

DIGITAL TRANSFORMATION AND SUSTAINABILITY READINESS IN BRUNEI'S CONSTRUCTION INDUSTRY: AN ASSESSMENT USING THE TOE FRAMEWORK

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Abstract

This study examines the digital transformation and sustainability readiness of Brunei's construction industry through the lens of the Technology-Organisation-Environment (TOE) framework. As digital transformation emerges as a vital driver of productivity and sustainability within the global construction sector, the research underscores that effective adoption extends beyond mere technology integration to encompass value creation and organisational alignment. Utilising a quantitative research design, the study investigates the technological, organisational, and environmental dimensions that affect the digital readiness of construction firms in Brunei. Key findings highlight the interplay of managerial capabilities, strategic focus, and regulatory influences, revealing critical barriers and facilitators to digital adoption. The results aim to provide actionable insights for stakeholders in Brunei's construction industry, contributing to the broader discourse on integrating digital technologies and fostering sustainable development in the context of Industry 4.0. This assessment serves as a foundation for future research and policy formulation, emphasising the importance of a holistic approach to digital transformation in enhancing operational efficiency and sustainability in construction practices.

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1.0 INTRODUCTION

Digital transformation has become a critical driver of productivity, sustainability, and competitiveness within the global construction industry. Recent studies emphasise that successful digital transformation in construction is not merely about technology adoption, but about value creation, systems integration, and organisational alignment (Hatoum & Nassereddine, 2024). For example, Zhong *et al.* identify value-oriented strategies and integrated digital systems as key success factors in construction digitalisation.

Similarly, Asif *et al.* (2024) highlight how digitalisation in the built environment reshapes sustainability outcomes while improving operational efficiency and lifecycle performance. From a regional perspective, Le *et al.* provide evidence that Industry 4.0 adoption across Southeast Asia is strongly influenced by managerial capability, strategic focus, and institutional readiness. Their comparative analysis demonstrates that digital technologies are fundamentally reshaping value chains, redefining work coordination, and transforming traditional construction practices, indicating that digital transformation is not an incremental improvement but a structural shift in how construction value is conceived, delivered, and sustained (Gheda *et al.*, 2025; Perera *et al.*, 2023).

In the context of Industry 4.0, technologies such as Building Information Modelling, the Internet of Things, artificial intelligence, and digital twins are increasingly revolutionising construction practices (Gheda *et al.*, 2025; Olanipekun & Sutrisna, 2021). These technologies enable enhanced project coordination, data-driven decision-making, and improved performance across the entire building lifecycle, giving rise to the concept of "smart construction" characterised by

interconnected digital systems and real-time data exchange (Gheda *et al.*, 2025; Rinchen *et al.*, 2024).

Within the ASEAN region, digital transformation widely recognised as a key enabler of sustainable development, with governments across Southeast Asia embedding digital mandates into national infrastructure and urban development policies to accelerate progress. Singapore, for instance, has made BIM compulsory for public-sector construction projects, with enforcement led by the Building and Construction Authority and supported by comprehensive regulatory frameworks and industry training programmes (Sabri & Kurnia, 2025).

2.0 LITERATURE REVIEW

The literature on digital transformation distinguishes between digitisation, digitalisation, and full digital transformation, where the latter represents a structural shift in business models and decision-making cultures rather than merely the adoption of isolated tools (Owais *et al.*, 2025; Zulu *et al.*, 2023).

This perspective aligns with the concept of Construction 4.0, which integrates advanced technologies such as Building Information Modelling, robotics, automation, the Internet of Things, artificial intelligence, and digital twin technologies to enhance productivity, efficiency, and sustainability in construction workflows (Jelodar, 2025).

