# Drivers and Practices for Technology Adoption in Construction

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**Abstract:** *Construction continues to face persistent productivity, safety, and coordination challenges, yet the last five years have seen rapid growth in digital solutions such as building information modelling (BIM), artificial intelligence (AI), digital twins, immersive training tools, and blockchain-enabled information sharing. This paper synthesises recent journal evidence on (i) how construction organisations adopt technology, (ii) the main drivers that accelerate adoption, and (iii) policy levers that can improve diffusion across fragmented supply chains. Drawing on technology–organisation–environment (TOE) and related adoption perspectives, the discussion explains why adoption in construction is rarely a single purchasing decision and is instead a staged change programme that requires governance, capability building, and integration with project delivery processes. Key drivers include cost and schedule certainty, competitive pressure and client requirements, safety performance, sustainability and carbon reporting, and the need for trustworthy, near real-time data flows across stakeholders. The paper argues that policies are most effective when they combine demand-side measures (public procurement requirements and standardised information deliverables), supply-side measures (skills development, incentives, and demonstrator projects), and ecosystem measures (interoperability standards, data governance, and platform coordination).*

**Keywords:** technology adoption; construction digitalisation; BIM; digital transformation

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## 1. Introduction

The construction sector is characterised by temporary project organisations, fragmented supply chains, and heterogeneous participants. These structural features shape technology diffusion in ways that differ from more vertically integrated industries: benefits are often distributed across firms, data ownership is contested, and learning is repeatedly 'reset' as teams disband at project close. Recent company-level research therefore frames construction digitalisation as a transformation problem rather than a purely technical upgrade, emphasising the interplay of strategy, culture, capability, and ecosystem coordination (Nyqvist et al., 2025; Zulu et al., 2023).

In practice, organisations commonly encounter 'pilot purgatory', where promising tools are trialled on a few projects but fail to scale because of interoperability gaps, unclear value realisation, limited digital skills, and misaligned incentives across clients, contractors, and consultants (Turk, 2023; Chen et al., 2024). This pattern is especially visible when digital deliverables are optional and the supply chain treats models, sensor data, or dashboards as ‘extra’ work rather than as the baseline method of delivery.

At the same time, the benefits of digital technologies are becoming harder to ignore. AI methods are increasingly used for planning, monitoring, prediction, optimisation, and automation across project phases, frequently combined with BIM and sensing to support data-driven decision making (Pan & Zhang, 2021). Digital twin approaches extend BIM by linking virtual models to near real-time site and asset data, enabling monitoring, simulation, and traceability (Lee et al., 2021; Long et al., 2024). Complementary technologies such as blockchain are explored to improve trust and accountability in multi-party information sharing and contractual transactions, although adoption still faces governance and capability constraints (Mahmudnia et al., 2022; Lee et al., 2021).

This paper focuses on drivers and organisational practices for adopting technology in construction and on policies that can increase adoption at scale. It addresses five questions: (1) how do construction organisations typically adopt technology; (2) what organisational practices enable adoption; (3) what drivers motivate adoption; (4) what policies can improve adoption at industry level; and (5) what recommendations follow for practitioners and policymakers. The discussion draws exclusively on recent peer-reviewed journal literature from ScienceDirect, Emerald Insight, and Taylor & Francis Online.

## 2. How Organisations Adopt Technology in Construction

### 2.1 Adoption as a Staged Change Programme

Technology adoption in construction typically progresses through staged activities: problem identification, option screening, piloting, process redesign, scaling, and institutionalisation. The staged nature matters because construction technologies often embed assumptions about information flows (e.g., who creates and approves models), decision rights (e.g., who can change baseline data), and risk allocation (e.g., responsibility for sensor accuracy). When these socio-technical questions are unresolved, organisations treat technology as an add-on rather than a delivery system.

Company-level analysis of digital transformation argues that firms must proactively manage change by addressing fragmentation, limited client demand, and the weak influence of any single actor. Key drivers (e.g., shift toward data-driven industry) become actionable only when paired with managerial actions such as standardising processes, modifying routines, and engaging ecosystem partners (Nyqvist et al., 2025).

From the employee perspective, effective digital transformation depends on a bundle of determinants that sit under three clusters: organisation-related (e.g., hierarchy, size, resources), people-related (e.g., team orientation, training, knowledge), and leadership-related (e.g., awareness, attitude, leaders’ characteristics). This reinforces the view that adoption is not only an IT department task; it is an organisational change programme that must align operating models and behaviours (Zulu et al., 2023).

