Cadernos de Pós-Graduação em Direito Político e Econômico
Published by: Centro de Estudos Acadêmicos Press
ISSN: 1678-2127
Volume 26 *Issue 1,* 2026
Website: https://ceapress.org

Digital Transformation in Higher Education Institutions: An Integrative Review of Technologies, Barriers, Business Model Innovation, and Governance

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Soumission : 27/01/2026 Acceptation : 01/05/2026 Publication : 13/05/2026

Abstract
Digital transformation (DT) has emerged as a strategic imperative for higher education institutions (HEIs), but scholarly work on the topic remains dispersed across pedagogical, technological, and managerial domains. This paper provides an integrative review of four recent contributions: a systematic literature review of DT in HEI management, an intuitionistic fuzzy multi-criteria assessment of DT challenges for business model innovation (BMI), a triangular fuzzy MARCOS-SWOT evaluation of digital maturity and strategy prioritisation, and a qualitative stakeholder study of artificial intelligence (AI)-driven governance in Nigerian universities. Four questions guide the synthesis: which technologies enable DT in HEI management, what barriers constrain implementation, how DT priorities are established and measured, and which critical success factors recur across contexts. The analysis identifies convergence on AI, cloud computing, big data, and the Internet of Things as foundational enablers; on a four-part barrier taxonomy comprising structural elements, management and strategy, implementation, and skills; and on culture and leadership, strategy and planning, human capital, technology and infrastructure, and governance as recurring success factors. It also identifies meaningful divergence. Decision-analytic studies conducted in comparatively resource-rich systems rank cost structures, scalability, and data governance most highly, whereas stakeholder-based evidence from resource-constrained systems foregrounds electricity, connectivity, digital literacy, and equity of access. The paper argues that this

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divergence is not contradictory but reflects a maturity-contingent ordering of priorities, and it proposes an integrated framework linking enabling conditions, transformation levers, and business-model outcomes. Implications are drawn for institutional leaders, policymakers, and researchers, and a research agenda emphasising longitudinal, multi-institution, and implementation-focused designs is set out.
Keywords*:* digital transformation, higher education institutions, business model innovation, digital maturity, artificial intelligence, educational governance

Introduction

Higher education is being reshaped by a cluster of digital technologies whose combined effect extends well beyond the automation of existing routines. Artificial intelligence, big data analytics, cloud computing, and the Internet of Things now underpin data collection, interpretation, and decision-making in ways that alter how universities teach, administer, and compete (Carmo et al., 2025; Klingenberg et al., 2019). The strategic case for adoption is widely accepted: digital technologies are associated with operational efficiency, improved stakeholder experience, business model innovation, and the pursuit of sustainable competitive advantage (Correani et al., 2020; Verhoef et al., 2021). What remains contested is how transformation should be organised inside institutions whose governance is collegial, whose funding is often public, and whose value proposition is only partly commercial.

Higher education institutions (HEIs) occupy an unusual position in this debate. They possess distinctive characteristics that separate them from firms, yet they are not insulated from the pressures that conventional business sectors experience (Kaplan & Haenlein, 2016). Over the past two decades they have gradually and deliberately absorbed managerial practices drawn from private enterprise (Abdelkafi et al., 2018), and scholars have increasingly asked how the business model construct applies to educational organisations (Posselt et al., 2019). The rise of educational technology firms, which deploy sophisticated platforms with greater mobility and flexibility than most incumbent institutions can match, has intensified competitive pressure on HEIs and sharpened the question of whether traditional academic business models remain viable (Carmo et al., 2025; Renz & Hilbig, 2020).

Despite a substantial and growing literature, three gaps persist. First, most studies concentrate on the adoption of particular technologies or on their pedagogical application, and comparatively few address the strategic and managerial dimensions of transformation within institutional management (Carmo et al., 2025). Second, research at the intersection of DT, business model innovation (BMI), and higher education is thin; the literature tends to address two of these three axes at a time (Li et al., 2024). Third, although evaluative models for digital maturity have proliferated, applications in the high-uncertainty, multi-stakeholder environments typical of universities remain limited, and existing models are often descriptive

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rather than prescriptive (Sahin et al., 2026). Alongside these conceptual gaps sits a geographic one: much of the evidence base is drawn from European, North American, and East Asian systems, while the constraints facing institutions in sub-Saharan Africa and comparable settings receive far less attention (Nnaji et al., 2026; Okoye et al., 2023).

This paper responds to those gaps through an integrative review. Rather than adding a further primary study, it synthesises four recent and methodologically distinct contributions, together with the reference bases on which they draw, in order to construct a coherent account of what is known and what remains unsettled. The four anchor studies are: (a) a systematic literature review of DT in HEI management using the Literature Grounded Theory method (Carmo et al., 2025); (b) an intuitionistic fuzzy MEREC-RS-ARAS assessment of DT challenges for BMI in HEIs (Li et al., 2024); (c) a triangular fuzzy MARCOS-SWOT model for evaluating digital maturity and prioritising transformation strategies in universities (Sahin et al., 2026); and (d) a qualitative stakeholder study of AI-driven DT and governance in Nigerian HEIs (Nnaji et al., 2026).

