

Digital Transformation and Strategic Goals Effects on Performance in Higher Education Institutions in Zambia

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Abstract

Higher Education Institutions (HEIs) in Zambia have made significant IT investments aligned with global digital transformation agendas, yet measurable returns and documented strategic alignment remain largely absent. This study investigates how digital transformation investments influence operational efficiency in resource-constrained environments, focusing on Zambian HEIs. It integrates the Strategic Alignment Model (SAM), Strategic Alignment Maturity Model (SAMM), Technology-Organisation-Environment (TOE) framework, and the Lean Iceberg framework to examine relationships among digital transformation, strategic goals, and operational efficiency. Strategic alignment was tested as a moderating variable, with power instability as a contextual moderator. Data were collected via a quantitative survey of 391 respondents across four HEIs and analysed using structural equation modelling (SEM) in Posit Cloud RStudio. Findings reveal that digital transformation does not directly increase operational efficiency. Rather, it influences efficiency indirectly by first strengthening the clarity of strategic goals, which subsequently drives efficiency improvements. Power instability emerged as a significant moderator of strategic goals, though its effect on the digital transformation–efficiency relationship was insignificant. Moderation and mediation effects of strategic alignment were also rejected. Overall, the study finds that in resource-constrained contexts, digital transformation follows a 'J-Curve' trajectory — benefits are delayed until institutions establish strong strategic goals and mitigate environmental barriers such as power instability. The findings offer a context-specific model of strategic alignment, providing HEI leaders with practical guidance for prioritising strategic planning and building resilience to maximise digital transformation outcomes.

Keywords: digital transformation, strategic alignment, strategic goals, power instability, higher education, structural equation modelling

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Introduction

Strategic alignment refers to the degree of congruence between business objectives, IT goals, and organisational structure, as outlined by Henderson and Venkatraman (1992). Njanka et al. (2021) define IT alignment as the extent to which business and IT functions are interdependent and share knowledge to achieve common objectives. Achieving strategic alignment requires that all organisational components, including goals, operations, departments, teams, processes, and systems, are directed toward a unified vision (Businessmap, 2025). Empirical research demonstrates that aligning IT and organisational goals is critical for the success of IT investments (Henderson & Venkatraman, 1993). The alignment of information systems has become an increasingly important area of planning and research, particularly for educational institutions that depend on technology to enhance productivity and competitiveness (Al-Twijri et al., 2024). The global value of information systems continues to rise (Laudon & Laudon, 2022).

Digital transformation is now central for HEIs globally. It is changing teaching, research, and administration (Guri-Rosenblit, 2018; McCarthy et al., 2023; Alenezi, 2021). Institutions are adding new technologies and updating their practices, business models, and processes. This shift goes beyond just adopting new technology. Research shows that digital transformation also means understanding stakeholder needs and aligning services with education and research goals (Eden et al., 2019). Thus, educational institutions worldwide are using digital tools to improve student learning and institutional results.

HEIs are rapidly adapting to global digital transformation, which has heightened the significance of information and communication technologies (ICTs) in higher education (Akour & Alenezi, 2022; Chaush & Dika, 2013). Institutional progress varies, and stakeholders anticipate tangible benefits from information systems investments, expecting these systems to enhance institutional performance (Chaush & Dika, 2013). However, the realisation of these benefits is often uncertain, despite the widely held view that aligning IT with institutional strategy is essential for deriving value from IT investments (Henderson & Venkatraman, 1999; Njanka et al.; Palacios, 2021; Ori & Szabó, 2023; Gkrimpizi et al., 2023). In some cases, HEIs implement new IT systems merely to replicate existing manual processes, a phenomenon Michael Hammer described as “paving cow paths” (Hammer, 1990).

While numerous studies have examined strategic alignment and digital transformation, the direct relationship between them remains insufficiently established, particularly because most research is conducted in contexts with robust infrastructure and abundant resources. Existing models emphasise the importance of strong coordination among business strategy, IT strategy, IT infrastructure, and key organisational processes (Dairo et al., 2021; Ali, 2019; Coltman et al., 2015). In contrast, HEIs in Zambia encounter significant challenges, including limited funding, underdeveloped IT systems, and a shortage of skilled personnel to effectively manage digital tools (Kalunga & Nsofu, 2022). Across sub-Saharan Africa, HEIs also face inadequate infrastructure, persistent funding constraints, and complex stakeholder environments (World Bank, 2024; Chigada & Madzinga, 2019). Zambia specifically contends with frequent power outages lasting up to 12 hours daily, low income levels, and slow progress in expanding educational access (Bwalya & Kunda-Wamuwi, 2019; Ministry of Education, 2023). Staff

resistance to change further impedes the success of digital initiatives (Chishimba, 2019). These contextual factors position Zambia as a pertinent setting for investigating the interplay among strategic goals, alignment, and digital transformation, and their collective impact on HEI efficiency. This analysis is particularly timely given the prevalence of power disruptions and infrastructure failures that threaten the success of digital projects.

In this study, three fundamental research questions have been raised, building directly on these contextual complexities:

- 1) What is the current state of digital transformation maturity in Zambian HEIs?
- 2) How effectively do information systems in HEIs support strategic objectives in resource-constrained environments?
- 3) How do environmental factors, particularly power instability, moderate the relationship between the institutional strategic goals and operational excellence and between digital transformation and operational excellence?

Empirical evidence shows a strong link between strategic alignment and organisational performance, though its benefits depend on context (Haraisa, 2022). Smith and Thomas (2020) find that alignment is most evident during periods of strategy uncertainty. Conversely, they state that when strategies are fixed and inflexible, alignment could obstruct innovation and adaptability. In sub-Saharan Africa, environmental instability has a greater impact (Juju et al., 2020) and warrants special attention. The study suggests that in unstable environments, alignment alone is not enough to boost performance; a solid infrastructure is needed to manage instability. This view helps expand strategic alignment models by showing how contextual elements, such as the environment, shape organisational development.

Literature Review

The Evolution of Strategic Alignment

The work of Henderson and Venkatraman (1993) highlighted the importance of strategic alignment, which entails aligning technology in line with business objectives. Their Strategic Alignment Model (SAM) posits that organisational performance depends on the alignment of the four domains that conceptualise the model: business strategy, information technology strategy, organisational infrastructure, and IT infrastructure. The subject of business-IT alignment has been studied in detail in the literature, and numerous reviews have examined its various aspects (BITA) (Ori & Szabó, 2023; Coltman et al., 2015). SAM opened the door to a revolutionary perspective, viewing organisations not solely as possessing a good strategy or advanced technology in isolation, but as organisations that should be viewed in terms of how well the four dimensions of the model fit together.

