

An Integrated Assessment of Technical and Managerial Constraints Leading to Delays in Housing Mega-Projects

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Abstract - Delays remain one of the most persistent challenges in large-scale residential construction projects. These schedule overruns disrupt progress, elevate project costs, strain stakeholder relationships, and compromise delivery targets. This study investigates the dominant constraints contributing to delays in mega residential developments in India. A structured questionnaire survey was administered to 24 respondents representing contractors, consultants, project managers, site engineers, and related professionals. The collected data were analyzed using the Relative Importance Index (RII) to prioritize the perceived delay factors. Results show that sudden shortages of labour and materials constitute the most critical causes of delay (RII = 0.800), followed by inadequate front-end planning (RII = 0.788), delays in top-management decision-making (RII = 0.775), poor communication across project stages (RII = 0.766), and economic fluctuations (RII = 0.766). The study highlights how supply-chain instability, weak managerial coordination, and environmental uncertainty significantly influence mega residential project timelines. Recommendations include integrated planning systems, decision-governance frameworks, strengthened supply-chain mechanisms, and digital communication platforms. These findings offer valuable guidance for stakeholders seeking to reduce time overruns and enhance project performance.

Key Words: Mega residential projects, construction delays, Relative Importance Index, supply-chain issues, planning efficiency, time overruns, project management.

1. INTRODUCTION

Construction projects form the backbone of urban development, driving social and economic progress. Yet, despite technological advancements, schedule delays remain common, particularly in large and complex residential developments. A delay occurs when an activity surpasses its planned duration, causing disturbances in

workflow sequencing and extending overall project timelines. Such delays often trigger financial losses, disputes, reduced productivity, reputational damage, and strained stakeholder relationships (Patil et al., 2013). Mega residential projects—characterized by multi-tower complexes, extended timelines, large labour forces, and numerous subcontracted packages—are particularly vulnerable to delays due to their interconnected activities and dependency on multiple approval layers.

This paper synthesizes empirical evidence gathered through structured surveys, supported by statistical analysis, to identify and prioritize delay-causing factors. The aim is to generate actionable insights for practitioners and decision-makers.

2. LITERATURE REVIEW

A substantial body of research has examined the complex and interdependent causes of delays in construction projects, particularly in large-scale residential developments. Across global studies, certain delay factors recur consistently, demonstrating the systemic nature of time overruns in the construction industry. One of the most frequently cited contributors is design-related uncertainty. Lokeshwaram and Bharath (2023) found that incomplete drawings, design errors, and frequent revisions disrupt workflow sequencing and force repeated rework, thereby extending project durations. Complementing this finding, Ajayi and Chinda (2022) demonstrated through DEMATEL–System Dynamics modelling that design deficiencies at the planning stage create compounding schedule delays as work progresses, highlighting the significance of early-stage quality control.

Communication challenges also play a substantial role in prolonging project timelines. Tariq and Gardezi (2023) observed that weak communication not only delays construction activities but also escalates conflicts among stakeholders, creating further disruptions. Their study suggests that communication issues intersect with financial and managerial delays, indicating that improving coordination could simultaneously address multiple root causes. Financial instability, especially delayed payments from owners, is another recurrent theme in literature. Ojoko et al. (2016) identified contractor financial stress as a major barrier to timely

completion, leading to labour shortages, procurement delays, and reduced productivity. Contractor-centric issues such as inadequate supervision, limited experience, and improper planning have also appeared prominently. Studies by Kamandang & Casita (2018) and Kamandang et al. (2018) identified insufficient planning, slow approvals, and inconsistent labour availability as major contributors to time overruns, especially in developing economies.

Theoretical frameworks further enrich understanding of delays. Ghaffari and Emsley (2015) highlight how Critical Chain Project Management (CCPM) seeks to optimize resource allocation but faces challenges in practical adoption. Kraiem and Diekmann (1987) introduce the concept of concurrent delays, demonstrating how overlapping delays from different stakeholders complicate accountability.

Collectively, past studies emphasize that construction delays stem from multi-dimensional problems involving planning inefficiencies, design discrepancies, supply-chain challenges, financial instability, and communication issues. The present study builds on this foundation by evaluating these delay

patterns within the context of mega residential projects using primary RII-based analysis.

