

Navigating the digital transformation path: The role of digital leadership and technological capability through the dynamic capability model

Research Article

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Abstract: This article explored the impact of digital transformation on enterprise performance and considered how digital leadership can employ an enterprise's technological capabilities to improve efficiency. Also, digital culture was moderate in unveiling technological changes. The dynamic capability theory was employed to develop the theoretical model. The study employed a quantitative approach to the investigation. In total, 459 questionnaires spanning the different manufacturing enterprises in Ghana were collected from managers. These questionnaires were validated and analyzed using the structural equation model of SmartPLS4. The findings indicate that digital leadership and technological capability had a favorable relationship with digital transformation. Similarly, digital transformation had a significant nexus with enterprise performance. Additionally, digital transformation established a partial mediating effect on enterprise performance. The study's findings demonstrated that digital culture directly moderates the relationship between digital leadership and digital transformation. Accordingly, the theoretical implication of the research affirms the dynamic capability model and literature gaps on digital transformation, digital leadership, digital culture, and technological capabilities. With the ever-increasing speed of technologies and changing consumer dynamics, the outcome of the investigation serves as a policy assistant to governments, policy makers, and managers in their strategic decision-making processes (R2-Q4).

Keywords: *Digital leadership • Digital transformation • Digital culture • Technological capability • Dynamic capability theory*

JEL classification: *M10 • O31 • O32*

1. Introduction

In today's rapidly sustainable and changing environment, digital transformation (DIGIT) and technological capacity (TECH) have emerged as material factors driving organizational performance. Wu et al. (2022) assert that many industries employ digital technology to enhance productivity, deliver superior customer service, and maintain a competitive edge. Enterprises are under more pressure than ever before to prove they are environmentally responsible due to growing interest in sustainable business practices from governments, customers, and other interested parties (Konopik et al., 2022; Ren et al., 2024). In light of this, many businesses advocate for digital

leadership (DIGIL) to address this issue. Moral obligations and the desire to enhance customer loyalty, reputation, and competitive advantage materialized this trend. Digital leaders are critical in facilitating the affiliation between digital transformation, technology, and organizational performance (Mihu et al., 2023). Digital transformation involves the integration of digital technologies into various organizational functions, processes, and strategies (Tieng et al., 2022). Technologies such as artificial intelligence, big data analytics, cloud computing, the Internet of Things (IoT), and automation enable organizations to enhance operational efficiency, innovation, and customer experience (Priyono et al., 2020; Wang et al., 2023). These technologies have been shown to positively impact organizational performance by improving productivity, cost-

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effectiveness, agility, and competitiveness (Ellström *et al.*, 2021; Kolade *et al.*, 2021).

According to industry data, the attainment rate of digital transformation programs is less than 30% (Heubeck, 2023; Mulyana *et al.*, 2024). One of the five key variables contributing to success is the presence of competent executives who are knowledgeable in digital technology (Munsamy *et al.*, 2023). Literature on digital transformation is scarce, and it is necessary to thoroughly comprehend the qualities and skills necessary for successful digital leadership. Digital leaders also create a culture that embraces change, fosters innovation, and promotes digital literacy among employees (Benitez *et al.*, 2022). By breaking down silos and facilitating collaboration, digital leaders drive cross-functional digital initiatives and enable the effective adoption and utilization of digital technologies (Shukla *et al.*, 2023). Digital culture is an institutional culture that integrates technological values and norms into its operations (Sumrit, 2021). Similarly, Mai *et al.* (2023) explored digital leadership employing the institutional model to unveil the affiliation between digital transformation and enterprise model innovation. The outcome from the investigation established that leadership characteristics include innovativeness, agility, and participativeness. Empirical studies conducted in recent years provide valuable insights into the role of digital culture in the nexus between digital leadership and digital transformation. Hautala-Kankaanpää (2022) digital platform forms, Mihi *et al.* (2023) digital transformation drivers, and on a transition from TV to YouTube (Lee Ludvigsen & Petersen-Wagner, 2023). They collectively emphasize the crucial role of enterprise culture in shaping the outcomes of digital leadership and influencing the success of DIGIT initiatives. These studies underscore the importance of fostering a supportive digital culture that aligns with and enhances digital leadership behaviors to drive and sustain digital transformation in organizations effectively.

Furthermore, the role of digital leadership in the relationship between digital transformation, technology, and organizational performance has gained significant attention in academic and industry research (Chatterjee *et al.*, 2023; Mai *et al.*, 2023). Digital leaders act as catalysts, ensuring digital transformation initiatives align with the organization's strategy and goals (Wu *et al.*, 2022). They provide guidance and support to employees, empowering them to leverage technology to its full potential. Digital leaders drive the transformation efforts through their influence, facilitate organizational learning, and create an environment conducive to innovation and growth (Davison *et al.*, 2023). Understanding the mediating role

of digital leadership is crucial for organizations seeking to maximize the benefits of digital transformation and technology adoption (Kolade *et al.*, 2021). By investing in developing digital leadership capabilities, organizations can enhance performance outcomes and achieve sustainable competitive advantage in the digital era (Benitez *et al.*, 2022). Organizations in many industries increasingly recognize the importance of digital transformation as they adapt to the quickly changing digital environment (Cserdi *et al.*, 2022; Hung *et al.*, 2023). Nevertheless, achieving successful digital transformation is accompanied by various obstacles, including the need to synchronize organizational structures and processes and the requirement to build the essential technological capabilities. This article uses the dynamic capability model as a theoretical lens to explore the role of digital leadership and technological capability in digital transformation.

