Addressing Planning and Execution Challenges: Site-Based Approaches for Urban Street Development Projects in India

Prapti Jaykumar Dave
Final Year Student, M. Tech. (Civil) Construction Engineering & Management
BVM Engineering College, V.V. Nagar.
daveprapti2002@gmail.com

Dr. Reshma L. Patel
Assistant Professor, Civil Engineering Department, BVM Engineering College, V.V. Nagar
rlpatel@bvmengineering.ac.in

Prof. (Dr.) J. R. Pitroda
Professor, Civil Engineering Department, BVM Engineering College, V.V. Nagar
jayesh.pitroda@bvmengineering.ac.in

Mr. Dipak Bharti Goswami
Project Manager, PSP Projects Ltd., Ahmedabad, Gujarat

Abstract - Urban street development projects in India are increasingly challenged by complex planning deficiencies, fragmented execution mechanisms, and on-site management inefficiencies. This review paper synthesizes insights from twenty empirical and conceptual studies to identify, evaluate, and consolidate the major planning and execution challenges faced during urban street infrastructure development. The collective analysis reveals that inefficiencies often originate from overlapping factors such as inadequate project planning, poor coordination among stakeholders, delayed decision-making, financial constraints, and design-related ambiguities. Site-based challenges particularly concerning material management, equipment allocation, traffic diversion planning, and utility relocation—emerge as recurrent sources of delay and cost escalation. Studies on Indian contexts highlight that unclear project scopes, weak communication channels, insufficient risk assessment, and lack of integrated scheduling tools contribute significantly to time and cost overruns. Comparative findings from both Indian and international case studies underscore the universal importance of adopting structured project management frameworks, enhanced site supervision, and stakeholder collaboration mechanisms. Furthermore, the integration of digital technologies such as BIM, GIS, and remote monitoring tools has been identified as a transformative approach to improving planning accuracy, progress tracking, and coordination efficiency at the site level. The synthesis concludes that a shift from conventional top-down planning to adaptive, site-based management frameworks supported by real-time data systems and participatory decision-making can substantially improve execution reliability, sustainability, and public service continuity in urban street development projects. This review thus provides a consolidated foundation for policymakers, urban planners, and project managers to implement data-driven, site-responsive strategies that address the persistent planning and execution challenges in India's evolving urban infrastructure landscape.

Keywords: Adaptive Management, BIM Integration, Cost Overrun, Execution Challenges, GIS Application, Infrastructure Development, Planning Efficiency, Project Coordination, Site-Based Approach, Urban Street Development

1. Introduction

Urban street development represents one of the most intricate and multidimensional components of modern infrastructure planning, directly influencing the functionality, liveability, and sustainability of cities. Streets are not merely conduits for transportation they are dynamic urban spaces that facilitate socio-economic interactions, pedestrian movement, and environmental integration. In rapidly urbanizing nations such as India, the design, planning, and execution of street development projects present a series of challenges that extend beyond conventional engineering and managerial parameters. These challenges stem from the confluence of administrative fragmentation, inadequate stakeholder

coordination, unpredictable urban growth, and resource limitations, all of which significantly impact project timelines, costs, and performance outcomes [1],[2].

The process of developing and upgrading urban streets in India is further complicated by site-specific contextual factors. These include variations in soil and drainage conditions, utility conflicts, traffic management constraints during construction, and the dynamic nature of urban settlements. While global studies have explored delay causation and project performance indicators in road and infrastructure projects[1],[3],[4], the localized dynamics of Indian urban streets where design must coexist with dense, mixed-use environments remain less systematically understood. In this context, urban streets in India are unique socio-technical systems that combine engineering complexity with human-centered spatial functionality. Addressing planning and execution challenges in such projects, therefore, demands an interdisciplinary lens that integrates technical efficiency, contextual adaptability, and participatory governance [2],[5],[6].

Despite significant investment in urban development programs such as the Smart Cities Mission and AMRUT, recurring issues of project delay, inadequate design integration, and fragmented implementation persist across Indian cities [7],[8],[9].Research indicates that nearly 60% of infrastructure projects in India experience schedule slippages due to planning deficiencies, bureaucratic delays, and site-level execution challenges [7],[10],[11]. These inefficiencies are not isolated incidents but systemic outcomes of inadequate risk anticipation, insufficient data-driven decision-making, and poor inter-departmental synchronization. Delays in project completion not only escalate costs but also disrupt public mobility, strain local economies, and reduce citizen confidence in municipal governance [12],[13],[7].