Other studies (Ali, 2019; Dairo et al., 2021; Njanka et. al, 2021) have established this core idea and found a positive correlation between strategic alignment and superior organisational performance, including profitability, market share, and competitive agility. The Strategic Alignment Maturity Model (SAMM) extends the strategic alignment model by conceptualising alignment as a developmental process that encompasses six maturity levels. Ilmudeen (2013) identified six maturity domains that gauge an organisation's maturity: communication, competence, governance, partnership, scope and architecture, and skills.

Although the models above are persuasive, it is worth noting that a significant portion of their findings has been obtained from the developed world, where environmental conditions, such as infrastructure stability and resource abundance, differ. It is for this reason that some scholars have called for contextualised adaptations of the strategic alignment theory to meet distinct environments, such as sub-Saharan Africa, where scarce resources and limited infrastructure may significantly alter the alignment dynamics (Chege, 2024). This study responds to this call by examining strategic alignment in the specific context of Zambian higher education. Earlier studies that applied the strategic alignment models have indicated that universities with higher alignment maturity have reported better operational outcomes (Bogdanova & Parashkevova, 2016). It is this call for extended studies that our study addresses by investigating how strategic alignment and digital transformation are conceived, practised, and challenged within the unique and demanding context of Zambian higher education.

Digital Transformation in HEIs

Digital transformation in higher education encompasses embedding digital technologies across all aspects of institutional operations, changing how institutions deliver value to their stakeholders (Alenezi, 2021). This transformation outspreads mere technology adoption to include process reengineering, cultural change, and strategic realignment. The conception of IT's role as a business support function has undergone a fundamental shift in recent years, with extensive research revealing the strategic importance of IT in business (Palacios, 2025; Laudon & Laudon, 2022). Additionally, the role of IT in higher education has undergone substantial change, with some institutions now utilising technology to support teaching, learning, research, and administrative tasks (Al-Twijri et al., 2024).

Despite this strategic role of IT, research in Sub-Saharan African higher education still discloses multiple unique contextual factors that influence digital transformation success, such as infrastructure reliability, particularly power and internet connectivity, as issues in the digital success initiatives (World Bank, 2024; Chimbaka, 2024; Phiri, 2019). There are indications that faculty digital literacy and institutional change management capacity also serve vital functions in defining transformation outcomes (Deja, 2021).

This study further incorporates the Technology-Organisation-Environment (TOE) framework to extend understanding of digital transformation in developing countries, where resource constraints are predominant. The model is useful for adopting the environmental dimension to understand contextual moderation (Baker, 2012), as was the case in this study. This addresses the environmental dimension gap not covered by the other study frameworks, such as SAM and SAMM.

Power Instability: The Environmental Moderator

In the Zambian context, as in other developing nations, power instability (load shedding) is a serious impediment to the digital transformation process, as some communities go without power for over 12 hours (Bwalya & Kunda-Wamuwi, 2019). The severity of both scheduled and unscheduled load shedding, as documented by the Energy Regulation Board (2024), directly weakens the fundamental foundations of digital transformation. Where these exist,

applications such as cloud-based learning management systems, digital admissions portals, or virtual research labs are rendered unusable without a steady electrical power supply.

This study positions power instability as a critical environmental moderator or mediator, rather than merely a background condition. It is posited that power instability dynamically alters the strength and direction of the relationship between digital transformation and operational efficiency in HEIs.

Theoretical Framework

An integrated theoretical framework was adopted to examine strategic alignment and digital transformation in Zambian HEIs. No single theoretical model fully captures the complex relationships among technology, strategic alignment, and external environmental pressures. Accordingly, this study employs a framework that synthesises four complementary models to provide a comprehensive analysis of strategic alignment and digital transformation within Zambian HEIs.

A theoretical framework describes the theories expressed by experts in the field into which a study is conducted. Simply put, the theoretical framework is a structure that summarises concepts and theories developed from earlier studies and provides the researcher with a theoretical background. Swanson (2018) describes a theoretical framework as “the structure that can hold or support a theory of a research study”, thus a theoretical framework increases the internal validity of quantitative data. Selecting a research framework helps define the assumptions that inform the study approach in the chapters to follow, such as methodology and data analysis (Vinz, 2023). Furthermore, a theoretical framework serves as the foundation for any research study, guiding the exploration of concepts, relationships, and variables that influence the research problem (Salawu et al., 2023).

Digital transformation in Zambian HEIs requires a multi-layered, holistic methodology that combines strategic, technological, and organisational capabilities to achieve sustainable performance. This view of a comprehensive framework is supported by other authors such as Nugroho et al. (2025 and Mohamed Hashim et al. (2022). Based on this understanding, the models used in the theoretical framework are briefly described below:

1. The Strategic Alignment Model (SAM): This model, as espoused by Henderson and Venkatraman (1993), formed the basis of the study and provided the direction for the study. The model provided direction on the fundamental need for congruence between organisations' strategic intent and technological competencies (Ali, 2019). Further, the model postulates that peak performance is not achieved by excellence in isolation but through the functional fit between four key domains: business strategy, IT strategy, organisational infrastructure, and IT infrastructure. Conversely, strategic misalignment leads to costly inefficiencies: underutilised software, redundant processes, and frustrated stakeholders, a perilous scenario for institutions operating with limited resources (Ori & Szabó, 2023).
2. The Strategic Alignment Maturity Model (SAMM): While SAM identifies the components of alignment, SAMM, developed by Luftman (2000), evaluates the quality of alignment execution. SAMM serves as a diagnostic framework for assessing the maturity and depth of the IT-business relationship. Application of SAMM enables the assessment of both the presence

and the maturity, robustness, and resilience of alignment to internal and external shocks (Luftman, 2000). The model's strength lies in its comprehensive approach, which is based on six validated critical factors for measuring strategic alignment: communication, partnership, governance, competency, architecture, and skills. These factors facilitate the diagnosis of both the existence and the nuanced maturity levels of alignment within an organisation (Ilmudeen, 2013; Njanka et al., 2021).