In recent years, empirical research has proven that TECH, DIGIL, and DIGIT have been explored extensively. Nevertheless, research on the nexus between enterprise performance (ENTP) and digital culture (DIGIC) has been scant. The affiliation between DIGIT, DIGIL, and enterprise efficiency has resulted in inconsistent results in previous research. Some studies have shown material affiliation, while others have shown immaterial or no influence. The primary goal of this research is to fill in some significant gaps in the current literature. The DIGIT and TECH capability practices of manufacturing enterprises in developing economies have not been adequately examined in the numerous research evaluations concentrating on the direct nexus between DIGIT and performance. Also, existing literature demonstrates that digital culture is a key moderator that affects the affiliation between DIGIL and DIGIT, affecting enterprise performance. There is a lack of research in developing nations; however, other developing nations with comparable cultures can benefit from studying Ghana's small and medium-sized manufacturing enterprises (SMEs) in conjunction with the country's new initiatives, such as the one-district-one factory (1D1F). In order to give a complete evaluation of the relationship, the study used a survey method. The 1D1F program in Ghana has been significant, as it aims to encourage digital transformation and sustainable manufacturing practices among the country's manufacturing companies. Various kinds of green innovation exist in prior studies: product, process, and service innovation. However, these factors have been investigated separately. According to Kolade *et al.* (2021) and Masoud Masoud and Basahel, (2023), external networks, government subsidiaries, and entrepreneurial capability are needed to develop innovation with SMEs. Again, the dynamic

capability approach is employed to model the conceptual affiliation between DIGIL, DIGIT, TECH, DIGIL, and ENTP. The dynamic capability theory has been established in prior literature to be associated with the variables channeled through DIGIC and enterprise performance. Therefore, our evaluation utilizes digital culture to moderate the influence of digital leadership on SMEs' transformation (Alraheedi et al., 2022; Hautala-Kankaanpää, 2022). The study investigated manufacturing organizations (SMEs) in Ghana to identify the affiliation between enterprise efficiency and the extent of DIGIL, DIGIT, TECH, and DIGIC employed by these firms. For manufacturing managers in Ghana and other sub-Saharan African countries, investing in DIGIL, DIGIT, TECH, and DIGIC and establishing robust eco-oriented partnerships are essential for achieving sustainable performance objectives. The results provide material insights into this context. To complete the study, the robust Smart PLS4 econometric model was utilized to investigate the causation affiliation among the variables. The remaining part of the evaluation includes the literature and theoretical highlights, method, results and discussions, conclusion, and policy.

2. Theoretical background

2.1 Dynamic capability theory

The dynamic capability model has been linked previously with literary investigations on digital transformation, technology capabilities, digital leadership, and DIGIC (Tagscherer & Carbon, 2023; Zhang et al., 2023). Enterprises have recently assessed the material relevance of digital transformation in institutional strategies. Mihi et al. (2023) established that institutional culture focuses on three capabilities: digital intensity, digital savvy, and conditions and interactions to attain transformative digital capability. Around the world, pharmaceuticals, beauty, and closures industries are integrating digital practices into all levels of operation. Digitality has transformed communication challenges between leaders and command lines (Benitez et al., 2022). In the emergence of effective digital transformation, Cserdi et al. (2022) revealed that the dynamic capability of an enterprise is the fundamental strategic procedure to achieve successful digitalization. Additionally, Teece (2016) commented that dynamic capability is highly significant compared to the resource-based view when an enterprise operates in a volatile environment.

Furthermore, enterprises that want to integrate the digital transformation process must consider the digital culture in the firm's dynamic capabilities. In Finland,

Hautala-Kankaanpää (2022) explained that digital culture was an influencer of manufacturing enterprise platforms to adopt transformation linked to the efficiency of their operation. Employees from the multinational enterprises in Tech were explored by Munsamy et al. (2023) on the digital leadership scales during the fourth industrial revolution. The results from SPSS AMOS analysis demonstrated that six dimensions of digital leadership are highly affiliated with digital culture. Similarly, in 14 high-tech institutions, Balakrishnan and Das (2020) explored SMEs' digital transformation and innovation. The results illustrate that process innovation aligns with digital transformation and culture influences to achieve enterprise performance. According to Mihi et al. (2023), technological capabilities are the resources capabilities of an organization, such as IT resources, and are the driving force for digital transformation. Although technological capability is simple to integrate in large institutions, this cannot be said for SMEs in emerging nations. In Thai, Tieng et al. (2022) investigated ICT capability and enterprise efficiency among 141 entrepreneurs. The empirical results revealed that entrepreneurs who invest in ICT capabilities have an effect on enterprise efficiency and competencies. Previous literary works have employed the resource's base view to test for the variables of digital transformation (Bazrkar et al., 2022), digital leadership (Benitez et al., 2022; Davison et al., 2023), and technological capability (Persaud & Zare, 2023; Ren et al., 2024). To close the theoretical gaps, the dynamic capabilities were adopted to explore the affiliation between DIGIT, DIGIL, TECH, and DIGIC variables on enterprise performance in SMEs in an emerging country like Ghana.

2.2 Digital leadership and digital transformation synopsis

Digital leadership refers to individuals' skills, competencies, and behaviors in guiding and influencing others toward achieving organizational goals. Effective leadership is crucial in driving digital transformation initiatives and navigating uncertainties. Hung et al. (2023) conducted a study examining the role of digital leadership in driving successful digital transformation. The researchers surveyed executives from diverse organizations and found that effective digital leadership was critical in achieving DIGIT success. They identified key DIGIL capabilities such as strategic vision, technological understanding, and the ability to drive cultural change. In China, Davison et al. (2023) explored the impact of digital leadership on enterprise performance in the context of digital transformation.

The researchers found a favorable affiliation between digital leadership and enterprise performance using survey data from large organizations. They revealed that digital leaders played a crucial role in aligning DIGIT initiatives with organizational goals, fostering a culture of innovation. In Europe, Benitez *et al.* (2022) investigated the influence of digital leadership on employee engagement during digital transformation. The researchers surveyed employees of a multinational organization undergoing digital transformation. The findings revealed a significant material affiliation between digital leadership and employee engagement. Tagscherer and Carbon (2023) evaluated 92 articles between 2011 and 2021 on the nexus between DIGIT and digital leadership. The researchers found that digital transformation initiatives were positively associated with digital leadership behaviors. Digital leaders, characterized by their ability to drive innovation, embrace technological advancements, and foster a digital culture, were instrumental in leading successful digital transformation. Therefore, the authors argue that a positive relationship between DIGIL and DIGIT can be elucidated through the lens of DCM and the novel from literary work. Thus, DCM provides theoretical ground for investigating the relationship between DIGIL and DIGIT. Manufacturing enterprises that cultivate dynamic capabilities are poised to effectively respond to DIGIT, leading to improved enterprise performance as they adopt, innovate, and align their strategies with market demands.

Hypothesis 1: DIGIL positively influences DIGIT efforts.