Despite the potential of these tools to redefine traditional project management practices, the actual integration of digital technologies into day-to-day project workflows remains inconsistent across contexts (Qadir *et al.*, 2025). Scholarly investigations suggest that this inconsistency is often attributed to a complex interplay of organisational, technological, and

environmental barriers that impede the seamless adoption of innovations such as building information modelling, augmented and virtual reality, laser scanning, robotics, and 3D printing throughout the built asset lifecycle (Olanipekun & Sutrisna, 2021). Consequently, understanding the specific dynamics of these barriers requires a robust theoretical framework that can systematically evaluate the technological, organisational, and environmental dimensions influencing adoption outcomes (Olanipekun & Sutrisna, 2021; Qadir *et al.*, 2025).

The Technology–Organisation–Environment framework, or TOE originally developed by Tornatzky and Fleischer, provides a comprehensive structure for analysing the technological, organisational, and environmental contexts that shape the innovation adoption process within enterprises. This model is particularly relevant for the construction sector, as it allows researchers to assess how technological readiness, organisational capability, and environmental regulation collectively influence efficiency, safety, and sustainability outcomes (Qadir *et al.*, 2025). Specifically, the technological dimension examines the characteristics and compatibility of digital tools, the organisational dimension assesses internal resources, management support, and workforce readiness, whilst the environmental dimension considers regulatory pressures, industry standards, and external stakeholder expectations (Gong *et al.*, 2024; Qadir *et al.*, 2025).

By adopting this multidimensional perspective, the study extends the application of the TOE framework to evaluate the specific drivers and barriers influencing digital adoption within Brunei's construction sector, drawing on established decision-making factors identified in contemporary construction research (Hatoum & Nassereddine, 2024; Qadir *et al.*, 2025).

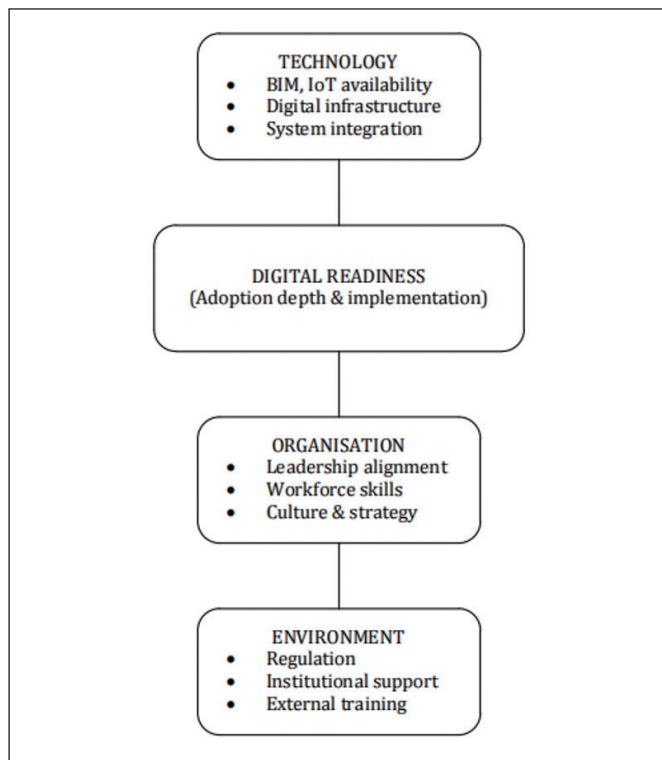


Figure 1: TOE framework to assess digital transformation readiness in Brunei's construction industry

3.0 METHODOLOGY

This study adopts a conceptual and policy-focused research methodology to assess Brunei's readiness for digital transformation in the construction sector. Instead of collecting primary empirical data, the research synthesises existing academic literature, government policy documents, and regional case studies to develop a structured readiness assessment. This approach is appropriate given the exploratory and strategic nature of the study, which focuses on institutional alignment, policy context, and sectoral transformation rather than operational-level data.