3. The TOE Framework delivers the crucial contextual map for our study by inducing three-pronged contexts from the model. The Technological Context focuses on the existing internal and external technologies available to the institution (e.g., the state of the ICT infrastructure and cloud services). The Organisational Context is focused on the institution's internal characteristics, including its size, scope, managerial structure, and human capital, while the Environmental Context delves into the external arena in which the institution operates, including government regulations, competitive pressures, and crucially for this study, the pervasive challenge of load shedding and infrastructural instability. TOE ensures our study is grounded in the realities of the Zambian context, where environmental factors can powerfully enable or constrain even the most strategically solid plans. This model challenges us to dive deeper to identify and strengthen the hidden, foundational capabilities that enable sustainable performance. The multi-layered models, such as SAM (strategic fit), SAMM (maturity measurement), TOE (contextual constraints), and the Lean Iceberg Model, ensure we build a foundation strong enough to withstand the pressures of steering digital transformation (Kaira & Phiri, 2022), specifically drawing attention to the importance of knowledge management systems in Zambian HEIs.

Methodology

Research Design and Philosophical Approach

The research adopted a quantitative, cross-sectional design, with a questionnaire administered to 498 respondents. The quantitative method was suitable for this study because it provided a means to test the theoretical relationships proposed (Creswell, 2018).

Population and Sampling

As of 2023, Zambia had 60 universities (10 public and 50 private) (HEA, 2024), all of which constituted the study population. Probability Proportional to Size (PPS) sampling was applied to select four HEIs for the study (three public and one private). The selection of four institutions was deemed sufficient, as including additional universities was unlikely to yield further relevant data. A total of 498 respondents—including students, academic staff, IT specialists, and senior administrators—were invited to complete the online questionnaire. This technique helped collect diverse perspectives on institutional digital transformation and strategic alignment processes.

Data Collection Instrument

This study used a systematic survey instrument to collect data. The questionnaire had five sections (four constructs and general demographics) using a five-point Likert scale. The sections covered demographics (A1), digital transformation (B1-B4), operational efficiency

(C1-C4), strategic goals constructs (D1-D5) and power instability measures (E1-E4). The instrument was piloted with 50 respondents and refined based on feedback.

Data Collection Procedure

Data collection occurred over four months using the online survey platform (Google Forms). This was achieved by sharing the link with prospective respondents using probability sampling. Respondents were given the opportunity to consent to participate in the study, and those who consented completed the questionnaire. Ethical approval to undertake the study was obtained from appropriate institutional management, and all respondents remained anonymous.

Data Analysis Approach

Data analysis followed a systematic approach, with preliminary steps including checking for missing data, performing frequency and descriptive statistics, and testing for normality.

Reliability Analysis: Cronbach's alpha for internal consistency of the data was also computed using both the Statistical Package for the Social Sciences (IBM SPSS Statistics, Version 28) and the RStudio (Posit Cloud) lavaan package.

Exploratory Factor Analysis (EFA): This was conducted in SPSS using the factor reduction method to determine the underlying factor structure of digital transformation and strategic alignment indicators in HEIs (to assess construct validity).

Confirmatory Factor Analysis (CFA): Using the components extracted from the Principal Component Analysis (PCA) in SPSS, the measurement model was validated in RStudio.

Structural Equation Modelling: Hypothesis testing, including mediation and moderation effects, was conducted in RStudio.

Model Comparison: Model fit was evaluated using multiple indices (CFI, TLI, RMSEA, and SRMR) in accordance with recommended practices.

Results

This section is organised by research questions to make it easier to follow the results and discussion. It is divided into three parts: the state of digital transformation in HEIs, how information systems bolster strategic goals, and how environmental factors affect operational efficiency.

Sample Characteristics

The study received a total of 391 valid responses from 4 Zambian HEIs, representing an approximately 78 per cent response rate. This was satisfactory, as it exceeded the required sample size of 383.

Descriptive Statistics and Reliability Analysis

To assess the reliability of the quantitative measurement tool, we calculated Cronbach's alpha, which is a widely used measure of internal consistency. Cronbach's alpha assesses the degree to which a set of items within an instrument is related, indicating whether they consistently measure the same construct (Noor & Fuzi, 2025). The findings for the reliability tests are

presented in Table 1, which also includes descriptive statistics. Most reliability coefficients exceeded 0.90, indicating very high reliability (Noor & Fuzi, 2025).

RQ1: The state of digital transformation in HEIs

As shown in Table 1, when digital transformation constructs are measured to determine their Means, the data analytics dimension emerged as the lowest-scoring (Mean = 1.904). This indicates a significant requirement to develop data analytics within HEIs in Zambia. The descriptive statistics generally revealed low levels of digital transformation maturity across Zambian HEIs (Mean = 2.404) as shown in Table 1 below:

Table 1 Descriptive Statistics and Reliability Analysis

Construct	Mean	SD	Cronbach's
B. Digital transformation	2.404	0.483	0.907
<i>B1 (IT Infrastructure)</i>	2.286	0.363	0.908
<i>B2 (Learning Technologies)</i>	2.983	0.545	0.921
<i>B3 (Administrative Processes)</i>	2.443	0.693	0.940
<i>B4 (Data Analytics)</i>	1.904	0.329	0.860
C. Operational Excellence	2.648	0.475	0.849
<i>C1 (Academic Excellence)</i>	2.928	0.301	0.811
<i>C2 (Process Efficiency)</i>	2.452	0.479	0.778
<i>C3 (Financial Management)</i>	2.842	0.537	0.911
<i>C4 (User Experience)</i>	2.272	0.582	0.895
D. Strategic Goals	2.648	0.470	0.812
E. Power Instability	3.481	0.118	0.840

Hair et al. (2016) [cited in (Noor & Fuzi, 2025)] specified that values of reliability analyses can be interpreted based on the following strengths: < 0.6 = Poor, 0.6 to < 0.7 = Moderate, 0.7 to < 0.8 = Good, 0.8 to < 0.9 = Very Good, and > 0.9 = Excellent. The values from our study suggest a very good to excellent Cronbach's Alpha fit, indicating that the model was well-suited to the measurements.

As can be seen from the above assessment results for the current state of digital transformation (DT) maturity across Zambian HEIs, it was observed that HEIs are in a generally in transition in terms of digital transformation. This was characterised by foundational progress but uneven advancement across key domains. As shown in Table 4.4, the overall DT maturity score ($M = 2.404$, $SD = 0.483$) suggests a moderate developing level of maturity. The progression in digital transformation shows a relatively low maturity IT infrastructure ($M=2.286$) in HEIs under study. This was seen as a necessary platform for a successful digital transformation in HEIs in Zambia. Nonetheless, the maturity is seen to be similar in core functional areas: learning

technologies (M=2.983) and administrative processes (M=2.443) that were found to be at a semi operational but nascent stage. Data analytics capability presented a lag score (M=1.904) indicating that although HEIs in Zambia have made some investments in technology, these institutions have not yet advanced to the level of becoming data driven institutions like other intelligently automated organizations. The DT maturity was also found to exist within a context where strategic goals are perceived clearly (M=2.638) and power instability framed the environment in which digital evolution is taking place in Zambia (M=3.481).