2.3 Digital leadership and technological capability synopsis

The concept of digital leadership has been part of recent investigations with huge research gaps on the significance of its role in digital technology and performance (Rupeika-Apoga *et al.*, 2022; Tagscherer & Carbon, 2023). The Digital Officer is directly responsible for the company's digital transformation and has a portfolio that may include several different responsibilities (Davison *et al.*, 2023). DeLone *et al.* (2018) explained digital technology capabilities as the ability to employ technological applications to create value for customers, suppliers, and the enterprise. In Canada, Persaud and Zare (2023) examined the nexus between absorptive capability and technological models in the context of innovation-driven firms. Through interviews and surveys with 447 innovation managers, the researchers found a favorable affiliation between digital leadership behaviors and technological capabilities. To achieve a proactive strategy within the environment, Bhatia (2021)

explored the mediating effect of technology on process innovation and management of the environment. The PLS test illustrated that technology had a significant favorable affiliation with enterprise learning, process innovation, and environmental strategy. In China, manufacturing enterprises, Jiang *et al.* (2020) investigated the nexus between digital leadership and technological communication in the context of information technology (IT) departments. Through surveys and interviews with IT leaders, the researchers found that digital leadership behaviors favorably influenced technological leadership capabilities. Previous literary articles had confirmed a favorable affiliation between Zhe and Hamid (2021), digital technology and innovation in Malaysia, and Tarighi *et al.* (2021), learning and technological capability in Iran. Therefore, the study assumes that digital technology capabilities support a digital strategy in upsurging digital transformation when channeled through DIGIL. Considering these positive effects of DIGIL on TECH, the next hypothesis was developed as follows.

Hypothesis 2: DIGIL has a positive effect on DIGIT.

2.4 Technology capability and digital transformation synopsis

Technology refers to the tools, systems, and innovations that enable digital transformation. It includes emerging technologies such as artificial intelligence, cloud computing, big data analytics, IoT, and others (DeLone *et al.*, 2018). Recently, digital manufacturing has become a sustainable means to reduce emissions and improve the process and product development to achieve a green environment (Wu *et al.*, 2022). Within developed and emerging nations, Gillani *et al.* (2020) conducted a study evaluating the influence of technological capability on DIGIT in the manufacturing sector. Analysis of 931 enterprises' data from manufacturing firms revealed that higher technological capability favorably influenced the adoption and effectiveness of digital transformation initiatives. Employing the ISM method and MICMAC analysis, Mohapatra *et al.* (2022) investigated the difference between technological capability and digital transformation in enterprises during COVID-19. Technological capability, including IT infrastructure, digital skills, and access to digital resources, accounted for digital technologies and transformed their business processes, leading to improved competitiveness and performance. Firms with advanced technological capabilities, such as automated warehousing, fleet management systems, and real-time tracking technologies, were more likely to undergo digital transformation, leading to improved efficiency, visibility, and customer satisfaction. Established enterprises implementing digital strategy have

been found to benefit from (a) enhanced digital product or developing entirely new ones and (b) improving employees' relationships and adaptability to new applications. However, for an effective synergy of DIGIT and TECH activities in an enterprise, DIGIL is crucial. Zhao and Huang (2022) highlighted the significance of DIGIL in producing a desirable performance using technological capabilities. The following hypothesis is developed by extending insight from these studies to the TECH context.

Hypothesis 3: Technological capability positively impacts digital transformation.

2.5 Digital transformation and organizational performance synopsis

Digital transformation involves the integration of digital technologies into various organizational functions, processes, and strategies, leading to improved operational efficiency, innovation, and customer experience (Bazrkar et al., 2022). The relationship between digital transformation and organizational performance has become a growing interest in recent years, as organizations increasingly recognize the importance of leveraging digital technologies to enhance their performance and competitiveness (Masoud & Basahel, 2023). Mohammed and AL-Abrrow (2023) conducted a comprehensive study examining the impact of digital transformation on firm performance. Through a meta-analysis of multiple empirical studies, the article identifies a strong favorable relationship between digital transformation and various dimensions of organizational performance, including financial performance, innovation, and leadership. Using the SEM test and employing the RBV and RD model in SMEs in China, Zhang et al. (2023) investigated the factors of digital transformation on organizational efficiency. The results of 180 enterprises' empirical investigations produced a positive affiliation between digital transformation and enterprise efficiency. During the COVID-19 era, Rupeika-Apoga et al. (2022) conducted a study examining the impact of technology adoption on organizational performance. The researchers analyzed data from various industries in Latvia and found that organizations that successfully integrated technologies into their operations experienced significant performance improvements. Technology adoption was associated with increased productivity, cost savings, and better decision-making capabilities, leading to enhanced organizational performance. Therefore, it is hypothesized that organizations that undergo successful DIGIT will experience enhanced organizational performance.

Hypothesis 4: Digital transformation positively influences organizational performance.

2.6 Digital culture moderating nexus

Organizations must quickly adopt new technological solutions to be competitive in today's fast-paced world. It is now essential for businesses to foster a digital culture in order to modernize their processes and enrich their relationships with both consumers and staff (Persaud Zare, 2023). A company's "digital culture" is its norms and values as influenced by its use of digital resources (Sumrit, 2021). The role of DIGIC in the affiliation between digital leadership and DIGIT has emerged as a material area of inquiry in contemporary organizational studies. The term "culture" describes the guiding principles that help an organization be adaptable while it undergoes change or transformation. Honesty, encouragement, selectiveness, consistency, adaptability, no-blame, non-punitive evaluation, failure as a learning opportunity, innovation as business as usual, teamwork, empowerment, and a positive attitude toward customers and staff are all examples of such principles (Balakrishnan & Das, 2020). Hautala-Kankaanpää (2022) surveyed Finnish enterprises, and data from 194 were analyzed using the SEM test. The variable digital culture was adopted as a moderating construct on the affiliation between digital platform and enterprise performance. The results illustrate that digital culture had a material moderating effect on the relationship. Additionally, another strand of authors (Balakrishnan & Das, 2020; Mihi et al., 2023) found that DIGIC compels enterprises to adopt and implement DIGIT practices through pressures from customers, government institutions, and competitors, which in the long term results in the efficiency of manufacturing enterprises. In conclusion, the study argues that DIGIC moderates the link between DIGIL and DIGIT. This means that DIGIC strengthens or weakens the influence of DIGIL initiatives by organizations in their digital strategies. The inference is that from a DCM perspective, the moderation effect of DIGIC between DIGIL and DIGIT highlights an enterprise's ability to develop dynamic capabilities related to digital transformation. Thus, the following hypothesis was derived:

Hypothesis 5. Digital culture has a favorable influence on digital transformation.

Hypothesis 5a. Digital culture moderates the link between digital leadership and digital transformation.