Globally, studies by Mahamid [1] et al. and Al-Momani [4]highlight that causes of delay in infrastructure projects are often a function of ineffective communication, inaccurate project estimation, and resource misallocation. In developing countries, however, the magnitude of these challenges intensifies due to institutional rigidity and frequent design modifications during execution. Indian research, such as that by Doloi et al.[7] and Iyer and Jha[13], reinforces these insights, revealing how weak planning mechanisms, insufficient stakeholder engagement, and contractor-related inefficiencies contribute to persistent time and cost overruns. Within the urban street context, these issues manifest as disruptions to ongoing city life, uncoordinated relocation of underground utilities, and poor integration of pedestrian and vehicular systems[6],[14].

Urban street development further intersects with the broader discourse on sustainable and inclusive cities. As contemporary planning frameworks increasingly emphasize walkability, green infrastructure, and equitable accessibility, the street becomes a central site of experimentation and innovation. However, integrating these aspirations within the Indian urban context characterized by heterogeneous land use, informal markets, and constrained municipal capacities requires adaptive, site-based strategies [15],[5]. Recent works on design thinking and adaptive planning frameworks [2],[15] propose the blending of participatory design methodologies with quantitative project management approaches, providing a balanced framework that can respond dynamically to on-site contingencies.

Moreover, the execution challenges in Indian urban street projects are often magnified by operational realities such as encroachments, utility overlaps, delays in material procurement, and limited contractor accountability. Site-specific management approaches, if effectively structured, have the potential to mitigate many of these bottlenecks through real-time monitoring, stakeholder coordination, and modular scheduling [12],[11],[16]. Integrating modern digital tools such as Building Information Modelling (BIM), Geographic Information Systems (GIS), and Internet of Things (IoT)-based monitoring systems can further enhance decision-making accuracy and streamline workflow communication [5],[14].

Therefore, this review paper aims to critically examine and synthesize the planning and execution challenges associated with urban street development in India, emphasizing **site-based approaches** as a pragmatic framework for overcoming systemic inefficiencies. By reviewing twenty key research contributions from global and Indian contexts, the paper identifies recurring causes of delay, evaluates adaptive planning strategies, and formulates a structured approach toward improving project delivery performance. The ultimate objective is to propose a **multi-dimensional model** that links urban design principles with project management techniques enabling the transformation of Indian urban streets into resilient, efficient, and people-centric infrastructures.

2. METHODOLOGY

2.1. Research Design and Approach

This study adopts a **qualitative and evidence-based review design** to identify **planning and execution challenges** in urban street development projects across India, emphasizing **site-specific approaches**. It integrates insights from **academic literature, government policies**, and **field experiences** under programs like the **Smart Cities Mission** and **AMRUT**. The approach bridges the gap between **planning frameworks** and **on-ground implementation realities**.

2.2. Literature Identification and Selection

Relevant literature from **Elsevier**, **SpringerLink**, and **Google Scholar** was reviewed for the period **2010–2025** using keywords such as *urban street development, construction delays, site-based management, and execution challenges*. Out of 148 initial sources, **20 key publications** were selected based on **relevance, credibility**, and **applicability** to Indian urban contexts, including journal papers, theses, and policy documents.

2.3. Data Extraction and Categorization

Information from each paper covering **study area, objectives, methods, and findings** was systematically extracted. Data were grouped under five themes:

1. Planning Framework Gaps
2. Execution Challenges
3. Stakeholder Coordination
4. Technological Interventions
5. Sustainable Urban Development

This helped link policy-level issues with site-level impacts.

2.4. Analytical Framework

A **comparative and qualitative content analysis** was applied to synthesize findings across the selected studies. A **problem-solution matrix** and **root-cause mapping** were used to trace execution issues—such as material delays or utility conflicts back to planning deficiencies. Each intervention was assessed through a **SWOT-based framework** for its technical and managerial feasibility.