Four research questions organise the synthesis:

RQ1. Which technologies enable digital transformation in the management of higher education institutions, and how do they interrelate?

RQ2. What barriers and challenges constrain implementation, and how can they be classified?

RQ3. How are digital transformation priorities established, weighted, and measured in institutional decision-making?

RQ4. Which critical success factors recur across contexts, and how are they conditioned by institutional and national circumstances?

The remainder of the paper is organised as follows. The next section develops the conceptual background, distinguishing DT from adjacent constructs and situating BMI within the higher education context. The method section describes the review design. Findings are then presented in five subsections corresponding to technologies, barriers, evaluation approaches, critical success factors, and governance and equity. A discussion section proposes an integrated framework and reconciles apparently divergent findings. The paper closes with implications, limitations, and a research agenda.

Conceptual Background

Defining Digital Transformation

There is no settled definition of digital transformation, either as a term or in terms of the scope it covers (Carmo et al., 2025; Wessel et al., 2021). Early formulations treated DT as the deployment of technology to improve business performance (Westerman, 2018). Later work insisted that transformation is a firm-wide process that alters the logic of value creation and capture, rather than a technology project (Verhoef et al., 2021). A unified definition that has

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gained traction describes DT as a process of fundamental change enabled by the innovative use of digital technologies, accompanied by the strategic leverage of key resources and capabilities, with the purpose of radically improving an entity and redefining its value proposition for stakeholders (Gong & Ribiere, 2021). That formulation is useful for higher education because the entity in question may be an organisation, a network, a sector, or society at large, and because it foregrounds the value proposition rather than the technology stack.

Definitional disagreement is not merely semantic. Some scholars treat a narrow technology-enabled change, such as implementing a new enterprise resource planning system, as transformation, while others reserve the term for radical and evolutionary change unfolding over time (Loebbecke & Picot, 2015). Others again frame DT as a strategy, a paradigm, or a process (Berman & Marshall, 2014). Because the construct is used inconsistently, comparisons across studies must be made with care, and claims about maturity or success are only interpretable when the underlying definition is stated.

Digitisation, Digitalisation, and Transformation

A useful distinction separates three stages. Digitisation converts analogue information into digital formats without requiring significant revision of processes or business models (Gobble, 2018). Digitalisation embeds digital technologies into existing operations, improving efficiency without necessarily altering the underlying logic. Digital transformation goes further, redefining organisational processes, strategies, and operating models through the strategic and innovative
incorporation of digital technologies (Bharadwaj et al., 2013; Carmo et al., 2025). In the higher education context the distinction matters because many institutions describe as transformation what is in substance the digitisation of administrative paperwork. DT in HEIs paves the way for a university model characterised by the advanced integration of digital technologies into all institutional activities, requiring the reconfiguration of systems, data, and equipment alongside people and culture (Carmo et al., 2025).

Business Model Innovation in the Higher Education Context

A business model articulates the logic and evidence supporting a value proposition for the customer together with a viable structure of revenues and costs for the organisation delivering that value (Teece, 2010). Business model innovation refers to designed, non-trivial changes to the key elements of that model or to the architecture connecting those elements (Foss & Saebi, 2016). When changes are driven by or embodied in digital technologies, the result is digital BMI (Bican & Brem, 2020). Business model dimensions are not independent; they form configurations, so change in one dimension entails modular change in others (Kulins et al., 2016).

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Applying this construct to HEIs is not straightforward. Universities operate within multi-stakeholder value networks combining public and private actors, with value linked to economic and social development goals as well as to financial return (Li et al., 2024). DT-driven BMI in higher education generates tensions that must be managed rather than resolved (Rof et al., 2020). Notwithstanding a large literature relating business models to commercial sectors, comprehensive research on BMI in higher education remains scarce, and seventeen DT challenges bearing on BMI in HEIs have been identified, spanning capability building, process and structure change, revenue and cost effects, competitive exposure, and communication strategy (Li et al., 2024).