Tornatzky and Fleischer's Technology–Organisation–Environment framework serves as the core theoretical foundation. It enables a systematic assessment of digital readiness by examining technological capabilities, organisational preparedness, and the external policy and regulatory environment. This framework is particularly suited to construction-sector evaluations in emerging and small-scale economies such as Brunei. Figure 1 presents the TOE framework adopted in this study to assess digital transformation readiness in Brunei's construction industry. The framework illustrates how technological capabilities, organisational readiness, and environmental conditions jointly influence firms' digital adoption and implementation outcomes.

Table 1: Operationalisation of the TOE framework and evidence sources

TOE Dimension	Indicators Assessed	Evidence Sources Used
Technology	Availability of digital infrastructure (e.g., BIM platforms, IoT readiness); system integration capability; maturity of digital tools across the project lifecycle	Academic literature on Construction 4.0; national policy documents; ASEAN digital construction benchmarks
Organisation	Leadership commitment to digitalisation; existence of digital strategy; workforce digital skills; organisational learning culture; SME capability constraints	Peer-reviewed studies; industry reports; comparative evidence from ASEAN construction sectors
Environment	Regulatory alignment; enforcement mechanisms; institutional coordination; availability of external support (training, advisory services, incentives)	Government policy documents; regional best-practice cases (e.g., Singapore, Malaysia, Vietnam); international construction studies

Table 1 outlines the indicators used to assess digital transformation readiness under the TOE framework and the corresponding evidence sources employed in this study.

Its methodological relevance aligns with previous TOE-based studies that use regional comparisons to contextualise national performance and identify transferable best practices (Amade, 2022; Hatoum & Nassereddine, 2024; Addy *et al.*, 2023; Qadir *et al.*, 2025). Such comparative analysis highlights structural gaps and strategic enablers that may not be visible when examining Brunei in isolation, offering a more nuanced understanding of digital adoption dynamics in similar institutional settings (Maaz *et al.*, 2025; Tjandra *et al.*, 2022).

This approach recognises that digital transformation readiness is shaped by a complex interplay of technological, organisational, and environmental factors, which the TOE framework systematically categorises (Alkhamery *et al.*, 2021; Hatoum & Nassereddine, 2024). Table 1 summarises the key empirical findings across the technological, organisational, and environmental dimensions of the TOE framework, highlighting dominant patterns, constraints, and moderating factors influencing digital readiness among construction firms.

4.0 RESEARCH DESIGN

A secondary-data research design underpins this study. There are no primary data collection such as surveys, interviews, or field observations was conducted. Instead, the analysis draws on a structured review of peer-reviewed publications, national development plans, policy reports, ASEAN documents, and official government portals. This approach ensures a comprehensive evidence base that is both credible and aligned with the study's conceptual objectives.

Key national references include Wawasan Brunei 2035 and the Twelfth National Development Plan, which articulate the country's long-term development priorities and digital ambitions (Jelodar, 2025). These were evaluated alongside scholarly and industry literature (Hatoum & Nassereddine, 2024; Olanipekun & Sutrisna, 2021; Qadir *et al.*, 2025) to determine the extent to which national digitalisation objectives are reflected in construction-sector practices.

Benchmarking against regional counterparts particularly Singapore, Malaysia, and Vietnam provides comparative insights into more advanced digital construction ecosystems. This mirrors methods in previous TOE-informed studies that emphasise systematic qualitative analysis (Addy *et al.*, 2023; Hatoum & Nassereddine, 2024). The research process followed three sequential phases:

1. literature and policy review,
2. regional benchmarking, and
3. synthesis and development of a tailored digital transformation roadmap.

4.1 Selection of Literature and Policy Sources

Sources were obtained from Google Scholar, Scopus-indexed journals, regional repositories, and government portals. Inclusion criteria required publications focused on digital transformation in construction, smart technologies, sustainable infrastructure, or ASEAN development initiatives. Documents were limited to the period 2015–2025. Core policy materials included Wawasan Brunei 2035 and the Twelfth National Development Plan (Jelodar, 2025). Regional benchmarking used Vietnam's BIM implementation roadmap, construction guidelines from the Philippine Department of Public Works and Highways, and digital construction strategies from Singapore and Malaysia. Scholarly works by Olanipekun & Sutrisna (2021), Hatoum & Nassereddine (2024), and Qadir *et al.* (2025) substantiated the theoretical grounding of the TOE framework.