2.7 Gaps synopsis

The inspection outcomes from the literary works have highlighted contradictions in elements, establishing material, immaterial, and mixed findings. Induced from the results, making decisions could affect policy implications

for digital transformation and digital leadership on enterprise performance. Different methodologies, principles, and periods have been employed to expound on the affiliation between the variables. This investigation adopted a more robust SMARTPLS SEM to handle complex theoretical models. As evidenced in the literary work, few investigations have been carried out in emerging communities. Therefore, the emerging community context assessment on DIGIT, DIGIC, and TECH will close these gaps. Hence, the evaluation results will serve as a policy document for institutions, academia, and government.

2.8 Conceptual framework development

These research papers highlighted the complex interplay between digital transformation, technology, and leadership in an uncertain world. They provide material insights into the challenges leaders face, the strategies required to navigate uncertainty, and the impact of DIGIT on enterprise efficiency. By integrating theoretical frameworks with empirical findings, these research papers offer a deeper understanding of the dynamics at play and provide practical implications for organizations and leaders seeking to thrive in the digital era. The proposed research model aims to examine the affiliation between digital transformation, technology, and leadership in driving enterprise success in the context of manufacturing enterprises. The model incorporates key variables and their hypothesized relationships, as shown in Figure 1.

3. Research methodology

3.1 Research design and sampling

Manufacturing enterprises in Ghana were considered to achieve the research objective and test the hypothesis developed on the relationship between the variables. Ghana is at the genesis of building a manufacturing hub of Africa, with the government’s policy in 2015 to implement the one district-one factory (1D1F). The 1D1F is a policy initiative to have one manufacturing company in each of the 275 districts in Ghana. According to the Ghana Statistical Service, these manufacturing companies have been established to adapt to digital change rather than the traditional form. This will help the sector produce sustainable goods that meet international standards (R1-Q5 and R2-Q6). The research employed quantitative methods to comprehensively understand the relationships between digital transformation, digital leadership, technology capability, digital culture, and enterprise performance. A comprehensive literature assessment underpins the employed deductive technique. This method provides a systematic assessment of observations to develop hypotheses, which are subsequently tested by gathering data through surveys. A convenience sampling technique was employed to provide a diverse and inclusive sample of enterprises. Statistical power analysis was used to establish the sample size, estimate the bias, and guarantee reliable results. The inverse square root (Kock & Hadaya, 2018)

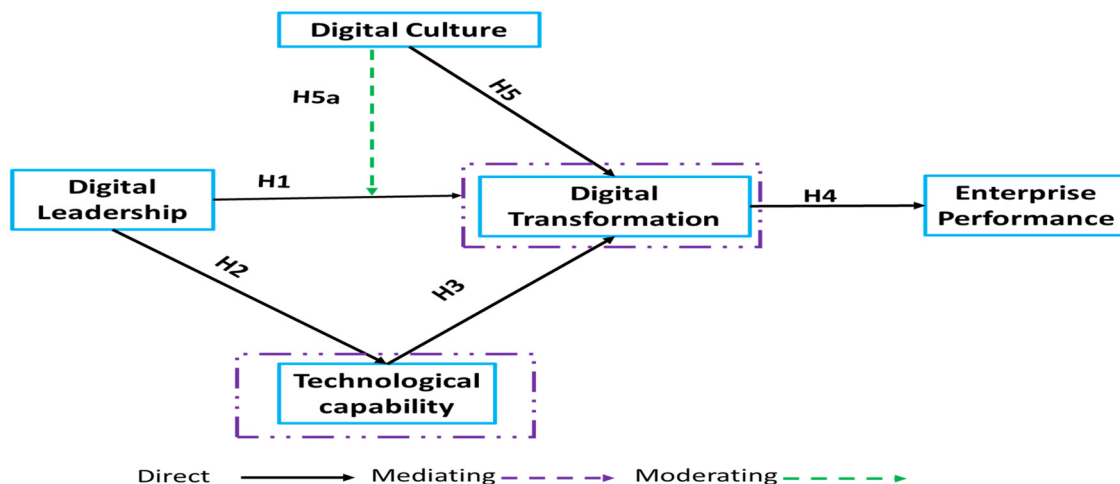


Figure 1. Conceptual model.

Source: Author’s contribution.

and statistical power analysis (G* power), with 0.95 statistical power and 0.03 effect size, were used while considering the sample size. Seventy-four data points were needed, with a 0.95 statistical power and a medium-sized effect of 0.15 anticipated. Furthermore, utilizing the inverse square root, 618 data points were sufficient to obtain a statistical power of 0.80 and a minimal path coefficient of 0.10 to actualize a significant effect of 0.05 (Kock & Hadaya, 2018). A sample size of 386 is suitable for an unknown population (Janes et al., 2017). An average sample size of 360 was deemed fit for the data analysis. Questionnaires were distributed via Google Forms to the managers within the selected manufacturing organizations, and 650 responses were received. About 459 usable responses, representing 70.6% of the sample size, seem appropriate for this study. The survey utilizes five Likert-scale questions to measure perceptions of digital transformation, digital leadership, technology capability, digital culture, and enterprise performance.

3.2 Measures and common method bias

Existing literature has indicated that adopting a measuring scale that has been previously tested helps to reduce bias and increase data reliability and validity. Five scales were employed to measure digital transformation, digital leadership, technological capability, digital culture, and enterprise performance. Table 1 illustrates the various measured scales, proxies, and references adopted. The researchers followed the empirical literature to check for common method bias of the developed questionnaires, adopting the suggestions of Podsakoff et al. (2003). The current study employed SPSS 23 and Herman's one-factor procedure. The results demonstrated that a single construct explained about 43% of the variance. With the threshold of 50%, this result was accepted for further analysis. Similarly, KMO and Bartlett's test of sample validity had a value of 0.875 and 0.001, illustrating that no standard method bias exists in the questionnaire data gathered.

3.3 Data analysis

Previous research has indicated that when multiple dimensions are presented in a model, it is significant to adopt the SEM approach as it predicts all the constructs' validity and reliability (Streukens & Leroi-Werelds, 2016). Because of its advantages over other statistical methods, the partial least squares structural equation modelling

(PLS-SEM) was employed for the statistical study. For example, PLS-SEM is the suggested method when the research goal is theory development and variance explanation (prediction of the constructs) (Hair et al., 2022). Also, the approach works well with complex models and small sample sizes and rarely makes any assumptions about the underlying data. Moreover, it is relatively robust as long as the missing data are maintained below a reasonable threshold. Furthermore, using SEM, endogenous components that explain the most variation are estimated and examined (Roldán & Sánchez-Franco, 2012). Because PLS-SEM does not require normally distributed data, it is a better choice. Finally, given that the study's primary goal was to assess the hypotheses, PLS-SEM was judged to be more suitable for creating a theoretical model and verifying the proposed causalities. The technique consists of two models: measurement and structural evaluation.

