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Technological Factors and Digital Innovation Adoption: Insights from Family-Owned MSMEs in an Emerging Economy

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Abstract

Innovation through digital technologies, or digital innovation adoption (DIA), is of great importance to the success of family-owned micro-, small- and medium-sized enterprises (MSMEs) in today's rapidly changing digitally driven business environment. These digital changes, which impact markets and business models, as well as products and services, are becoming increasingly frequent and highlight the technological influences on family businesses. Given the need to understand these influences on DIA in the context of family businesses, this study investigated the relationships between several technological factors and DIA among Kenyan family-owned MSMEs, as well as the relationship between DIA and the financial performance of these businesses. An online survey was administered, and a structured measuring instrument was used for data collection. Structural equation modelling was used to test the hypotheses, based on 355 usable questionnaires. The findings highlighted that the technological factors, particularly compatibility and cost, were related to DIA, and that DIA, in turn, was related to the perceived financial performance of Kenyan family-owned MSMEs. The study expanded family business research to non-Western contexts and responded to calls to investigate both digital innovation and the external factors that influence innovation adoption in the context of family businesses. These findings provide valuable insights to researchers, practitioners and policymakers working with smaller family businesses in Kenya that have relatively low levels of digital maturity, particularly regarding technological factors associated with DIA, and the MSMEs' ability to compete in an increasingly digital global environment.

Keywords: family business; digital innovation adoption; TOE framework; DOI theory; technological factors; MSMEs; emerging economy; Kenya

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1. Introduction

1.1. Background

Innovation through digital technologies (DTs) is increasingly central to the survival and growth of micro-, small- and medium-sized enterprises (MSMEs). In Kenya, where MSMEs contribute substantially to employment and Gross Domestic Product, and where most businesses are family-owned (Central Bank of Kenya, 2021, 2023; Kaibung'a, 2022; Republic of Kenya, 2024), digital innovation adoption (DIA) can transform business models, operational processes and market access. Family businesses, however, face distinctive tensions when responding to digital disruption, as they need to balance economic with

non-economic goals, socioemotional wealth goals, preserve legacy practices and manage family governance dynamics, which can increase risk aversion or slow managerial change (Calabrò et al., 2019; Soluk et al., 2021).

The broader literature on digital innovation highlights technological attributes and organisational readiness as central determinants of adoption (Oliveira & Martins, 2011; Hund et al., 2021; Yoo et al., 2024). By contrast, family business research has tended to emphasise family-specific drivers, such as succession concerns as well as socioemotional wealth and family mindsets. In addition, research has given relatively less attention to how the intrinsic characteristics of DTs themselves affect adoption choices in family businesses (Calabrò et al., 2019). Hu and Hughes (2020) explicitly call for research on external determinants of innovation in family businesses, noting the predominance of studies focused on internal contextual factors. In addition, much of the available empirical evidence is derived from Western or advanced-economy settings, creating a geographic gap in understanding how technological factors operate in non-Western, resource-constrained contexts (Ramdani et al., 2022).

Technological attributes such as relative advantage, compatibility, complexity, costs and cybersecurity risk influence the innovation-decision process because they shape perceived benefits, disruption and risk associated with technology adoption (Tornatzky & Fleischer, 1990; Rogers, 2003; Van den Berg & Van der Lingen, 2019). For MSMEs in emerging economies, infrastructure limitations, tighter budgets and elevated cybersecurity concerns may alter the relative importance of these attributes and, thus, the trajectory of DIA (Ghobakhloo et al., 2022; Omrani et al., 2022; Yujie et al., 2024). The Technology–Organisation–Environment (TOE) framework (Tornatzky & Fleischer, 1990) provides an integrative lens for examining technology adoption by recognising the technological, organisational and environmental contexts in which adoption decisions occur. However, the present study focused specifically on the technological attributes of DTs and their influence on adoption decisions. This focus was further grounded in Rogers's (2003) Diffusion of Innovations (DOI) theory, which identifies innovation attributes as important determinants of adoption. Accordingly, the TOE framework provided the broader contextual lens for the study, while the DOI theory provided a theoretical basis for examining selected technological attributes of DTs (Henao-Ramírez & López-Zapata, 2021; Omrani et al., 2022). The selected technological factors included relative advantage, compatibility, complexity, costs and cybersecurity. Relative advantage, compatibility and complexity were supported by DOI theory, while costs and cybersecurity were supported by the broader technology-adoption literature.

1.2. Problem Statement and Purpose of the Study

Despite the recognised importance of digital innovation for MSME competitiveness as well as the vulnerabilities and priorities of family businesses, family business research provides limited insight into how technological attributes influence DIA in family-owned MSMEs. This limitation often results from a heavy emphasis on family-internal determinants at the expense of organisational and technological factors (Calabrò et al., 2019), insufficient empirical attention to technological determinants for family businesses (Hu & Hughes, 2020), as well as a geographic bias toward Western contexts that leaves non-Western family-owned MSMEs under-studied (Ramdani et al., 2022). These gaps hinder theoretical development and constrain practical guidance for managers and policymakers seeking to promote effective DIA in family-owned MSMEs.

Guided by the TOE framework, the objective of this study was to investigate the relationships between selected technological attributes and DIA among Kenyan family-owned MSMEs as well as the relationship between DIA and the financial performance of

these businesses. DIA is operationalised as the process by which value-adding novelties enabled by DTs (changes in offerings, processes or business models) are operationalised and assimilated into organisations through managerial adoption decisions (Damanpour & Schneider, 2006; Pichlak, 2016; Hund et al., 2021; Yoo et al., 2024). In essence, DIA refers to the adoption and implementation of innovations enabled by DTs within organisations.

Theoretically, the study foregrounded technological attributes (namely, relative advantage, compatibility, complexity, cost, cybersecurity) within family business research, extending prior family-centric accounts by clarifying how these attributes drive DIA in family businesses (Tornatzky & Fleischer, 1990; Calabrò et al., 2019; Soluk et al., 2021). By testing the model with data from Kenyan family-owned MSMEs, the study contextualised adoption theory in a non-Western, resource-constrained setting and showed how infrastructure, budget and security constraints could modulate technology-adoption relationships (Ghobakhloo et al., 2022; Omrani et al., 2022; Ramdani et al., 2022). Practically, the findings provide family business owners or managers with a prioritisation roadmap, which emphasises investments in DTs that demonstrate compatibility, to increase the likelihood of DIA occurring in family-owned MSMEs in Kenya. For policymakers, the study highlights costs and compatibility as critical enablers to accelerate MSME digitalisation in an emerging economy context (Smart Africa, 2021; Yujie et al., 2024).

The article proceeds with a literature review, followed by the research method, results, discussion and study conclusions.

2. Literature Review

2.1. Digital Innovation and DIA in Family Businesses

Although the TOE framework encompasses technological, organisational and environmental dimensions, the present study intentionally focused on the technological dimension based on the specific focus and scope of the study. The use of the TOE framework served as the overarching contextual lens for understanding technology adoption, rather than implying that all three dimensions must necessarily be incorporated into a single empirical model. The study sought to identify which attributes of DTs shaped adoption decisions in family-owned MSMEs, as these represented technology-related characteristics that owners and managers evaluated when considering whether to adopt a digital innovation or not. This technological focus was further supported by Rogers's (2003) DOI theory, which identifies innovation attributes as important determinants of digital adoption. Accordingly, the TOE framework provided the study's broader contextual lens, while DOI provided a theoretical basis for examining selected technological attributes of DTs. The exclusion of organisational and environmental factors did not imply that these dimensions were theoretically unimportant or that they did not influence DIA; rather, they were outside the defined explanatory focus of the study. Importantly, the study did not seek to provide an exhaustive explanation of all determinants of DIA, but to extend understanding of selected technological determinants within the specific context of family-owned MSMEs in Kenya. This focused application was further supported by calls for greater attention to technology-related determinants of innovation in family businesses and emerging-economy contexts (Calabrò et al., 2019; Hu & Hughes, 2020; Ramdani et al., 2022).

As was argued in the introduction, family businesses face distinctive tensions when responding to digital disruption because they must balance economic with non-economic goals, socioemotional goals and priorities as well as preserve legacy, governance and routines (Calabrò et al., 2019; Soluk et al., 2021). The literature review builds on this premise by locating technological attributes as theoretically important but under-studied determinants in family business settings. Existing reviews and empirical studies confirm a dominant focus on family-internal drivers (for example, succession, family values and mindset)

and note a relative neglect of organisational and technological determinants (Calabrò et al., 2019; Hu & Hughes, 2020). In addition, post-2017 work has begun to unpack family-specific influences, such as inter- and intra-family communication, digital mindset and entrepreneurial action, but these studies primarily emphasise actors and attitudes rather than the properties of technologies that businesses evaluate for adoption (Kraus et al., 2020; Pöschl & Freiling, 2020; Rashid & Ratten, 2020; Soluk, 2022). Because family businesses commonly prioritise stability, reputation and control, technological attributes that reduce perceived disruption or demonstrate clear benefits may exert disproportionate influence on adoption decisions, which motivated this study's focused examination of the technology dimension in family businesses.

2.2. Technological Factors Influencing DIA in Family-Owned MSMEs

In this study, the TOE framework (Tornatzky & Fleischer, 1990) was adopted to demonstrate the relationships between several technological factors and DIA in family-owned MSMEs. The TOE framework organises adoption determinants into three interrelated contexts, namely, technological, organisational and environmental, which have been widely used to study DT adoption in SMEs (Oliveira & Martins, 2011; Henao-Ramírez & López-Zapata, 2021; Omrani et al., 2022). For family-owned MSMEs in emerging economies, the technological context is particularly salient because constrained resources, limited information technology infrastructure and family governance considerations make the inherent features of a technology (namely, its benefits, fit, complexity, costs and security) decisive in adoption decisions (Van den Berg & Van der Lingen, 2019; Ghobakhloo et al., 2022). In addition, the adoption and diffusion literature identify several recurrent technological attributes (factors) relevant to organisational adoption decisions (Rogers, 2003; Ghobakhloo et al., 2022; Ramdani et al., 2022). Descriptions of these recurrent factors in the context of this study are summarised in Table 1.