3. METHODOLOGY

The methodological framework for this study was structured to comprehensively examine delay factors affecting mega residential construction projects using a systematic and data-driven approach. A mixed-method research design was adopted, integrating structured quantitative data collection with analytical ranking techniques to ensure the validity, reliability, and applicability of the results. The study began with the development of a detailed questionnaire based on an extensive review of existing literature, ensuring coverage of all significant delay categories such as planning efficiency, communication, managerial decision-making, labour and material availability, economic conditions, and design accuracy. Purposive sampling was used to select experienced professionals actively engaged in project execution, ensuring that the responses captured real-world insights rather than academic perspectives (Refer Figure 1).



Fig. 1: Flow Chart of Methodology Adopted

1. **Problem Identification:** Recognized the need to evaluate delay factors affecting mega residential projects.
2. **Literature Review:** Conducted extensive review to identify established delay categories, modelling approaches, and knowledge gaps.
3. **Questionnaire Development:** Designed a structured questionnaire based on literature-identified delay factors.

4. **Pilot Testing:** Tested questionnaire with a small expert group for clarity and refinement.
5. **Sampling Strategy:** Applied purposive sampling to select respondents with direct project execution experience.
6. **Data Collection:** Collected primary data from 24 professionals using a five-point Likert scale.

7. **Data Preparation:** Verified, cleaned, and classified responses for accuracy and consistency.
8. **RII Calculation:** Used Relative Importance Index to quantify severity levels of each delay factor.
9. **Ranking Analysis:** Ranked all factors according to RII values to identify critical delay contributors.
10. **Interpretation:** Analysed patterns, interrelationships, and implications of top-ranked delay factors.
11. **Validation:** Cross-checked findings with literature and thesis insights for reliability.
12. **Conclusions & Recommendations:** Formulated improvement strategies based on analytical outcomes.

3.1 Data Collection

Primary data were obtained through a structured questionnaire designed after an extensive literature survey. The survey covered factors related to planning, communication, approvals, economic conditions, material and labour availability, design accuracy, equipment reliability, and managerial performance. To further strengthen methodological robustness, the questionnaire was evaluated for clarity and relevance through pilot testing with a small group of professionals. Their feedback helped refine the structure, improve question interpretation, and eliminate redundancies. The final questionnaire adopted a five-point Likert scale, enabling respondents to express the perceived severity of each delay factor. This scale allowed for nuanced responses that could be statistically analyzed. The Relative Importance Index (RII) methodology was employed due to its proven effectiveness in quantifying subjective judgments and prioritizing factors according to their impact level. RII provides a structured framework to convert qualitative perceptions into numerical rankings, allowing easy comparison and identification of critical delay sources. Furthermore, RII is widely used in construction management research, ensuring comparability with previous studies and enhancing the academic rigour of the findings. This multi-layered methodological approach ensures that the study's results are both statistically grounded and practically meaningful.

3.2 Respondent Profile

A total of 24 professionals participated, representing diverse roles: -



Fig. 2: Respondent Positions

Practitioner roles dominate: Contractor (29.2%) and Consultant (25%) lead, followed by Site Engineer (16.7%) and Project Manager (16.7%); Professional Engineer/Architect (8.33%) and Planning Engineer (4.2%) are less represented. This composition prioritizes perspectives tied to execution oversight, field coordination, and subcontractor/vendor control areas that typically surface delays linked to labor output, rework, sequence conflicts, and material logistics. Although fewer in number, planning and design roles can still illuminate the quality of baselines, WBS integrity, and how changes propagate dimensions that should be explicitly contrasted with contractor/consultant views. Respondents ranged from below 5 years to above 20 years of industry experience (Refer Figure 2).

3.3 Data Analysis

The collected primary data was further examined using the Relative Importance Index (RII) method. This analytical tool was employed to assess and prioritize the identified factors based on stakeholder responses, thereby offering insights into their comparative significance and influence on project performance.

Mathematical equation for the calculation of Relative Importance Index (RII) as follows;

$$\text{Relative Importance Index (RII)} = \frac{\sum 5N_5 + 4N_4 + 3N_3 + 2N_2 + 1N_1}{A \times N}$$

Where,

N5 = No of respondents for most influential Factor.

N4 = No of respondents for slightly influential Factor.

N3 = No respondents for moderate influential Factor.

N2 = No of respondents for less influential Factor.

N1 = No of respondents for least influential Factor.

A = Highest Weightage.

N = Number of Respondents.