RQ2 Measurement Model Assessment - Support of IS towards strategic targets

This section presents the findings of the exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) conducted to determine the underlying factor structure of digital transformation, institutional aims, and strategic alignment indicators in Zambian HEIs. The assumptions for factorability to assess the suitability of the data for factor analysis were the Kaiser-Meyer-Olkin (KMO) test and Bartlett’s Test of Sphericity, which were conducted:

Bartlett’s Test of Sphericity was significant ($\chi^2 = 5443.27$, $df = 528$, $p < .001$), supporting factorability. The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was 0.892, indicating meritorious sampling adequacy.

Confirmatory factor analysis supported a four-factor measurement model with fit indices shown below in Table 2:

Table 2 CFA Model Fit Indices.

χ^2 /df	p-value	CFI	TLI	RMSEA	SRMR
221.417/203 = 1.09	0.179	0.992	0.991	0.015	0.032

The measurement model demonstrated strong psychometric properties. All the standardised factor loadings ranged from 0.62 to 0.89, with most exceeding the 0.65 threshold. This provided a meaningful relationship between the indicators and the latent constructs under measure. Convergent validity was established through average variance extracted (AVE) values exceeding 0.65 for all constructs, exceeding the recommended threshold of 0.50. Discriminant validity was confirmed through the Fornell-Larcker criterion, with the square root of each construct's AVE exceeding its correlations with other constructs. Composite reliability estimates ranged from 0.85 to 0.92, indicating excellent internal consistency from the constructs (Noor & Fuzi, 2025). This evidence provides strong support for the measurement model's reliability and validity.

Structural Model Results

The structural equation model demonstrated excellent fit to the data, as shown in Table 3 below:

Table 3 Model Fit Indices.

Fit Index	Finding	Normal value	*Interpretation
χ^2 /df	1.03	< 3.0	Excellent Fit

p-value	0.283	> 0.05	Good Fit
CFI	0.994	> 0.95	Excellent Fit
TLI	0.993	> 0.95	Excellent Fit
RMSEA	0.010	< 0.06	Excellent Fit
SRMR	0.034	< 0.08	Excellent Fit

* interpretation based on Noor & Fuzi (2025)

χ^2 = Chi-square; *df* = degrees of freedom; CFI = Comparative Fit Index; TLI = Tucker-Lewis Index; RMSEA = Root Mean Square Error of Approximation; SRMR = Standardized Root Mean Square Residual.

The model indicates excellent fit (CFI = 0.992, RMSEA = 0.013) and explains 93.3% of the variance in Strategic Goals, as shown in Figure 1 below. Given the strong overall fit of the model, we proceeded to examine the specific standardised path coefficients to test the research hypotheses.

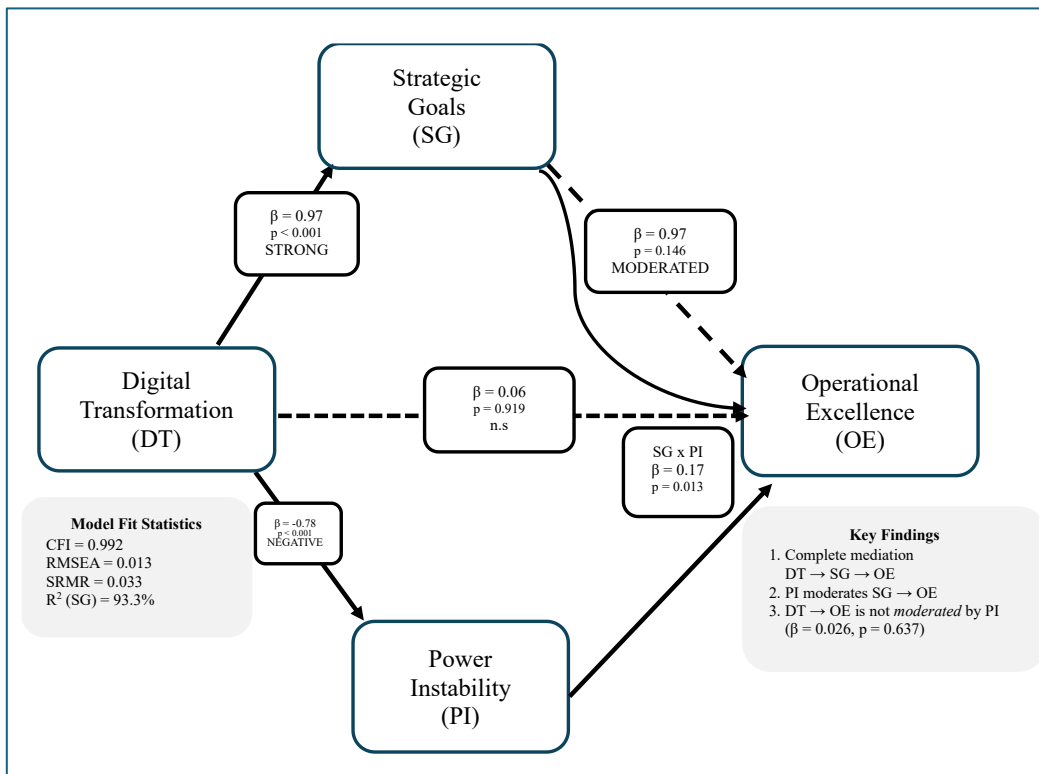


Figure 1 SEM Path Model, $n = 391$

The SEM path model shows complete mediation:

Digital Transformation influences Operational Excellence through Strategic Goals rather than directly ($\beta = 0.97$, $p < 0.001$). This relationship is significantly moderated by Power Instability: ($\beta = 0.17$, $p = 0.013$), indicating that environmental factors, such as infrastructure stability, have a substantial impact on the strategic implementation effectiveness. The SEM model also reveals that the interaction term between Strategic Goals and Power Instability (PI moderates SG → OE) was positive and statistically significant ($\beta = 0.168$, $p = 0.013$), indicating that the

relationship between Strategic Goals and Operational Excellence is strengthened in contexts of higher power instability.