Theoretical Lenses

Three theoretical perspectives recur across the corpus and are used here to organise interpretation. Socio-technical systems theory holds that sustainable innovation occurs when technology, people, and institutional culture co-evolve, and that social and technical subsystems are interdependent (Geels, 2004; Nnaji et al., 2026). Institutional theory explains how organisational norms, governance structures, and legitimacy pressures shape reform, and why digital governance standards must be embedded in national and institutional policy to overcome bureaucratic inertia (Benavides et al., 2020; Van Wijk et al., 2018). Diffusion of innovations theory accounts for the staged spread of innovations through awareness, persuasion, and implementation, and explains why feedback-driven management accelerates institutionalisation of new technologies (Hoicka et al., 2022; Palm, 2022). Taken together, the three lenses suggest that DT outcomes in HEIs are determined less by technology selection than by the alignment of technical capability, institutional rules, and human adoption behaviour. A complementary lens is the dynamic capabilities perspective, which frames DT as an ongoing process of strategic renewal requiring the sensing, seizing, and reconfiguring of resources (Warner & Wager, 2019).

Method

Design

This study adopts an integrative review design. Integrative reviews are appropriate when the objective is to synthesise conceptually and methodologically heterogeneous evidence into a unified account rather than to estimate an effect size. The approach follows the configurative logic described in the integrative review literature (Ermel et al., 2021), in which scientific knowledge is analytically generalised through the synthesis of existing studies, and evidence is decomposed, analysed, and reintegrated to generate new understanding rather than merely catalogued.

Corpus

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The corpus comprises four anchor studies selected for complementarity along three dimensions: methodological approach, disciplinary orientation, and geographic context. Breadth is supplied by a systematic review of thirty-seven primary studies (Carmo et al., 2025). Analytical depth is supplied by multi-criteria decision-making (MCDM) models under uncertainty (Li et al., 2024; Sahin et al., 2026). Contextual depth is supplied by interpretative phenomenological analysis of stakeholder experience in a resource-constrained system (Nnaji et al., 2026). The reference bases of these four studies were then used as a secondary layer, from which supporting sources were drawn where they substantiated, qualified, or contradicted claims made in the anchor studies. Table 1 summarises the anchor corpus.

Table 1
Characteristics of the Four Anchor Studies

Study	Context	Design	Analytic approach	Principal contribution
Carmo et al. (2025)	International; 37 primary studies	Systematic literature review	Literature Grounded Theory; bibliometric, scientometric, and content analysis; meta-synthesis	Taxonomy of 20 technologies, four barrier categories, and a set of critical success factors for HEI management
Li et al., 2024	Six HEIs; expert panel of four decision makers	Multi-criteria decision analysis with case study	Intuitionistic fuzzy MEREC-RS-ARAS with sensitivity and comparative validation	Objective-subjective weighting of 17 DT challenges for business model innovation in HEIs
Sahin et al., 2026	Universities in Turkiye; expert panel of 21	Multi-criteria decision analysis with strategy formulation	Triangular fuzzy numbers with MARCOS ranking; SWOT-derived strategies; 180-scenario robustness check	Prioritisation of eight DT strategies against 18 criteria; framework for digital maturity assessment

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Nnaji et al., 2026	Nigerian HEIs; 21 stakeholders	Qualitative study with documentary analysis	Interpretative phenomenological analysis and thematic analysis	Four dominant governance and capacity issues; AI-STMsPA framework for staff training and appraisal

Analytic Procedure

Analysis proceeded in three stages. In the first, each anchor study was read in full and coded against the four research questions, using a mixed coding scheme comprising a priori codes derived from the research questions and emergent codes identified during reading, following an established open, axial, and selective coding sequence (Ermel et al., 2021). In the second, codes were compared across studies to identify convergence, divergence, and silence. Convergence denotes claims supported by more than one study using different methods; divergence denotes claims that conflict; silence denotes topics addressed by one study and unaddressed by the others. In the third stage, the resulting categories were reorganised into the integrated framework presented in the discussion.

Methodological Limitations

Three limitations should be stated at the outset. First, the corpus is small and purposively selected; it is not exhaustive of the field and does not support claims about the distribution of findings across the whole literature. Second, because the anchor studies use incompatible units of analysis, from ranked criteria weights to interview themes, comparison is interpretive rather than statistical. Third, the review inherits the limitations of its sources, including the single-institution or single-panel designs of the MCDM studies and the restricted geographic coverage of the qualitative study.

Findings

Technologies Enabling Transformation in Institutional Management

Twenty distinct technologies have been identified in the DT literature on HEI management and classified along two axes (Carmo et al., 2025): by data function, into generation and capture, transmission, conditioning and processing, and application (Klingenberg et al., 2019); and by role in the technology stack, into enabling, integration, and application technologies (Gurria, 2017). Table 2 summarises the resulting clusters.