Demographic variable	Frequency	Percentage
Gender		
Male	238	52
Female	221	48
Age (in years)		
≤25	41	8.93
26–35	203	44.23
36–45	137	29.85
46–55	51	11.11
Above 55	27	5.88
Education		
HND	56	12.20
Bachelors	262	57.08
Masters	119	25.93
PhD	22	4.79
Working experience		
Less than 5	70	15.25
5–10	263	57.30
11–15	94	20.48
16–20	28	6.10
Above 20	4	0.87
Position		
Top	66	14.38
Middle	195	42.48
Junior	163	35.51
Front liner	35	7.63

Table 1. Demographic profile of respondents. Source: Authors' own compilation.

Hair et al. (2017) state that the structural and measurement models must be evaluated independently to achieve accurate findings. For this reason, the measurement model was first looked at in this evaluation. Convergent and discriminant tests were run for validity and reliability. These encompass the Cronbach alpha (CA), composite reliability (CR), variance inflation factor (VIF), average variance extracted (AVE), HTMT, and Fornell–Larcker validity (Hair et al., 2022). Next, the route coefficients of the structural model, where the direction of the hypotheses was developed, were determined using the bootstrapping method (5,000 iterations). The study's significance level concerning the significant routes was established using a 95% confidence interval. Also acquired were the fit indices. Version 4.1.0.6 of the Smart PLS program was used for all these analyses (Ringle et al., 2022).

4. Results

4.1 Demographic profile of respondents

Table 1 demonstrates the respondents' demographic profile – gender, age, participants' education, working experience, and position within the various manufacturing enterprises. Around 238 of the 459 respondents were male, whereas the remaining were women. More than 50% of the participants surveyed ranged between 26 and 45 years old. This meant that enterprises in the manufacturing sector employed the younger generation, who were capable of working. Moreover, about 88% of the respondents have had bachelor's degrees. Regarding work experience, the majority had worked for over 5 years. Among the participants, more than 77% were junior and middle managers.

4.2 Measurement model

Reliability, convergent validity, and discriminant validity were evaluated to validate the measurement model. The degree to which one measure strongly correlates with another measure measuring the same construct is known as convergent validity (Hair et al., 2017, 2022). According to Hair et al. (2014), discriminant validity guarantees that a concept measure is empirically distinct and captures phenomena of interest that other measures in a structural equation model fail to capture. Since every construct in this study was modeled as reflecting, the indicators should share a large percentage of the variance (Hair et al., 2014).

Indicator reliability (outer loadings) and AVE were examined to determine convergent validity, as shown in Table 2. All AVE values were greater than 0.5, which attested to the validity of convergence (Hair et al., 2014). Also, every item's loading was higher than the criterion value of 0.7, indicating the attainment of dependability. Moreover, CA and CR of the constructs were used to evaluate the measures' dependability.

According to Hair et al. (2017, 2022), CA estimates reliability based on the intercorrelations of the observed indicator variables, whereas CR prioritizes the indicators based on their dependability. According to Hair et al. (2022), all the CR and CA values were 0.7, showing the reliability of the measurements. The square root of the AVE values was compared with the latent variable correlations, taking discriminant validity into account.

To verify good discriminant validity, the square roots of the AVE for each construct were greater than the correlations for the other components in the study (Fornell–Larcker, 1981) (Table 3). The authors examined the cross-loadings that arise when an indicator's outer loading on the nexus construct exceeds the aggregate of its cross-loadings and affiliations with all other constructs. From Table 4, the cross-loadings are less than the outer loadings of the indicators, indicating that discriminant validity is achieved. Table 5 illustrates the results of the heterotrait–monotrait ratio of correlations (HTMT) test, which was introduced by Henseler et al. (2015) to remedy the issues related to the Fornell–Larcker. The discriminant validity results are achieved as each deattenuated correlation is less than 0.85.

4.3 Structural model

The study evaluated the structural model to confirm the predictive ability of the model and the significance of the affiliation among the constructs (Hair et al., 2022) after obtaining an acceptable validity and reliability. In our study, three endogenous (technological capability, digital transformation, and firm performance) and two exogenous constructs (digital culture and digital leadership) are present in the model. Given that the VIF values for every item ranged from 1.00 to 4.40 (Hair et al., 2017), the researchers detected that the data show no multicollinearity. Moreover, the significance of the proposed relationships was validated. Accordingly, the path coefficients show the proposed correlations as Streukens and Leroi-Werelds (2016) indicated. The bootstrapping with replacement technique, considering 5,000 resamples, was run in Smart PLS4 to test the proposed correlations and outcomes, as illustrated in Table 5.

Construct	Item	Loadings	CR	CA	AVE	VIF
Digital culture	DIGIC1	0.796	0.929	0.897	0.767	1.746
	DIGIC2	0.875				2.545
	DIGIC3	0.902				4.179
	DIGIC4	0.924				4.543
Digital leadership	DIGIL1	0.905	0.952	0.937	0.800	4.026
	DIGIL2	0.911				4.663
	DIGIL3	0.915				4.400
	DIGIL4	0.893				3.723
	DIGIL5	0.845				2.719
Digital transformation	DIGIT1	0.813	0.919	0.888	0.694	2.459
	DIGIT2	0.864				3.064
	DIGIT3	0.910				3.436
	DIGIT4	0.825				2.247
	DIGIT5	0.744				1.650
Enterprise performance	ENTP1	0.857	0.950	0.934	0.791	3.019
	ENTP2	0.915				4.444
	ENTP3	0.897				3.536
	ENTP4	0.896				3.522
	ENTP5	0.881				3.235
Technological capability	TECH1	0.871	0.952	0.936	0.797	2.756
	TECH2	0.881				3.469
	TECH3	0.892				3.532
	TECH4	0.923				4.613
	TECH5	0.897				3.788

Table 2. Item loadings, CR, CA average, and variance extracted.

Source: Authors’ own compilation.