Hypothesis Testing Results

The study tested three hypotheses based on the conceptual framework:

Table 4 Testing Hypothesis

	Symbol	Statement	Result
H1	DT → OE (Direct effect)	Digital transformation directly affects operational efficiency in HEIs	$\beta = 0.063, p = 0.919$; NOT SUPPORTED
H2	SG → OE (Main Effect)	Institutional strategic goals directly affect operational efficiency in HEIs	$\beta = 0.967, p = 0.146$; large effect but NOT SUPPORTED
H3	DT → SG	Digital transformation directly affects institutional strategic goals in HEIs	$\beta = 0.966, p = 0.001$; SUPPORTED

The results from hypothesis testing show that:

1. Digital Transformation (DT) improves Operational Excellence (OE) only indirectly, by first enhancing Strategic Goal (SG) clarity.
2. Power Instability (PI) strengthens the positive effect of SG on OE, making strategic clarity even more critical in challenging environments like where power instability is prevalent.
3. The DT-OE relationship is not moderated by PI, suggesting that DT initiatives can be affordably managed by HEIs despite this power instability environmental constraint.

While our model did not test whether DT reduces the occurrence of power instability, an external environmental factor, the non-significant moderation finding suggests that DT may just as well equip institutions with better capacities to manage and mitigate its operational impacts from power instability.

The testing of hypotheses revealed a non-significant direct relationship between digital transformation and operational efficiency ($\beta = 0.063, p = 0.919$). The minimal effect size (6.3% of a standard deviation change), together with the high p-value (0.919), strongly supports the view that digital transformation initiatives, in isolation, do not directly translate into improved operational efficiency within the HEIs under study. The results directly challenge the conventional literature from the developed world, which proposes that technological adoption improves operational performance. Our study evidence shows that the relationship between digital transformation and operational excellence is more complex than a mere direct pathway.

The hypothesis that strategic goals affect operational efficiency in HEIs was only partially supported. The direct effect showed a large standardized coefficient ($\beta = 0.967$), although it was not statistically significant ($p = 0.146$). Nevertheless, significant moderation analysis showed that the relationship between strategic goals and operational efficiency is conditional

on some factors. In this study, the relationship is conditional on power instability levels ($\beta = 0.168$, $p = 0.013$), indicating that the effectiveness of strategic goals in driving operational excellence in HEIs depends on environmental infrastructure stability, such as power stability. This is expected based on the large size effect ($\beta = 0.967$) of strategic goals on operational efficiency.

Mediation Analysis

The analysis revealed complete mediation through strategic goals:

Indirect effect (DT \rightarrow SG \rightarrow OE): $\beta = 0.934$, $p = 0.014$; Total effect: $\beta = 0.997$, $p = 0.001$;
Variance explained in strategic goals: $R^2 = 93.3$

The mediation analysis revealed a complete mediation model, suggesting that strategic goals fully mediate the relationship between digital transformation and operational efficiency in HEIs in Zambia. Although the direct effect between DT and OE was non-significant ($\beta = 0.063$, $p = 0.919$), the indirect path through strategic goals was found to be significant ($\beta = 0.934$, $p = 0.014$). The total effect of digital transformation on operational efficiency was also highly significant ($\beta = 0.997$, $p = 0.001$), with digital transformation explaining 93.3% of the variance in institutional strategic goals.

This finding suggests that the benefits of digital transformation on operational performance in HEIs are largely appreciated through enhanced strategic goal alignment and achievement, rather than through direct technological efficiencies or adoptions. The strength of these relationships suggests that digital initiatives serve as powerful enablers of strategic capabilities, which in turn drive operational excellence.

RQ3 – Environmental factors' moderation effect on digital transformation

In marked contrast to the positive dynamics among the other study variables, Power Instability emerged as strongly inhibiting the effects of digital transformation and strategic goals. The moderation analysis demonstrated a strong and consistent negative correlation between load shedding impacts and all three main research variables:

- i) Digital Transformation ($r \approx -.76$, $p < .001$),
- ii) Strategic Goals ($r \approx -.74$, $p < .001$), and
- iii) Operational Excellence ($r \approx -.78$, $p < .001$).

The results clearly show that power instability is a major external barrier that directly compromises the status of digital infrastructure, consequently disrupting strategic initiatives and hindering the attainment of operational excellence in HEIs in Zambia. The study demonstrates the vulnerability of digital and strategic investments to infrastructure shortcomings, such as power instability, when considered in the context of these investments.

Analysis of environmental variables

The relationship: Strategic Goals \times Power Instability \rightarrow Operational Excellence: $\beta = 0.168$, $p = 0.013$, suggests that power instability conditions affect the effectiveness with which the strategic goals are translated into operational efficiency. This suggests that, under high-power

instability, strategic goal clarity becomes a significant factor in attaining operational superiority.

Testing strategic alignment as a moderator or mediator for digital transformation

Three complementary measures of strategic alignment were developed:

1. Profile-based Alignment – calculated the similarity between individual respondent patterns on digital transformation items (B1-B4) and strategic goals items (D1-D5) from the questionnaire using the standardised Euclidean distance. Higher scores indicated greater alignment between technology initiatives and strategic priorities.
2. Correlation-based Alignment: Computed individual-level correlations between digital transformation and strategic goals responses.
3. Gap-based alignment - Measured as the inverse of the absolute difference between composite digital transformation and strategic goals scores, where smaller gaps indicated better alignment.

The profile-based measure was selected as the primary indicator due to its superior distributional properties (M = 0.539, SD = 0.09, range = 0.355-0.829, acceptable skewness = 0.50).

When strategic alignment was subjected to both mediator and moderator testing for both digital transformation and strategic goals, the findings from the study are shown in Table 5 below:

Table 5 Results of Moderation and Mediation Analysis Testing the Role of Strategic Alignment (SA)

Analysis Type & Effect Tested	Path / Interaction	β	SE	p-value	Sig
A. Moderation Effects	Digital Transformation \times Strategic Alignment \rightarrow OE	0.366	0.374	0.328	No
	Strategic Goals \times Strategic Alignment \rightarrow OE	0.095	0.418	0.821	No
	Power Instability \times Strategic Alignment \rightarrow OE	0.480	0.391	0.221	No
B. Mediation Effects	Digital Transformation \rightarrow Strategic Alignment \rightarrow OE	-0.006	-	0.437	No
	Strategic Goals \rightarrow Strategic Alignment \rightarrow OE	-0.020	-	0.119	No

OE = Operational Excellence; β = Standardized path coefficient; SE = Standard Error.