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Table 2

Technology Clusters in the Digital Transformation of HEI Management

Cluster	**Representative technologies**	**Primary function in HEI management**	**Illustrative sources**
Enabling and infrastructural	Cloud computing, Wi-Fi networks, cybersecurity systems, blockchain	Provide the technical substrate on which advanced systems operate; reduce infrastructure cost; support continuity of service	Hashim et al., 2022; Ramachandran et al., 2014
Data generation and capture	Internet of Things, RFID, mobile services, virtual and augmented reality	Capture environmental, behavioural, and academic data in real time; support resource monitoring and personalisation	Haddud et al., 2017; Wang, 2022
Conditioning, storage, and processing	Big data platforms, analytics, institutional data warehouses	Convert dispersed raw data into decision-ready knowledge for managers	Sanchez, 2020; Fernandez et al., 2023
Application	Artificial intelligence, chatbots, virtual assistants, robotic process automation, MOOCs, online learning video, gamification	Deliver services directly to students and staff; automate administrative routines; personalise learning pathways	Mangundu, 2023; Rodriguez-Abitia & Bribiesca-Correa, 2021

Four technologies dominate the literature: the Internet of Things, cloud computing, big data, and artificial intelligence (Carmo et al., 2025). Their prominence suggests a common adoption trajectory in which infrastructural and data-handling capability is established before application-layer systems are deployed. Co-occurrence analysis reinforces this reading: artificial intelligence, cloud computing, analytics, and big data appear most frequently not only individually but in combination, indicating that value is realised through integration rather than through isolated deployments (Carmo et al., 2025).

Cloud computing is repeatedly identified as a driving force in university business models because it lowers infrastructure costs, accelerates the provision of virtual computing resources, and improves institutional mobility and continuity (Hashim et al., 2022). The Internet of Things extends monitoring from classrooms to residences, enabling efficient management of lighting, climate control, and security while generating real-time data that supports the personalisation of teaching (Haddud et al., 2017; Wang, 2022). Artificial intelligence occupies a pivotal position across both academic and administrative domains, supporting chatbots, dropout risk management, performance tracking, predictive resource

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analysis, adaptive learning, and admissions processing (Mangundu, 2023). Big data solutions support the reconfiguration of study programmes, the optimisation of infrastructure, and the efficient allocation of resources and investment (Fernandez et al., 2023). The practical implication is architectural: institutions realise most value when data flows from sensors, analytics platforms, and AI applications are unified within a single cloud-based ecosystem that supports predictive modelling and real-time decision-making (Carmo et al., 2025).

A caveat is warranted. The frequency with which a technology appears in the literature reflects research attention as much as institutional practice. Bibliometric evidence indicates that publication on DT in higher education accelerated from 2017 and again from 2020, a pattern attributable in substantial part to pandemic-era pressure (Abad-Segura et al., 2020; Carmo et al., 2025). Technology prominence in the corpus therefore partly reflects the conditions of a particular period rather than a stable ordering of institutional priorities.

Barriers and Challenges

Barriers to DT in HEI management can be organised into four thematic groups (Carmo et al., 2025), presented in Table 3. The taxonomy is notable because it distinguishes barriers arising from institutional structure from those arising from managerial choice, from implementation practice, and from individual capability, thereby indicating where remedial action should be directed.

Table 3

Four-Part Taxonomy of Barriers to Digital Transformation in HEI Management

Group	Description	Representative manifestations and sources
Structural elements	Foundational conditions required for a transformation vision to be viable	Leadership capacity, digital skills base, technological knowledge, resistance to change, and complexity of systems integration (Aditya et al., 2021; Alenezi, 2021; Alhubaishy & Aljuhani, 2021)
Management and strategy	Managerial, strategic, and educational difficulties in adopting new technologies	High cost and complexity of transformation; risks to profitability, efficiency, privacy, and data security (Alhubaishy & Aljuhani, 2021; Brunetti et al., 2020; Demartini et al., 2020)
Implementation	Difficulties encountered in executing initiatives once approved	Absence of standardisation and automation of services; lack of a detailed implementation roadmap (Fernandez et al., 2023; Gafurov et al., 2020; Hashim et al., 2022; Zaoui &

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Souissi, 2020)

Skills	Competency shortfalls across the academic community	Shortage of digital skills among employees, teachers, and students; inadequate technical support (Mikheev et al., 2021)

Complementary evidence sharpens the picture. Failures in project prioritisation, decentralised decision-making, internal resistance, and limited digital literacy have also been documented (Alenezi, 2021). Other work identifies a lack of alignment in vision, capacity, and commitment, the absence of a clear organisational strategy, competing priorities, limited resources, inadequate leadership, and insufficient organisational agility (Brunetti et al., 2020; McCusker & Babington, 2018). Poorly managed transformation carries downside risk to profitability, data security, and privacy (Alhubaishy & Aljuhani, 2021).

