科学学研究 STUDIES IN SCIENCE OF SCIENCE
中国科学学与科技政策研究会
中国科学院科技战略咨询研究院
清华大学科学技术与社会研究中心
ISSN 1003-2053 CN 11-1805/G3

SME Performance Outcomes: The Role of Technological Absorptive Capacity and E-Business Innovation

中小企业绩效结果：技术吸收能力与电子商务创新的作用

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Abstract. This study examines the relationship between technological absorptive capacity and SME business performance, with e-business innovation as a mediating mechanism. Using data from 179 sunflower oil–processing SMEs in Tanzania and applying PLS-SEM, the findings show that technological absorptive capacity significantly enhances business performance, both directly and indirectly through e-business innovation. The mediation effect is partial, indicating that absorptive capacity influences performance partly by fostering e-business innovation. Multigroup analysis reveals no statistically significant differences between SMEs in the Dodoma and Singida regions, although effect sizes are generally stronger in Dodoma, where the mediating role of e-business innovation is also more pronounced. Overall, the study provides empirical evidence of the importance of technological absorptive capacity and e-business innovation in improving SME performance and offers relevant implications for managers, policymakers, and researchers.

Keywords: Business performance, E-business innovation, Technological absorptive capacity, Multigroup analysis

摘要: 本研究探讨了技术吸收能力与中小企业（SMEs）经营绩效之间的关系，并将电子商务创新作为中介机制。基于坦桑尼亚179家向日葵油加工中小企业的数据，并采用**偏最小二乘结构方程模型（PLS-SEM）**进行分析，研究结果表明，技术吸收能力对企业绩效具有显著的直接影响，同时也通过电子商务创新产生间接影响，且该中介作用为部分中介。多组分析结果显示，多多马（Dodoma）与辛吉达（Singida）地区中小企业在假设关系上不存在显著差异，但多数路径系数在多多马地区表现得更强，且电子商务创新的中介效应在多多马样本中更为明显。总体而言，本研究为技术吸收能力和电子商务创新在提升中小企业绩效中的关键作用提供了经验证据，并对企业管理者、政策制定者及学术研究具有重要启示。

关键词： 企业绩效,电子商务创新,中小企业,技术吸收能力,多组分析，并在学科领域中较为常用

Received: 30 November 2025 **Revised:** 20 December 2025 **Accepted:** 27 January 2026 **Published:** 14 February 2026

Citation: Chaniluma, D. A., David, D. J., & Amini, I. (2026). SME performance outcomes: The role of technological absorptive capacity and e-business innovation: 中小企业绩效结果：技术吸收能力与电子商务创新的作用. *Studies in Science of Science*, 44(2), 97–113.

1. Introduction

In the era of the Fourth Industrial Revolution, technological advancement has become increasingly central to the competitiveness of small and medium-sized enterprises (SMEs) (Mubarak et al., 2021). SMEs play a crucial role in economic development, contributing significantly to employment and gross domestic product (GDP) worldwide (WTO, 2020). In Tanzania, SMEs account for approximately 35–40% of GDP and provide more than 20% of employment opportunities (Lwesya, 2021). Despite their substantial economic contribution, SMEs continue to face persistent performance challenges across different contexts, particularly in developing economies (Changalima et al., 2023; Ringo et al., 2024; Setyaningsih et al., 2024). In response to these challenges, prior studies increasingly emphasize technological absorptive capacity (TAC) as a critical capability enabling SMEs to adapt to technological change, foster innovation, and improve business performance (Müller et al., 2021; Ismail, 2023b).

The literature consistently highlights that SMEs' ability to absorb technology generates important technological and competitive advantages (Lal, 2007), facilitating the development of innovative technological solutions (Bedoya-Villa et al., 2023). TAC refers to a firm's capacity to acquire, assimilate, transform, and exploit external technological knowledge for technological and product innovation (Lichtenthaler, 2016; Ismail, 2023b). However, despite increasing policy support and digitalization initiatives in developing countries (Kayisire & Wei, 2016; Maziriri et al., 2024), SMEs have not yet fully leveraged technological adoption to enhance performance. Business innovation, particularly in digital forms, has been shown to improve firm outcomes (Mayowa et al., 2017; Al-Abbadi & Rumman, 2023), yet SMEs continue to face multiple constraints, including low innovation returns, competitive pressure from imported products, and limited market competitiveness (Ismail, 2022c; Mang'ana et al., 2023; Ringo et al., 2023).