The quality of this model was estimated using the standardized root mean square residual (SRMR), *R* square, *Q* square, and *f* square. The SRMR value of 0.068 corroborates a good fit (Henseler et al., 2015). An *R*-squared value of 0.812 (digital transformation) and 0.586 (enterprise performance) indicates that the independent variables in the

model account for more than 50% of the variation in digital transformation and enterprise performance. This suggests that the independent variables (such as digital leadership, technological capability, and digital culture) included have a good explanatory power in predicting DIGIT (Hair et al., 2017, 2022). Also, DIGIT is a key predictor

Constructs	DIGIC	DIGIL	DIGIT	OP	TECH	<i>R</i> ²	Adjusted <i>R</i> ²	<i>Q</i> ²
DIGIC	0.876							
DIGIL	0.696	0.894						
DIGIT	0.839	0.779	0.833			0.812	0.810	0.547
ENTP	0.670	0.868	0.766	0.889		0.586	0.585	0.460
TECH	0.868	0.686	0.818	0.637	0.893	0.470	0.469	0.369

DIGIC – Digital Culture; DIGIL – Digital leadership; DIGIT – Digital Transformation; OP – Firm Performance; TECH – Technological Capability. The bold figure is the square root of the average variance extract, indicating that a construct self correlation should be high than as compare with other constructs.

Table 3. Fornell–Larcker Criterion, *R*², and *Q*².

Source: Authors’ own compilation.

	DIGIC	DIGIL	DIGIT	ENTP	TECH
DIGIC1	0.796	0.561	0.735	0.586	0.701
DIGIC2	0.875	0.622	0.726	0.591	0.763
DIGIC3	0.902	0.616	0.708	0.586	0.767
DIGIC4	0.924	0.633	0.763	0.582	0.805
DIGIL1	0.640	0.905	0.718	0.835	0.642
DIGIL2	0.620	0.911	0.684	0.825	0.612
DIGIL3	0.635	0.915	0.705	0.832	0.610
DIGIL4	0.581	0.893	0.638	0.742	0.567
DIGIL5	0.627	0.845	0.730	0.646	0.628
DIGIT1	0.632	0.549	0.813	0.563	0.569
DIGIT2	0.687	0.653	0.864	0.650	0.611
DIGIT3	0.754	0.752	0.910	0.766	0.735
DIGIT4	0.649	0.711	0.825	0.677	0.605
DIGIT5	0.765	0.555	0.744	0.505	0.882
ENTP1	0.589	0.684	0.634	0.857	0.542
ENTP2	0.568	0.758	0.691	0.915	0.561
ENTP3	0.594	0.739	0.679	0.897	0.543
ENTP4	0.620	0.842	0.694	0.896	0.585
ENTP5	0.609	0.831	0.703	0.881	0.601
TECH1	0.864	0.639	0.733	0.602	0.871
TECH2	0.690	0.534	0.683	0.493	0.881
TECH3	0.730	0.620	0.730	0.564	0.892
TECH4	0.798	0.623	0.750	0.595	0.923
TECH5	0.785	0.637	0.752	0.583	0.897

DIGIC – Digital Culture; DIGIL – Digital leadership; DIGIT – Digital Transformation; ENTP – Firm Performance; TECH – Technological Capability. The cross-loadings that arise when an indicator's outer loading on the nexus construct exceeds the aggregate of its cross-loadings and affiliations with all other constructs.

Table 4. Cross loadings.

Source: Authors' own compilation.

Constructs	DIGIC	DIGIL	DIGIT	ENTP	TECH
DIGIC					
DIGIL	0.757				
DIGIT	0.800	0.847			
ENTP	0.732	0.726	0.834		
TECH	0.845	0.729	0.696	0.679	

DIGIC – Digital Culture; DIGIL – Digital leadership; DIGIT – Digital Transformation; ENTP – Firm Performance; TECH – Technological Capability.

Table 5. HTMT evaluation.

Source: Authors' own compilation.

of enterprise performance. Additionally, the blindfolding approach in PLS was utilized to evaluate the *Q* square of the endogenous constructs – digital transformation (0.547), enterprise performance (0.460), and technological capability (0.369). These values are greater than zero (between 0.369 and 0.547) and have a medium-sized effect, suggesting substantial predictive importance (Stone, 1974). Moreover, the *f*-squared values, which measure the contribution of each exogenous variable toward the model's predictive stability, were evaluated utilizing Cohen's (1988, 1992) threshold (small effect ≥ 0.02 ; moderate effect ≥ 0.15 , significant effect ≥ 0.35). All the *f*-squared values between 0.10 and 0.88 for the constructs were greater, indicating that a good predictive stability of the model is achieved.

In this study, the evaluation concerning the direct effects hypotheses is represented in Table 6. The bootstrapping approach in Smart PLS 4 was adopted (Ringle et al., 2022). The study hypothesized that digital leadership has a direct positive impact on DIGIT (H1) ($\beta = 0.340$; $p < 0.000$; $t = 7.325$), while DIGIL has a significant positive influence on technological capability ($\beta = 0.686$; $p < 0.000$; $t = 20.70$). Therefore, H1 and H2 are supported. A significant *t*-statistic was found on the relationship between technological capability and digital transformation ($\beta =$

	Path	Beta	Std. dev.	T-statistics	P-value	Confidence interval	Conclusion
H1	DIGIL → DIGIT	0.340	0.046	7.325	0.000	[0.196; 0.350]	Accepted
H2	DIGIL → TECH	0.686	0.033	20.70	0.000	[0.618; 0.748]	Accepted
H3	TECH → DIGIT	0.253	0.057	4.463	0.000	[0.197; 0.396]	Accepted
H4	DIGIT → ENTP	0.766	0.026	29.673	0.000	[0.713; 0.815]	Accepted
H5	DIGIC → DIGIT	0.382	0.049	7.784	0.000	[0.258; 0.440]	Accepted
H5a	DIGIL* DIGIC → DIGIT	0.147	0.021	6.919	0.000	[0.099; 0.182]	Accepted

DIGIC – Digital Culture; DIGIL – Digital leadership; DIGIT – Digital Transformation; ENTP – Firm Performance; TECH – Technological Capability.

Table 6. Direct effect and moderation effect.

Source: Authors' own compilation.

Path	Impact of IV on M (a)	Impact of M on D (b)	DI (c')	Indirect impact (a × b)	Total impact (c = c' + a × b)	VAF	Decision
DIGIL → TECH → DIGIT	0.686	0.253	0.340	0.173	0.513	33.7%	Partial mediation
			Beta	Std. dev.	T-stats	P-value	
DIGIC → DIGIT → ENTP			0.271	0.037	7.296	0.000	Accepted
DIGIL → DIGIT → ENTP			0.211	0.033	6.300	0.000	Accepted
TECH → DIGIT → ENTP			0.221	0.036	6.124	0.000	Accepted

DIGIC – Digital Culture; DIGIL – Digital leadership; ENTP – Firm Performance; DIGIT – Digital Transformation, IV – independent variable; M – mediator, D – dependent variable; DI – direct impact; VAF – Variance accounted for.