The same question has been approached through a different lens, identifying seventeen DT challenges specific to business model innovation (Li et al., 2024). These include building new digital capabilities, process and structure change with attendant cost and resistance, uncertainty about new offerings arising from changing student preferences, the absence of standardised protocols for managing digital technologies, a culture of constant accessibility, the absence of a fully digital mindset, the need for new partnerships, technical and service limitations on expanding the offering, self-limiting regional focus, user information overload, the lack of a coherent social media strategy under decentralisation, erosion of existing revenue sources, difficulty capturing new ones, exposure to global competition, the emergence of free business models, cost escalation and technological dependence, and the reduction of old cost sources. Under an integrated intuitionistic fuzzy MEREC-RS-ARAS weighting, the reduction of old cost sources carries the highest weight, followed by the free business model, self-limited regional focus, and the absence of an all-digital mentality.

A third perspective is grounded in stakeholder experience (Nnaji et al., 2026). Across twenty-one interviews with administrators, ICT personnel, policymakers, and student leaders, four dominant issues emerged: inadequate digital literacy among staff, weak governance implementation structures, limited readiness for AI adoption, and significant infrastructural deficits. Approximately ninety per cent of participants identified infrastructural limitations, notably unstable electricity, inadequate connectivity, and insufficient funding, as the principal obstacle, while about sixty-seven per cent stressed that ICT policies exist largely on paper because

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leadership does not drive their implementation. Ethical concerns regarding privacy, academic integrity, and equitable access were also prominent, and participants raised concerns about job displacement and regulatory gaps alongside their optimism about efficiency gains.

Read together, the three accounts are compatible but differently weighted. The systematic review and the MCDM study locate the binding constraint in strategy, culture, and cost architecture; the stakeholder study locates it in electricity, connectivity, and basic competence. This divergence is examined in the discussion.

Establishing and Measuring Priorities

A distinct strand of the literature addresses how institutions should decide what to do first. Early digital maturity work was largely descriptive, using classical MCDM techniques such as the analytic hierarchy process and the analytic network process to characterise current states (Durek et al., 2017). Subsequent work introduced fuzzy logic methods, including hesitant fuzzy AHP and hesitant fuzzy TOPSIS, to model the ambiguity of expert judgement more realistically (Buyukozkan & Guler, 2020). More recent contributions combine subjective expert assessment with objective weighting techniques and shift from measurement toward prescription, guiding transformation rather than merely describing it (Kocaoglu & Kirmizi, 2025). Related work has extended maturity assessment to sustainable transformation using interval-valued spherical fuzzy sets (Babacoglu et al., 2025) and to emerging domains such as metaverse adoption (Zhang et al., 2026).

Two of the anchor studies exemplify this development. The first integrates intuitionistic fuzzy sets with the method based on the removal effects of criteria (MEREC) for objective weighting, rank sum for subjective weighting, and additive ratio assessment (ARAS) for alternative ranking (Li et al., 2024). The combined weighting scheme is deliberate: MEREC supplies data-derived weights, rank sum incorporates expert priority, and a precision parameter allows analysts to vary the balance between them. Sensitivity analysis across values of that parameter left the top-ranked institution unchanged and the bottom-ranked institution unchanged, and comparative testing against intuitionistic fuzzy TOPSIS and WASPAS produced consistent rankings, supporting the stability of the approach.

The second combines triangular fuzzy numbers with the MARCOS method and uses SWOT analysis to generate the strategy set that is then ranked (Sahin et al., 2026). The eighteen criteria span financial viability, infrastructure compatibility, human resources and training, time management, impact, risk management, sustainability, stakeholder support, legal compliance, student experience, environmental impact, innovation and competitive advantage, scalability, data management and analytics, digital collaboration, social impact, change management, and performance monitoring. Data management and analytics emerged as the most influential criterion, followed by scalability, innovation and competitive advantage, and

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environmental impact; technological infrastructure compatibility and financial viability ranked lowest, which the authors interpret as reflecting their status as prerequisites rather than differentiators. Among strategies, developing and scaling online and hybrid learning platforms ranked first, followed by infrastructure support and device provision to reduce digital inequality, and awareness activities to reduce internal resistance. Robustness was tested across 180 scenarios in which criterion weights were progressively reduced and redistributed, with a similarity coefficient of 0.923 between scenario and original rankings, and comparative analysis against fuzzy MABAC, EDAS, TOPSIS, and MOORA produced consistent top and bottom placements.

Three observations follow. First, both studies conclude that a hybrid objective-subjective weighting produces more defensible results than either alone, a conclusion consistent with the wider methodological literature (Banhidi & Dobos, 2025). Second, both find that infrastructure ranks low precisely because it is treated as a baseline condition, which implies that criterion rankings encode assumptions about the maturity of the setting in which they are elicited. Third, and importantly for practice, the value of these models lies less in the numerical ranking than in the structured deliberation they impose: the elicitation, Delphi-style consensus rounds, and explicit criteria make institutional priorities discussable and auditable.

Alongside prioritisation sits measurement. The dimensions used in existing HEI digital transformation models vary considerably, but capacity building, planning and strategy, governance and finance, and digital and organisational culture appear in most models (Carmo et al., 2025). Available models also tend to be superficial, offering limited detail on the methods and tools required at each stage, and the literature does not yet provide a comprehensive account of implementation, which remains the most tangible phase of transformation (Zaoui & Souissi, 2020).