In Tanzania, although technology has been incorporated into national development strategies, SMEs remain at an early stage of strengthening TAC, and empirical evidence on how TAC translates into performance outcomes remains limited especially regarding the role of e-business innovation (EBI) (Ismail, 2023b). Digitalization, encompassing advanced e-business platforms, digital marketing, and innovative customer engagement mechanisms, offers SMEs opportunities to enhance efficiency, innovation, and competitiveness (Yin & Yu, 2022; Riedl et al., 2023; Dallocchio et al., 2024). TAC should therefore be viewed as a strategic capability that underpins e-business innovation and enables SMEs to respond effectively to dynamic market conditions (Bedoya-Villa et al., 2023). By strengthening TAC, SMEs can improve their capacity to innovate digitally, compete with larger firms, and establish sustainable market positions (Changalima et al., 2023; Bouwman et al., 2019).

Addressing this gap, the present study investigates the mediating role of e-business innovation in the relationship between technological absorptive capacity and SME business performance in the Tanzanian context. By providing context-specific empirical evidence, the study contributes to a deeper understanding of how TAC-driven digital innovation enhances SME performance and offers relevant insights for managers, policymakers, and development institutions seeking to strengthen SME competitiveness and support sustainable economic development.

2. Materials and Methods

Theoretical Review

This study posits that small and medium-sized enterprises (SMEs) capable of effectively absorbing and deploying externally sourced technologies constitute a key driver of superior business performance. Prior research widely recognizes that technological adaptation and innovation enable SMEs to achieve and sustain competitive advantages (Ortigueira-Sanchez et al., 2022; Leong et al., 2023). Nevertheless, the specific mechanisms through which technological absorptive capacity translates into improved SME performance remain insufficiently understood. Mahmood and Mubarik (2020) argue that technological absorptive capacity equips SMEs to thrive in rapidly evolving technological environments, particularly by enabling the adoption of innovation-driven solutions such as e-business applications.

The ability to acquire and utilize new technological knowledge from external sources represents a strategic asset that facilitates innovation. Empirical evidence provided by Ismail (2023b) suggests that SMEs investing in the development of technological absorptive capacity are better positioned to stimulate innovation and enhance overall business performance. This argument aligns with the Resource-Based View (RBV), which asserts that firms endowed with valuable, rare, and inimitable resources are more likely to achieve sustainable competitive advantage (Barney, 1991, 2021). In this context, the present study conceptualizes e-business innovation (EBI) as a critical mediating mechanism through which technological absorptive capacity is transformed into superior business performance.

Although alternative theoretical perspectives such as organizational learning theory have been used to explain the relationship between absorptive capacity and organizational outcomes (Kafouros et al., 2020), this study adopts the RBV to emphasize how multiple strategic resources are integrated into a coherent framework to support SME performance. Technological absorptive capacity enables SMEs to acquire, implement, and sustain complementary resources, including advanced technologies and external knowledge. These capabilities subsequently foster e-business innovations that enhance operational efficiency, market responsiveness, and competitiveness, thereby improving business performance. Given the accelerating adoption of digital technologies by SMEs (Dallocchio et al., 2024; Iheanachor et al., 2023), technological absorptive capacity and e-business innovation represent critical intangible resources for achieving superior performance in the digital economy. Accordingly, this study theorizes that technological absorptive capacity influences SME performance both directly and indirectly through e-business innovation.

Technological Absorptive Capacity And SME Business Performance

As SMEs increasingly pursue technological advancement, technological absorptive capacity has emerged as a crucial capability for managing operations and achieving superior performance. Prior studies link technological absorptive capacity to various organizational outcomes, highlighting its role in identifying, assimilating, and applying externally generated technological knowledge across diverse sectors. For instance, Lichtenthaler (2016) emphasizes its importance in developing technological and market knowledge, while Tzokas et al. (2015) document its influence on new product development. Valentim et al. (2016) further demonstrate that absorptive capacity enhances operational efficiency among SMEs.

