Critical Analysis of Project Delays in Building Construction Sector in the Indian Context: A Comprehensive Review

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Abstract. Construction delays remain a persistent challenge within the Indian building sector, affecting project timelines, cost performance, and stakeholder satisfaction. This study provides a comprehensive review of literature published between 2010 and 2025, identifying the primary causes, patterns, and mitigation strategies related to project delays. Delay factors are categorized into client, contractor, consultant, and external, related causes, covering issues such as inadequate planning, labour shortages, design revisions, funding constraints, and regulatory hurdles. The review also evaluates the adoption of modern project management approaches, including Building Information Modelling (BIM) and Lean Construction, within the Indian context. Findings indicate that while research is abundant in infrastructure sectors (highways, rail transport, and energy projects), limited attention has been given to institutional buildings and affordable housing. The study concludes that enhanced stakeholder coordination, integrated planning frameworks, and sector, specific delay models are vital for improving project delivery outcomes across India's diverse construction landscape.

Keywords: Construction, Delays, India, Infrastructure, Project Management

1 Introduction

As of FY 2024, India's construction sector employs nearly 55 million people and contributes approximately 9–10% to the national GDP, making it the second, largest employment generator after agriculture. Over the past decade, the sector has grown at a

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steady rate, driven by rapid urbanisation, expanding middle, class demand, and sustained public investment. Roughly 55% of the country's construction spending is allocated to infrastructure, roads, railways, metro systems, ports, airports, and power facilities, while the remaining 45% goes to real estate, including residential, commercial, and institutional development. Government programmes such as PM Gati Shakti, Smart Cities Mission, and PMAY,U have strengthened the project pipeline nationwide, with infrastructure investments also influencing property price appreciation in major Indian cities [1]. Figure 1 highlights the key project, related challenges that persist within this expanding construction landscape.

Fig. 1. Construction Project Challenges

Project duration and cost performance are closely interlinked: accelerating schedules increases direct expenses, whereas delays escalate overall costs due to inefficiencies. Figure 1 groups the main issues affecting project delivery[2] [3], ranging from cost and contractual problems to labour, site management, and external influences, which often stem from weaknesses in planning, coordination, and risk management rather than from isolated technical failures [4], [5]. In practice, these interrelated challenges frequently materialise as schedule slippages, making delay one of the most critical manifestations of poor project performance in the Indian context.[6]

Although several studies have identified delay factors, limited research focuses specifically on infrastructure, related delays within the Indian context. Highways and metro rail transit systems remain the most studied project types [7], [8], [9], [10], and larger projects tend to experience more pronounced delays compared to smaller ones [11]. This study reviews literature from 2010–2025 to categorise delay causes by origin and examine their broader impacts on project delivery outcomes in India.

2 Methodology of the study

The key variables generating delays in Indian construction projects between 2010 and 2025 were identified through a structured literature review. Peer , reviewed journal articles, conference papers, technical reports, and case studies were retrieved from Scopus, Web of Science, ScienceDirect, Google Scholar, and major publisher databases (Elsevier, Springer, Taylor & Francis, Emerald) using keywords such as "construction delays India", "delay analysis models", and "infrastructure project risks". The search was limited to studies focusing on construction and infrastructure projects in the Indian context, written in English, and providing empirical evidence on delay causes or delay, related models; after screening titles, abstracts, and full texts, a total of 25 studies were selected for detailed analysis. Delay factors reported in these studies were extracted, grouped by stakeholder origin (client, contractor, consultant, and external), and mapped to the analytical or modelling approaches used to diagnose and manage delays, as summarised in Figure 2.

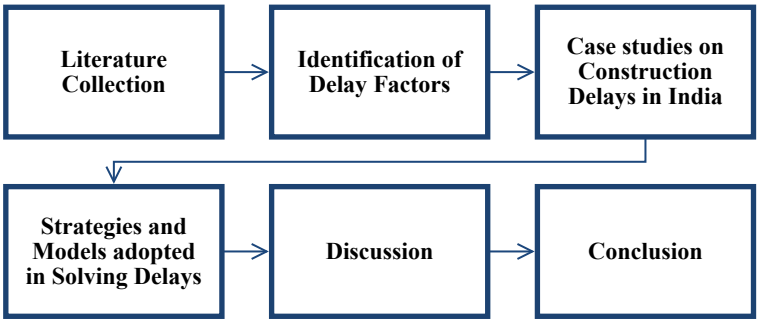

Fig. 2. Methodology adopted in study

3 Delays in Construction Projects

Several studies have examined why construction projects experience delays and cost overruns across different regions and sectors. At the project level, recurrent managerial and technical issues , such as inadequate planning, frequent design changes, and ineffective material management , have been widely reported as primary drivers of delay[12]. In the Indian context, these are compounded by late material ordering, inaccurate quantity estimates, and shortages of skilled and unskilled resources [5]. Financial and contractual factors, including delayed payments, variation orders, and disputes over scope or contract conditions, further extend project timelines [13]. In addition, external and regulatory influences such as adverse weather, strikes, policy changes, and social unrest introduce uncertainty that often disrupts carefully planned schedules.