### 2.2 Governance, Standards, and Information Requirements

Because construction projects involve multiple firms, adoption governance often centres on information requirements, standard operating procedures, and standards. BIM adoption studies in contractor firms show that successful uptake is enabled by committed leadership, a digital transformation strategy with realistic objectives, a capable supplier network, trust-based client relationships, upskilling programmes, and robust collaboration and communication structures (Shojaei et al., 2023).

These enablers matter because many technologies create value only when project parties share consistent data definitions and responsibilities. For example, digital twins rely on harmonising high-fidelity models, sensor streams, and operational data, and therefore require shared rules for data capture, validation, and model updates (Long et al., 2024). Similarly, blockchain-enabled information-sharing designs raise questions about access rights, data custody, and dispute resolution; without governance, the technical ability to 'write to the ledger' does not translate into organisational trust (Mahmudnia et al., 2022).

A useful way to think about governance is to treat information deliverables as contractual outputs. Public-sector contexts highlight this clearly: BIM implementation strategies for public infrastructure projects emphasise adequate IT infrastructure, availability of standards and guidelines, and supportive government policy as top-ranked strategies. These strategies essentially define 'what good looks like' for digital delivery, turning optional experimentation into an expected baseline (Belay et al., 2023).

### 2.3 Capability Building and Workforce Readiness

Capability building is a recurring adoption bottleneck, particularly for small and medium enterprises (SMEs). Digital competence surveys across the AEC sector show that even when practitioners recognise and understand certain technologies (e.g., BIM and cloud tools), implementation may remain limited; competence gaps are more pronounced for technologies such as blockchain and advanced analytics (Chen et al., 2024).

In construction, technologies often require new roles (e.g., BIM coordinators, digital engineers, data stewards) and redesigned processes (e.g., model-based clash resolution, digital approvals, sensor-driven progress measurement). Organisations that treat adoption as a socio-technical transition invest in training, communities of practice, and learning-by-doing, ensuring that pilots produce reusable templates (naming conventions, information exchange standards, dashboards) rather than one-off demonstrations (Zulu et al., 2023; Shojaei et al., 2023).

Workforce readiness also influences which technologies are chosen first. Technologies that deliver value with minimal process change (e.g., mobile reporting apps) often diffuse faster than those that require upstream standardisation and cross-firm workflows (e.g., integrated digital twin + blockchain). Consequently, adoption roadmaps commonly start with 'digitising the basics' (document control, progress capture) before moving toward data-centric integration and automation (Nyqvist et al., 2025; Long et al., 2024).

### 2.4 Technology Selection, Piloting, and Integration

Piloting is often the hinge between interest and routinised use. Effective pilots are aligned to a measurable pain point (e.g., safety incidents, rework, payment disputes), are co-designed with users, and have a plan for integration with BIM, project controls, and contractual processes. Pilots should also be evaluated against explicit adoption metrics (usage frequency, time savings, error reduction) and transformation metrics (process compliance, cross-team collaboration) rather than solely technical performance.

For safety-oriented adoption, virtual reality (VR) training has been examined through extended acceptance models. Findings suggest that perceived usefulness, perceived ease of use, and facilitating conditions (including organisational support and training arrangements) materially influence adoption, implying that ‘good content’ is insufficient without supportive implementation practices (Zhang et al., 2022).

For site intelligence, fog/edge computing platforms have been proposed to combine IoT, AI, and blockchain while improving responsiveness and privacy in sensitive, dynamic site environments. Such architectures demonstrate that adoption decisions are also architectural decisions: computing placement (edge versus cloud) and data governance design affect feasibility, cost, and trust (Kochovski & Stankovski, 2021).

## 3. Drivers for Adopting Technology in Construction

### 3.1 Productivity, Cost, and Schedule Certainty

A dominant driver is the pursuit of productivity and predictable delivery. Digital transformation is frequently justified by reduced rework, improved coordination, and better forecasting. Company-level analyses identify the shift toward a data-driven industry and targeted technological solutions as key drivers, particularly when supported by standardisation and process modification (Nyqvist et al., 2025).

AI adoption is motivated by the potential to automate information processing and to improve prediction and optimisation. A comprehensive review of AI in construction engineering and management notes growing application in areas such as computer vision, natural language processing, and optimisation, with future directions including AIoT, digital twins, robotics, and blockchain integration (Pan & Zhang, 2021).

Importantly, productivity benefits often require complementary investments. For instance, deploying AI-based progress analytics without reliable data capture (e.g., consistent BIM quantities or sensor streams) can lead to ‘automation of noise’. This is why digital twin frameworks stress lifecycle-wide integration and the quality of enabling data technologies (Long et al., 2024).