While these studies provide valuable insights drawing on evidence from South Korean SMEs (Tzokas et al., 2015) and Portuguese SMEs (Valentim et al., 2016) empirical evidence on the relationship between

technological absorptive capacity and SME business performance in sub-Saharan Africa remains limited. This gap is particularly evident in Tanzania, where SMEs increasingly rely on technological advancement to enhance performance. In response, this study examines SMEs operating in the sunflower oil-processing sector and proposes the following hypothesis:

H1. *Technological absorptive capacity positively affects SME business performance.*

Technological Absorptive Capacity And E-Business Innovation

Technological absorptive capacity is widely recognized as a foundational concept in technology management and innovation research (García-Morales et al., 2007; Lau & Lo, 2019). It plays a pivotal role in shaping SMEs' ability to engage in e-business innovation. SMEs capable of acquiring, assimilating, and applying new technological knowledge are better positioned to introduce innovative digital solutions within their business models. Technological absorptive capacity encompasses employees' technological proficiency, effective internal communication, and the integration of technological change into existing organizational processes (García-Morales et al., 2007; Lin et al., 2002).

In rapidly evolving digital environments (Riedl et al., 2023), SMEs with strong absorptive capacity are more likely to implement innovative e-business strategies that support competitive product and service development. Such capabilities enable SMEs to identify emerging opportunities, respond to shifting market demands, and deliver distinctive value propositions to customers. Although previous studies have examined technological absorptive capacity and e-business innovation independently (Putra & Santoso, 2020; Raymond et al., 2015, 2016), empirical investigations explicitly linking these constructs particularly in developing economies such as Tanzania remain scarce. Accordingly, this study advances the following hypothesis:

H2. *Technological absorptive capacity positively affects e-business innovation*

E-Business Innovation And SME Business Performance

E-business innovation encompasses a broad spectrum of digital transformations that significantly reshape how SMEs operate and access markets (Bi et al., 2017). Given SMEs' critical role in economic development, particularly in developing countries (Israel & Kazungu, 2019; Kabanda & Brown, 2015; Ismail et al., 2023), understanding how e-business innovation influences performance is essential. SMEs adopting digital marketing tools, e-commerce platforms, and cloud-based systems often benefit from expanded market reach, improved customer engagement, and enhanced operational efficiency (Bouwman et al., 2019; Changalima et al., 2023; Radicic & Petković, 2023).

When effectively implemented, e-business innovations streamline internal processes, reduce costs, and facilitate access to new markets, thereby strengthening SMEs' competitive positioning. Moreover, in highly competitive environments, SMEs must differentiate themselves from rivals (Ismail, 2023a; Makona et al., 2023), and e-business innovation offers opportunities to develop unique value propositions (Al-Abbadi & Rumman, 2023). Despite its importance, the relationship between e-business innovation and SME business performance remains underexplored, particularly in contrast to the extensive literature on large firms (Bordonaba-Juste et al., 2012). This gap is especially pronounced in Tanzania, where contextual challenges in digital adoption are often overlooked (Nkwabi & Mboya, 2019; Ismail, 2022b). Accordingly, this study proposes:

H3. *E-business innovation positively affects SME business performance.*

The Mediating Role Of E-Business Innovation

Although prior research has extensively examined technological absorptive capacity and innovation, limited attention has been given to the mechanisms through which technological absorptive capacity indirectly enhances SME business performance. This study argues that performance improvements depend not only on technology adoption but also on leveraging absorptive capacity to develop innovative e-business solutions. Previous studies demonstrate that innovation can mediate the effects of various organizational factors on SME performance (Medina & Rufín, 2009; Byukusenge et al., 2016; Umar et al., 2018; Yadav et al., 2019). However, empirical evidence on the mediating role of e-business innovation in developing-country contexts remains scarce.

Grounded in RBV, this study posits that technological absorptive capacity enhances performance by enabling SMEs to transform technological knowledge into e-business innovations that improve efficiency, competitiveness, and market responsiveness (Ismail, 2023b). Accordingly, the following hypothesis is advanced:

H4. *Technological absorptive capacity indirectly affects SME business performance through e-business innovation.*

Research Approach And Design

Aligned with the objectives of this study, a quantitative research approach was adopted to empirically examine the relationships among technological absorptive capacity (TAC), e-business innovation (EBI), and SME business performance. The quantitative approach is appropriate for testing hypothesized relationships using statistical techniques and has been widely recommended for theory testing and model estimation (Hair et al., 2020). Accordingly, the proposed hypotheses were examined based on the conceptual model illustrated in Fig. 1.