Table 7. Mediating effect and specific indirect effects.

Source: Authors' own compilation.

0.253; $p < 0.000$; $t = 4.463$) to warrant support for H3. Regarding H4, the study proposed that digital transformation positively and significantly influences firm performance ($\beta = 0.766$; $p < 0.000$; $t = 29.673$) and support was found for this relationship. Moreover, a material and favorable affiliation was between digital culture and digital transformation ($\beta = 0.382$; $p < 0.000$; $t = 7.784$). Thus, H5 was supported. The noteworthy and robust results of digital culture demonstrate that a substantial theoretical impact is achievable. Hence, the authors evaluated the moderating nexus of digital culture on the connection between DIGIL and digital transformation. The study discovered a considerable relationship between digital leadership and culture. The researchers discovered the impact of the interaction (DIGIC* DIGIL) on digital transformation ($\beta = 0.147$; $p < 0.000$; $t = 6.919$) was significant as predicted. Therefore, H5a is accepted.

Table 7 depicts the beta values of the mediation effect of technological capability on the nexus between DIGIL and DIGIT. The VIF value of 33.7% indicates that technological capability partially mediates the aforementioned link. Further, consider the specific indirect analysis in the PLS output, digital transformation emerged as a mediator on the affiliation between DIGIC and ENTP ($\beta = 0.271$; $p < 0.000$; $t = 7.296$), DIGIL and enterprise performance ($\beta = 0.211$; $p < 0.000$; $t = 6.300$), and technological capability and enterprise performance ($\beta = 0.221$; $p < 0.000$; $t = 6.124$) (Figure 2).

5. Discussions

The realization of digital transformation coupled with technological advancement has become a key element

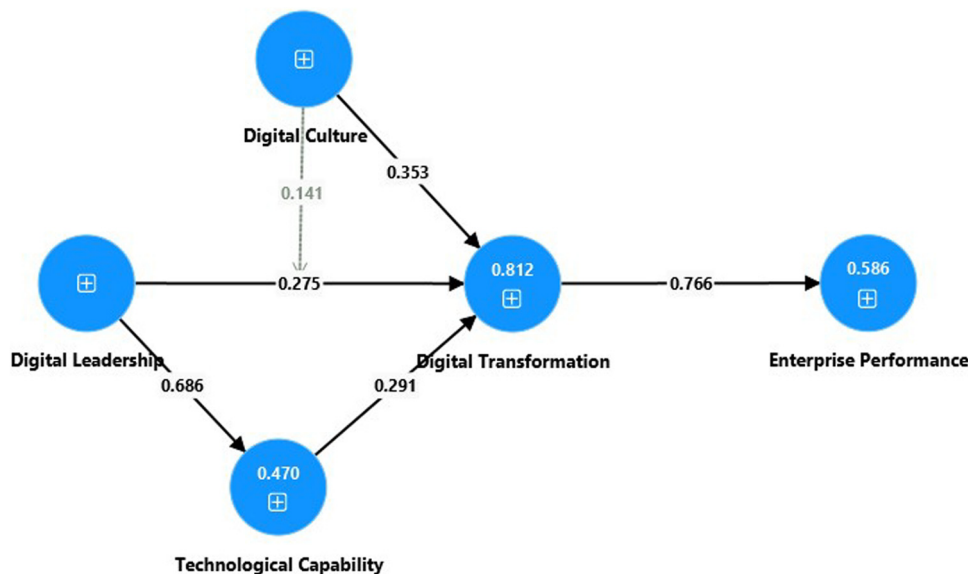


Figure 2. Structural model: Direct and indirect paths.

Source: Source: Author's own compilation from SMartpls4.

influencing organizational effectiveness in today's quickly evolving sustainable enterprise environment. Most importantly, DIGIL is highlighted as one of the most significant factors for the successful execution and application of digital transformation projects, technology utilization, and organizational effectiveness (Chatterjee *et al.*, 2023). However, studies and practice lack an in-depth comprehension of the linkages between these variables (Davison *et al.*, 2023; Mihi *et al.*, 2023; Tagscherer & Carbon, 2023). To bridge the lacuna between these studies, our study utilized the dynamic capability theory to evaluate the nexus among these variables. First, the study assessed DIGIT's antecedents, including digital leadership, digital culture, and technological capability. Consequently, the linkage between DIGIT and ENTP was examined, and the interaction effect of digital leadership and digital culture was presented.

The result of this study demonstrated that DIGIL has a strong and favorable impact on digital transformation. This outcome implies the notion that digital leadership is essential for the successful implementation and the aligning of digital transformation initiatives as the ability to drive cultural change, technological understanding, and strategic vision come handy to digital leaders (Hung *et al.*, 2023; Tagscherer & Carbon, 2023), thereby leading to firm performance (Davison *et al.*, 2023; Jameson *et al.*, 2022). The strong nexus between digital leadership and technological capability also corroborates that digital leadership has become an indispensable factor to warrant the survival and growth of a firm's digital technology adoption and innovation projects (Tarighi *et al.*, 2021; Tieng *et al.*, 2022) and sustainable technological communication (Jiang *et al.*, 2020). Altogether, individuals' ability, competencies, and behaviors to drive digital transformation projects and navigate uncertainty are essential for technological capability enhancement (Davison *et al.*, 2023; Persaud & Zare, 2023). Moreover, digital leadership increases technological capability through constant learning, digital entrepreneurship, and the ability to sense innovation opportunities (Zhe and Hamid, 2021; Tarighi *et al.*, 2021).

Additionally, this study confirms that technological skill is fundamental for digital transformation (Gillani *et al.*, 2020). In particular, the ability of businesses to mobilize and deploy IT and other resources and capabilities (such as data, hardware, software, technology, and technical talent) synergistically is the emphasis of technological capabilities (Mohapatra *et al.*, 2022), which enhances digital transformation. This result corroborates the assertion that significant technological capability is central to realizing digital transformation as speculated by prior literary works (for instance, Ellström *et al.*, 2021; Shen *et al.*, 2022; Yang *et al.*, 2021).