4.2 Regional Benchmarking Framework

Benchmarking was performed across six ASEAN countries—Singapore, Malaysia, Vietnam, Thailand, Indonesia, and the

Philippines—selected for their documented digital construction initiatives and institutional relevance to Brunei (Tjandra *et al.*, 2022). Selection criteria included:

1. publicly available national digital construction policies,
2. differing institutional maturity levels, and
3. alignment with ASEAN digital priorities, such as the ASEAN Smart Cities Network.

This comparative framework positions Brunei's digital readiness against regional peers, identifies transferable best practices, and highlights strategic gaps requiring policy and organisational attention.

4.3 Operationalisation of the TOE Framework

The TOE framework was operationalised across its three foundational dimensions (Gong *et al.*, 2024; Hatoum & Nassereddine, 2024):

Technology: Evaluation of digital infrastructure preparedness, availability of platforms such as BIM and IoT, and system integration extents within construction.

Organisation: Assessment of workforce digital proficiencies, leadership commitment, SME engagement, and training/professional development provisions.

Environment: Scrutiny of regulatory architectures, institutional coordination, policy mechanisms, and industry participation structures for digital transformation.

Indicators per dimension were adapted from ASEAN benchmarks and attuned to Brunei's contextual specificities. This operationalisation coheres with Vision 2035's aspiration for a technology-enabled society and RKN12's prioritisation of innovation-led, sustainable infrastructure. Predominantly qualitative, this methodology furnishes a robust scaffold for prospective empirical inquiries. Its outputs are designed to apprise policymakers, institutions like PUJA, and construction stakeholders with a cogent roadmap integrating academic rigour and regional exemplars (Hatoum & Nassereddine, 2024; Olanipekun & Sutrisna, 2021). The subsequent section presents the findings derived from this systematic analysis, structured according to the technological, organisational, and environmental dimensions of the TOE framework to elucidate the current state of digital readiness in Brunei's construction sector.

From the technological perspective, the study indicates that although foundational digital infrastructure is established, the adoption of advanced tools such as Building Information Modelling and Internet of Things solutions remains nascent and uneven (Qadir *et al.*, 2025; Sajat *et al.*, 2025). Basic software is commonly used for administrative purposes, but more complex, interoperable systems—capable of supporting data-driven decision-making and lifecycle performance management—are not yet widely integrated. This disparity stems from the technological context wherein perceived disruption, implementation risks, and uncertainty regarding benefits inhibit widespread adoption (Tjandra *et al.*, 2022).

Organisational constraints further exacerbate these limitations. Many firms lack top management support, a digitally competent workforce, and the information-sharing cultures needed to sustain complex transformation initiatives (Maaz *et al.*, 2025). The absence of comprehensive training programmes and strategic leadership commitment creates a capability

gap that prevents firms from leveraging digital technologies for productivity and sustainability gains (Gheda *et al.*, 2025). Autocratic and hierarchical organisational cultures contribute to slow adoption, stifling the collaborative innovation necessary for digital integration (Abdulqader *et al.*, 2025). Resistance is especially pronounced among long-tenured employees whose experiential expertise conflicts with new digital systems, following traditional change-cycle patterns where manual proficiency reinforces opposition (Bidhendi *et al.*, 2025). Such resistance arises not from technological naivety but from deeply ingrained institutional norms (Oti-Sarpong *et al.*, 2021).

The environmental dimension further reveals that regulatory frameworks and institutional mechanisms remain critical yet underdeveloped. Although policies encourage digitalisation, current regulations lack enforcement strength and strategic alignment, resulting in fragmented, voluntary adoption that fails to produce systemic transformation (Onososen & Innocent, 2025; Gheda *et al.*, 2025; Hatoum & Nasserredine, 2024). Traditional business models and conservative organisational mindsets reinforce a short-term approach in which firms prioritise immediate project delivery over long-term capability building (Gardner, 2022).