4. RESULTS AND ANALYSIS

4.1 RII Computation Table

The RII analysis provides a clear hierarchy of the delay factors affecting project performance, revealing that mega residential construction projects are predominantly influenced by organisational and resource-driven constraints rather than external factors. The highest-ranked issues—frequency of progress meetings (RII = 0.800) and sudden shortage of materials or labour (RII = 0.800)—highlight the critical importance of continuous monitoring and stable resource availability in maintaining workflow continuity. Close behind, early-stage planning effectiveness (RII = 0.788) and pending top-management decisions (RII = 0.775) indicate that insufficient front-end planning and managerial indecision create bottlenecks that disrupt critical-path activities and foster inefficiencies across project phases. Operational weaknesses, such as improper labour management (RII = 0.750) and staff experience limitations (RII = 0.741), emphasize the role of human-resource competence in timely project delivery. Moderate-impact factors—including design changes (RII = 0.700), inaccurate schedules (RII = 0.700), authority approvals (RII = 0.716), and communication gaps between engineers and contractors (RII = 0.708)—reflect recurring coordination and documentation challenges that lead to rework, delayed sequencing, and slowed decision cycles (Refer Table 1). In contrast, external constraints such as environmental impacts (RII = 0.583) and equipment failure (RII = 0.533) present comparatively lower influence, suggesting that internal managerial, planning, and supply-chain processes are the dominant drivers of schedule overruns. Collectively, the RII findings underscore that effective delay mitigation must prioritise strengthening early-stage planning, enhancing communication pathways, ensuring financial and managerial responsiveness, and stabilising labour and material supply systems to achieve predictable and timely project outcomes.

Table 1. RII Values for Delay Factors

Sr. No.	Delay Factor	RII
1	Impact of delays on overall performance	0.766
2	Early-stage planning effectiveness	0.788

Sr. No.	Delay Factor	RII
3	Pending decisions from top management	0.775
4	Environmental impacts	0.583
5	Improper communication	0.766
6	Authority approvals	0.716
7	Government policy changes	0.616
8	Plan/design changes	0.700
9	Material supply-chain issues	0.683
10	Labour productivity decline	0.683
11	Contractor experience	0.716
12	Client-driven changes	0.658
13	Equipment failure	0.533
14	Stakeholder communication errors	0.600
15	Staff experience and knowledge	0.741
16	Drawing errors during execution	0.708
17	Economic factors	0.766
18	Accuracy of project schedules	0.700
19	Frequency of progress meetings	0.800
20	Sudden shortage of materials/labour	0.800
21	Change of contractor mid-project	0.633
22	Communication gaps between engineers & contractors	0.708
23	Improper labour management	0.750

4.2 RII Ranking

The top five delay factors identified through the Relative Importance Index (RII) analysis collectively illustrate that project delays in mega residential construction emerge primarily from internal management and planning deficiencies rather than uncontrollable external events. The highest-ranked issues—frequency of progress meetings and sudden shortages of materials and labour (both RII = 0.800)—reveal the critical importance of continuous oversight and reliable resource availability (refer figure 3). Infrequent or ineffective review meetings weaken coordination, prevent timely problem-solving, and allow minor issues to escalate, while abrupt shortages in materials or labour disrupt workflows and halt progress on critical activities. Early-stage planning effectiveness (RII = 0.788) further highlights how foundational weaknesses in scheduling, risk anticipation, and activity sequencing create long-term ripple effects throughout the project lifecycle. Pending decisions from top management (RII = 0.775) demonstrate how administrative inefficiencies and slow approvals act as bottlenecks, delaying procurement, design confirmations, and financial authorisations. Finally, improper labour management (RII = 0.750) underscores the impact of inadequate supervision, productivity inefficiencies, and poor workforce coordination on project timelines. Together, these five factors indicate that strengthening

managerial responsiveness, improving planning robustness, ensuring supply-chain stability, and institutionalizing structured review mechanisms are

essential for preventing systemic delays in large-scale residential developments.