Table 1. Descriptions of technological factors influencing DT adoption in MSMEs.

Relative advantage (performance expectancy/perceived benefits/perceived usefulness): Measure of superiority a DT holds over the technology it replaces, which can be evaluated in economic terms as well as taking into account social status, convenience and contentment (Rogers, 2003; Ramdani et al., 2022; Ta & Lin, 2023).
Compatibility (facilitating conditions): Degree to which the DT is perceived as being consistent with existing values, needs and past experiences of potential adopters, as well as being compatible with existing IT infrastructure (Rogers, 2003; Ramdani et al., 2022; Faiz et al., 2024).
Complexity (effort expectancy, perceived ease of use): Degree to which a DT is seen as difficult to understand and use (Ghobakhloo et al., 2022; Ramdani et al., 2022; Ta & Lin, 2023; Faiz et al., 2024).
Costs (perceived or incurred): Initial costs (hardware and equipment, different software packages) and maintenance costs (licences, training, and expert consultants) associated with using DT (Ghobakhloo et al., 2022; Faiz et al., 2024). These costs have been investigated in terms of the perceived costs in some studies (Maduku et al., 2016; Shrivastava & Riaz, 2023) as well as incurred costs in other studies (investment made and associated expenses) (Sun et al., 2018; Faiz et al., 2024).
Cybersecurity risks: Degree to which the DT is perceived as insecure, unreliable and untrustworthy, lacking data protection, and providing insufficient protection to dissuade device hacking and vulnerability exploitation (Ghobakhloo et al., 2022; Hoang, 2024).
Trialability: Degree to which the DT can be experimented with before adoption (Rogers, 2003; Ramdani et al., 2022). Observability: Degree to which the results of DT are visible to others (Rogers, 2003).

Source: authors' compilation.

2.3. Hypotheses Development

Underpinned by the TOE framework, this study hypothesised that there were relationships between several technological factors and DIA, and that DIA was related to the perceived financial performance of Kenyan family-owned MSMEs. The technological factors of interest for the study related to the attributes of DTs, which influenced whether businesses would innovate using these DTs or not. When these attributes are perceived favourably, businesses are more likely to innovate using these DTs (DIA). In addition, successful DIA often enhances operational performance and customer satisfaction, leading to improved financial performance.

Five of the seven technological factors listed in Table 1 were selected as independent variables for investigation in this study, namely, relative advantage, compatibility, complexity, costs and cybersecurity. These factors were selected because most studies (see Table 2) using the TOE framework (e.g., Bakar et al., 2024; Faiz et al., 2024; Ibrahim et al., 2025; Nazir et al., 2024; Rehman et al., 2024) have identified these factors as influencing DT adoption among SMEs. However, trialability was not selected because these DTs are already widely known, accessible and usable among both technical and non-technical user populations, making opportunities for prior experimentation less central to adoption decisions (Nambisan et al., 2020; Hund et al., 2021). This was further supported by the widespread exposure to DTs in Kenya, particularly mobile-money technologies such as M-PESA. For example, as of Quarter 3, 2026, approximately 53 million mobile-money subscriptions were reported in Kenya, with Safaricom (2026) reporting approximately 43 million M-PESA users (Communication Authority of Kenya, 2026). M-PESA provides digital payment, savings, credit and insurance services, contributing to widespread familiarity with digital technologies among Kenyan users (Kingiri & Fu, 2020; Misati et al., 2024; Anning-Dorson, 2025). Moreover, trialability primarily influences the pre-adoption phase, whereas this study focused on the adoption decisions. Observability was similarly excluded because the selected factors, namely, relative advantage, compatibility, complexity, costs and cybersecurity, were considered more proximal determinants of DIA than the visibility of adoption outcomes. Against this background, the hypotheses were formulated for empirical testing.

Table 2. Studies supporting selected technological factors influencing DT adoption.

Factor	Dependent Variable	Reference
Relative advantage (+)	Digital technology adoption	Shahadat et al. (2023)
	Big data adoption	Lutfi et al. (2022); Maroufkhani et al. (2020)
	Blockchain adoption	Wong et al. (2020); Kumar et al. (2021)
	Social commerce adoption	Abed (2020); Bakar et al. (2024)
	Cloud-computing adoption	Alshamaila et al. (2013); Pathan et al. (2017)
	Social media marketing adoption	Nazir et al. (2024)
Compatibility (+)	Social customer relationship management adoption	Ahani et al. (2017)
	Cloud-computing adoption	Pathan et al. (2017)
	Blockchain technology adoption	Kumar et al. (2021)
	Metaverse adoption	Rehman et al. (2024)

Table 2. *Cont.*

Factor	Dependent Variable	Reference
Complexity (-)	Digital technology adoption	Alshamaila et al. (2013); Shahadat et al. (2023)
	Cloud-computing adoption	Pathan et al. (2017)
	Blockchain adoption	Wong et al. (2020); Kumar et al. (2021)
	Social media marketing adoption	Nazir et al. (2024)
Costs (-)	DT adoption	Ibrahim et al. (2025); Wong et al. (2020)
	Digital transformation adoption	Yujie et al. (2024)
Cybersecurity (+)	Cloud-computing adoption	Skafi et al. (2020)
	Industry 4.0 cloud-computing	Bakar et al. (2024)

Source: authors' compilation.

Relative advantage (perceived benefits/performance expectancy) refers to the extent that a DT is perceived as superior to current practice (Rogers, 2003; Ramdani et al., 2022). For example, family owners and managers are more likely to accept DTs that clearly improve efficiency, customer value or strategic positioning because visible benefits reduce perceived risk and justify change. As empirical SME studies find robust positive effects of perceived adoption benefit (Shahadat et al., 2023; Ramdani et al., 2022), it was hypothesised that

H1. *There is a positive relationship between the relative advantage of using DTs and DIA among Kenyan family-owned MSMEs.*

Compatibility captures the degree to which a DT fits with existing values, routines and infrastructure (Rogers, 2003; Ramdani et al., 2022). In family-owned MSMEs, where operations and decision processes are often informal and shaped by tradition, DTs that integrate smoothly with existing practices minimise disruption to family governance and operational continuity. Prior small- and medium-sized enterprise (SME) research reports compatibility as a consistent positive predictor of DT uptake (Pathan et al., 2017; Kumar et al., 2021) and, therefore, the study hypothesised that

H2. *There is a positive relationship between the compatibility of DTs with the business and DIA among Kenyan family-owned MSMEs.*

Complexity (effort expectancy/perceived ease of use) refers to the perceived difficulty of understanding and using DTs (Ghobakhloo et al., 2022; Ramdani et al., 2022). Higher complexity raises training requirements and reliance on external expertise, which is costly and risky for resource-constrained family-owned MSMEs and, thus, tends to deter adoption (Alshamaila et al., 2013; Shahadat et al., 2023). Accordingly, it was hypothesised that

H3. *There is a negative relationship between the complexity of DTs and DIA among Kenyan family-owned MSMEs.*

Costs include initial acquisition and ongoing expenses (hardware, software, licences, training, maintenance) and can be measured as perceived or actual financial burden (Maduku et al., 2016; Ghobakhloo et al., 2022). For MSMEs operating with tight budgets, higher costs pose a direct barrier to adoption; as a result, SME empirical studies typically find that higher perceived or incurred costs reduce DT uptake (Yujie et al., 2024;

Ibrahim et al., 2025). Based on these arguments and existing technology-adoption studies, it was hypothesised that

H4. *There is a negative relationship between the costs associated with using DTs and DIA among Kenyan family-owned MSMEs.*

Cybersecurity concerns relate to perceived security, privacy and reliability of DTs (Skafi et al., 2020; Ghobakhloo et al., 2022). Because family businesses often prioritise reputation and control, perceived security risks can strongly deter adoption; conversely, higher perceived security encourages uptake. SME studies in cloud and Industry 4.0 domains corroborate the importance of security perceptions for the adoption of DTs (Skafi et al., 2020; Bakar et al., 2024). Thus, it was hypothesised that

H5. *There is a positive relationship between perceived cybersecurity when using DTs and DIA among Kenyan family-owned MSMEs.*

The introduction emphasised the potential performance benefits of DIA. In addition, the literature indicates that the adoption of DTs can enhance operational efficiency, customer reach and process automation, translating into improved financial outcomes (Ferreira et al., 2019; Abou-Foul et al., 2021; Sinaga et al., 2023). For family-owned MSMEs, these gains depend on adoption depth and complementary capabilities, but the general expectation is positive. As a result, the study hypothesised that

H6. *There is a positive relationship between DIA and perceived financial performance among Kenyan family-owned MSMEs.*

3. Research Method

The study adopted a quantitative approach to theory development and was cross-sectional in nature. An online survey was administered, and a structured measuring instrument was used to collect the data. Structural equation modelling (SEM) was used to test and analyse the relationships between the dependent and independent variables, based on 355 usable questionnaires. The study complied with the ethics procedures of the authors' institution.

3.1. Study Population, Sampling and Sample Size

The study population consisted of Kenyan family-owned MSME owners and/or managers who met the required criteria, namely, their business was a family-owned business, they were licenced and recognised by the Micro and Small Enterprises Authority in Kenya, the business employed between 0 and 250 people, and had a digital maturity level (DML) of either digital indifference, digital observer, digital challenger or digital native (see Table 3). A family business was defined as being owned by a single family with more than 50% share in the business, and at least two family members working in the business.