For moderation effects, β represents the coefficient for the interaction term. For mediation effects, β represents the standardized indirect effect. Dashes (-) indicate that standard errors for indirect effects are not applicable in the provided output.

The analysis of strategic alignment moderation revealed a non-significant effect, with none of the interaction terms reaching statistical significance ($p > 0.05$). The overall model explained 27.2% of the variance in operational efficiency ($R^2 = 0.272$). The hypothesised moderating role of strategic alignment (SA) on both digital transformation and strategic goals was not significant (not supported) as shown in Table 5 above. None of the interaction terms ($DT \times SA$, $SG \times SA$, $PI \times SA$) regarding operational excellence were statistically significant (p -value was greater than 0.05). Furthermore, SA did not show a notable mediating effect in the relationships between DT and OE or between SG and OE, as both indirect paths were non-significant.

Interrelationships among study variables

A correlation analysis was conducted to examine relationships among the study's core constructs: digital transformation, strategic goals, and operational excellence. The results show a tightly interconnected, synergistic dynamic among digital transformation, strategic goals, and operational excellence within HEIs in Zambia. As detailed below, exceptionally strong positive correlations emerged between the core variables:

- Digital Transformation and Strategic Goals demonstrated a near-perfect positive relationship ($r = .912$, $p < .001$), indicating that organisations vigorously pursuing digital initiatives are almost invariably those with a strong, clearly articulated strategic vision that incorporates technology.
- Digital Transformation and Operational Excellence were also powerfully correlated ($r = .896$, $p < .001$). This suggests that digital maturity is closely linked to achieving higher levels of academic, administrative, and financial performance within an institution.
- Similarly, a very strong link was found between Strategic Goals and Operational Excellence ($r = .909$, $p < .001$), stressing the necessity of a well-defined strategic direction as a hallmark of high-performing institutions.

This pattern of strong intercorrelations suggests that digital transformation, strategic clarity, and operational efficiency are not isolated phenomena but rather form a mutually reinforcing system that may be termed the 'Triangular Relation Model'. In essence, they appear to advance in concert, creating a virtuous cycle in which strategic intent drives digital adoption, which, in turn, enables operational improvements that further strengthen the strategic goals, as shown in Figure 2.

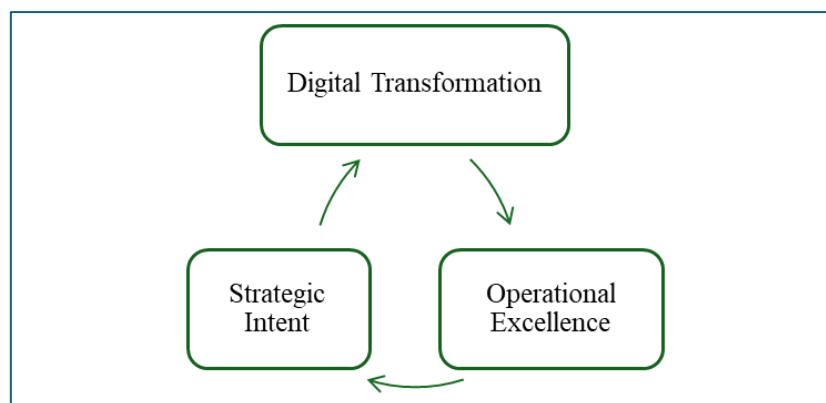


Figure 2 Relationships among core constructs – Triangular Relation Model

Stakeholder Engagement as an Area for Development

Analysis of stakeholder-related measures indicates average scores for student experience, industry engagement, and community outreach ranging from 3.1 to 3.4. While these scores are not low, they are notably lower than the strong alignment observed at the strategic level. This suggests that, although institutions demonstrate commitment to digital transformation in their strategies, translating this commitment into robust stakeholder experiences and partnerships remains a work in progress. There is significant potential to enhance stakeholder engagement, particularly by strengthening communication, collaboration, and the alignment of digital services with stakeholder needs in higher education.

Discussion

Theoretical Perspectives

This study makes several important theoretical contributions to the literature on digital transformation and strategic alignment, as discussed in this section. The strong model fit provides empirical support for the integrated application of your theoretical frameworks (SAM, TOE, Lean Iceberg) in the Zambian HEI context.

Environmental Moderation of Strategic Alignment

The significant moderating effect of power instability extends strategic alignment theory by demonstrating that environmental infrastructure constraints can increase the relevance of strategic alignment in practice. This outcome questions the generalizability of strategic alignment models commonly associated with developed-world settings, suggesting that environmental context fundamentally shapes alignment effectiveness.

The positive moderation coefficient ($\beta = 0.168$) suggests that, under conditions of power instability, strategic goal clarity becomes even more key to attaining operational excellence in HEIs. In resource-scarce contexts, it may be argued that this relationship requires more sophisticated strategic planning and clearer goal definition to achieve operational outcomes equivalent to those in developed countries. These results are consistent with strategic clarity and alignment of performance measures.

Mediation versus Direct Effects

The complete mediation pattern (DT \rightarrow SG \rightarrow OE) provides important understandings of the processes through which digital transformation influences organisational outcomes. Rather than creating direct operational improvements, digital technologies enhance institutional strategic capabilities, which, in turn, drive operational excellence. In other words, operational excellence may not be delivered immediately upon implementing digital transformation initiatives, but may take time to show benefits.

The finding that digital transformation principally strengthens strategic capacities beneath surface-level performance reinforces the Lean Iceberg Model's core insight about deep organisational capabilities. Schneider et al. (2024) and Saputro et al. (2025) both corroborate that digital transformation does not directly improve operational metrics, but instead enables organisations to develop higher-order capabilities by means of strategic reconfiguration, and that successful digitalisation depends on integrating digital strategy into core business

processes and developing sensing, seizing, and transforming capabilities, respectively. In other words, digital transformation is fundamentally about building robust, adaptive strategic foundations, rather than achieving only immediate surface-level performance gains identified by the Lean Iceberg Model.