### 3.2 Collaboration and Trustworthy Information Sharing

Construction’s contractual fragmentation creates information asymmetries that increase transaction costs and disputes. Digital twin approaches aim to create a shared operational representation by linking BIM to near real-time data updates, supporting coordination and decision making across stakeholders (Long et al., 2024).

However, stakeholders may still distrust shared data when incentives and accountability are unclear. An integrated digital twin and blockchain framework has been shown to make data transactions traceable through authenticated updates, thereby strengthening confidence in shared information (Lee et al., 2021).

At the same time, systematic reviews caution that blockchain adoption faces limitations related to governance, scalability, professional training, and regulatory uncertainty. This suggests blockchain is best treated as an enabler within broader process reform, rather than as a stand-alone ‘trust machine’ that automatically resolves collaboration problems (Mahmudnia et al., 2022).

### 3.3 Safety, Quality, and Risk Reduction

Safety and quality performance are strong motivators because incidents and defects carry high human and financial costs. Digital tools can change risk profiles by enabling earlier detection, improved training, and real-time monitoring.

Immersive technologies illustrate this logic: VR safety training can improve learning and engagement, yet acceptance depends on perceived value and facilitating conditions, including organisational training support, equipment quality, and alignment with site practices (Zhang et al., 2022).

Similarly, IoT-enabled site applications supported by fog computing are promoted for monitoring, access control, and hazard detection, but their feasibility depends on low-latency architectures, reliability under site constraints, and clear privacy safeguards—an adoption reality that links technical design to organisational trust (Kochovski & Stankovski, 2021).

### 3.4 Sustainability, Carbon Reporting, and Resilience

Sustainability imperatives are accelerating technology adoption, particularly where clients and regulators require quantifiable reporting. Digital transformation research indicates that digitalisation can enhance innovation efficiency in construction enterprises by alleviating financing constraints, upgrading human capital, and enabling knowledge spillovers (Liu et al., 2025).

Construction 5.0 discourse positions adoption as a pathway to human-centric, sustainable, and resilient buildings. Empirical modelling in this stream highlights the importance of aligning human-centric technology adoption with sustainability and resilience considerations to translate opportunities into implementable change (Yitmen et al., 2024).

From a delivery perspective, drivers for integrated digital delivery include lifecycle information needs, sustainability goals, and coordination benefits. A review of drivers for integrated digital delivery for sustainable construction frames adoption as an ecosystem phenomenon where value accrues across lifecycle stages and organisational boundaries (Larbi et al., 2025).

### 3.5 External Pressure: Clients, Competition, and Market Legitimacy

External pressure is frequently decisive. Industry analysis of ICT adoption in Europe highlights three vectors of technology transfer—standards and regulation, software, and people—suggesting that legitimacy and compliance can be as influential as technical merit (Turk, 2023).

Public infrastructure contexts amplify this effect. Empirical evidence on BIM implementation strategies in emerging markets identifies government policy, standards and guidelines, and IT infrastructure as central strategies, underscoring procurement and regulation as key levers for accelerating adoption (Belay et al., 2023).

Client demand also shapes investment horizons. When clients ask for model-based deliverables, data-rich handovers, or carbon reporting, firms have stronger incentives to invest in reusable capabilities. Conversely, when demand is sporadic, firms rationally limit investments to project-specific experiments—reinforcing 'pilot purgatory' dynamics (Nyqvist et al., 2025; Turk, 2023).

## 4. Policies to Improve Technology Adoption in Construction

### 4.1 Public Procurement as a Demand Signal

Public procurement can accelerate adoption by making digital deliverables a condition of tendering and by rewarding whole-life value rather than lowest initial cost. In the public infrastructure context, adoption strategies emphasise strategic IT infrastructure, standards and guidelines, and government policy—effectively creating a stable demand signal for digital delivery (Belay et al., 2023).

Procurement requirements are most effective when paired with capability support. Contractor-focused BIM research shows that enablers such as committed leadership, realistic digital strategies, and upskilling need time and investment; procurement that demands digital deliverables without supporting the supply chain can increase transaction costs or exclude SMEs (Shojaei et al., 2023; Chen et al., 2024).

A balanced approach is to introduce phased requirements, where baseline digital processes (e.g., common data environment usage, model-sharing protocols) are required early, while advanced requirements (e.g., digital twin-enabled asset management handovers) are introduced as the ecosystem matures (Long et al., 2024; Larbi et al., 2025).