A sample of family-owned Kenyan MSMEs was chosen through the non-probability sampling technique of convenience sampling. After obtaining an ethics clearance number (1123) from the Research Ethics Committee (Human) from the authors' affiliated institution, an electronic link to the questionnaire was emailed to 11,747 potential respondents. The details of the potential respondents were obtained from the Kenya National Bureau of Statistics' (2016) MSME database, the databases of Muigai et al. (2021, 2023) and a database developed by the researcher's own institution. The online survey was administered between 30 August 2024 and 4 March 2025. In total, 355 completed questionnaires were received from respondents who met the criteria for participation. The sample size was considered

suitable for the SEM model proposed, as a minimum of 200 for standard models that are not complex is adequate (Gana & Broc, 2018).

Table 3. Descriptions of DMLs.

DML Digital indifference: Relies heavily on manual processes, has limited digital skills and digital investments focus on spreadsheet use (Excel) as opposed to sophisticated digital applications/cloud-based tools.
DML Digital observer: Relies on several non-automated processes but focuses on digitalisation through investments aimed at acquiring digital skills and utilising digital applications as well as reporting tools based on existing digital solutions.
DML Digital challenger: Prioritises agility through a documented digital strategy focused on automating core processes to enhance productivity by making strategic investments in digital skills.
DML Digital native: Has a comprehensive strategy for digital innovation. Strives for complete process automation through an agile approach focused on process transformation, appropriate digital skills, talent prioritisation, an agile and adaptable culture, cloud-first commitment and digital technology utilisation as well as widespread analytics adoption.

Source: authors' compilation based on Kane et al. (2017) and International Data Corporation and Cisco (2020).

3.2. Profile of Respondents

The demographic profile of respondents and their businesses is summarised in Table 4.

Table 4. Demographic profile of family-owned business and respondent.

Characteristics of Business			**Characteristics of Respondent**		
Characteristic	**Category**	**%**	**Characteristic**	**Category**	**%**
Number of employees	<10	54.1	Position	CEO/MD	51.3
	10–50	31.0		CFO	4.2
	51–250	14.9		COO	8.5
Turnover	<$5000	23.7		CPO	2.0
	$5001–$50,000	34.4		Manager	18.0
	$50,001–$1M	36.1		Other	16.1
	Other	5.9	Gender	Male	66.2
Total assets	<$5000	21.1		Female	33.8
	$5000–<$1M	57.7	Age	Not willing to share	0.6
	$1M–$2.5M	15.8		<20	0.3
	Other	5.4		20–29	15.2
Tenure (years)	<5	25.9		30–39	24.5
	5–10	22.0		40–49	34.1
	11–15	16.6		50–59	18.0
	16–20	10.1		60+	7.3
	21–25	9.0			
	26–30	7.9			
	>30	8.5			

Table 4. *Cont.*

Characteristics of Business			Characteristics of Respondent		
Characteristic	**Category**	**%**	**Characteristic**	**Category**	**%**
Industry	Manufacturing	4.5			
	Retail	18.6			
	Services	61.4			
	Agriculture	4.8			
	Construction	1.1			
	Combined/Other	9.6			
Digital profile	Digital indifference	30.4			
	Digital observer	36.1			
	Digital challenger	21.4			
	Digital native	12.1			

Source: authors' compilation.

3.3. Instrument Development and Scales

The measuring instrument consisted of a section relating to demographic information, as well as a section with 33 randomised statements relating to the various technological factors under investigation, DIA and perceived financial performance. These statements were adapted from scales that had previously demonstrated acceptable validity and reliability in the literature (see Appendix A). To further strengthen the validity of the measurement instrument within the context of this study, its content validity was established through an independent review by two experts with research expertise in digital innovation and family business, followed by a pilot study involving a small group of Kenyan family-owned MSMEs. Feedback obtained from both the expert review and the pilot study informed minor questionnaire improvements. Responses were captured using a 7-point Likert scale, ranging from strongly disagree (1) to strongly agree (7).

3.4. Data Analysis

The statistical software, IBM SPSS Statistics (Version 20.0.2.0) and IBM AMOS Statistics 27, was used to undertake the descriptive and SEM analyses. Common method bias was not considered an issue as the total variance extracted by one factor was 29.29%, which was well below the cut-off level of 50% (Podsakoff et al., 2024). Furthermore, no item correlation exceeded the commonly accepted threshold of 0.80, which is often used to detect multicollinearity.

As the first step of undertaking SEM, the construct validity of the measuring instrument was established by evaluating the measurement models through confirmatory factor analysis (CFA) using several goodness-of-fit (GOF) indices (Orcan, 2018). The indices used were the Normed Chi-square (CMIN/df (x^2/df) = <3.00), the goodness-of-fit index (GFI > 0.90), the comparative fit index (CFI > 0.90), the standardised root mean residual (SRMR < 0.08) and the root mean squared error of approximation (RMSEA > 0.90). In addition, a CFA was undertaken on each of the factors under investigation. To assess the convergent validity of the measurement scales, the Average Variance Extracted (AVE) estimates of the constructs were compared to the threshold value of 0.5 (Hair et al., 2019). To assess the discriminant validity, the square root of the AVE estimate for a construct was compared to the correlation between that construct and all the other constructs. Cronbach's alpha (CA) coefficient and composite reliability estimates were used to assess the measuring instrument's reliability.

After establishing the validity and reliability of the measurement scales, the structural model was assessed as the second step in the data analysis. The same GOF indices used to assess the measurement model fit were used to assess the structural model fit.

4. Results

4.1. Descriptive Analysis

Table 5 highlights that the technological factors, namely, relative advantage, compatibility and cybersecurity, reported the highest mean scores. From Table 5, it is evident that most of the respondents agreed that their family businesses experienced a relative advantage over competitors because of using DTs (79.72%), that DTs were compatible with their operational needs and culture (72.96%), and that they were aware of cybersecurity risks and solutions associated with using DTs (72.11%). Costs reported a slightly lower mean score, with just under half of respondents (47.61%) agreeing that the costs (investment and expenses) incurred for using DT in their family business were high. Complexity scored the lowest mean score, with most respondents being either neutral (48.45%) or disagreeing (43.66%) that the use of DTs required mental effort and were difficult to integrate into their family businesses. Only 45.07% of the respondents agreed and 39.72% were neutral regarding DIA occurring in their family businesses. Only 37.46% of the respondents agreed that their family businesses were profitable, financially secure and successful, and had achieved their financial goals. Just over half (50.42%) were neutral in terms of their family businesses performing well financially.

Table 5. Descriptive statistics.

	Mean	Std.Dev	Disagree	Neutral	Agree
Relative advantage	5.621	1.030	2.25%	18.03%	79.72%
Compatibility	5.380	1.048	3.10%	23.94%	72.96%
Complexity	3.148	1.144	43.66%	48.45%	7.89%
Costs	4.674	1.196	6.20%	46.20%	47.61%
Cybersecurity	5.274	1.039	2.54%	25.35%	72.11%
DIA	4.562	1.391	15.21%	39.72%	45.07%
Perceived financial performance	4.391	1.221	12.11%	50.42%	37.46%

Source: authors' compilation.

4.2. Measurement Model Analysis

The validity and reliability results of the measurement model for relative advantage, compatibility, complexity, costs, cybersecurity, DIA and perceived financial performance are summarised in Table 6.

Initial results indicated that the removal of Costs3, as well as Cybsec1 and Cybsec2, would improve the model fit indices. These items were, therefore, removed because they exhibited low (<0.40) standardised regression weights (SRWs), resulting in a final measurement model with acceptable fit (CMIN/df = 1.910; CFI = 0.927; SRMR = 0.054; RMESEA = 0.051). The removal of Costs3, which assessed whether the costs of using DTs were greater than the associated benefits, resulted in the final costs construct referring to the financial investments and expenses associated with setting up, running, maintaining, supporting and training for the use of DTs, rather than perceptions of the DT costs relative to their associated benefits. Both CybSec1 and CybSec2 assessed perceptions of the effectiveness of national laws relating to consumer privacy and cybercrime, respectively, whereas the remaining cybersecurity items primarily reflected firm-level cybersecurity

awareness, protection practices and perceived cybersecurity. The differential loading might, therefore, indicate that the regulatory aspects of cybersecurity represented by CybSec1 and CybSec2 were empirically distinct from the firm-level cybersecurity aspects captured by the remaining items.

Table 6. Measurement model analysis.

Constructs	Items	SRW	CA	CR	AVE	√AVE
Relative advantage	RelAdv1	0.737	0.818	0.824	0.485	0.696
	RelAdv2	0.582				
	RelAdv3	0.775				
	RelAdv4	0.651				
	RelAdv5	0.712				
Compatibility	Comp1	0.765	0.841	0.846	0.526	0.725
	Comp2	0.677				
	Comp3	0.807				
	Comp4	0.731				
	Comp5	0.629				
Complexity	Complx1	0.477	0.775	0.784	0.426	0.652
	Complx2	0.665				
	Complx3	0.694				
	Complx4	0.667				
	Complx5	0.729				
Costs	Costs4	0.593	0.698	0.707	0.450	0.671
	Costs2	0.787				
	Costs1	0.615				
Cybersecurity	CybSec4	0.679	0.719	0.738	0.419	0.647
	CybSec3	0.683				
	CybSec6	0.672				
	CybSec5	0. 527				
Digital innovation adoption	DIA4	0.793	0.944	0.810	0.679	0.824
	DIA5	0.867				
	DIA6	0.819				
	DIA1	0.799				
	DIA2	0.858				
	DIA3	0.795				
	DIA7	0.839				
	DIA8	0.818				
Perceived financial performance	PerFinPer1	0.812	0.802	0.824	0.555	0.745
	PerFinPer4	0.751				
	PerFinPer3	0.911				
	PerFinPer5	0.408				

Source: authors' compilation.