Non-Significant Direct Effect of Digital Transformation on Operational Excellence

The findings from our study may be described as the J-Curve model of digital transformation in resource-constrained environments (Figure 3). The negative main effect of digital transformation on efficiency indicates an unavoidable initial resource drain, in which the costs of new systems, training, and the dual operation of old/new processes outweigh the benefits. The model combines previous theories and seeks to anticipate a non-linear relationship between digital transformation efforts or investments and the subsequent operational efficiency in resource-constrained environments. In line with the J-curve theory, investments in IT in HEIs require some learning before becoming proficient, as shown by Brynjolfsson (1993). This is why, despite the high investments in information technology, the initial trend is to result in a decrease in measured output as organisations incur costs for implementation, training, and steer through the disruption of routine methods—a period analogous to the 'valley of despair' in change management models (Kotter, 1995). In the context of this study, we argue that those strategic goals act as an important moderator, providing the institutional patience and sustained commitment of resources necessary to navigate the initial dip and progress toward the phase of positive returns.

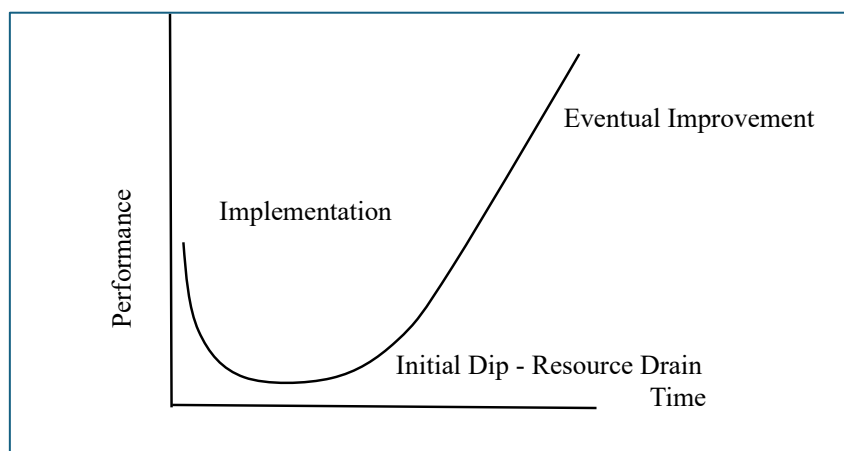


Figure 3 J-Curve of Digital Transformation

Adapted from Brynjolfsson, E., Rock, D., & Syverson, C. (2020). *The Productivity J-Curve: How Intangibles Complement General Purpose Technologies*. Cambridge: National Bureau of Economic Research.

This non-significant finding regarding digital transformation is consistent with emerging literature showing that its benefits are frequently facilitated by other organisational variables rather than operating through direct effects (Warner & Wäger, 2019; Verhoef et al., 2021). The study indicates the importance of complementary organisational capabilities and strategic alignment in achieving operational benefits from digital initiatives, as originally proposed by the resource-based view model (Kearns & Lederer, 2003).

That digital transformation has no direct effect on operational efficiency may be related with the concept of complementarity, which proposes that the value of technology is not directly realised but mediated through and dependent upon a set of complementary organisational investments (Brynjolfsson & Hitt, 2000). This study shows that digital initiatives alone are insufficient to achieve augmented operational performance in HEIs. Instead, the result emphasises that the operational benefits of digital transformation or IT investments depend on the simultaneous development of complementary organisational capabilities and a high degree of strategic alignment, as some authors argue (Fitzgerald et al., 2014; Westerman et al., 2014).

The results of this study offer empirical support for the 'J-Curve' pattern. The negative main effect of digital transformation regarding operational efficiency is consistent with the predicted initial 'dip,' or productivity paradox (Brynjolfsson et al, 2020). The positive moderating effect of strategic goals suggests that institutions with a clear strategic vision are more likely to interpret this 'dip' not as a failure but as a necessary investment, thereby persisting through the transition to achieve eventual performance gains.

Since the coefficient for overall digital transformation is negative or non-significant, it suggests that, on average across all institutions, the investment in digital transformation is not yet paying off, as evidenced by the initial dip shown in Figure 3. This is a major challenge for Zambian HEIs operating with limited budgets and infrastructure, which hinders their ability to immediately see the benefits of investments in digital technology innovations.

Strategic Goals and Strategic Alignment

The evidence shows a need to clarify the conceptual distinctions between strategic goals and strategic alignment in the context of digital transformation implementation. Strategic goals (referring to institutional objectives and priorities) were isolated to have a strong impact regarding operational excellence, while strategic alignment (IT strategy fit) did not show significant value in this study. This suggests that in resource-restricted environments, strategic goal clarity may be more important than attaining flawless alignment between IT and business strategies. The important implication of this finding for strategic alignment theory is that alignment processes may not be prominent when strategic outcome clarity is uncertain, as within environments where adaptation and flexibility are of utmost importance.

Contrary to expectations, strategic alignment did not function as an important moderator or mediator in the tested model. The analysis indicated no significant interaction effects (Table 5, Panel A), indicating that the strength of the relationships among the constructs DT, SG, and OE does not depend on SA level. Strategic alignment was also rejected as the conduit for DT or SG impact on OE, as both indirect mediation paths on OE were found to be non-significant (Table 5, Panel B).

Although strategic alignment did not show a significant moderating effect on either digital transformation or strategic goals related to operational improvement, it may lie beyond the scope of this study's interaction terms. Empirical studies have shown that institutions that clearly state how their digital initiatives Empirical studies have demonstrated that institutions that clearly elucidate how their digital initiatives attend to their core mission seem to be better equipped to withstand the initial dip in implementation (Benkhayat et al., 2024; Dairo et al.,

2021; Nugroho et al., 2025). Undoubtedly, strategic alignment can augment institutional resilience and secure continued resource commitment, even in times of scarce resources, thereby helping staff contextualise challenges as growing pains rather than failures. Ultimately, this creates the conditions that realise the intended gains in operational proficiency and transform the initial resource dip into a long-term strategic investment for HEIs.

Important implications from the study

Infrastructure as a core factor in digital transformation

This investigation emphasises the crucial importance of reliable infrastructure for achieving successful digital transformation. The significant moderating effect of power instability demonstrates that environmental infrastructure serves as a foundational layer that can either enable or constrain strategic initiatives. Infrastructure investment is indeed a prerequisite for digital transformation, not simply a parallel initiative, as substantiated by multiple research findings. Xiaofang et al. (2024) demonstrated that network infrastructure effectively promotes enterprise digital transformation, with its impact increasing as infrastructure scale expands. Their study revealed two key channels: easing corporate financing constraints and improving core technical capabilities. Complementary research by Wang & Man (2022) further reinforces the finding that network infrastructure is central to the corporate digitalisation process. The impact varies by enterprise type, with non-state-owned enterprises and technology-intensive firms reported to benefit the most. The evidence for infrastructure support in digital transformation spans multiple studies and methodologies, thereby providing firm endorsement for the scale-dependent effectiveness of network infrastructure in driving enterprise digital transformation. Digital transformation requires decision-makers to direct investments in the digital network architecture and human capital (ElMassah & Mohieldin, 2020). The evidence suggests a strong, causative relationship between infrastructure investment and digital transformation, with infrastructure acting as an enabling foundation rather than a supplementary element.