2.5. Validation and Quality Assurance

Findings were verified against official references such as **IRC guidelines**, **MoHUA Urban Roads Manual**, and **Smart Road DPRs**. Case examples from **Ahmedabad**, **Pune**, and **Indore** were used for contextual validation. Each study was evaluated for **relevance, credibility,** and **practical applicability**, ensuring a balanced synthesis of academic and field insights.

2.6. Limitations of Methodology

The review is limited by **restricted access to municipal project data** and **city-specific DPR details**. Differences in governance frameworks across states posed contextual challenges. However, cross-referencing and triangulation of multiple sources helped minimize these limitations.

2.7. Ethical Considerations

Only **published and publicly available data** were used, with due citations following **IEEE referencing standards**. No confidential or proprietary project information was included.

3. Literature Review — Key Findings from Selected Studies

3.1. Delay causation—foundational analyses

1. **Global & non-Indian evidence.** Al-Ghafly's thesis (Saudi Arabia) established a detailed taxonomy of delay causes in public utility projects, concluding that contractor performance, owner administration, and insufficient early planning are primary contributors; financial difficulties (contractor cash flow, delayed owner payments) were shown to exert outsized impacts[17]. Assaf et al. (1995) similarly demonstrated that financing and scheduling weaknesses dominated delay causes in large building projects [3]. Al-Momani (2000) applied regression analysis on 130

Jordanian projects to show that poor design and change orders frequently correlated with extended durations[4]. Seboru's study (Kenya) reinforced the universality of payment delays, slow decision making, and planning deficiencies [18].

2. **Indian quantitative studies.** Doloi et al. (2012) offered a rigorous factor-analysis and regression treatment of Indian construction projects, identifying lack of commitment, inefficient site management, poor coordination, and improper planning as critical factors[7]. Devi & Sindhu (2025) provided sector-specific insights for roads and bridges using PCA and RII, highlighting material and site constraints and contractor inefficiency as dominant factors [11]. Shafi's thesis (2020) and Honrao & Desai (2015) delivered regionally focused evidence (UT J&K, highway projects) emphasizing local site constraints like narrow rights-of-way, ground conditions, and late land handover as prime execution bottlenecks[12],[16]. Across Indian studies, late progress payments, procurement inefficiencies, and insufficient pre-construction investigations recur as high-impact causes[7],[8],[10],[11].

3. **Stakeholder disagreement and perception.** Several studies noted divergence in stakeholder perceptions: contractors often attribute blame to owners (slow payments, inadequate rights), while owners highlight contractor capacity gaps; consultants and owners sometimes align, but contract design and tendering practices remain flashpoints [3],[17],[19].

3.2. Planning & design perspectives

1. **Design thinking and participatory urban redevelopment.** Kumar et al. (2016) applied design thinking in Indian redevelopment work, illustrating that participatory, prototype-driven methods produce solutions better aligned with resident needs and ultimately improve implementation buy-in[2]. Srivastava et al. (2024) and Kamal et al. (2024) emphasized urban design principles (imageability, transparency, human scale) and public space regeneration (Chandni Chowk case), highlighting how context-sensitive design reduces friction during execution by anticipating user behaviour and spatial constraints[6],[5]. Garg et al. (2023) contributed empirical user-experience insights to inform streetscape planning frameworks[14].

2. **Hybrid and adaptive planning frameworks.** Singla et al. (2024) proposed a hybrid two-tier model combining deterministic optimization (genetic algorithms) with LLM-based regional planners that balances city-wide objectives with sub-region priorities—implicitly supporting site-sensitive planning that can reduce later change orders and rework[15].

3.3. Execution & site-level operational analyses

1. **Resource flows, logistics, and right-of-way constraints.** Papers focusing on highways and water supply projects (e.g., Aditya et al., Honrao & Desai) identified utility relocation, constrained working space, and sequencing challenges (e.g., pipe laying → testing → road reinstatement) as practical execution impediments[8][16]. Shafi's thesis and Mahamid et al. exposed how segmentation, restricted movement (political or physical), and equipment shortages translate into severe delays on the ground [1][12].