When assessing the convergent validity of the measurement scales, it was observed that the AVE values for relative advantage (0.485), complexity (0.426), costs (0.450) and cybersecurity (0.419) fell below the conventional threshold of 0.50. Nevertheless, these constructs demonstrated acceptable composite reliability values, ranging from 0.707 to 0.846. According to Fornell and Larcker (1981), convergent validity may still be considered acceptable where the AVE is below 0.50, provided that the composite reliability exceeds 0.60. In addition, the SRWs were statistically significant and generally of acceptable strength, providing further support for the adequacy of the measurement model. Taken together, the composite reliability values, statistically significant SRWs and satisfactory model fit provided reasonable support for the reliability and convergent validity of the measurement scales, despite the AVE values being below the conventional 0.50 threshold for four constructs.

Discriminant validity was assessed using the Fornell–Larcker criterion. The results indicated that the square root of the AVE for most constructs exceeded their correlations with the other constructs. However, an exception was observed for relative advantage and compatibility, for which the correlation was relatively high ($r = 0.738$) and exceeded the square root of the AVE for both relative advantage (0.696) and compatibility (0.725). This finding indicated some degree of empirical overlap between the two constructs and represented a limitation in terms of the strict application of the Fornell–Larcker criterion.

Nevertheless, the correlation of 0.738 does not indicate extreme construct redundancy, as relative advantage and compatibility remain conceptually distinct constructs within innovation adoption research (Rogers, 2003). As indicated in Tables 1 and 2, the two constructs had also been consistently conceptualised and examined as distinct constructs in prior DT and innovation adoption research. Furthermore, both constructs demonstrated acceptable composite reliability (0.824 and 0.846, respectively), while their respective SRWs were statistically significant and of acceptable strength. The overall measurement models also demonstrated acceptable fit. Therefore, although the relatively high correlation between relative advantage and compatibility warranted acknowledgement as a limitation of the measurement model, the combination of their conceptual distinctiveness, established treatment as separate constructs in prior research, acceptable reliability, significant factor loadings and overall model fit provided a reasonable basis for retaining the constructs in the structural model.

Apart from costs (CA = 0.698), which was marginally below the recommended cut-off of 0.70, all other factors reported CA coefficients above 0.70 (Hair et al., 2019). In addition, all composite reliability values were reported as being above the threshold value of 0.70. These results provided evidence of generally acceptable internal consistency for the scales measuring the constructs under investigation. Overall, despite some AVE values falling below the conventional threshold of 0.50 and some overlap between relative advantage and compatibility, the results provided reasonable support for the convergent and discriminant validity of the measurement scales.

4.3. Structural Model Analysis

For the study, the structural model analyses involved four iterations to achieve an acceptable model fit. The model fit indices for these iterations are summarised in Table 7.

As is evident in Table 7, the initial model (model 1) reported a GFI (0.793) value and an SRMR (0.1883) below the recommended cut-off values (Hair et al., 2019). In addition, relative advantage (0.037; $p = 0.592$) and complexity (0.001; $p = 0.993$) were not significantly related to DIA. Therefore, hypotheses H1 and H3 could not be supported. The modified structural model (model 2) excluded these non-significant relationships but demonstrated unacceptable fit. In addition, the modification indices showed that by allowing complexity and cybersecurity to co-vary, the model fit would improve. Although these constructs

were theoretically distinct, it was acknowledged that they were related and some degree of shared variance existed between them. A revised structural model (model 3) was specified in which the hypothesised relationships between the remaining factors (compatibility, costs and cybersecurity) and DIA, as well as between DIA and perceived financial performance, were tested. Apart from a GFI (0.897), model 3 demonstrated an acceptable fit. However, cybersecurity was no longer significantly related (0.449; $p = 0.111$) to DIA and, therefore, hypothesis H5 was not supported. To improve the model fit further, this non-significant relationship was removed, and a final model was defined (model 4). In model 4, the hypothesised relationships between the remaining factors and DIA as well as between DIA and perceived financial performance were tested. The fit indices for model 4 demonstrated a good fit. The findings showed that compatibility (0.790; $p < 0.001$) and costs (0.345; $p < 0.001$) were significantly and positively related to DIA. While the relationship for compatibility was consistent with the hypothesis, the positive relationship for costs was contrary to the hypothesised negative relationship. Support was, thus, found for hypothesis H2 but not for H4. A significant and positive relationship was also reported between DIA and perceived financial performance (0.331; $p < 0.001$), showing that the more Kenyan MSMEs implement DIA, the more likely they were to perceive their businesses as performing well financially. Support was, thus, found for H6.

Table 7. Model fit indices.

SEM Model	CMIN/df	GFI	CFI	SRMR	RMSEA
Model 1	3.235	0.793	0.814	0.1883	0.079
Model 2	2.905	0.868	0.897	0.1488	0.073
Model 3	1.992	0.897	0.947	0.0713	0.053
Model 4	1.856	0.923	0.964	0.062	0.049
Model fit guidelines	<3.00	>0.90	>0.90	<0.08	<0.07
	Denotes acceptable values within recommended cut-off values				
	Denotes unacceptable values within recommended cut-off values				

Source: authors' compilation.

5. Discussion

The findings showed that compatibility was significantly and positively related to DIA, suggesting that the more compatible DTs were with Kenyan family-owned MSMEs' current operational needs, organisational culture, values and beliefs, current business practices, business strategy and current IT infrastructure, the more likely DIA would occur in these businesses. As such, these MSMEs were more likely to be innovative using DTs. A positive relationship between compatibility and DIA is well supported in the literature by studies that have investigated the relationship between compatibility and the adoption of DTs (see Table 2). According to Ahani et al. (2017), compatibility was one of the most significant factors influencing the adoption of the DTs investigated in their study.

Costs were found to have a significant positive relationship with DIA, contrary to the hypothesised negative relationship. However, this finding should be interpreted with caution. It is important to note that the items measuring costs were adapted from existing technology-adoption measures; however, following the removal of Costs3, the final costs construct primarily captured financial investments and expenses associated with the implementation of DTs, rather than perceptions of DT costs relative to their associated benefits. The positive relationship, therefore, indicated that higher levels of DIA were associated with

greater DT-related financial investment and expenditure. This did not necessarily imply that higher costs encouraged DIA or that costs functioned as an enabler of DIA. Rather, greater levels of DIA might be accompanied by greater expenditure because more extensive or sophisticated use of DTs required greater investment in implementation, maintenance, support and employee training. Alternatively, businesses with greater financial resources might be better positioned to undertake such investments. Given the cross-sectional nature of the study, these possible explanations could not be established causally.

The finding relating to costs did, however, concur with other studies among SMEs that had also reported positive relationships between the investment made, the costs incurred and DT adoption. For example, Ibrahim et al. (2025) found that the costs incurred, though initially high, were found to be a critical contributor to the adoption of the DT investigated in their study, and were associated with other long-term benefits. Similarly, Wong et al. (2020) reported that the high costs incurred when implementing DTs were not empirically supported as an inhibitor but rather a motivator that drove the adoption of DTs. The findings also aligned with Yujie et al. (2024), who found that in highly uncertain environments, businesses with a large amount of DT infrastructure and management support could generate high levels of digital transformation.

The three other technological factors, namely, relative advantage, complexity and cybersecurity, were not found to be significantly related to DIA. This suggested that whether or not Kenyan family-owned MSMEs associated these factors with using DTs, they had no influence on DIA occurring in these businesses. These findings suggested that the technological dimensions of the TOE framework were not equally salient in the context of this study, and that their influence on DIA was contingent on contextual conditions.

Finding no relationship between relative advantage and DIA was, however, somewhat surprising given that Christiansen et al.'s (2022) extensive review, summarising past research, identified relative advantage as one of the most common factors affecting the decision to adopt DTs. The current study's finding also contradicted other SME studies that had reported positive relationships between relative advantage and the adoption of DTs (see Table 2). This finding had no relationship in this study and was also inconsistent with the study of Martini et al. (2023), who reported that a lack of awareness and knowledge about the advantages of information technology or DTs for a business negatively influenced digital innovation. In the current study, even though most respondents showed an awareness of these advantages, in that they perceived their family businesses as experiencing a relative advantage over competitors because of using DTs (see Table 5), a positive relationship was not reported.

In contrast to the findings of this study, several studies (see Table 2) had reported complexity as having a positive influence on DT adoption. However, as with the results in the current study, no relationship between complexity and technology adoption had been reported in some SME studies. For example, Kumar et al. (2021) found no support that the degree of complexity influenced the adoption of blockchain technology, whereas AlBar and Hoque (2019) reported that complexity had no significant influence on ICT adoption. AlBar and Hoque (2019) argued that the family businesses in their sample were based in a country where technology adoption policies were sanctioned by the prevailing government (AlBar & Hoque, 2019). Similarly, Maduku et al. (2016) found no support for their hypothesis that the complexity associated with using DTs impacted mobile marketing adoption. Maduku et al. (2016) attributed their findings to the self-confidence their participants expressed when using mobile media, which was the result of their familiarity with DTs. As suggested by Maduku et al. (2016), finding no relationship between complexity on DIA in this study could be attributed to the fact that the majority of respondents appeared to be self-confident in the use of DTs, in that they perceived DTs as easy to use, requiring little

mental effort and being relatively straightforward to integrate into their family businesses (see Table 5).