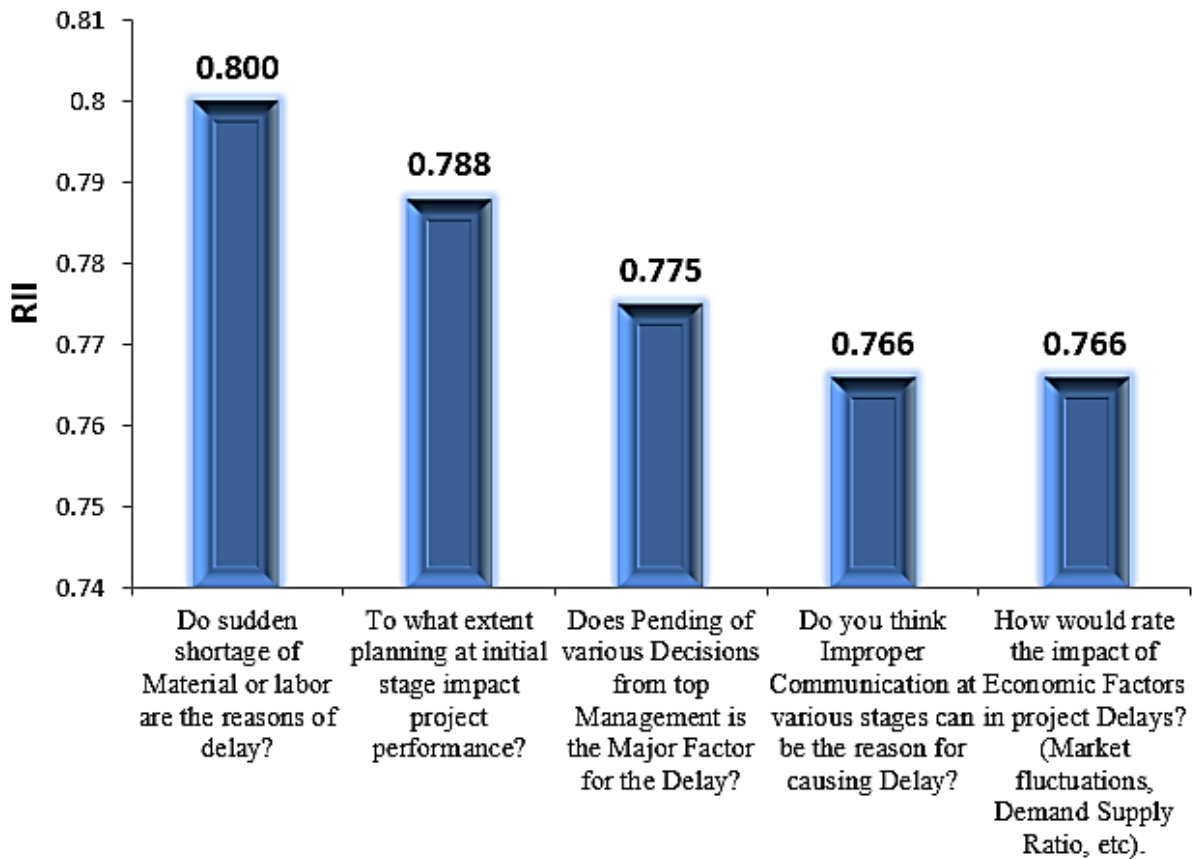


Fig. 3: Major Causes for the delay

5. CONCLUSION

The findings of this study, supported by both primary data and extensive insights demonstrate that delays in mega residential projects arise from an intricate mix of managerial, technical, financial, and logistical constraints. The study emphasized that large residential developments—because of their multi-tower configuration, dependency on multiple subcontractors, and extensive approval chains—are inherently vulnerable to interruptions. The RII-based analysis further validates these observations, revealing that sudden shortages of labour and materials pose the most significant risks to timely project delivery. This aligns with the thesis findings that supply-chain volatility, unreliable vendor performance, and fluctuating labour availability frequently halt progress during critical execution stages. Inadequate early-stage planning was identified as another key contributor, consistent with the thesis conclusion that insufficient risk assessment, incomplete design coordination, and improper resource forecasting generate cascading delays. Slow top-management

decision-making, particularly concerning design clarifications and financial approvals, also reflects systemic governance gaps highlighted in the thesis. Communication-related delays—stemming from poor coordination between consultants, contractors, and site engineers—were similarly reinforced by both the survey results and the thesis observations, which noted that fragmented communication often leads to rework, misunderstandings, and inefficient sequencing of activities. Economic conditions, including inflation, price fluctuations, and market instability, further compound delays by affecting procurement cycles and cost planning. The thesis emphasized that mega residential projects, because of their long gestation periods, are especially sensitive to such macroeconomic uncertainties. Overall, this study concludes that improving schedule performance in mega residential projects requires a multi-dimensional strategy that integrates robust early-stage planning, structured decision-governance mechanisms, reliable supply-chain systems, and technology-driven communication platforms. Strengthening these areas will significantly reduce time overruns, enhance productivity, and improve overall project outcomes.

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