. The professional responses that are contained in the dataset show that delays in approvals, lack of formality signing off, and change in the vision of a project is usually as a result of political and administrative nature.

These results are in line with previous studies in the developing economies that have established that political interference and bureaucratic delays are the key risks of delivering public infrastructure (Enshassi et al., 2009). The findings of Sambasivan and Soon (2007) corroborate the results of the study by Nguyen et al. (2009), which revealed that time wastages in the project due to clients are quite high especially in matters related to decision making

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and scope changes. The current research expands this knowledge by showing how these aspects are magnified in stadium projects because they are of a symbolic and strategic value.

7.0 Mitigation Strategies

The mitigation solutions in this section are based on critical delay factors identified through RII analysis and supported by industry experts inputs. The strategies address technical, managerial, design and external risks specific to stadium construction.

S. No	Category	Delay Factor	Mitigation Strategy	Description	Reference
7.1	Technical	Unskilled workforce and technical errors	Skill development and training programmes	Implement systematic training focused on construction techniques, interpretation of complex drawings and adoption of innovative technologies to reduce rework and execution delays.	Fashina et al. (2021)
7.2	Technical	Poor quality control and supervision	Strengthened quality control and supervision	Deploy qualified engineers conduct regular inspections, staged quality audits and timely corrective actions to ensure compliance with specifications and avoid rework.	Singh (2022)
7.3	Management	Poor coordination and communication	Early stakeholder involvement	Engage clients, consultants, contractors and operators during early planning and design stages to align objectives, reduce disputes and improve decision-making speed.	Leslie (2007); Fashina et al. (2021)
7.4	Management	Delayed approvals and unclear authority	Unambiguous decision-making hierarchy	Establish a clear decision-making structure with defined responsibilities and centralized authority to reduce administrative bottlenecks.	Singh (2022)
7.5	Management	Unrealistic project schedules	Real-time scheduling and milestone tracking	Develop realistic timelines based on resources and planning supported by continuous schedule monitoring to detect deviations early.	Fashina et al. (2021)
7.6	Design	Design changes and late design completion	Design freeze policies	Implement formal design freeze after defined project stages to minimize scope creep, rework and coordination issues between design and construction teams.	Singh (2022)
7.7	Procurement	Delay in imported materials	Early procurement planning	Identify long-lead items early plan advance procurement and coordinate supplier agreements and customs clearance to reduce supply chain risks.	Fashina et al. (2021)

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7.8	External / Policy	Regulatory approvals and policy changes	Buffer time allocation	Include buffer periods in project schedules to absorb delays caused by approvals, land acquisition and administrative uncertainties.	Singh (2022)
7.9	Financial / Contractual	Funding delays and external risks	Transparent financing and risk-sharing contracts	Ensure timely fund disbursement through clear financial mechanisms and adopt contracts that equitably distribute risks related to political, economic and force majeure events.	Fashina et al. (2021); Singh (2022)

Source: Created by authors

7.0 Conclusions

7.1 Summary of key findings

This paper reviewed the reasons behind the delays in construction projects of stadiums in an organized quantitative methodology. According to the results of the survey analysis involving the industry professionals, the analysis shows that management-related, design-related, and external factors have the greatest contribution to the project delays. Delayed decision-making, numerous design changes, political pressure, funding disruption, and acquiring specialized materials were mentioned as the high-impact delay causes regularly. Technical causes, such as unskilled labor, execution faults, also caused delays, but were usually ranked lowly with issues relating to governance and coordination.

The findings showed that there is no single cause of delays in the construction of stadium but as a result of interplay between various organizational, technical and external factors as a support to the observations made in previous construction delays studies (Sambasivan and Soon, 2007; Enshassi et al., 2009). The study will investigate how the RII works in ranking factors that contribute to delays. The use of RII was a successful and dependable approach in ranking the delay factors in construction projects of stadiums. RII allowed ranking the causes of delay systematically by calculating the perceptions of respondents on the dimensions of importance, frequency, and severity, as well as identifying the critical factors. Such a high internal consistency of a questionnaire, which has been established with the help of the values of Cronbach Alpha that are above the acceptable levels, is another argument in favor of the strength of the RII-based results. These findings are in line with the past studies that emphasize RII as a practical and well-established delay analysis tool, in research connected to construction management (Doloi et al., 2012; Singh, 2022).

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