Despite the hypothesised positive relationship between the perceived existence of cybersecurity when using DTs and DIA among Kenyan family-owned MSMEs, no relationship was reported between these variables. This finding contradicted several other studies that had reported both positive (see Table 2) and negative relationships (Asiaei & Rahim, 2019; Abed, 2020; Lutfi et al., 2022) between perceived cybersecurity and the adoption of DTs. Chen and Lai (2022), for example, reported that SMEs were most concerned about information security in the technical dimension when adopting information technology. However, the majority of Kenyan family-owned MSMEs agreed that they had an awareness of the cybersecurity risks and protection solutions available when using DTs, which could possibly explain the findings of this study (see Table 5).

An explanation for relative advantage, complexity and cybersecurity having no relationships with DIA in this study might be a result of the contextual conditions under which the technological dimensions of the TOE framework were empirically tested. Firstly, the empirical studies informing the hypotheses of this study investigated the influence of technological factors on DT adoption among SMEs (see Table 2). However, more than half of the participating family businesses in the current study were micro-enterprises (fewer than ten employees), based on the widely used employee-number metric of business size (Tumiwa et al., 2020; International Finance Corporation, 2021). Secondly, less than half of the respondents perceived DIA to be occurring in their family businesses, while more than two-thirds described their businesses as digitally immature. In addition, most participating Kenyan family-owned businesses were classified at the digital indifference or digital observer levels of digital maturity, which were characterised by a reliance on manual and non-automated processes (see Table 3). These findings suggested that DIA was still at an early stage among many of the participating family businesses. Furthermore, only one third of respondents perceived their businesses to be performing financially (see Table 5), suggesting that the modest financial performance of many businesses may have limited their ability to undertake DIA. Collectively, these contextual conditions suggested that the technological dimensions of the TOE framework received only partial empirical support in this context, with only compatibility and costs being reported as being associated with DIA among Kenyan family-owned MSMEs.

One possible explanation for the findings of this study was that, at an early stage of DIA, the participating family businesses might have prioritised DTs that were affordable and compatible with their existing processes, making relative advantage less important in the DIA decision. Similarly, complexity might have been less influential where the DTs considered by respondents were relatively user-friendly or supported by external providers. Cybersecurity might likewise have been less important among businesses with lower levels of digital maturity, particularly where cybersecurity was not perceived as an immediate strategic concern. However, these explanations are tentative as the cross-sectional design did not allow the study to establish whether the influence of these factors changed as businesses became more digitally mature.

The family business context might also provide an important lens for interpreting these findings, as family involvement, long-term orientation and socioemotional considerations may shape how owners and managers evaluate the attributes of DTs. These attributes may influence the importance attached to factors such as compatibility, costs and relative advantage when making decisions relating to DIA. However, these potential family-specific influences were not directly investigated in this study and, therefore, cannot be inferred from the findings.

6. Conclusions

6.1. Theoretical Contributions

The study contributed to the family business literature by investigating DIA among family-owned MSMEs, which is a research field where limited studies have been conducted to date. Most studies have focused on innovation and family businesses in general, and not on DIA in this context. Understanding DIA in the context of family businesses has become pertinent given the limited studies that exist, and that many family businesses aim to digitise their business processes to eliminate bureaucratic manual processes (Calabrò & McGinness, 2021; Tirdasari et al., 2022).

The current study also contributed to the literature in that it focused on DIA among MSMEs, whereas most studies have focused on large businesses. To date, only one study could be identified that had focused on digitalisation among MSMEs (Pöschl & Freiling, 2020), whereas the majority of the studies focused on large family businesses (Rashid & Ratten, 2020; Xie et al., 2023; Tirdasari et al., 2026), which were often based in Europe (Kraus et al., 2020; Soluk et al., 2021; Soluk & Kammerlander, 2021; Ano & Bent, 2022; Soluk, 2022; Tutar & Sarkhanov, 2024). Bornhausen and Wulf's (2024) research also called for more DIA studies to be undertaken among smaller and younger SMEs, which was the focus of the current study.

According to Ramdani et al. (2022), little is known about DIA among MSMEs in Africa. As such, the study also contributed to the literature in the context of resource-constrained environments by providing a quantitative foundation for understanding DIA in an emerging economy such as Kenya. It is not uncommon for MSMEs in such economies in Africa to face resource constraints associated with accessing finance and electricity supply, both of which are needed to support DIA (Endris & Kassegn, 2022). As a result, studies such as the current study, undertaken among MSMEs in resource-constrained countries, could enrich the current understanding of how they manage their critical resources during the implementation of DIA.

In their review on innovation in family businesses, Calabrò et al. (2019) observed that no study had focused on DIA in family businesses, and only a few had focused on a topic closely associated with DIA, namely, technological innovation. Kammerlander et al. (2018) as well as Soluk et al. (2021) also noted that few studies had examined the factors influencing DIA in a family business context. Calabrò et al. (2019) highlighted the need to evaluate the factors influencing DIA at an organisational level, whereas Hu and Hughes (2020) were of the opinion that organisations should consider the external context in which they operated, as dramatic changes were often caused by digitalisation. In summary, the current study advances family business research by extending understanding of DIA in family-owned MSMEs and providing empirical evidence from an emerging, non-Western context that has received limited scholarly attention, thereby highlighting the importance of contextual conditions in shaping the technological determinants of DIA.

The study's findings suggest that the relevance of specific technological factors may vary according to the contextual characteristics of a business, thereby highlighting potential boundary conditions for applying the technological dimension of the TOE framework to family-owned MSMEs in emerging economies. Rather than providing general support for the TOE framework, the findings suggest that its explanatory power may depend on the context in which DIA occurs. As such, the study refines the contextual application of the TOE framework and extends the TOE literature by offering a more nuanced understanding of its applicability to family-owned MSMEs in emerging economies.

The findings also provide partial support for DOI theory, particularly through the significant positive relationship between compatibility and DIA. However, the non-significant relationships for relative advantage and complexity indicate that not all DT attributes

demonstrated the expected relationships with DIA in the study's context. This finding provides a more nuanced empirical perspective on the applicability of individual DOI attributes to family-owned MSMEs in Kenya.

6.2. Managerial Implications

Several managerial implications are also suggested in this study. Firstly, family-owned MSMEs should give priority to selecting DTs for implementation that are compatible with their current business operations, while respecting their existing organisational culture, values and beliefs. Family-owned MSMEs could achieve this by selecting new DTs that integrate smoothly into their current business practices and strategies, which would also enhance their long-standing processes and traditions. Both the older generations and the digital-savvy new generations, as well as long-standing employees, should be included in discussions about digital change and the use of DTs for innovation. Inclusivity would ensure that the DTs chosen for innovation and the resulting changes that occurred would align with both the business and family needs.

Secondly, family-owned MSMEs should also invest large amounts of time and money into DT infrastructure as this would lead to technology advantages and lay the foundation for digital transformation (Yujie et al., 2024). Family-owned MSMEs should view the financial investments and expenses incurred for DTs not as costs to be avoided, but as strategic enablers of DIA. By allocating sufficient resources toward the setup, running, maintenance, support and training associated with DTs, they could enhance their business's capacity for DIA and long-term competitiveness. Moreover, by actively increasing their knowledge and awareness of DT benefits, family-owned MSMEs are more likely to view these costs as strategic contributions to DIA rather than a financial burden.

6.3. Limitations and Recommendations for Future Research

A limitation of this study concerns the sampling strategy, sampling frame and response rate. Although the final sample provided sufficient statistical power for the planned SME analysis, the use of non-probability convenience sampling and a sampling frame that included the 2016 Kenya National Bureau of Statistics' MSME database might have limited the representativeness and generalisability of the findings. Although the 2016 database was supplemented with more recent databases, businesses established after 2016 may not have been adequately represented, while the status and characteristics of businesses included in the older database may have changed. In addition, the low response rate introduced the possibility of non-response bias, as respondents may have differed systematically from businesses that had not participated in the study. Future studies should, where possible, use more recent and comprehensive sampling frames and probability-based sampling techniques, together with strategies to improve response rates, to enhance the representativeness and generalisability of the findings.

As the participating MSMEs were predominantly micro- and small businesses, with relatively low levels of digital maturity, the composition of the sample limited the generalisability of the findings. The investigation was also limited to Kenya-based family-owned MSMEs that were accessible to the researcher. Consequently, the findings may not fully reflect the experiences of larger or more digitally mature family-owned MSMEs and cannot necessarily be generalised to all family businesses. Caution should, therefore, be exercised when extending these results to the broader population of family-owned MSMEs or large corporate family businesses. Future studies should replicate this study using probability-based or alternative sampling techniques, where feasible, and investigate these factors among a more representative and diverse MSME sample, including greater representation of larger and digitally mature family-owned MSMEs as well as large corporate family busi-

nesses. Such efforts would strengthen the external validity of the findings and establish whether these factors influence DIA across different family business contexts.

A further limitation relates to the measurement properties of some constructs. Although the scales demonstrated generally acceptable internal consistency reliability, some limitations were evident in relation to convergent and discriminant validity. These limitations tempered the strength of the measurement evidence supporting the findings. As a result, future studies should further validate and refine the measurement scales using larger and more diverse samples and alternative measures of convergent and discriminant validity.

Another limitation relates to the operationalisation of costs. Although the original scale included an item assessing costs relative to the benefits of DT use, this item did not load adequately and was removed. Consequently, the final measure primarily captured financial investment and expenditure associated with DT adoption and use, rather than perceived cost barriers or cost–benefit evaluations. This limits the extent to which the finding can distinguish between costs as a potential barrier to adoption, and financial investment as an indicator of commitment or resource availability. Future research should distinguish between these dimensions by separately examining DT-related expenditure, perceived cost barriers and cost–benefit perceptions.

In addition, the use of perceived rather than objective measures of financial performance should also be noted. Although perceptual measures are widely accepted in MSME research owing to the limited availability and reliability of objective financial data (Hayidakis, 2021; Gadedjisso-Tossou et al., 2024), respondents' subjective assessments may not fully reflect actual business performance. Future research should seek to validate these findings using objective financial indicators where such data are available.