### 4.2 Standardisation, Interoperability, and Data Governance

Interoperability standards and data governance reduce coordination costs and adoption risk. TOE-based research identifies that technology, organisational, and environmental factors jointly shape success, implying that governance mechanisms (e.g., standards, incentives, regulation) must complement organisational readiness and technology capabilities (Zhong et al., 2025).

Digital twin research similarly calls for universal industry standards and lifecycle-spanning stakeholder integration to unlock value beyond isolated phases. Without agreed semantics, model-update rules, and validation practices, digital twin implementations remain siloed and cannot support reliable decision making (Long et al., 2024).

For blockchain-enabled designs, clearer regulatory guidance and governance models are repeatedly identified as prerequisites for broader adoption, because decentralised systems raise questions about accountability, access rights, and dispute resolution (Mahmudnia et al., 2022; Lee et al., 2021).

### 4.3 Incentives, Demonstrators, and Shared Infrastructure

Financial incentives and demonstrator projects can reduce first-mover risk and convert awareness into repeatable practice. Construction 5.0 research emphasises translating opportunities into implementable pathways by aligning technology adoption with sustainability and resilience goals; demonstrators can build confidence in these pathways when results are openly shared (Yitmen et al., 2024).

Demonstrators should be designed as ‘capability accelerators’ rather than as isolated showcases. For example, pilot programmes can require multi-firm participation (client–contractor–consultant), mandate standardised information exchanges, and publish reusable artefacts such as data schemas and process templates (Larbi et al., 2025; Shojaei et al., 2023).

Shared digital infrastructure—such as reference data libraries, secure identity and access management, and common data environments—can lower adoption cost by avoiding duplicated investment across projects. Platform approaches are especially relevant for SMEs that struggle to fund bespoke systems (Turk, 2023; Chen et al., 2024).

### 4.4 Skills Policies and Professional Accreditation

Skills policies are central because many technologies fail at the ‘last mile’ of user competence. Survey evidence shows uneven digital competence across technologies and organisational types, with SMEs and new firms often lagging behind larger organisations (Chen et al., 2024).

Organisational qualitative evidence indicates that employees view training, team orientation, and leadership attitudes as determinants of digital transformation effectiveness. This suggests skills programmes should include leadership development, change management, and incentives for knowledge sharing—not only tool-specific training (Zulu et al., 2023).

Professional accreditation and micro-credentials can help standardise expectations for roles such as BIM manager, information manager, and digital twin steward. Standardising competencies can reduce hiring friction and improve the portability of skills across projects—important in an industry where teams are temporary (Shojaei et al., 2023; Long et al., 2024).

### 4.5 Ecosystem Coordination and Integrated Digital Delivery

Because value is often realised across multiple parties, policy should encourage ecosystem coordination. Integrated digital delivery drivers include sustainability objectives, lifecycle information needs, and the coordination benefits of shared processes (Larbi et al., 2025).

Company-level transformation research similarly argues that addressing fragmentation requires coordinated actions and standardised processes, with managerial and ecosystem actions needed to overcome weak demand and limited single-actor influence (Nyqvist et al., 2025).

In practice, ecosystem coordination can be supported through government-backed data-sharing agreements, reference architectures for digital twins, and procurement models that reward collaboration. Complementary regulation can clarify data governance, cyber-security expectations, and liability boundaries for model-based delivery (Turk, 2023; Mahmudnia et al., 2022).

## 5. Conclusion

Technology adoption in construction is best understood as a socio-technical transformation that requires staged implementation, governance, and ecosystem coordination. Recent literature shows that adoption is enabled by leadership commitment, realistic strategies, upskilling, and collaboration structures (Shojaei et al., 2023; Zulu et al., 2023).

Drivers for adoption are increasingly multi-dimensional: firms pursue productivity and predictability, better collaboration and trusted data, improved safety outcomes, and sustainability and resilience performance (Pan & Zhang, 2021; Lee et al., 2021; Yitmen et al., 2024). The adoption of advanced technologies also depends on ‘foundational’ capabilities in data capture and standardisation, as highlighted by digital twin and ICT adoption research (Long et al., 2024; Turk, 2023).

Policy can accelerate adoption when it combines demand signals (procurement requirements and standardised deliverables), enabling infrastructure (interoperability standards and data governance), and capability building (skills, incentives, and demonstrators). Evidence suggests that TOE-aligned success factors and integrated digital delivery approaches can help move firms beyond isolated pilots toward scalable, repeatable digital practices (Zhong et al., 2025; Larbi et al., 2025; Nyqvist et al., 2025).

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## Conflict of Interest Statement

The authors declare that there is no conflict of interest regarding the publication of this study.

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