This study delivers a dual-lens, focused-moderation framework for digital transformation and operational efficiency in resource-limited settings. The framework interrogates the relationship from two major additional viewpoints. Firstly, strategic alignment serves as a lens to examine the internal logic and purposeful direction of technological change, ensuring that digital is not merely technologically sound but also, from a strategic perspective, coherent and value-driven. Secondly, the lens of load shedding impact presents another external challenge: “even if a digital initiative is strategically justified, can it be reliably and sustainably implemented given our severe infrastructure constraints?” This challenge acknowledges the exacting environmental realities that can potentially sever the link between strategic intent and operational outcomes. By employing these two moderators in tandem, this study moves beyond a simplistic cause-and-effect model to reveal how the journey from digital investment to superior operational performance is simultaneously a matter of strategic choice and infrastructural possibility.

Adaptive strategic responses

The positive moderation effect indicates that successful institutions in unstable environments

develop adaptive strategic competencies. Rather than being defeated by infrastructure constraints, high-performing institutions appear to use strategic goal clarity as a compensatory mechanism. This finding implies that developing-country HEIs should invest heavily in strategic planning capabilities and communication systems to maintain organisational coherence amid environmental uncertainty.

Practical Study Implications

For higher education institution management

To begin with, the study delivers a strategic planning focus, driven by a strong DT → SG relationship ($\beta = 0.966$) and a significant moderation effect, which calls for emphasis on strategic planning as an important success factor for digital transformation. HEIs' administrators should: invest in strategic planning capabilities and processes; develop clear, measurable strategic goals aligned with digital transformation initiatives; establish robust communication mechanisms to maintain strategic consistency during infrastructure disruptions; and create adaptive planning processes that can respond to environmental uncertainty.

Further, setting up infrastructure stability is another focus for HEIs. The power instability moderation effect shows that backup power systems and infrastructure redundancy are more than operational necessities; they are strategic imperatives that enable HEIs to attain their strategic goals.

The study indicates significant opportunities to improve stakeholder relationship management and engagement during infrastructure disruptions, given the current moderate satisfaction scores.

For decision-makers

The study offers empirical evidence for prioritising infrastructure investment to achieve power infrastructure reliability as a mainstay of higher education digital transformation. This implication points to the policymakers' need to develop an integrated digital infrastructure and education methods that foster stabilising power in HEIs. This could be done by creating incentive structures for investment in institutional infrastructure robustness. Regarding capacity-building support, the data analytics capability gap ($M = 2.76$) indicates a requirement for focused programs to develop institutional analytical competencies.

Existing literature comparisons

This study's findings are consistent with the existing literature in several ways. Firstly, the findings confirm the long-standing alignment paradox on the relationships between alignment and performance outcomes (Gerow et al., 2014). The limited support for the direct IT performance relationship is still consistent with meta-analytic findings (Kearns & Sabherwal, 2006).

The study makes a novel contribution by identifying power instability as a major environmental moderator of strategic goal attainment. Previous research has largely focused on organisational and industry-level moderators while overlooking infrastructure-level environmental factors (Luftman et al., 2017). The negative relationship between strategic alignment and operational

excellence ($\beta = -0.146$) contradicts most developed-country research but may reflect contextual factors specific to resource-limited settings where perfect alignment may indicate inflexibility rather than strategic sophistication.

Limitations and Future Research

Study limitations

This study has several limitations. Its cross-sectional design means we cannot draw conclusions about cause and effect. Strategic alignment develops over time, so understanding how power instability affects it would require long-term studies. Also, measuring alignment based on individual views may not reflect how it works at the organisational level. The study was also focused on HEIs in Zambia, making it probable that its findings may not apply to other sub-Saharan African countries or organisations.

Future research

For future research, we suggest employing time-series studies to establish causal relationships and possibly capture the temporal dynamics of strategic alignment amid infrastructure uncertainty. Further qualitative case studies could provide more profound insights into the mechanisms by which power instability influences strategic alignment processes. Other studies could also develop a context-specific theory, adapted from strategic alignment theory and specifically suited for resource-constrained environments, incorporating infrastructure reliability as a foundational construct.

Conclusion

This study makes a novel contribution to the study of strategic alignment in HEIs in Sub-Saharan Africa by providing important perspectives on digital transformation and the effects of strategic goals on performance in resource-restricted settings. The results show that while digital transformation helps clarify strategic goals, turning these goals into operational excellence is strongly influenced by environmental factors, such as reliable power infrastructure. The research makes several key contributions. Theoretically, it extends strategic alignment theory by showing that environmental infrastructure is a key factor and that clear strategic goals are more important than perfect alignment in uncertain situations. Methodologically, it provides a tested model for evaluating strategic alignment in developing countries. In practice, it provides useful advice for HEI administrators and policymakers on how to get the most from digital transformation investments when resources are limited. The main takeaway is that power instability does not just slow down digital transformation—it changes how digital initiatives add value. When infrastructure is uncertain, having clear strategic goals is even more important for success, so institutions in developing countries need strong strategic planning to overcome these challenges. For Zambian HEIs, the research shows the call for strategic planning that considers infrastructure issues and builds flexibility. For decision-makers, the study shows that investing in infrastructure is essential for digital transformation in education. Upcoming research is recommended to use long-term studies to understand cause and effect, develop theories suited to developing countries, and test ways to improve strategic alignment when resources are tight. The goal is to create practical systems that help HEIs in developing countries succeed with digital transformation despite the

challenges. This study shows that, while strategic alignment theory remains useful in developing countries, it must be adapted to local conditions. The way forward is not just to use models from developed countries, but to create new ones that tackle the distinctive challenges and opportunities in higher education in developing countries. The results are especially relevant for HEIs in Sub-Saharan Africa with limited resources. Leaders in these institutions should focus on investing in flexible digital technologies that can address external challenges, for example, renewable energy and adaptable technology models. Such strategies can help build effective educational environments in difficult conditions through digital transformation.

Conflict of Interest

The authors declare that there is no conflict of interest.

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In this study, ChatGPT and Grammarly AI tools were used to edit the manuscript.

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