Addressing these entrenched barriers requires interventions that align technological capability with organisational culture and institutional mandates (Naji *et al.*, 2024; Oti-Sarpong *et al.*, 2021). This includes establishing supportive learning environments, valuing the institutional knowledge of older employees, and adopting process-centric approaches that reduce perceptions of displacement (Olanipekun & Sutrisna, 2021; Xames & Topcu, 2025). Effective change management—built on informing, guiding, and involving employees is necessary to mitigate fears of job loss, competence concerns, and perceived loss of control (Valtonen & Holopainen, 2025; Cieslak & Valor, 2024; Noroozi, 2024).

Tailored interventions must also consider demographic differences, as older individuals may struggle to keep pace with rapid technological advancement (Nkomo & Kalisz, 2024). Successful transformation ultimately depends on leadership that supports data-driven decision-making, collaborative problem-solving, and adaptive management (Seppänen *et al.*, 2025). Resistance often stems from directors reluctant to change established practices, even when employees are ready to innovate (Zulu *et al.*, 2023). Establishing urgency and forming strong guiding coalitions are therefore critical for overcoming managerial inertia and driving sector-wide transformation (Nesindande *et al.*, 2024).

5.0 RESULTS

The findings derived from the structured synthesis and regional benchmarking analysis reveal distinct patterns across the technological, organisational, and environmental dimensions of the TOE framework. Overall, organisational factors demonstrate comparatively stronger associations with digital readiness outcomes than technological or environmental conditions. Table 2 synthesises the empirical findings reported in the Results section, highlighting dominant patterns, constraints, and moderating factors influencing digital readiness across Brunei's construction firms.

Table 2: Summary of results by TOE dimension

TOE Dimension	Key Findings	Evidence from Results
Technology	High awareness but uneven implementation of digital tools	BIM and digital systems adoption concentrated among large firms; SMEs face cost barriers
	Financial constraints limit adoption	Software, hardware, and integration costs cited as major barriers
	Digital literacy affects effective usage	Firms with lower workforce digital skills show weaker implementation
Organisation	Strong association between leadership alignment and adoption	Firms with clear digital strategies demonstrate higher uptake
	Firm size moderates readiness	SMEs lack financial, managerial, and time resources
	Workforce skills moderate adoption outcomes	Digital skills strengthen link between technology access and implementation
	Organisational culture influences diffusion	Learning-oriented cultures show higher acceptance of digital tools
Environment	Regulatory pressure alone insufficient	Policy mandates weakly associated with implementation levels
	External support positively influences adoption	Firms with access to training/advisory services report higher uptake
	Environmental effects strongest for SMEs	SMEs depend more on external institutional support

Table 3: Summary of results by TOE dimension

Dimension	Current level	Gap Severity
Technology	Moderate	Medium
Organisation	Low-Moderate	High
Environment	Moderate	Medium

To further illustrate the relative strengths and constraints identified across the TOE dimensions, Table 3 presents a consolidated digital readiness profile of Brunei's construction sector. The visual representation highlights the comparative positioning of technological capability, organisational preparedness, and environmental support mechanisms, thereby clarifying areas where capability gaps are most pronounced.

5.1 Technological Dimension

Within the technological dimension, the results show that while awareness of digital tools such as Building Information Modelling (BIM) and digital permitting system is relatively high, actual implementation remains uneven and is predominantly observed among larger firms. Small and medium-sized enterprises (SMEs) report significantly lower adoption levels, citing financial constraints related to the cost of software, hardware, and system integration as major barriers. These findings are consistent with prior studies that identify cost-related barriers as a key determinant of limited digital uptake among smaller firms (Santos, 2023).