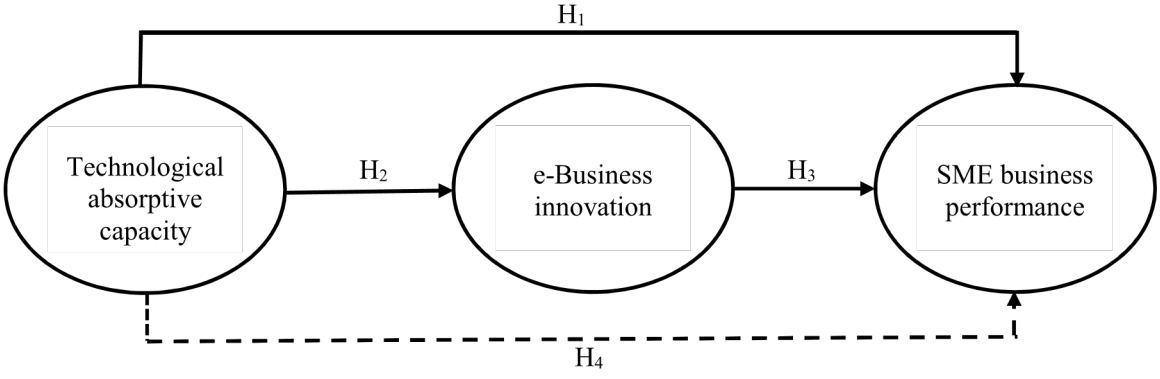

Figure 1. Conceptual Model

An analytical cross-sectional research design was employed, whereby data were collected from respondents at a single point in time (Setia, 2016). This design enabled the assessment of both direct and indirect relationships, particularly the mediating role of EBI in the linkage between TAC and SME business performance.

Sample And Data Collection

The study focused on SMEs engaged in sunflower oil processing, a strategically important agro-processing activity within Tanzania's economy (Njiku & Nyamsogoro, 2019; Mchopa et al., 2020). Data were collected from SMEs operating in Dodoma and Singida, two regions recognized as major hubs for agro-processing activities and sunflower oil production (Hamza et al., 2022; Moshi & Matotola, 2023). These regions also represent the country's central sunflower-growing corridor.

To ensure data relevance and quality, the survey instrument included two screening questions, with SMEs required to have been in operation for at least three years. This criterion ensured that respondents possessed sufficient experience with technological adoption and business operations consistent with the study's objectives. A total of 203 questionnaires were initially collected. Following data screening, 22 questionnaires were excluded due to missing values, and two additional questionnaires were removed for failing to meet the inclusion criterion. The final sample comprised 179 SMEs that provided complete and usable responses.

A post-hoc power analysis conducted using G*Power indicated that the final sample size yielded a statistical power of 0.987, exceeding the recommended threshold of 0.80 and confirming the adequacy of the sample for multivariate quantitative analysis (Kang, 2021).

Measurement And Analytical Procedures

All study constructs were measured using previously validated scales, ensuring content validity and consistency with prior research. Technological absorptive capacity (TAC) was measured using three items capturing firms' capabilities in technological development, adaptation of external technologies, and awareness of competitors' technologies, as adopted from Ismail (2023b). E-business innovation (EBI) was operationalized using four items related to the implementation of e-business solutions, integration of e-business strategies into overall business plans, allocation of financial resources, and availability of technological infrastructure and competencies (Rapp et al., 2008). SME business performance was assessed using five subjective indicators, including net income performance, sales growth, and competitive performance relative to rivals, following Ismail (2023a) and Sampaio et al. (2020).

Data analysis technique

The study employed partial least squares structural equation modeling (PLS-SEM) using SmartPLS 4 to analyze the data. PLS-SEM is well suited for estimating complex models involving latent variables and mediating relationships and is particularly effective with relatively small sample sizes (Hair et al., 2013, 2019). This technique enabled the simultaneous estimation of direct and indirect effects, aligning with the study's objective of examining the mediating role of EBI in the TAC–business performance relationship. In addition, a bootstrap-based multigroup analysis (MGA) was conducted to examine potential regional differences between SMEs located in Dodoma and Singida. SmartPLS 4 was also utilized for this purpose to ensure methodological consistency

Non-Response Bias And Common Method Bias

Consistent with prior survey-based studies, potential methodological biases were assessed to ensure the robustness of the findings (Ismail et al., 2023; Karmaker et al., 2023; Ringo et al., 2023). Non-response bias

(NRB) was examined by comparing early and late respondents using independent sample t-tests. The results revealed no statistically significant differences across constructs ($p > 0.05$), indicating the absence of NRB.