Building on these findings, Table 1 organises the main delay , related issues into thematic categories , cost overrun, disputes, litigation, arbitration, labour, external influences, communication failures, and site management, showing how different mechanisms collectively affect overall execution efficiency[14], [15]. Rather than listing individual causes repeatedly in the text, these categories provide a consolidated view of how managerial, financial, contractual, and external factors interact to produce time overruns in Indian construction projects. Railway construction projects in India frequently face cost and time overruns while contributing to environmental degradation due to material wastage. A study based on stakeholder surveys identifies delays in material delivery as the most critical factor impacting metro project timelines, highlighting the strong link between material management and project delays [28].Modern construction projects face increasing complexity, frequent changes, and unstable physical and financial conditions, making on-time and on-budget completion challenging. These factors often lead to delays, prompting this study to identify the root causes of project delays and explore ways to minimize them [29].

Table 1. Factors affecting Delays in Project [6]

Category	**Related Factors**
Cost Overrun	Cost overruns often arise due to improper or inaccurate cost forecasting, economic fluctuations, reworks caused due to the construction errors, and project complexity.
Disputes	Frequently occur due to negligence in clarifying the scope, sub , standard contracts, modifications in agreements, poor contracting methods, and not using the standard building codes.
Total Litigation	Commonly driven by delayed payments, late handover of land by the owner, contract changes, and complexities within the project.
Arbitration	It tends to emerge from contract deficiencies, payment disputes, execution errors, and delays in project start time.
Labour Issues	By low workforce motivation, unsafe or unsuitable construction methods, labour shortages, and major on , site accidents.
External Influences	Such as economic stability, delayed government approvals, stakeholder approvals, and transport disruptions significantly impact project timelines.
Communication Failures	lack of coordination, poor planning, insufficient management, and unclear responsibilities and communication among stakeholders.
Site Management Issues	It includes poor on site conditions, inadequate site layout, restricted site access, and delayed project starts, all of which prolong project duration.

4 Various Case studies on Construction Delays

Indian case studies on construction delays span residential and housing projects, large infrastructure schemes, and regional public works, revealing both common patterns and sector, specific variations. In residential and building projects, Desai and Bhatt [16] identified nine categories comprising 59 delay factors in Central Gujarat housing, with owner , driven changes, poor contractor planning, and resource shortages as dominant issues, while a student hostel project attributed the largest share of responsibility to contractors, followed by clients, consultants, and natural factors. These building, sector studies emphasise local decision, making, planning quality, and resource management as critical drivers of delay.

Infrastructure, focused studies highlight broader financial and macroeconomic influences. Doloi et al. [17]and subsequent work show that cost estimation errors, inflation, and funding constraints commonly lead more than half of Indian infrastructure projects to experience delays ranging from a few months to over two years [5], [18]. Material , related research links ineffective material management to productivity losses and advocates measures such as improved supply planning and the use of alternative materials (for example, fly ash blocks) to reduce time and cost overruns [19], [20].

Regional analyses, such as studies from Odisha, indicate that rapid construction growth can intensify owner , related delays, with conflicts, poor coordination, and weak decision , making emerging as major causes of underperformance [21]. Comparative work further suggests that India lags behind peer countries like China and Bangladesh in schedule performance, indicating systemic challenges that go beyond individual project management practices[22]. Across sectors, these case studies consistently show that larger and more complex projects are more vulnerable to compounded delays, whereas smaller schemes are often affected by a narrower set of localised factors.

5 Strategies and Models adopted in Solving Delays

Delays in Indian construction projects originate from intertwined managerial, technical, financial, and external sources, with contractor, related issues such as weak site management, inadequate planning, labour shortages, and limited financial capacity particularly prominent. In response, the literature proposes a combination of analytical models, managerial practices, and technological tools to diagnose and mitigate delay risks, as reflected in the trends shown in Figure 3.

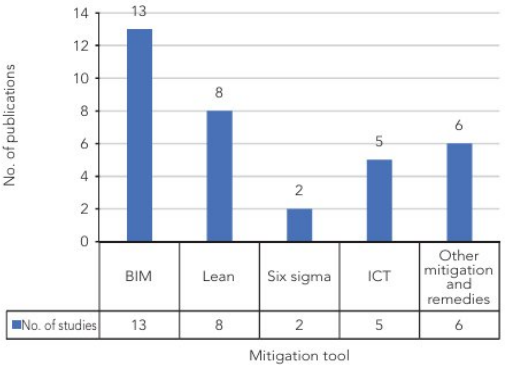

Fig. 3. Trends in Studies of Mitigation Tool adoption in Delay Analysis [30]

5.1 Analytical and decision Support models

Several multi, criteria and statistical techniques have been applied to identify, prioritise, and predict delay factors in uncertain environments. Fuzzy AHP is used to weight and rank causes where expert judgements are imprecise, typically highlighting equipment shortages, lack of skilled labour, inadequate supervision, and budget limitations as critical risks [23]. TOPSIS and related hybrid approaches (such as Fuzzy TOPSIS–Best–Worst and Fuzzy AHP–Decision Tree models) support ranking of project risks and prediction of delay outcomes, often placing project funding, contractor performance, land acquisition, and key resource availability among the most influential drivers, especially in road and megaprojects [24]. Broader statistical methods, including regression, correlation, factor analysis, ANOVA, and Structural Equation Modelling, are employed to quantify relationships between delay factors and project performance, and to test causal pathways in Indian settings.