The analysis further indicates that access to digital tools does not necessarily translate into effective usage. Firms reporting lower levels of workforce digital literacy also demonstrate lower levels of implementation, suggesting that technological readiness is associated not only with access to digital infrastructure but also with employees' ability to utilise these tools effectively (Syah *et al.*, 2025; Saka *et al.*, 2021). This pattern is particularly evident among SMEs, where limited technical capability constrains the operationalisation of available technologies.

5.2 Organisational Dimension

The organisational dimension exhibits the strongest association with digital readiness outcomes. The results indicate that leadership competency and strategic alignment are positively associated with higher levels of digital adoption. Firms with clearly articulated digital strategies and leadership commitment to digital initiatives demonstrate significantly greater uptake of digital technologies than firms without such alignment (Johari *et al.*, 2024).

Firm size further moderates organisational readiness, with smaller firms reporting limited access to financial resources, time, and dedicated managerial capacity to support digital initiatives. These constraints are associated with lower adoption levels and reduced implementation scope (Zulu *et al.*, 2023). The findings also show that organisations reporting higher levels of workforce digital skills exhibit stronger relationships between technology availability and actual implementation, indicating that employee capability moderates organisational digital readiness outcomes (Bilal *et al.*, 2024).

In addition, the results suggest that organisational culture is associated with digital adoption levels. Firms characterised by internal support for learning and experimentation report higher levels of acceptance and use of digital tools, whereas firms lacking such support demonstrate slower diffusion of digital practices (Shojaei & Burgess, 2022; Zulu *et al.*, 2023). Organisations without a coherent digital strategy also report difficulties aligning technology investments with business objectives, which is associated with fragmented and limited adoption (Johari *et al.*, 2024).

5.3 Environmental Dimension

Within the environmental dimension, regulatory pressure and institutional support exhibit a weaker direct association with digital adoption than anticipated. The results indicate that policy mandates alone are not significantly associated with higher implementation levels, particularly where enforcement mechanisms and targeted support are limited (Gheda *et al.*, 2025).

However, the study shows that firms with access to external support mechanisms such as industry training programmes and technical advisory services report higher levels of digital implementation than firms without such access. Where external requirements and incentives are unclear or absent, environmental factors are negatively associated with the extent of digital technology use (Masry & Chronéer, 2025). This pattern is most pronounced among SMEs, which rely more heavily on external support to compensate for internal resource limitations.

Overall, the findings indicate that digital readiness in Brunei's construction sector is associated with organisational preparedness, with technological infrastructure and environmental support exercising conditional influence. While awareness of digital tools is widespread, effective implementation is uneven and strongly associated with organisational readiness factors particularly leadership alignment, workforce capability, and firm size. Environmental factors exhibit a conditional influence, with external support mechanisms playing a more significant role than regulatory pressure alone in shaping adoption outcomes.

6.0 DISCUSSION

The findings reinforce the view that digital transformation is fundamentally an organisational change process shaped as much by human and strategic factors as by technological capability. Consistent with prior research, technology alone does not determine transformation success; organisational culture, leadership alignment, and workforce competence play equally critical roles in building digital advantage (Cyfert *et al.*, 2025; Lu, 2024; Mladenova *et al.*, 2025). A supportive and innovation-oriented business culture enables firms to move beyond superficial tool adoption towards meaningful integration of digital practices (Fahmi *et al.*, 2023; Zulu *et al.*, 2023). This cultural alignment is particularly important for SMEs, where resource constraints necessitate strategic clarity and internal cohesion (Tonder *et al.*, 2023).

From a Resource-Based View perspective, internal capabilities especially human capital constitute a central source of competitive advantage in digital transformation (Silva *et al.*, 2025). The digital self-efficacy of leaders and the digital literacy of employees significantly influence transformation outcomes (Costa *et al.*, 2023; Inga-Ávila *et al.*, 2023). Managerial attitude, competence, and the ability to reconfigure resources are decisive in translating digital opportunities into operational performance (Minh *et al.*, 2024; Hu *et al.*, 2024; Mou *et al.*, 2022). Firms that embed digitalisation within organisational strategy and align it with clearly defined roles and objectives are more likely to achieve sustainable outcomes than those treating digital tools as optional add-ons (Mladenova *et al.*, 2025; Colapinto *et al.*, 2021).