A further limitation concerns the data-informed refinement of the structural model. Non-significant paths were removed, and complexity and cybersecurity were allowed to covary to improve model fit. Although these modifications resulted in a more parsimonious model, data-informed model modifications may capitalise on sample-specific relationships and potentially result in model overfitting. Consequently, the fit of the final model should be interpreted with caution. Future studies should test the model using independent samples or cross-validation to establish the robustness and generalisability of the revised model.

A limitation of this study is also that it focused exclusively on the technological dimension of the TOE framework and selected technological factors, excluding the organisational and environmental dimensions, as well as trialability and observability factors. This delimitation limits the comprehensiveness of the model, as organisational and environmental conditions may also influence DIA among family-owned MSMEs. In particular, examining the environmental context would be particularly valuable in the Kenyan setting, where infrastructure limitations, regulatory frameworks and market characteristics may shape both the feasibility and attractiveness of being innovative through using DTs. Consequently, the findings should not be interpreted as providing an exhaustive explanation of DIA, and the study's contribution is necessarily confined to advancing understanding of selected technological determinants within the specific context examined. Future research should incorporate the organisational and environmental dimensions, as well as trialability and observability, to provide a more comprehensive understanding of the factors influencing DIA among family-owned MSMEs.

The literature suggests that family-specific factors may play an important role in DIA among family-owned MSMEs. Their exclusion reflects the defined scope of the study, which focused on whether selected technological determinants influenced DIA within the relatively under-researched context of family-owned MSMEs, rather than developing a comprehensive model incorporating technological and family-specific factors. Accordingly, family ownership established the contextual boundary of the study, while the selected

technological factors constituted its explanatory focus. Nevertheless, the exclusion of family-specific factors, such as family dynamics and socioemotional wealth, limits the comprehensiveness of the model and its ability to capture potentially important family-specific influences on DIA. Future research should integrate these family-specific factors with technological determinants to provide a more comprehensive explanation of DIA in family-owned MSMEs.

Several studies (Maduku et al., 2016; Kumar et al., 2021; Shahadat et al., 2023) have provided evidence for a negative relationship between perceived costs and innovation adoption. As a result, future studies should also investigate the influence of perceived costs rather than incurred costs, as in this study. Moreover, although well supported in the literature, the technological factors relative advantage, complexity and cybersecurity were found to have no influence on DIA occurring in the participating Kenyan MSMEs. These non-significant findings should be interpreted with caution, given the cross-sectional design and the potential influence of methodological limitations, including sampling bias, potential non-response bias and measurement limitations. At the same time, the possibility that these factors may have limited relevance to DIA in the context examined cannot be excluded. Future research should, therefore, investigate these relationships using alternative measures, more representative samples and longitudinal designs to establish whether the non-significant relationships are context-specific or reflect more general patterns.

In conclusion, this study examined the relationships between several technological factors and DIA among family-owned MSMEs in Kenya. The findings indicated that only relative advantage and costs were significantly related to DIA among the participating businesses, while DIA was positively associated with perceived financial performance. However, these findings contribute to the digital innovation and family business literature by providing empirical evidence from an under-researched emerging economy context and highlighting the relevance of selected technological factors in relation to DIA. Overall, the study demonstrates that the technological dimensions of the TOE framework are not equally salient in the context of this study, and that their association with DIA is contingent on contextual conditions. The findings also provide valuable insights for researchers, practitioners and policymakers seeking to support DIA among smaller family businesses with relatively low levels of digital maturity in an emerging economy context.

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Abbreviations

The following abbreviations are used in this manuscript:

DT(s)	Digital Technology(ies)
DIA	Digital Innovation Adoption
SME	Small and Medium Enterprise
MSME	Micro, Small and Medium Enterprise
TOE	Technological, Organisational and Environmental
DOI	Diffusion of Innovations
DML	Digital Maturity Level

Appendix A. Measurement Scale Items and Sources

Item No.	Statement	Sources
	Relative advantage	
RelAdv1	DT enables us to have more efficient business operations than those that previously existed.	Pathan et al. (2017); AlBar and Hoque (2019); Wong et al. (2020); Maroufkhani et al. (2020); (Maroufkhani et al. (2022)
RelAdv2	DT improves the quality of our business operations.	Pathan et al. (2017); Wong et al. (2020); Maroufkhani et al. (2020); Maroufkhani et al. (2022); Lutfi et al. (2022)
RelAdv3	DT increases the productivity of our employees.	Abed (2020)
RelAdv4	DT enables us to lower costs in general.	Maroufkhani et al. (2020); Maroufkhani et al. (2022); Lutfi et al. (2022)
RelAadv5	DT increases our ability to outperform the competition.	Lutfi et al. (2022); Shahadat et al. (2023)
	Compatibility	
Comp1	DT is compatible with our current operational needs.	Pathan et al. (2017); Shahadat et al. (2023)
Comp2	DT is compatible with our culture, values, and beliefs.	Pathan et al. (2017); Shahadat et al. (2023)
Comp4	DT is compatible with the current business strategy.	Alharbi et al. (2016)
	Complexity	
Complex1	DT requires a lot of mental effort on the part of our employees.	Pathan et al. (2017); Maduku et al. (2016); Wong et al. (2020)
Complex2	DT is difficult to use in business operations.	Maduku et al. (2016); Pathan et al. (2017); AlBar and Hoque (2019); Wong et al. (2020); Kumar et al. (2021); Lutfi et al. (2022); Maroufkhani et al. (2022)
Complex3	DT is difficult to integrate into existing business processes.	AlBar and Hoque (2019); Wong et al. (2020); Kumar et al. (2021); Maroufkhani et al. (2020).
Complex4	DT is difficult to maintain.	Maroufkhani et al. (2020); Maroufkhani et al. (2022); Lutfi et al. (2022)
Complex5	DT is difficult for our employees to use.	Maduku et al. (2016); Pathan et al. (2017); AlBar and Hoque (2019); Maroufkhani et al. (2020); Maroufkhani et al. (2022); Lutfi et al. (2022)

Item No.	Statement	Sources
	Costs	
Costs1	DT setup costs are high.	Kumar et al. (2021)
Costs2	The costs of running, maintaining, and supporting DT are high.	Maduku et al. (2016); Shahadat et al. (2023)
Costs4	The amount of money invested in training employees for using DT is high.	Maduku et al. (2016); Kumar et al. (2021); Shahadat et al. (2023)
	Cybersecurity	
CybSec3	We believe that there are secure electronic transaction services available when using DT.	Abed (2020); Kumar et al. (2021)
CybSec4	We are aware of cyber security protection solutions (e.g., anti-virus protection, strong password use) available when using DT.	Hasan et al. (2021)
CybSec5	We are becoming more cyber secure with regard to DT.	Hasan et al. (2021)
CybSec6	We are aware of the cybersecurity risks associated with using DT.	Maroufkhani et al. (2020); Kumar et al. (2021); Hasan et al. (2021); Hasani et al. (2023)
	Digital Innovation Adoption	
DIA1	We use DT to continuously offer new combinations of products/services to our customers.	Soluk et al. (2021)
DIA2	We use DT to provide customers/clients with products/services that offer unique benefits that are superior to those of our competitors.	Hayidakis (2021)
DIA3	We use DT to regularly make unique changes to the appearance, packaging, shape, and volume of our offerings without changing their basic technical and functional features.	
DIA4	We use DT to routinely renew the in-business management information system and information-sharing practices.	
DIA5	We use DT to routinely renew the organisational structure to facilitate communication and coordination between different functional areas in the business.	
DIA6	We use DT to consistently come up with new and creative ways to market our products/services to our current and potential customers/clients.	
DIA7	We use DT to provide unique customer and after-sales services to our customers.	
DIA8	We use DT to renew our business routines, procedures and processes.	Hayidakis (2021); Soluk et al. (2021)

Item No.	Statement	Sources
	Perceived financial performance	
PerFinPer1	We view our business as financially secure.	Farrington (2009); Matchaba-Hove (2014); Hayidakis (2021)
PerFinPer2	We have experienced growth in profits over the past two years.	
PerFinPer3	We regard our business as being financially successful.	
PerFinPer4	We regard our business as profitable.	
PerFinPer5	We have achieved our financial goals.	

Source: authors' compilation.

References

Abed, S. (2020). Social commerce adoption using TOE framework: An empirical investigation of Saudi Arabian SMEs. *International Journal of Information Management*, *53*, 102118. [CrossRef]

Abou-Foul, M., Ruiz-Alba, J. L., & Soares, A. (2021). The impact of digitalization and servitization on the financial performance of a firm: An empirical analysis. *Production Planning & Control*, *32*(12), 975–989. [CrossRef]

Ahani, A., Rahim, N. Z. A., & Nilashi, M. (2017). Forecasting social CRM adoption in SMEs: A combined SEM-neural network method. *Computers in Human Behaviour*, *75*, 560–578. [CrossRef]

AlBar, A. M., & Hoque, M. R. (2019). Factors affecting the adoption of information and communication technology in small and medium enterprises: A perspective from rural Saudi Arabia. *Information Technology for Development*, *25*(4), 715–738. [CrossRef]

Alharbi, F., Atkins, A., & Stanier, C. (2016). Understanding the determinants of cloud computing adoption in Saudi healthcare organisations. *Complex and Intelligent Systems*, *2*(3), 155–171. [CrossRef]

Alshamaila, Y., Papagiannidis, S., & Li, F. (2013). Cloud computing adoption by SMEs in the northeast of England: A multi-perspective framework. *Journal of Enterprise Information Management*, *26*(3), 250–275.