Common method bias (CMB) was assessed using two complementary approaches. First, Harman's single-factor test showed that a single factor accounted for 38.99 % of the total variance, which is below the recommended threshold, suggesting no serious CMB concern (Podsakoff et al., 2003). Second, the variance inflation factor (VIF) values for the inner model were all below 3.3, further confirming that CMB did not pose a significant threat to the validity of the structural model (Kock, 2015).

3. Result

Measurement MODEL

Following the two-step procedure inherent in PLS-SEM, the measurement model was evaluated prior to estimating the structural model. Assessing the measurement model is essential to ensure the reliability and validity of the constructs and to support the robustness of subsequent structural analyses. Internal consistency reliability was confirmed, as both Cronbach's alpha and composite reliability (CR) values exceeded the recommended threshold of 0.70 for the full sample as well as for the regional subsamples (Dodoma and Singida), as reported in Table 1 (Hair et al., 2019). Indicator reliability was also established, with all standardized factor loadings exceeding the recommended cut-off value of 0.708, indicating that the indicators adequately represented their respective constructs (Ringle et al., 2023).

To assess potential multicollinearity among reflective indicators, variance inflation factor (VIF) values were examined. All VIF values were below the conservative threshold of 5, suggesting no multicollinearity concerns across the full sample and subsamples. Convergent validity was further supported, as the average variance extracted (AVE) for each construct exceeded the minimum acceptable value of 0.50, indicating that the constructs explained a sufficient proportion of variance in their indicators (Hair et al., 2019).

Discriminant validity was evaluated using multiple complementary criteria, including the Heterotrait–Monotrait ratio (HTMT), the Fornell–Larcker criterion, and cross-loadings. As presented in Table 2, all constructs satisfied the required thresholds across the full sample and subsamples, confirming adequate discriminant validity (Ab Hamid et al., 2017; Ringle et al., 2023).

Table 1. Measurement model results.

Sample	Construct	Item	VIF	Outer Loading	Cronbach's α	CR	AVE
Complete	**TAC**	–	–	–	0.727	0.845	0.646
		TAC1	1.489	0.842			
		TAC2	1.356	0.751			
		TAC3	1.478	0.815			
	EBI	–	–	–	0.832	0.888	0.666
		EBI1	2.033	0.843			
		EBI2	1.549	0.753			
		EBI3	1.802	0.820			
		EBI4	2.013	0.845			
	BPF	–	–	–	0.829	0.880	0.594
		BPF1	1.978	0.804			
		BPF2	1.708	0.765			
		BPF3	1.737	0.776			
		BPF4	1.738	0.748			
		BPF5	1.703	0.760			

Sample	Construct	Item	VIF	Outer Loading	Cronbach's α	CR	AVE
Dodoma	**TAC**	–	–	–	0.726	0.844	0.644
		TAC1	1.397	0.834			
		TAC2	1.439	0.778			
		TAC3	1.456	0.794			
	EBI	–	–	–	0.849	0.899	0.691
		EBI1	2.290	0.879			
		EBI2	1.449	0.717			
		EBI3	2.248	0.855			
		EBI4	2.381	0.865			
	BPF	–	–	–	0.830	0.880	0.595
		BPF1	1.977	0.793			
		BPF2	1.764	0.790			
		BPF3	1.982	0.803			
		BPF4	1.555	0.717			
		BPF5	1.567	0.752			
Singida	**TAC**	–	–	–	0.724	0.845	0.646
		TAC1	1.682	0.849			
		TAC2	1.276	0.720			
		TAC3	1.554	0.835			
	EBI	–	–	–	0.807	0.872	0.630
		EBI1	1.930	0.789			
		EBI2	1.879	0.796			
		EBI3	1.647	0.764			
		EBI4	1.707	0.824			
	BPF	–	–	–	0.831	0.881	0.597
		BPF1	2.069	0.816			
		BPF2	1.715	0.735			
		BPF3	1.480	0.730			
		BPF4	2.376	0.806			
		BPF5	2.123	0.773			

Structural Model

After establishing the adequacy of the measurement model, the structural model was evaluated. First, multicollinearity among the predictor constructs was assessed by examining the inner model variance inflation factor (VIF) values. All VIF values were below the conservative threshold of three, indicating that multicollinearity was not a concern in the structural relationships (Hair et al., 2019).