Human capital development emerges as a critical enabling mechanism. Employee digital knowledge and platform proficiency directly affect transformation capability and indirectly shape performance outcomes (Thi & Thu, 2025). However, SMEs often encounter skill gaps, resistance to change, and legacy-system dependence, which constrain progress (Seppänen *et al.*, 2025). Addressing these barriers requires targeted skill enhancement, leadership development, and structured change management processes (Bozkuş, 2023; Agustian *et al.*, 2023; Krajčák *et al.*, 2023). Evidence further suggests that employee skills positively moderate the relationship between organisational capabilities and digital transformation outcomes (Hu *et al.*, 2024).

At the ecosystem level, coordinated institutional support is essential. Partnerships with educational institutions and industry associations, along with structured training initiatives, can reduce capability gaps and strengthen relational capital

within the sector (Awonuga *et al.*, 2024; Bhuiyan *et al.*, 2024). Policymakers play a pivotal role by promoting lifelong learning frameworks, incentivising workforce reskilling, and supporting affordable digital infrastructure (Azigi & Baffour, 2024; OECD, 2023; Oikawa *et al.*, 2024). Educational reform and targeted literacy initiatives are particularly important for enhancing SME competitiveness and bridging digital divides (Raji *et al.*, 2024; Přivara *et al.*, 2025; Syah *et al.*, 2025). Regulatory clarity, cybersecurity assurance, and data protection mechanisms further enhance trust and participation in digital systems (Ewim *et al.*, 2024; Tóth *et al.*, 2025).

Regional benchmarking was conducted across six ASEAN construction ecosystems—Singapore, Malaysia, Vietnam, Thailand, Indonesia, and the Philippines—to contextualise Brunei’s digital transformation readiness within comparable institutional environments. The comparison focused on key structural dimensions aligned with the TOE framework, including the presence and enforcement of BIM mandates, SME enablement mechanisms, digital skills ecosystems, and overall sectoral maturity.

Singapore represents the most advanced benchmark, characterised by mandatory BIM implementation, strong regulatory enforcement, and institutionalised training infrastructure. Malaysia and Thailand demonstrate structured yet evolving approaches, with sectoral mandates and expanding digital skills initiatives. Vietnam and Indonesia exhibit roadmap-based or policy-driven frameworks with moderate enforcement and developing institutional support. The Philippines reflects an emerging digital construction ecosystem with framework-level policies and comparatively limited SME support structures.

On the other hand, Brunei’s positioning reflects policy encouragement rather than enforcement-backed mandates, with developing training ecosystems and emerging SME support mechanisms. The comparative assessment highlights that the primary gap lies not in policy intent but in the institutional depth, enforcement consistency, and capability-building infrastructure required to translate strategic objectives into widespread sectoral adoption.

To contextualise the findings within the broader regional landscape, Table 3 compares Brunei’s digital readiness positioning with selected ASEAN construction ecosystems. This benchmarking exercise highlights differences in policy enforcement, SME support structures, and institutional maturity, providing a reference point for identifying transferable practices and strategic gaps.

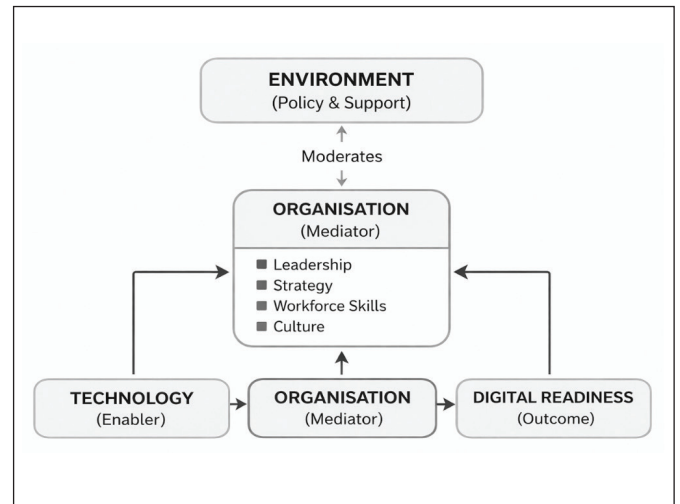


Figure 2: Interaction of TOE dimensions influencing digital transformation outcomes