2. **Contracting, procurement, and payment issues.** Multiple studies (Mahamid et al., Al-Ghafly, Al-Kharashi & Skitmore, Seboru) underline the deleterious effects of awarding contracts on lowest bid alone, delayed progress payments, and weak contractor prequalification practices that instigate low performance, cash stress, and risk transfer disputes[1],[17],[19],[18].

3.4. Quantitative methods for delay analysis and prediction

1. **RII, PCA and regression.** Several Indian studies employed Relative Importance Index and PCA to prioritize delay attributes and to distill latent factors that explain variance in project performance[7],[4],[13],[11]. Al-Momani's regression models offered predictive relationships between planned and actual durations, useful for pre-contract risk assessment [4].

2. **Agreement metrics and rank correlations.** Spearman rank correlations in studies by Mahamid and Seboru examined agreement between contractors and consultants on delay ranking, revealing moderate agreement but persistent differences in attribution[1][18].

4. Comparative Analysis and Cross-Study Synthesis

To establish a consolidated understanding of planning and execution challenges in urban street development, this section presents a **comparative synthesis of the twenty reviewed studies**.

The analysis emphasizes their focus areas, methodological approaches, major findings, and identified research gaps.

This tabular presentation ensures clarity in drawing correlations between global and Indian contexts relevant to urban infrastructure planning and execution.

Table 1. Comparative Analysis of Reviewed Studies

Paper No.	Author(s) & Year	Focus Area / Context	Methodology / Approach	Key Findings / Contributions	Identified Gaps / Limitations
1	Mahamid, Bruland & Dmaidi (2012)	Road construction delays	Empirical analysis of delay causes	Major causes include design errors, payment issues, and poor coordination	Context based in Palestine; limited Indian relevance
2	Kumar et al. (2016)	Urban redevelopment, India	Case study using design thinking	Enhanced planning and stakeholder integration through participatory processes	Qualitative approach; lacks quantitative data
3	Singla et al. (2024)	Adaptive urban planning	AI-integrated hybrid framework	Promotes balanced city growth via data-driven modelling	Conceptual framework; lacks field validation
4	Al-Ghafly (1995)	Public utility construction delays, Saudi Arabia	Case-based master's thesis	Identified weak planning, poor supervision, and contractor inefficiency	Region-specific; not urban-focused
5	Assaf, Al-Khalil & Al-Hazmi (1995)	Large building project delays	Quantitative survey	Payment delays, design revisions, and poor communication were critical	Outdated; limited applicability to modern contexts
6	Kamal, Vasanth & Khan (2024)	Urban regeneration – Chandni Chowk, Delhi	Case study	Demonstrates integration of pedestrianization and urban design	Does not discuss planning methodologies or execution tools
7	Al-Kharashi & Skitmore (2009)	Saudi public sector projects	Statistical factor analysis	Identifies bureaucratic delays and contractor inefficiency	Administrative context differs from India
8	Doloi et al. (2012)	Indian construction delays	Regression and factor analysis	Coordination and resource management are dominant delay factors	Limited to generic construction, not street-specific
9	Shafi (2020)	Highway projects in J&K, India	Empirical thesis study	Terrain and weather significantly	Focused on regional conditions only

				impact schedule adherence	
10	Kumar R. (2016)	Indian project delays	Empirical analysis	Identified 35 major causes; poor DPR and resource allocation	Contractor-side perspective dominant
11	Srivastava, Das & Kumar (2024)	Futuristic mixed-use street (Patna)	Urban design case study	Merges land-use, mobility, and aesthetic principles	Missing practical execution parameters
12	Al-Momani (2000)	Construction delay factors	Quantitative model analysis	Planning failures and design errors lead to overruns	Non-sector-specific generalization
13	Iyer & Jha (2005)	Cost performance – Indian construction	Statistical model	Managerial and coordination deficiencies reduce efficiency	Emphasizes cost, not scheduling delays
14	Aditya, Douglass & Bhattacharya (2017)	Water infrastructure delay in India	Case study	Bureaucratic approvals and procurement lags cause delays	Water sector specific; not transferable to streets
15	Devi & Sindhu (2025)	Infrastructure project delays – India	Field data with statistical tools	Categorized delays as client-, contractor-, and external-induced	Lacks technological mitigation focus
16	Garg et al. (2023)	Urban streetscape design, India	Planning framework	Defines street functionality via user expectations	Planning-centric, minimal project execution analysis
17	Agrawal (2015)	National infrastructure policy challenges	Policy and economic review	Highlights institutional inefficiencies and financing barriers	Macroscopic focus; lacks project-level insights
18	Doloi et al. (2012)	Construction delays – India	Correlation and regression analysis	Confirms managerial coordination as primary delay driver	Duplicate of dataset in Paper 8
19	Honrao & Desai (2015)	Highway construction delay	Field-based quantitative study	Labor, material shortage, and scheduling gaps dominate	Highway-centric; lacks urban integration insights
20	Seboru (2015)	Road construction delays – Kenya	Empirical quantitative study	Identified universal delay categories applicable globally	Contextual mismatch; no Indian policy linkage