Critical Success Factors

Eight critical success factor domains recur across the reviewed literature: culture and leadership, strategy and planning, management and processes, technology and infrastructure, human capital, partnerships and collaboration, sustainability, and user experience (Carmo et al., 2025). Table 4 sets out representative practices within each domain. The domains are interdependent and are effective only when integrated holistically into institutional strategic plans rather than pursued as separate workstreams.

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Table 4

Critical Success Factor Domains and Representative Practices

Domain	Representative practices	Supporting sources
Culture and leadership	Create openness to change and experimentation; develop leaders committed to transformation; maintain transparent communication and stakeholder engagement	Ivancic et al., 2019; Msila, 2022
Strategy and planning	Define clear objectives; build a comprehensive plan with goals, deadlines, and allocated resources; monitor progress through performance indicators	Kuzu, 2020; Johan et al., 2019
Management and processes	Implement change management to overcome resistance; develop optimised and automated administrative workflows; adopt agile methods	Fernandez et al., 2023; Majdalawieh & Khan, 2022
Technology and infrastructure	Invest in robust and scalable infrastructure; adopt innovative solutions for teaching and management; ensure information security and data protection	Hashim et al., 2022; Maltese, 2018
Human capital	Equip the academic community with digital skills; promote continuous professional development; attract and retain digital talent	King et al., 2015; Mikheev et al., 2021
Partnerships and collaboration	Establish partnerships with other institutions, businesses, and relevant organisations; collaborate on research and innovation; share resources and best practice	Brunetti et al., 2020; Sahin et al., 2026
Sustainability	Integrate sustainable practices to minimise environmental impact; optimise resource consumption; raise sustainability awareness	Trevisan et al., 2024; Barnett, 2018

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User experience	Develop accessible and usable digital solutions; prioritise user experience at every stage; collect feedback and test iteratively	Rodriguez-Abitia & Bribiesca-Correa, 2021; Alenezi, 2021

Leadership carries particular weight. It is responsible for establishing a shared understanding of transformation objectives and for fostering alignment and support among staff (Ivancic et al., 2019). Both internal enablers, such as organisational structure, skills development, and cultural change, and external enablers, such as collaborative partnerships, are necessary; a transformation initiative cannot operate in isolation from the wider organisation. Systematic review evidence on digital leadership maturity in higher education reaches a similar conclusion, identifying leadership as an underdeveloped research area relative to its practical importance (Jameson et al., 2022).

Human capital is the second domain on which the corpus converges most strongly. Empirical work confirms a significant skills gap in AI integration affecting both students and faculty, with faculty adoption remaining low and often attributable to insufficient training and the absence of structured support for curriculum adaptation (Walter, 2024). Systematic reviews note that most implementation effort focuses on students, with comparatively little attention to equipping instructors and managers (Bond et al., 2024; Crompton & Burke, 2023). Digital literacy also mediates technology acceptance among administrative staff, which suggests that training is not merely a downstream implementation task but a precondition for adoption (Kabakus et al., 2023).

Governance, Equity, and Context Dependence

The fourth finding concerns the conditioning effect of institutional and national context. Digital transformation in HEIs is not an isolated process but the outcome of dynamic interaction among technological, organisational, social, economic, environmental, and cultural dimensions (Carmo et al., 2025; Maltese, 2018). Economically, transformation is associated with more profitable operating models and lower information exchange costs; socially, it reshapes the student lifecycle and the format of education; environmentally, it is linked to the adoption of cleaner technologies; culturally, it emphasises connected and adaptive knowledge and the role of networks in academic life (Perez Gama et al., 2018; Rodriguez-Abitia & Bribiesca-Correa, 2021).

How sharply these dimensions can be reordered by context is demonstrated in the Nigerian setting (Nnaji et al., 2026), where digital illiteracy among faculty and administrative staff complicates the

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adoption of tools for governance, research, and teaching; ICT-based initiatives have been fragmented and lack a systematic approach to building digital competence; and structured AI-enabled training and digital appraisal mechanisms are largely absent, producing inconsistent adoption and widening the internal digital divide. Long-standing barriers documented in the Nigerian literature include irregular energy supply, poor connectivity, limited financial capacity, insufficient expert skills, managerial and technical inflexibility, and weak regulatory support (Eze et al., 2013). The urban-rural digital divide compounds educational inequality, with urban students enjoying greater access to e-learning tools (Kundu, 2019).