Anning-Dorson, T. (2025). The evolution and impact of business models in Africa's emerging digital economy. In *Digital business transformation in Africa, Volume I*. Palgrave studies in technology and innovation in Africa. Palgrave Macmillan. [CrossRef]

Ano, B., & Bent, R. (2022). Human determinants influencing the digital transformation strategy of multigenerational family businesses: A multiple-case study of five French growth-oriented family firms. *Journal of Family Business Management*, *12*(4), 876–891. [CrossRef]

Asiaei, A., & Rahim, N. Z. (2019). A multifaceted framework for adoption of cloud computing in Malaysian SMEs. *Journal of Science and Technology Policy Management*, *10*(3), 708–750. [CrossRef]

Bakar, M. R. A., Razali, N. A. M., Ishak, K. K., Ismail, M. N., & Sembok, T. M. T. (2024). Adoption of industry 4.0 with cloud computing as a mediator: Evaluation using TOE framework for SMEs. *International Journal on Informatics Visualization*, *8*(2), 554–563. [CrossRef]

Bornhausen, A. M., & Wulf, T. (2024). Digital innovation in family firms: The roles of non-family managers and transgenerational control intentions. *Small Business Economics*, *62*(1), 1429–1448. [CrossRef]

Calabrò, A., & McGinness, T. (2021). Mastering a comeback: How family businesses are triumphing over COVID-19. (COVID-19 edition 1). KPMG International Website: KPMG Private Enterprise and Step Project for Family Enterprising. Available online: https://assets.kpmg.com/content/dam/kpmg/xx/pdf/2021/03/family-business-survey-report.pdf (accessed on 16 January 2023).

Calabrò, A., Vecchiarini, M., Gast, J., Campopiano, G., Massis, A. D., & Kraus, S. (2019). Innovation in family firms: A systematic literature review and guidance for future research. *International Journal of Management Reviews*, *21*(3), 317–355. [CrossRef]

Central Bank of Kenya. (2021). *2020 survey report on MSME access to bank credit*. Available online: https://www.centralbank.go.ke/uploads/banking_sector_reports/1275966539_2020%20Survey%20Report%20on%20MSME%20Access%20to%20Bank%20Credit%20-%20Final%20-%2015%2007%2021.pdf (accessed on 15 June 2025).

Central Bank of Kenya. (2023). *Survey report on MSME access to bank credit: May 2023*. Available online: https://www.centralbank.go.ke/uploads/banking_sector_reports/170784843_2022%20Survey%20Report%20on%20MSME%20Access%20to%20Bank%20Credit%20-%20May%202023.pdf (accessed on 1 March 2025).

Chen, C. L., & Lai, W. H. (2022). Influencing factors of information technology adoption in Taiwan's SMEs under the trend of digital transformation. *Review of Integrative Business and Economics Research*, *11*, 115–128.

Christiansen, V., Haddara, M., & Langseth, M. (2022). Factors affecting Cloud ERP adoption decisions in organizations. *Procedia Computer Science*, *196*, 255–262. [CrossRef]

Communication Authority of Kenya. (2026). *Statistics*. Available online: https://www.ca.go.ke/statistics (accessed on 18 August 2026).

Damanpour, F., & Schneider, M. (2006). Phases of the adoption of innovation in organizations: Effects of environment, organization and top managers. *British Journal of Management*, *17*(3), 215–236. [CrossRef]

Endris, E., & Kassegn, A. (2022). The role of micro-, small and medium enterprises (MSMEs) to the sustainable development of sub-Saharan Africa and its challenges: A systematic review of evidence from Ethiopia. *Journal of Innovation and Entrepreneurship*, *11*(1), 20. [CrossRef]

Faiz, F., Le, V., & Masli, E. K. (2024). Determinants of digital technology adoption in innovative SMEs. *Journal of Innovation and Knowledge*, *9*(4), 100610. [CrossRef]

Farrington, S. M. (2009). *Sibling partnerships in South African small and medium-sized family businesses* [Doctoral dissertation, Nelson Mandela Metropolitan University].

Ferreira, J. J., Fernandes, C. I., & Ferreira, F. A. (2019). To be or not to be digital, that is the question: Firm innovation and performance. *Journal of Business Research*, *101*, 583–590. [CrossRef]

Fornell, C., & Larcker, D. F. (1981). Structural equation models with unobservable variables and measurement error: Algebra and statistics. *Journal of Marketing Research*, *18*(3), 382–388. [CrossRef]

Gadedjisso-Tossou, A., Gueyie, J. P., & Couchoro, M. K. (2024). Female managers, informal enterprises, and their perceived financial performance in Togo. *Journal of African Business*, *25*(1), 115–141. [CrossRef]

Gana, K., & Broc, G. (2018). *Introduction à la modélisation par équations structurales: Manuel pratique avec lavaan*. ISTE Group.

Ghobakhloo, M., Iranmanesh, M., Vilkas, M., Grybauskas, A., & Amran, A. (2022). Drivers and barriers of Industry 4.0 technology adoption among manufacturing SMEs: A systematic review and transformation roadmap. *Journal of Manufacturing Technology Management*, *33*(6), 1029–1058. [CrossRef]

Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2019). *Multivariate data analysis* (8th ed.). Cengage.

Hasan, S., Ali, M., Kurnia, S., & Thurasamy, R. (2021). Evaluating the cyber security readiness of organizations and its influence on performance. *Journal of Information Security and Applications*, *58*, 102726. [CrossRef]

Hasani, T., O'Reilly, N., Dehghantanha, A., Rezania, D., & Levallet, N. (2023). Evaluating the adoption of cybersecurity and its influence on organizational performance. *SN Business & Economics*, *3*(5), 97. [CrossRef]

Hayidakis, H. D. (2021). *Innovation in family and non-family small and medium-sized businesses in South Africa* [Master's dissertation, Nelson Mandela University].

Henao-Ramírez, A. M., & López-Zapata, E. (2021). Analysis of the factors influencing adoption of 3D design digital technologies in Colombian firms. *Journal of Enterprise Information Management*, *35*(2), 429–454. [CrossRef]

Hoang, H. (2024). Navigating the digital landscape: An exploration of the relationship between technology-organization-environment factors and digital transformation adoption in SMEs. *SAGE Open*, *14*(4), 21582440241276198. [CrossRef]

Hu, Q., & Hughes, M. (2020). Radical innovation in family firms: A systematic analysis and research agenda. *International Journal of Entrepreneurial Behavior & Research*, *26*(6), 1199–1234. [CrossRef]

Hund, A., Wagner, H. T., Beimborn, D., & Weitzel, T. (2021). Digital innovation: Review and novel perspective. *The Journal of Strategic Information Systems*, *30*(4), 101695. [CrossRef]

Ibrahim, M. I., Shaari, H., & Perumal, S. (2025). Examining the adoption of the IOE among manufacturing SMEs in Malaysia. *PaperASIA*, *41*(1b), 218–231. [CrossRef]

International Data Corporation & Cisco. (2020). *Small business digital transformation: A snapshot of eight of the world's leading markets. Brazil|Canada|Chile|France|Germany|Mexico|United Kingdom|United States*. Available online: https://www.cisco.com/c/dam/en_us/solutions/small-business/resource-center/small-business-digital-transformation.pdf (accessed on 21 July 2022).

International Finance Corporation. (2021). *MSME digital finance: Resilience and innovation during COVID-19*. Available online: https://documents.worldbank.org/en/publication/documents-reports/documentdetail/154881638852819751/msme-digital-finance-resilience-and-innovation-during-covid-19 (accessed on 1 July 2022).

Kaibung'a, J. M. (2022). *Knowledge transfer strategy and performance of medium-size family owned businesses in Kenya* [Unpublished Doctoral thesis, Kenyatta University]. Available online: https://ir-library.ku.ac.ke/items/558044db-aeaf-442f-9163-05b1eb625450 (accessed on 11 January 2026).

Kammerlander, N., König, A., & Richards, M. (2018). Why do incumbents respond heterogeneously to disruptive innovations? The interplay of domain identity and role identity. *Journal of Management Studies*, *55*(7), 1122–1165. [CrossRef]

Kane, G. C., Palmer, D., Phillips, A. N., Kiron, D., & Buckley, N. (2017, July 13). Achieving Digital Maturity. *MIT Sloan Management Review and Deloitte*. Available online: https://sloanreview.mit.edu/projects/achieving-digital-maturity/ (accessed on 21 July 2022).

Kenya National Bureau of Statistics. (2016). *Kenya—Small and medium enterprises (MSME) survey 2016*. Available online: https://statistics.knbs.or.ke/nada/index.php/catalog/69 (accessed on 14 May 2025).

Kingiri, A. N., & Fu, X. (2020). Understanding the diffusion and adoption of digital finance innovation in emerging economies: M-Pesa money mobile transfer service in Kenya. *Innovation and Development*, *10*(1), 67–87. [CrossRef]

Kraus, S., Clauss, T., Breier, M., Gast, J., Zardini, A., & Tiberius, V. (2020). The economics of COVID-19: Initial empirical evidence on how family firms in five European countries cope with the corona crisis. *International Journal of Entrepreneurial Behavior & Research*, *26*(5), 1067–1092. [CrossRef]

Kumar, B. A., Garg, A., & Gajpal, Y. (2021). Determinants of blockchain technology adoption in supply chains by Small and Medium Enterprises (SMEs) in India. *Mathematical Problems in Engineering*, *1*, 5537395.