The results of the hypothesis testing based on the path coefficients and their statistical significance are reported in Table 3 for the complete sample as well as the regional subsamples (Dodoma and Singida). Based on the complete sample, all hypothesized relationships were supported at $p < 0.005$. Specifically, technological absorptive capacity (TAC) exerted a positive and significant effect on business performance (BPF) ($\beta = 0.341$, $t = 3.956$, $p < 0.001$) and on e-business innovation (EBI) ($\beta = 0.381$, $t = 4.494$, $p < 0.001$). In addition, EBI was positively associated with BPF ($\beta = 0.285$, $t = 4.034$, $p < 0.001$). The mediating role of EBI in the relationship between TAC and BPF was also supported ($\beta = 0.109$, $t = 2.849$, $p = 0.004$). All bias-corrected confidence intervals excluded zero, confirming the robustness of these effects (e.g., TAC → BPF: CI = 0.164, 0.498).

The results for the Dodoma subsample were largely consistent with those of the complete sample. TAC exhibited a positive and significant effect on BPF ($\beta = 0.319$, $t = 2.921$, $p = 0.004$) and on EBI ($\beta = 0.424$,

t = 3.872, p < 0.001). Likewise, EBI significantly influenced BPF (β = 0.330, t = 3.574, p < 0.001). The mediating effect of EBI on the TAC–BPF relationship was also supported in the Dodoma sample (β = 0.140, t = 2.444, p = 0.015).

In contrast, while the Singida subsample demonstrated significant direct effects of TAC on BPF (β = 0.390, t = 2.856, p = 0.004) and on EBI (β = 0.340, t = 2.753, p = 0.006), as well as a significant relationship between EBI and BPF (β = 0.236, t = 2.224, p = 0.026), the mediating effect of EBI was not supported. The indirect effect of TAC on BPF through EBI was statistically insignificant in the Singida sample (β = 0.080, t = 1.431, p = 0.152). This finding suggests regional heterogeneity in the strength of the mediation mechanism.

The predictive power of the structural model was further assessed using R^2 values. For the complete sample, R^2 values of 0.145 for EBI and 0.272 for BPF (see Fig. 2) indicate that TAC explains approximately 14.5% of the variance in EBI, while TAC and EBI jointly explain 27.2% of the variance in BPF. In the Dodoma subsample, TAC accounted for approximately 18% of the variance in EBI, whereas TAC and EBI together explained about 30% of the variance in BPF. Similarly, in the Singida subsample, TAC explained 11.6% of the variance in EBI, and TAC and EBI jointly accounted for approximately 27% of the variance in BPF. These values indicate low but acceptable predictive power, consistent with recommendations for behavioral research models (Hair et al., 2019).

Finally, predictive relevance (Q^2) was assessed using the blindfolding procedure. The Q^2 values were 0.184 (BPF) and 0.122 (EBI) for the complete sample; 0.180 (BPF) and 0.143 (EBI) for the Dodoma subsample; and 0.187 (BPF) and 0.035 (EBI) for the Singida subsample. Since all Q^2 values exceeded zero, the results confirm that the structural model exhibits adequate predictive relevance for both the complete sample and the regional subsamples (Ringle et al., 2023).

Table 2. Discriminant validity.

	Dodoma			Singida		
Complete sample						
HTMT			**HTMT**			**HTMT**		
	BPF	EBI	TAC		BPF	EBI	TAC		BPF	EBI	TAC
BPF				BPF				BPF			
EBI	0.495			EBI	0.545			EBI	0.426		
TAC	0.571	0.485		TAC	0.570	0.542		TAC	0.607	0.414	
Fornell-Larcker criterion				**Fornell-Larcker criterion**				**Fornell-Larcker criterion**			
	BPF	EBI	TAC		BPF	EBI	TAC		BPF	EBI	TAC
BPF	0.771			BPF	0.772			BPF	0.773		
EBI	0.415	0.816		EBI	0.465	0.831		EBI	0.369	0.794	
TAC	0.450	0.381	0.804	TAC	0.459	0.424	0.802	TAC	0.471	0.340	0.804
Cross loadings				**Cross loadings**				**Cross loadings**			
	BPF	EBI	TAC		BPF	EBI	TAC		BPF	EBI	TAC
BPF1	**0.804**	0.318	0.320	BPF1	**0.793**	0.336	0.330	BPF1	**0.816**	0.311	0.328
BPF2	**0.765**	0.286	0.331	BPF2	**0.790**	0.335	0.396	BPF2	**0.735**	0.233	0.293