DIGIT has a strong affirmative and material effect on ENTP ($\beta = 0.766$; $p < 0.000$; $t = 29.673$) to indicate that a unit increase in digital transformation is more likely to enhance firm performance by 76%, with all other things being held constant. The reason has been that optimizing strategic and operational business processes can be made possible by digital transformation, giving rise to a competitive advantage, an indicator of firm performance. Moreover, upgraded operational effectiveness, customer experience, satisfaction, involvement, and innovation (Bazrkar *et al.*, 2022) can have benefits that impact organizational performance. Further, increased market share and faster sales growth are linked to smart investments in digital transformation projects (Zhang *et al.*, 2021). The outcome substantiates that of prior studies (Mohammed & AL-Abrow, 2023; Rupeika-Apoga *et al.*, 2022; Zhang *et al.*, 2023).

An organization's values, conventions, and guiding principles are reflected in its digital culture, which enables it to be more adaptable while it is undergoing change or transformation in its use of digital resources. Specifically, an organization with a strong culture toward positive attitudes and behaviors and adaptability is more likely to undergo digital transformation. Altogether, digital culture fosters the development of innovative technologies (Balakrishnan & Das, 2020). In the context of digitalization, several studies attest to the impact of digital culture on DIGIT (Lee Ludvigsen & Petersen-Wagner, 2023; Mihi *et al.*, 2023). This study asserts that digital culture is even more advantageous toward digital transformation, adding to the empirical evidence of the nexus between the two (Alrasheedi *et al.*, 2022; Cserdi *et al.*, 2022). Organization's culture remains an underlying factor in its behavior in the contemporary world, and DIGIL is emerging as a crucial area of inquiry in the wake of digital transformation. Hence, the interaction between DIGIL and culture and how they drive digital transformation was plausible. Hence, the study evaluated the moderating influence of digital culture on the connection between DIGIL and digital transformation. The study demonstrates that digital culture helps organizations use their digital leadership skills to support digital transformation, improving firm performance, with a close to moderate positive moderation impact. This research suggests that while digital leadership is helpful for organizations' strategic decisions in this fast-paced, digital world, digital leaders with a strong digital culture are even more advantageous for DIGIT. A digitally inclined leader would be much more likely to transform the organization digitally when their culture toward utilizing technology is strong. Distinctively, our study confirms that digital leadership enhances digital

transformation through technological capability, suggesting that technological capability is significant in the digital economy. Similarly, in the current organizational environment where technology is heavily deployed and required, firm performance will be enhanced through digital leadership, technological capability, and digital culture when more emphasis is placed on digital transformation.

6. Conclusion, theoretical, and policy

6.1 Conclusion

The changing ecological landscape of business within the manufacturing sector has seen speed in technology and its effect on consumer taste and product development. The evaluation assessed the interrelationships between digital transformation, digital leadership, digital culture, and technological capability on enterprise performance, with questionnaires on 459 participants and employing the robust Smart PLS analytical approach. The investigation illustrated that digital leadership and technological capability had a favorable material affiliation with digital transformation. Again, digital transformation affirms a partial direct material mediating nexus with enterprise performance. Further, digital culture asserts a moderating relationship between DIGIL and DIGIT. The findings demonstrate a corroborated inspection outcome in the dynamic capability model context. The expounds of the evaluation estimates communicate to managers and policymakers that digital transformation can be accomplished through proper integration of digital leadership, technological capabilities, and digital culture to utilize the enterprise's resources efficiently.

6.2 Theoretical and practical suggestions

The current investigation contributes theoretically to the dynamic capability model and digital transformation assessment. First, the theoretical support of DCM gives a solid foundation for understanding why manufacturing enterprises pursue digital transformation practices. One unique theoretical contribution of our study is the empirical validation of the DCM within the context of digital transformation. While DCM has been explored deeply in management and marketing research fields, its application to digital transformation is scarce. This study demonstrates how enterprises can develop dynamic capabilities, such as digital leadership and technology capabilities, to keep pace with innovation and improve enterprise

performance. The results of the authors' investigation reveal that the direct and mediating role of digital leadership and technological capabilities had a positive relationship with digital transformation, enriching DCM and supporting novel studies into enterprise performance. The study identifies specific contextual factors that influence the effectiveness of digital transformation practices in moderating digital culture. This contributes to a more context-aware approach to digital transformation, acknowledging that the impact of these practices can vary depending on institution, industry, and government policy. Again, this study adds to the literary works on enterprise performance investigation by empirically validating a theoretical model premise on a unified model of digital leadership, technological capability, digital culture, and digital transformation practices, bringing together the past studies into an extensive one. The outcome from the research provides novel insights into the existing literary work on digital transformation, digital leadership, digital culture, technological capability, and enterprise performance, through the DCM in the adoption, implementation, and continuous improvement of digital transformation practices. The findings established how enterprises can transform their manufacturing innovation processes through dynamic capabilities to achieve efficiency (R2-Q8). The result of this study provides valuable guidance to practitioners. The evaluation suggests that organizations should foster their performance by recognizing that digital transformation is a game changer regarding strategic choices. Moreover, organizations seeking to improve their performance should embrace digital transformation by having an effective digital leader, embracing cultures that foster innovation, and being technologically capable. The results highlighted that enterprises could appreciate their performance efficiency when digital leadership is channeled through digital transformation. Additionally, culture, previously considered a catalyst for technological adoption and transformation, was found to moderate the affiliation through digital leadership. Hence, it is suggested that institutions within the manufacturing enclave should integrate digital culture with digital leadership. Furthermore, it was evident that various technological capabilities accelerate digital transformation. It is recommended that the government provide enterprises with tax breaks and subsidies to employ various technological strategies.

6.3 Further research and limitations

Although this research offers a new contribution to the digital transformation agenda, it has some drawbacks that present an opportunity for future studies. Our

research was limited to the geographical context of Ghana. Even though Ghana is considered the gateway to West Africa, its economy differs from that of other emerging economies. Future research must compare the other outcomes with those of other developing countries such as Bangladesh, Nigeria, and Togo. After that, the findings can be generalized to emerging countries. Again, the study only employed data-collection managers, which may cause data bias. Researching different participants, such as employees and individuals with diverse digital transformation knowledge, is suggested. Furthermore, quantitative research uses questionnaires as a data collection strategy. Future evaluation could employ different methodologies, including qualitative. Finally, the direct effect of the moderating role of digital culture could be explored in different sectors, such as the banking sector (R1-Q4).

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Author contributions

Takyi, Bludo, and Aloysius: Conceptualization, writing—original draft, writing—review & editing, data curation, methodology, resources, formal analysis. Miloslava: review & editing, and supervision.

Conflict of interest statement

The authors declared no potential conflicts of interest concerning this article’s research, authorship, and/or publication.

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