4.1 Interpretation and Synthesis

The comparative analysis underscores three major thematic insights:

1. **Planning Deficiencies:** Poor project preparation, weak DPR formulation, and misaligned timelines remain the leading causes of delay, consistent across Indian and international contexts.
2. **Execution Challenges:** On-site inefficiencies, material shortages, and inter-agency coordination failures continue to hinder timely completion.
3. **Emerging Innovations:** Few contemporary studies (e.g., Kumar et al. [2], Singla et al. [3]) emphasize *design thinking* and *AI-driven adaptive frameworks* that hold potential for reforming current practices.

The synthesis suggests that **urban street development in India** requires a shift toward **site-based, data-integrated, and participatory planning** approaches supported by advanced digital tools such as BIM, GIS, and Primavera scheduling to overcome existing systemic constraints.

5. Planning and Execution Challenges — A Structured Presentation

This section synthesizes the challenges into categories with explanation and empirical grounding.

A. Institutional & Policy Barriers

1. **Fragmented governance.** Multiple agencies (municipal, utilities, traffic police) with overlapping responsibilities elongate approval cycles and complicate sequencing[9],[8].
2. **Procurement rules and low-price bias.** Emphasis on lowest bid without robust prequalification increases likelihood of poor contractor selection and subsequent performance problems[1],[17],[19].

B. Planning-Stage Deficiencies

1. **Poor site investigation and design coordination.** Insufficient geotechnical and utility mapping leads to mid-construction change orders [4],[11]~~.~~[11].
2. **Inadequate scheduling and risk forecasting.** Absence of realistic contingency planning and scenario analysis undermines ability to manage ~~changes .~~changes. **Inadequate scheduling and risk forecasting.** Absence of realistic contingency planning and scenario analysis undermines ability to manage changes [7],[4].

C. Execution & Operational Issues

1. **Material & equipment shortages, and supply chain disruptions.** Late procurement or import delays cascade into idle labour and equipment [1],[11].
2. **Traffic and public management.** In dense streets, managing traffic diversions and minimizing public disruption becomes a major scheduling constraint [5][16].
3. **Labor productivity and supervision.** Low skill levels and inadequate supervision slow progress and degrade quality [7][13].

D. Financial & Contractual Problems

1. **Delayed payments and cash flow stress.** Contractor insolvency risk increases when progress bills are delayed [17],[18].
2. **Claims and disputes.** Ambiguous scopes and inadequate contract clauses generate claims, further delaying projects[3],[8].

E. Social & Environmental Constraints

1. **Community resistance and informal economies.** Hawkers, encroachments and small businesses affect access and reinstate needs; poor stakeholder engagement fuels resistance[5],[14].
2. **Environmental and heritage considerations.** Historic streets (e.g., Chandni Chowk) need specialized interventions that extend planning timelines[5].

6. Site-Based Approaches and Best Practices

Drawing on the literature, effective site-based strategies combine design sensitivity, active management, and technological support.

A. Pre-Construction & Site Intelligence

1. **Comprehensive site surveys and utility mapping.** Early geotechnical, utility (GIS/GPR), and socio-economic surveys reduce surprises during execution [8],[16]~~[14], [19]~~.

2. **Staged feasibility and constructability reviews.** Value engineering and constructability checks reduce late design changes[4],[11] [12], [15].

B. Contracting & Procurement Reforms

1. **Qualification-based selection and performance bonds.** Moving beyond price-only selection to include technical capacity and past performance mitigates risk[17],[19] [4], [7].[19] [4], [7].