BPF3	**0.776**	0.342	0.390	BPF3	**0.803**	0.328	0.419	BPF3	**0.730**	0.382	0.370
BPF4	**0.748**	0.283	0.324	BPF4	**0.717**	0.373	0.241	BPF4	**0.806**	0.179	0.431
BPF5	**0.760**	0.360	0.358	BPF5	**0.752**	0.421	0.364	BPF5	**0.773**	0.292	0.380
EBI1	0.380	**0.843**	0.265	EBI1	0.497	**0.879**	0.341	EBI1	0.234	**0.789**	0.176
EBI2	0.294	**0.753**	0.289	EBI2	0.282	**0.717**	0.350	EBI2	0.320	**0.796**	0.208
EBI3	0.328	**0.820**	0.333	EBI3	0.397	**0.855**	0.364	EBI3	0.214	**0.764**	0.304
EBI4	0.351	**0.845**	0.354	EBI4	0.344	**0.865**	0.362	EBI4	0.366	**0.824**	0.349
TAC1	0.426	0.319	**0.842**	TAC1	0.466	0.352	**0.834**	TAC1	0.373	0.287	**0.849**
TAC2	0.332	0.239	**0.751**	TAC2	0.300	0.322	**0.778**	TAC2	0.417	0.125	**0.720**
TAC3	0.318	0.354	**0.815**	TAC3	0.314	0.345	**0.794**	TAC3	0.355	0.383	**0.835**

Table 3. The structural model results.

Relationship	**Coeff Beta**	**T statistics**	**P-Values**	**f2**
TAC → BPF	0.341	3.956	0.000	0.136
TAC → EBI	0.381	4.494	0.000	0.170
EBI → BPF	0.285	4.034	0.000	0.096
TAC → EBI → BPF	0.109	2.849	0.004	-
Dodoma sample				
TAC → BPF	0.319	2.921	0.004	0.119
TAC → EBI	0.424	3.872	0.000	0.219
EBI → BPF	0.330	3.574	0.000	0.128
TAC → EBI → BPF	0.140	2.444	0.015	-
Singida Sample				
TAC → BPF	0.390	2.856	0.004	0.186
TAC → EBI	0.340	2.753	0.006	0.131
EBI → BPF	0.236	2.224	0.026	0.066
TAC → EBI → BPF	0.080	1.431	0.152	-

The bootstrap multigroup analysis (MGA) results are reported in Table 4, comparing SMEs from the Dodoma and Singida regions. The MGA was conducted to examine whether the hypothesized relationships differ significantly across regions. Overall, the findings indicate no statistically significant regional differences in any of the hypothesized paths between the two samples.

Specifically, the effect of technological absorptive capacity (TAC) on business performance (BPF) was marginally weaker for SMEs in Dodoma than in Singida; however, this difference was not statistically significant ($p = 0.330$). In contrast, the effects of TAC on e-business innovation (EBI), EBI on BPF, and the

mediating role of EBI in the TAC–BPF relationship were relatively stronger in the Dodoma sample compared to Singida. Nevertheless, these differences were also statistically insignificant at the 5% level, indicating that the structural relationships operate similarly across the two regions.

4. Discussion

The discussion of the findings is anchored in the proposed theoretical framework, which posits that technological absorptive capacity (TAC) enhances e-business innovation (EBI), thereby improving SME business performance. Using PLS-SEM on data collected from 179 sunflower oil–processing SMEs in Tanzania, the results demonstrate that TAC functions as a critical driver of SME performance, primarily through its influence on EBI. These findings provide deeper insights into how the interaction between TAC and EBI can be leveraged to enhance SME performance within the agro-processing sector.

Consistent with prior empirical evidence (Ismail, 2023b; Marco-Lajara et al., 2023), the results suggest that sustained improvements in SME performance in developing economies can be achieved by fostering EBI and advancing digital transformation initiatives. The study further confirms that TAC has a positive and significant effect on EBI, indicating that weak SME performance in developing countries may be mitigated by strengthening firms' technological absorptive capabilities. This conclusion aligns with Rehman et al. (2020), who emphasize that TAC plays a pivotal role in enhancing SME performance in developing-country contexts.