In response, an AI-Driven Staff Training Modules and Performance Appraisal framework has been proposed (Nnaji et al., 2026), combining AI-supported training to raise digital literacy and ICT proficiency, automated and data-driven performance appraisal to support merit-based promotion, AI-assisted administration to stabilise academic calendars and resource allocation, digitalised recruitment and promotion to reduce patronage, and the integration of AI into curriculum development. A Higher Education Governance Innovation Pathway is also proposed, describing the movement from manual governance through a crisis synthesis stage, in which conflict challenges established practice but actors are not yet ready to adapt, through a lag stage, to a critical learning stage characterised by trial, error, and the construction of operational consistency. The framework is explicitly linked to Sustainable Development Goals 4, 8, 9, and 16.

Ethical governance recurs as a cross-cutting requirement. Institutions must establish frameworks to hold algorithmic systems accountable, mitigate bias, and protect user privacy, in line with the emphasis on transparency, accountability, and fairness in the wider ethics literature (Airaj, 2024; Azman & Tumkaya, 2025). International guidance reinforces the importance of inclusivity, human rights, and ethical standards in AI adoption (Abulibdeh et al., 2024). The equity dimension is not incidental: when technology is not equally accessible, learning disparities widen, and platform development alone cannot deliver equitable digital education without complementary policies securing physical access to infrastructure for disadvantaged groups (Sahin et al., 2026).

Discussion

An Integrated Framework

The findings support a three-layer framework in which enabling conditions, transformation levers, and business-model outcomes are arranged in a sequence of dependence rather than a hierarchy of importance.

The first layer comprises enabling conditions: reliable power and connectivity, baseline digital literacy, financial capacity, and legal and regulatory clarity. These conditions are not differentiators. Where they are met, they disappear from institutional priority rankings, which

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explains why financial viability and infrastructure compatibility ranked lowest among eighteen criteria in the Turkish setting (Sahin et al., 2026). Where they are not met, they dominate everything else, which explains why ninety per cent of Nigerian stakeholders named infrastructure as the principal barrier (Nnaji et al., 2026). The apparent contradiction between these two findings dissolves once enabling conditions are recognised as necessary but not sufficient.

The second layer comprises transformation levers: leadership and culture, strategy and planning, human capital development, data governance and analytics capability, and process redesign. These are the variables over which institutional management has direct discretion and on which the corpus converges most strongly. Data management and analytics ranked first among criteria in the fuzzy MARCOS-SWOT assessment (Sahin et al., 2026); capacity building, planning and strategy, governance and finance, and digital and organisational culture recurred across most maturity models reviewed (Carmo et al., 2025); and digital literacy and governance implementation were the first two themes to emerge in the Nigerian stakeholder study (Nnaji et al., 2026). The convergence across three quite different methods is the strongest single result of this review.

The third layer comprises business-model outcomes: revenue structure, cost structure, value proposition, delivery channels, partnerships, and competitive position. This is the layer addressed directly by the BMI challenge assessment (Li et al., 2024), and it is the layer most often omitted from technology-centred studies. The finding that the reduction of old cost sources and the emergence of free business models carry the highest weights among seventeen challenges is significant because both are economic rather than technical, and because both operate on the institution from outside. A university may execute the second layer competently and still find its business model undermined by competitors whose cost structures differ fundamentally.

Reconciling Divergent Priorities

The corpus contains three substantive divergences worth examining rather than smoothing over.

The first is the ordering of infrastructure. As set out above, this is best understood as maturity-contingent rather than contradictory. A practical corollary is that maturity models developed in one national system should not be transplanted without recalibration, a point acknowledged in the source study itself, which notes that generalisability depends on the composition of the expert panel and the institutional context in which criteria are defined (Sahin et al., 2026).

The second concerns the role of technology relative to strategy. One tradition holds that transformation depends on the digital strategy adopted by business leaders rather than on technology implementation (Kane et al., 2015); another treats the deployment of technologies

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as the definitional core (Westerman, 2018). The evidence reviewed here favours the former without dismissing the latter. Technology adoption does not guarantee transformative outcomes (Nnaji et al., 2026), yet the absence of an integrated technical architecture demonstrably limits what strategy can achieve (Carmo et al., 2025). The productive formulation is that strategy determines whether technology produces transformation, while technology determines the ceiling on what strategy can deliver.

The third concerns AI specifically. Stakeholders in the Nigerian study were divided: roughly fifty-seven per cent expressed optimism about AI for teaching, administration, and research, while others raised concerns about job displacement and institutional capacity to sustain AI systems (Nnaji et al., 2026). This division is not a measurement artefact; it reflects a genuine tension between innovation and institutional preparedness, and it argues for phased adoption policies that pair capability building with workforce protection. The same tension appears in the ethics literature, which converges on the view that responsible transformation requires ongoing ethical vigilance rather than one-time compliance (Nadim & Di Fuccio, 2025).