Building on the empirical patterns and regional comparison, Figure 2 conceptualises the interaction among technological capability, organisational readiness, and environmental conditions, illustrating the mediating role of organisational preparedness in translating digital infrastructure into effective transformation outcomes. The model illustrates the mediating role of organisational readiness in translating digital infrastructure and policy conditions into effective transformation outcomes.

Overall, the findings suggest that sustainable digital transformation in Brunei’s construction sector depends not merely on technological availability, but on the strategic integration of leadership vision, organisational culture, workforce capability, and supportive institutional conditions. Aligning human capital development with long-term strategic planning is therefore central to strengthening sector-wide digital readiness and competitiveness (Awonuga *et al.*, 2024; Budiarti & Firmansyah, 2024; Utomo *et al.*, 2023).

7.0 CONCLUSION

The study assessed digital transformation and sustainability readiness in Brunei’s construction sector using the Technology-Organisation-Environment framework, integrating secondary-data synthesis with regional benchmarking analysis requires the alignment of technological capacity, organisational readiness, and environmental support under the TOE framework.

Table 3: Comparative digital readiness positioning within selected ASEAN construction ecosystems

Country	BIM Mandate	Enforcement Strength	SME Support	Digital Skills Ecosystem	Overall Maturity
Singapore	Mandatory	Strong	Extensive	Institutionalised	High
Malaysia	Sectoral / Partial	Moderate	Moderate	Expanding	Moderate–High
Vietnam	Roadmap-based	Emerging	Moderate	Developing	Moderate
Thailand	Strategic roadmap	Moderate	Developing	Expanding	Moderate
Indonesia	Policy-driven	Moderate	Emerging	Developing	Moderate
Philippines	Framework-based	Emerging	Limited–Moderate	Developing	Moderate–Low
Brunei	Policy encouragement	Limited	Emerging	Developing	Moderate

While digital infrastructure provides a necessary foundation, successful adoption is driven by organisational capabilities and external enablers, particularly for SMEs facing financial and digital literacy constraints (Ammeran & Latip, 2024; Seppänen *et al.*, 2025). Strengthening skills development, leadership commitment, and industry partnerships is therefore essential to accelerate Construction 4.0 adoption and enhance competitiveness (Romero & Mammadov, 2024; Syah *et al.*, 2025).

The findings underscore the importance of stakeholder collaboration, structured training, and phased implementation to support national digital-economy aspirations (Gheda *et al.*, 2025; Supriadi *et al.*, 2023). However, the cross-sectional design limits causal inference. Future research should adopt longitudinal and mixed-method approaches to track digital maturity, assess policy impacts, and refine interventions such as skills assessments, ESG integration, and SME-oriented incentives (Bidhendi *et al.*, 2025; Ghobakhloo *et al.*, 2024; Silva *et al.*, 2025). Synthesising these findings, the analysis demonstrates that digital transformation readiness in Brunei's construction sector is shaped by the interaction of technological capability, organisational preparedness, and environmental support structures. ■

AUTHORS' CONTRIBUTIONS

Lee Tuck Chin	Conceptualisation, research design, methodology development, secondary-data synthesis and regional benchmarking analysis, framework operationalisation, visualisation, drafting of the original manuscript, and revision of the final version.
Sai Keong Chan	Conceptual guidance, methodological supervision, critical review and intellectual revision of the manuscript, and overall academic oversight of the research.

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