Lutfi, A., Alsyouf, A., Almaiah, M. A., Alrawad, M., Abdo, A. A. K., Al-Khasawneh, A. L., Ibrahim, N., & Saad, M. (2022). Factors influencing the adoption of big data analytics in the digital transformation era: Case study of Jordanian SMEs. *Sustainability*, *14*(3), 1802. [CrossRef]

Maduku, D. K., Mpinganjira, M., & Duh, H. (2016). Understanding mobile marketing adoption intention by South African SMEs: A multi-perspective framework. *International Journal of Information Management*, *36*(5), 711723. [CrossRef]

Maroufkhani, P., Iranmanesh, M., & Ghobakhloo, M. (2022). Determinants of big data analytics adoption in small and medium-sized enterprises (SMEs). *Industrial Management & Data Systems*, *123*(1), 278–301. [CrossRef]

Maroufkhani, P., Wan Ismail, W. K., & Ghobakhloo, M. (2020). Big data analytics adoption model for small and medium enterprises. *Journal of Science and Technology Policy Management*, *11*(4), 483–513. [CrossRef]

Martini, M., Setiawan, D., Suryandari, R. T., Brahmana, R. K., & Asrihapsari, A. (2023). Determinants of digital innovation in micro and small industries. *Economies*, *11*(6), 172. [CrossRef]

Matchaba-Hove, M. (2014). *The entrepreneurial orientation of small businesses in the Eastern Cape* [Doctoral dissertation, Nelson Mandela Metropolitan University].

Misati, R., Osoro, J., Odongo, M., & Abdul, F. (2024). Does digital financial innovation enhance financial deepening and growth in Kenya? *International Journal of Emerging Markets*, *19*(3), 679–705. [CrossRef]

Muigai, S. W., Mungai, E., & Velamuri, R. (2023). Intergenerational transmission of entrepreneurship: An East African perspective of SME owner's choice of joining the family business or independent own founding. *Cogent Business & Management*, *10*(1), 2195023. [CrossRef]

Muigai, S. W., Mungai, E., & Velamuri, S. R. (2021). Effects of parental entrepreneurial performance on the mode of entrepreneurial entry by the next-generation family members: Evidence from an emerging economy. *Journal of Family Business Management*, *12*(4), 577–596. [CrossRef]

Nambisan, S., Lyytinen, K., & Yoo, Y. (Eds.). (2020). *Handbook of digital innovation*. Edward Elgar Publishing.

Nazir, M. A., Rizwan, H., & Zhu, X. (2024). A thematic analysis of factors influencing small and medium enterprise adoption of social media marketing: A TOE framework perspective. *Qualitative Market Research: An International Journal*, *28*(1), 178–204. [CrossRef]

Oliveira, T., & Martins, M. F. (2011). Literature review of information technology adoption models at firm level. *The Electronic Journal Information Systems Evaluation*, *14*(1), 110–121.

Omrani, N., Rejeb, N., Maalaoui, A., Dabić, M., & Kraus, S. (2022). Drivers of digital transformation in SMEs. *IEEE Transactions on Engineering Management*, *71*, 5030–5043. [CrossRef]

Orcan, F. (2018). Exploratory and confirmatory factor analysis: Which one to use first? *Journal of Measurement and Evaluation in Education and Psychology*, *9*(4), 414–421. [CrossRef]

Pathan, Z. H., Jianqiu, Z., Akram, U., Latif, Z., Khan, M. K., & Tunio, M. Z. (2017). Essential factors in cloud-computing adoption by SMEs. *Human Systems Management*, *36*(4), 261–275. [CrossRef]

Pichlak, M. (2016). The innovation adoption process: A multidimensional approach. *Journal of Management & Organization*, *22*(4), 476–494. [CrossRef]

Podsakoff, P. M., Podsakoff, N. P., Williams, L. J., Huang, C., & Yang, J. (2024). Common method bias: It's bad, it's complex, it's widespread, and it's not easy to fix. *Annual Review of Organizational Psychology and Organizational Behavior*, *11*(1), 17–61.

Pöschl, A., & Freiling, J. (2020). The impact of family-external business succession on digitalization: Exploring management buy-ins. *International Journal of Information Systems and Project Management*, *8*(2), 24–46. [CrossRef]

Ramdani, B., Raja, S., & Kayumova, M. (2022). Digital innovation in SMEs: A systematic review, synthesis and research agenda. *Information Technology for Development*, *28*(1), 56–80. [CrossRef]

Rashid, S., & Ratten, V. (2020). A dynamic capabilities approach for the survival of Pakistani family-owned business in the digital world. *Journal of Family Business Management*, *10*(4), 373–387. [CrossRef]

Rehman, A., Behera, R. K., Islam, M. S., Elahi, Y. A., Abbasi, F. A., & Imtiaz, A. (2024). Drivers of metaverse adoption for enhancing marketing capabilities of retail SMEs. *Technology in Society*, *79*, 102704. [CrossRef]

Republic of Kenya. (2024). *Fourth medium term plan 2023–2027: Bottom-up economic transformation agenda for inclusive growth. (Medium term plan towards 2020 IV)*. Government of Kenya. Available online: https://vision2030.go.ke/wp-content/uploads/2024/03/FINAL-MTP-IV-2023-2027_240320_184046.pdf (accessed on 24 June 2025).

Rogers, E. M. (2003). *Diffusion of innovations* (5th ed.). Free Press.

Safaricom. (2026). *Annual report and financial statements*. Available online: https://www.safaricom.co.ke/images/Downloads/2026_Safaricom_Annual_Report_Updated.pdf (accessed on 18 August 2026).

Shahadat, M. H., Nekmahmud, M., Ebrahimi, P., & Fekete-Farkas, M. (2023). Digital technology adoption in SMEs: What technological, environmental and organizational factors influence in emerging countries? *Global Business Review*. [CrossRef]

Shrivastava, V. K., & Riaz, S. (2023, July 3–6). *Adoption of big data and AI in UAE SMEs in unpredictable environment*. 2023 9th International Conference on Control, Decision and Information Technologies (CoDIT) (pp. 816–821), Rome, Italy.

Sinaga, K. A. S., Irene, J., & Christanti, R. (2023). Digital adoption and financial performance: Evidence from Indonesian SMEs in food and beverage sector. *Return: Study of Management, Economic and Business*, *2*(4), 423–434. [CrossRef]

Skafi, M., Yunis, M. M., & Zekri, A. (2020). Factors influencing SMEs' adoption of cloud computing services in Lebanon: An empirical analysis using TOE and contextual theory. *IEEE Access*, *8*, 79169–79181. [CrossRef]

Smart Africa. (2021). *Digital economy*. Available online: https://smartafrica.org/wp-content/uploads/2021/08/Kenya_Digital_Economy_2019.pdf (accessed on 12 January 2025).

Soluk, J. (2022). Organisations' resources and external shocks: Exploring digital innovation in family firms. *Industry and Innovation*, *29*(6), 792–824. [CrossRef]

Soluk, J., & Kammerlander, N. (2021). Digital transformation in family-owned Mittelstand firms: A dynamic capabilities perspective. *European Journal of Information Systems*, *30*(6), 676–711. [CrossRef]

Soluk, J., Miroshnychenko, I., Kammerlander, N., & De Massis, A. (2021). Family influence and digital business model innovation: The enabling role of dynamic capabilities. *Entrepreneurship Theory and Practice*, *45*(4), 867–905. [CrossRef]

Sun, S., Cegielski, C. G., Jia, L., & Hall, D. J. (2018). Understanding the factors affecting the organizational adoption of big data. *Journal of Computer Information Systems*, *58*(3), 193–203. [CrossRef]

Ta, V. A., & Lin, C.-Y. (2023). Exploring the determinants of digital transformation adoption for SMEs in an emerging economy. *Sustainability*, *15*(9), 7093. [CrossRef]

Tirdasari, N. L., Dhewanto, W., & Arief, N. N. (2022, September 15–16). *Digital adoption in the family business: A state-of-the-art review*. 17th European Conference on Innovation and Entrepreneurship (Vol. 17, pp. 529–536), Pafos, Cyprus. [CrossRef]

Tirdasari, N. L., Dhewanto, W., & Nurlaela Arief, N. (2026). Exploring challenges of digital adoption in family business. *Journal of the International Council for Small Business*, *7*(1), 190–206. [CrossRef]

Tornatzky, L. G., & Fleischer, M. (1990). *The processes of technological innovation*. Lexington Books.

Tumiwa, J. R., Tuegeh, O. D. M., & Nagy, A. S. (2020). Factor influencing MSMEs performance measurement: A literature review. *The Annals of the University of Oradea*, *29*, 151.

Tutar, H., & Sarkhanov, T. (2024). Digital innovation in family businesses in the post-pandemic period: A case study. *Journal of International Studies*, *17*(2), 100–117. [CrossRef]

Van den Berg, J., & Van der Lingen, E. (2019). An empirical study of the factors affecting the adoption of mobile enterprise applications. *South African Journal of Industrial Engineering*, *30*(1), 124–146. [CrossRef]

Wong, L. W., Leong, L. Y., Hew, J. J., Tan, G. W. H., & Ooi, K. B. (2020). Time to seize the digital evolution: Adoption of blockchain in operations and supply chain management among Malaysian SMEs. *International Journal of Information Management*, *52*, 101997. [CrossRef]

Xie, X., Zhang, H., & Blanco, C. (2023). How organizational readiness for digital innovation shapes digital business model innovation in family businesses? *International Journal of Entrepreneurial Behaviour & Research*, *29*(1), 49–79. [CrossRef]

Yoo, Y., Henfridsson, O., Kallinikos, J., Gregory, R., Burtch, G., Chatterjee, S., & Sarker, S. (2024). The next frontiers of digital innovation research. *Information Systems Research*, *35*(4), 1507–1523. [CrossRef]

Yujie, Z., Idris, S. B., & Lily, J. B. (2024). Research on the influencing factors of DT of SMEs from TOE perspective. *Global Business & Finance Review* (*GBFR*), *29*(3), 108–119. [CrossRef]

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