2. ~~**Payment discipline and milestone-linked disbursements.** Timely progress payments improve contractor liquidity and morale, reducing delays [1], [20].~~**Payment discipline and milestone-linked disbursements.** Timely progress payments improve contractor liquidity and morale, reducing delays[1],[18] [1], [20].

C. Site Operational Measures

1. **Micro-sequencing and work zone planning.** Adopt fine-grained sequences tailored to narrow urban corridors (e.g., utility relocation → temporary reinstatement → main work → permanent reinstatement) to maintain traffic and commerce while enabling progress [8],[16] [14], [19].

2. **Dedicated logistics corridors for material delivery.** Scheduled delivery windows and off-peak mobilization mitigate congestion and enable steady material flows[11],[16] [19], [15].

D. Participatory and Design-Led Approaches

1. **Design thinking & prototyping.** Rapid prototyping and resident testing create solutions better aligned with local needs, reducing opposition and rework[2],[6] [2], [11].

2. **Community engagement during planning and execution.** Early stakeholder workshops and information campaigns reduce resistance and improve compliance[5],[14] [6], [16].

E. Digital & Monitoring Tools

1. **BIM, GIS, and digital twins.** Use of 3D models and digital twins helps visualize conflicts (utilities, furniture) and sequence work to reduce clashes[15],[14] [3], [16].

2. **Progress dashboards & mobile reporting.** Real-time reporting via mobile apps allows site engineers to flag issues, seek approvals faster, and maintain accountability[11],[9] [15], [17].

7. Emerging Tools and Frameworks — Evidence and Applicability

A. Analytical & Predictive Tools

1. **Relative Importance Index (RII), PCA, regression.** These methods help prioritize interventions and create predictive models for schedule risk[7],[4],[11] [8], [12], [15]. RII provides ranked priorities; PCA reduces dimensionality to key latent factors (resource shortages, administrative delays). Regression models quantify expected time overrun relative to project attributes.

2. **Monte Carlo and probabilistic scheduling.** While less represented in the selected literature, probabilistic modelling offers explicit contingency sizing and can be combined with RII outputs for risk-aware scheduling.

B. Integrated Planning Models

1. **Hybrid adaptive frameworks.** Singla et al.'s hybrid planning approach indicates the value of combining optimization algorithms with region-level agents to balance top-down objectives and local needs—this can be adapted to street projects by incorporating site agents representing neighbourhood and agency constraints[15] [3].

C. Digital Field Management

1. **BIM for streets & utilities.** BIM is increasingly applied to linear infrastructure and underground utilities; integrating BIM with GIS provides a shared platform to coordinate trades and avoid utility damage[14],[11] [16], [15].

2. **IoT & sensor networks.** For active monitoring of work zones, temporary traffic signal control, or monitoring air quality during work (relevant for heritage corridors), IoT sensors offer real-time data that informs adaptive scheduling.

8. A Proposed Integrated Framework: Adaptive Site-Based Planning & Execution (ASPE) Model

A. Framework Overview

The ASPE Model synthesizes literature recommendations into a phased, iterative approach:

1. **Phase 0 — Pre-Feasibility & Stakeholder Mapping.** Identify agencies, utilities, merchants, transport operators; conduct initial risk mapping (land acquisition needs, heritage constraints).
2. **Phase 1 — Site Intelligence & Design Integration.** Deploy GPR/utility mapping, traffic studies, and community workshops; produce 3D BIM models and constructability checklists.
3. **Phase 2 — Procurement & Contracting.** Use prequalification, performance-linked contracts, milestone payments, and defined dispute resolution pathways.
4. **Phase 3 — Execution with Live Monitoring.** Employ mobile reporting, digital dashboards, and daily coordination huddles; maintain micro-sequencing to keep critical flows (pedestrian, emergency) functional.
5. **Phase 4 — Transition & Post-Implementation Review.** Collect user feedback, monitor performance metrics, and feed lessons into future projects (institutional learning).

Each phase integrates policy levers (clearance timelines), design thinking (iterative prototyping), and digital tools (BIM/GIS dashboards). The model is intentionally modular, enabling adaptation to resource and governance realities across Indian cities.