5.2 Managerial and process oriented strategies

Beyond modelling, studies recommend strengthening core project management practices to tackle recurrent delay mechanisms. Suggested measures include more realistic scheduling and cost forecasting, improved contract formulation and risk allocation, timely payments and variation management, and enhanced coordination among clients, contractors, consultants, and regulatory bodies [25]. Several works underline the importance of systematic material planning, supply chain integration, and workforce

management to reduce disruptions on site, particularly in resource, intensive infrastructure and housing projects.

5.3 Technological and integrated delivery approaches (BIM, Lean, IPD)

Technological and organisational innovations such as BIM, Lean Construction, and Integrated Project Delivery (IPD) are increasingly discussed as enablers for delay reduction, although adoption in India remains uneven. Internationally, BIM is mandated for many public projects in countries like the UK and USA, where it supports clash detection, coordinated design, and 4D scheduling; in India, diffusion is slower due to low organisational readiness and perceived implementation risks [26]. Lean tools are more commonly applied for waste reduction and rework minimisation, and studies show that combining Lean principles with BIM can improve workflow reliability and reduce time loss, but integrated Lean–BIM–IPD frameworks are rarely implemented and often constrained by managerial reluctance and skill shortages. As indicated in Figure 3, empirical work on such mitigation tools has increased over time, yet validation across diverse Indian project types , particularly institutional buildings and affordable housing , remains limited[23], [27].

6 Discussion

Construction delays in India emerge from the interaction of three broad clusters of issues: project, level management weaknesses, structural industry constraints, and limited uptake of analytical and technological tools. At the project level, contractor inefficiencies, poor planning, weak supervision, labour shortages, and material procurement delays, combine with client, side problems such as slow decision, making and frequent design alterations to generate recurrent schedule slippages. These are reinforced by communication gaps among stakeholders and fragmented contractual arrangements, which slow down approvals, claims resolution, and change management.

Structural constraints at industry and policy levels further amplify these project, level weaknesses. Prolonged regulatory approvals, land acquisition challenges, and exposure to macroeconomic volatility (inflation, funding constraints) increase the likelihood that initial schedules and budgets become unrealistic over time, particularly for large infrastructure projects. Case studies consistently show that Indian projects lag behind international benchmarks in achieving planned completion times, suggesting that delay is not only a site, management problem but also a symptom of wider institutional and governance limitations.

The review also indicates that, although tools such as Fuzzy AHP, TOPSIS, regression models, and SEM have improved the diagnosis and prioritisation of delay

factors, their integration into routine project control systems remains limited. Moreover, empirical research is concentrated in highways, metro systems, and other large, scale infrastructure, with relatively sparse evidence on institutional buildings, affordable housing, and smaller urban projects. This imbalance restricts the generalisability of existing delay models and highlights the need for sector, and region, specific frameworks that better reflect India's diverse project portfolio.

7 Future Scope

1 Develop sector, specific delay models for under, represented segments such as institutional buildings, affordable housing, and small, and medium, scale urban projects, capturing their distinct procurement structures, stakeholder profiles, and risk patterns.
2 Undertake region, specific studies that account for variations in regulatory processes, land acquisition practices, labour markets, and supply chain maturity across different Indian states and urban–rural contexts.
3 Design longitudinal studies that track key delay factors across the project life cycle, from planning and design through construction and handover, to better understand how early, stage decisions influence downstream time performance.
4 Promote wider adoption and empirical testing of digital and analytical tools (BIM, 4D/5D modelling, Lean–BIM integration, data analytics, and AI, based forecasting) for delay prediction, real, time monitoring, and proactive risk management in Indian projects.
5 Strengthen capacity building and institutional frameworks by investing in training for clients, contractors, and consultants, and by developing guidelines and contractual mechanisms that support collaborative delivery models such as IPD and Lean, oriented project governance.

8 Conclusion

This review shows that construction delays in India are driven by interrelated project, level management shortcomings, structural industry and regulatory constraints, and partial adoption of analytical and technological support tools. By synthesising findings from 2010–2025, the study consolidates delay causes across clients, contractors, consultants, and external agents, and maps them to the principal modelling and mitigation approaches currently applied in the Indian context.

The analysis highlights significant research and practice gaps, particularly the dominance of evidence from large transport and infrastructure projects and the limited coverage of institutional buildings, affordable housing, and smaller urban schemes. It also underscores the unrealised potential of BIM, Lean Construction, IPD, and advanced data, driven models to move from isolated pilot applications toward mainstream delay

management practices. Addressing construction delays in India will require coordinated action: clients, contractors, consultants, and policymakers must work towards more integrated planning frameworks, collaborative contractual arrangements, and sustained investment in digital and human capabilities to achieve reliable time performance across the country's diverse construction portfolio.

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