Additionally, the findings indicate that fostering e-business innovation (EBI) among SMEs in developing countries requires targeted efforts to strengthen their ability to acquire, assimilate, and apply new technological knowledge in daily business operations. This result is consistent with Becheikh (2013), who emphasized that access to external knowledge, technology familiarity, and absorptive capacity are critical enablers of innovation within SMEs in developing economies. The evidence further suggests that EBI is enhanced when SMEs improve their proficiency in using new technologies and effectively integrate technological systems into routine operational processes.

The importance of strengthening technological absorptive capacity (TAC) is further supported by Shahadat et al. (2023) and Sukrat and Leeraphong (2023), who argue that SMEs in developing countries must be empowered to embrace digital transformation by enhancing their readiness to respond to competitive pressures in the digital marketplace. In line with this, the results imply that SMEs should intensify their TAC to overcome the slow pace of digital adoption and leverage digital transformation as a mechanism for improving business performance. This conclusion aligns with Ismail (2023b), who advocates for deliberate strategies that prepare SMEs to adapt to technological changes that continuously reshape business models and operational practices.

Furthermore, the bootstrap multigroup analysis comparing SMEs in Dodoma and Singida two key regions within Tanzania's sunflower oil–producing corridor revealed no statistically significant regional differences in the effects of TAC and EBI on business performance. Although TAC exhibited a relatively stronger association with business performance in Singida than in Dodoma, this difference was not significant and may be attributed to the relatively greater expansion of business opportunities in Singida's sunflower oil–processing sector (Njiku & Nyamsogoro, 2019). Nevertheless, these opportunities do not translate into meaningful performance disparities attributable to TAC.

In contrast, the relationship between TAC and EBI, as well as the mediating role of EBI in enhancing business performance, appeared more pronounced among SMEs in Dodoma. This may reflect the higher concentration of sunflower oil–processing firms and greater exposure to innovation-related training initiatives in the region (Hamza et al., 2022; Moshi & Matotola, 2023). Consequently, SMEs in Dodoma

are more likely to achieve favorable business outcomes through EBI-driven mechanisms than their counterparts in Singida. However, it is important to note that these regional differences remain statistically insignificant.

5. Conclusions and Implications

This study provides robust empirical evidence on the pivotal role of technological absorptive capacity (TAC) in enhancing e-business innovation (EBI) and, in turn, improving the business performance of SMEs in Tanzania's sunflower oil–processing industry. The findings confirm that TAC is a key driver of SME performance by facilitating the acquisition, assimilation, and application of technological knowledge, which supports digital transformation and innovation in business operations. EBI is shown to exert a positive influence on business performance, underscoring the importance of SMEs' ability to adapt to digital change in competitive markets. Although regional differences between Dodoma and Singida were observed, these variations were not statistically significant, suggesting that the role of TAC and its linkage with EBI remains consistently important across regions. Nevertheless, SMEs in Dodoma benefiting from greater exposure to training and innovation-related initiatives demonstrated stronger outcomes in leveraging TAC and EBI. Overall, the study highlights that strengthening TAC through capacity building, training, and investment in digital transformation is essential for improving SME performance in developing economies, particularly in agro-processing sectors where technological advancement can yield substantial gains.

From a theoretical perspective, this study extends the Resource-Based View (RBV) by demonstrating how intangible resources, specifically TAC and EBI, jointly contribute to SME business performance. By empirically validating the mediating role of EBI, the study advances understanding of the mechanisms through which TAC translates into superior performance outcomes, particularly in non-technology-based SMEs. The multigroup analysis further enriches the literature by offering region-specific insights, while confirming the generalizability of the proposed relationships. Managerially, the findings emphasize the need for SME owners and policymakers to prioritize investments in technological infrastructure, digital skills development, and managerial readiness for digital transformation. Despite its contributions, the study is limited by its focus on SMEs in two regions and a single industry, as well as the exclusion of younger and start-up firms. Future research is encouraged to expand the scope to other sectors, regions, and firm life cycles, and to explore additional mediators and moderators that may further illuminate the complex pathways linking TAC, innovation, and SME performance.

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