B. Practical Implementation Notes

1. **Decision rights:** empower site engineers with delegated authority for low-risk operational choices to avoid bottlenecks.
2. **Coordination cells:** create temporary inter-agency coordination cells for project duration.
3. **Training & capacity:** invest in site-level skill development and digital literacy for field teams.

9. Strategic Recommendations

A. For Policy Makers & Urban Local Bodies (ULBs)

1. **Institutional reforms:** Establish single-window clearances for street projects that coordinate permissions across utilities, traffic police, and heritage bodies with statutory timelines. (Targets: reduce approval lead times and eliminate sequential waits.)
2. **Procurement policy changes:** Shift procurement to a best-value approach combining technical capacity, proposed execution methodology, and price; require contractors to demonstrate logistics plans for congested urban sites.

B. For Project Managers & Contractors

1. **Adopt site intelligence:** Mandate detailed utility investigations and BIM/GIS data as part of tender documents.
2. **Implement performance measurement:** Use KPIs (cycle time per unit length, reinstatement time, downtime due to utility conflicts) to trigger management escalation.

C. For Designers & Planners

1. **Embed participatory prototyping:** Integrate design thinking workshops early, use low-fidelity physical prototypes (temporary kiosks, walking audits) to test flows.
2. **Prioritize constructability:** Include a constructability review as a formal stage before construction mobilization.

D. For Funders & Regulators

1. **Payment assurance mechanisms:** Introduce escrow or milestone-linked escrow mechanisms to protect contractor cash flow; reduce payment disputes that cause stoppages.
2. **Post-project audits & data transparency:** Publish post-implementation performance audits to build institutional learning and accountability.

10. Limitations and Future Research Directions

A. Limitations. This review is constrained by the published evidence available in the selected 20 studies and their respective scopes. Sample sizes and regional focus vary; some studies are theses with limited generalizability. Additionally, while digital tool adoption is advocated, empirical evidence on long-term impact of BIM/IoT in Indian street projects is still limited in the selected literature.

B. Future research. Future empirical work should include controlled before-after studies of ASPE-like implementations, cost–benefit analyses of BIM and digital monitoring in Indian street projects, and comparative studies across cities with differing governance models to refine context-specific adaptations.

11. Conclusion

The following are the conclusion based on literature review:

1. Integrated and Realistic Planning: Most studies confirm that inadequate pre-construction planning, incomplete DPRs, and lack of realistic scheduling are primary causes of inefficiency and delays in urban infrastructure and street development projects across India.
2. Site-Based Management Efficiency: On-site coordination, supervision quality, and adaptability in managing unforeseen conditions (traffic, utilities, weather) directly determine project performance and timeline adherence.
3. Institutional and Regulatory Bottlenecks: Delays in land acquisition, multi-agency approvals, and environmental clearances continue to impede progress, highlighting the urgent need for governance reforms and streamlined approval systems.
4. Data-Driven and Digital Approaches: Adoption of technologies like BIM, GIS mapping, and Primavera scheduling improves planning accuracy, progress tracking, and decision transparency, thereby minimizing rework and cost overruns.
5. Stakeholder Coordination and Communication: Effective collaboration between contractors, consultants, government agencies, and local communities reduces conflicts and ensures smooth project execution in congested urban environments.
6. Skilled Workforce and Capacity Building: A recurring challenge across studies is the lack of trained site engineers and project managers capable of applying advanced planning and risk mitigation tools at the ground level.
7. Financial and Contractual Constraints: Delayed payments, underfunded contracts, and weak private sector financial capacity hinder project sustainability and contractor performance in large-scale urban street projects.
8. Risk Management and Contingency Planning: Incorporating systematic risk assessment and response mechanisms during both planning and execution phases helps anticipate uncertainties and enhances resilience in project delivery.
9. Sustainable and Context-Sensitive Execution: Street development must integrate climate resilience, pedestrian safety, and environmental sustainability principles, ensuring long-term urban livability and reduced maintenance demands.
10. Need for Governance and Policy Reform: Establishing transparent monitoring systems, performance-linked contracts, and accountability-driven frameworks is critical to transforming India's urban street development from reactive execution to proactive, data-informed management.

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