Theoretical Contribution

The synthesis makes three theoretical contributions. First, it extends the business model innovation literature into a sector where the construct has been applied sparingly, showing that the DT challenges most salient for HEI business models are economic and competitive rather than technical (Li et al., 2024; Posselt et al., 2019). Second, it demonstrates the complementarity of decision-analytic and interpretive methods: MCDM approaches make trade-offs explicit and auditable but presuppose that enabling conditions are met, while phenomenological approaches surface the conditions that MCDM studies hold constant. Third, it supports the socio-technical claim that outcomes depend on the co-evolution of technology, people, and institutional culture, since every anchor study independently identified human and cultural factors as more binding than technical ones once basic infrastructure was in place (Geels, 2004; Nnaji et al., 2026).

Implications

For Institutional Leaders

Five implications follow for university management. First, audit enabling conditions before setting strategic priorities; ranking exercises conducted on an unstable base will produce misleading results. Second, treat data governance and analytical capability as the central investment rather than as a supporting function, given its position as the highest-weighted criterion in the reviewed evaluation model (Sahin et al., 2026). Third, institutionalise professional development as a continuous, inclusive, and modular process differentiated by

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existing levels of digital literacy, rather than as episodic training (Walter, 2024). Fourth, embed change management and internal communication in the transformation programme from the outset, since resistance is consistently identified as a structural barrier rather than a residual friction (Aditya et al., 2021). Fifth, use the business model as an analytical instrument, benchmarking against new entrants, incumbents, and platform firms in order to infer the model the institution intends to occupy (Li et al., 2024).

For Policymakers

For system-level actors, four implications are indicated. Policy should support online and hybrid learning infrastructure at national scale; provide financial and technical incentives that reduce digital inequality, including device provision and connectivity subsidy for disadvantaged students; make cybersecurity and data protection part of accreditation and quality assurance; and encourage joint procurement, shared infrastructure, and public-private consortia that reduce transformation cost and accelerate knowledge transfer (Sahin et al., 2026). In public systems, governments hold formal stakeholder positions within institutional governing bodies and can therefore act directly as agents of change (Li et al., 2024). Where digital literacy is the binding constraint, certification frameworks recognising digital competence as a core professional requirement offer a low-cost lever (Nnaji et al., 2026).

For Researchers

The corpus points to a clear agenda. Implementation remains the least documented phase of transformation despite being the most tangible (Zaoui & Souissi, 2020). Longitudinal designs are needed to establish how enabling technologies affect efficiency, innovation, and competitiveness over time (Carmo et al., 2025). Multi-institution and cross-national comparison would test whether the maturity-contingent ordering proposed here holds. Methodologically, alternative approaches including structural equation modelling could complement MCDM by testing relationships among identified challenges rather than only ranking them (Li et al., 2024), and further work might integrate strategic factors such as SWOT categories directly into criterion weighting rather than treating strategy formulation and evaluation as sequential stages (Sahin et al., 2026).

Limitations

This review is subject to several limitations. The corpus is small and purposively assembled, so the synthesis should be read as an analytical rather than a statistical generalisation. The anchor studies themselves carry limitations that propagate into the synthesis: the MCDM studies rely on expert panels whose composition shapes criterion weights and whose judgements introduce a degree of subjectivity even when fuzzy representation reduces individual bias; the qualitative

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ISSN: 1678-2127
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study covers a limited geographic range within a single national system; and the systematic review depends on specified databases and may under-represent lesser-cited but relevant work. In addition, the pace at which digital technologies evolve imposes a temporal constraint, since the landscape can shift materially between data collection and publication. Finally, because the anchor studies define digital transformation differently, some apparent agreement may be terminological rather than substantive.

Conclusion

Digital transformation in higher education has moved from a technology agenda to a governance agenda. The evidence synthesised here indicates that artificial intelligence, cloud computing, big data, and the Internet of Things constitute the enabling technology base; that barriers cluster into structural, managerial, implementation, and skills categories; that priority setting is best conducted through hybrid objective-subjective evaluation that makes trade-offs explicit; and that culture and leadership, strategy and planning, human capital, technology and infrastructure, and data governance recur as critical success factors across methods and contexts.

The review also shows that the ordering of these priorities is contingent on institutional maturity. Where power, connectivity, funding, and basic competence are secure, differentiation arises from data governance, scalability, and strategic positioning; where they are not, those enabling conditions dominate and no amount of strategic sophistication compensates for their absence. Recognising this contingency reconciles findings that otherwise appear to conflict and cautions against transplanting maturity models across systems without recalibration.

For institutions, the practical message is that transformation is a strategic rather than a technical undertaking, requiring the co-evolution of infrastructure, capability, culture, and business model. For the field, the most pressing need is detailed, longitudinal, implementation-focused research that documents how institutions actually move from intention to operation, and that specifies the methods and tools appropriate to each stage. Until that evidence exists, the roadmap for digital transformation in higher education management will remain, as the literature currently indicates, incompletely drawn.

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