Technology Adoption and Distribution Channel Efficiency of SMEs in Taraba State, Nigeria

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Abstract

This study investigates the influence of technology adoption on the distribution channel efficiency of Small and Medium Enterprises (SMEs) in Taraba State, Nigeria. Anchored in Dynamic Capabilities Theory, the study examines four technology dimensions—mobile applications, e-commerce platforms, inventory management systems (IMS), and electronic payment systems (EPS)—as predictors of distribution channel efficiency, operationalized through time, cost, service, and resource utilization efficiency. A descriptive and correlational research design was employed, with data collected from 386 SMEs across five Local Government Areas using a structured Likert-scale questionnaire. Multiple regression analysis was conducted using SPSS v26. The overall model was statistically significant [$F(4, 381) = 28.731$, $p < .001$], explaining 23.2% of the variance in distribution channel efficiency ($R^2 = .232$). E-commerce platforms emerged as the dominant predictor ($\beta = 0.473$, $p < .001$), followed by mobile applications ($\beta = 0.114$, $p = .017$). IMS recorded no significant independent effect ($\beta = -0.018$, $p = .768$), while EPS produced a statistically significant negative coefficient ($\beta = -0.165$, $p = .006$), interpreted as a suppression artifact rather than a genuine adverse effect. Findings confirm that e-commerce adoption is the most impactful lever for distribution efficiency among Taraba State SMEs. Integrated technology adoption strategies and targeted policy support are recommended to deepen digital utilization and strengthen SMEs logistics performance.

Keywords: Technology adoption, distribution channel efficiency, SMEs, Taraba State.

1. Introduction

Technological advancement has transformed business operations globally, reshaping how products and services are distributed and delivered. For Small and Medium Enterprises (SMEs), technology adoption has become a critical strategy for enhancing operational efficiency, competitiveness, and customer satisfaction. Technologies such as mobile applications, e-commerce platforms, and digital payment systems have enabled SMEs to improve inventory management, logistics coordination, order processing, and customer engagement. In supply chain management, distribution channel efficiency refers to the ability to deliver products in the right quantity, at the right time, and at minimum cost through

effective coordination of logistics, transportation, inventory, and information flow (Chopra & Meindl, 2023).

Empirical evidence indicates that digital technologies contribute significantly to improved operational performance, customer service delivery, and inventory management among SMEs (Vu *et al*., 2025; Quaye *et al*., 2024; Mensah & Xu, 2025; Huang *et al*., 2025). Despite these benefits, many Nigerian SMEs continue to face challenges such as high distribution costs, delayed deliveries, inefficient inventory management, and weak supply chain coordination. Existing studies have focused largely on general operational outcomes, with limited attention to the specific effects of technology adoption on distribution channel efficiency in terms of time, cost, service quality, and resource utilization.

This gap is particularly pronounced in Taraba State, Nigeria, where SMEs operate under conditions of inadequate infrastructure, limited finance, weak institutional support, and low technological capability. This study examines the influence of technology adoption on the distribution channel efficiency of SMEs in Taraba State while the specific objectives are: (i) to examine the effect of mobile applications on distribution channel efficiency; (ii) to assess the influence of e-commerce platforms on distribution channel efficiency; (iii) to evaluate the influence of inventory management systems on distribution channel efficiency; and (iv) to determine the effect of electronic payment systems on distribution channel efficiency. Based on the stated objectives, the following hypotheses were formulated:

H_{01}: Mobile application adoption has no significant effect on distribution channel efficiency among SMEs in Taraba State.

H_{02}: E-commerce platform adoption has no significant effect on distribution channel efficiency among SMEs in Taraba State.

H_{03}: Inventory management systems have no significant effect on distribution channel efficiency among SMEs in Taraba State.

H_{04}: Electronic payment systems have no significant effect on distribution channel efficiency among SMEs in Taraba State.

The study provides empirical evidence to support managerial decision-making and policy formulation. The article is structured as follows: Section 2 reviews

relevant literature; Section 3 outlines the methodology; Section 4 presents data analysis and results; and Section 5 concludes with findings, implications, and recommendations.

2. Literature Review

2.1 Theoretical Review

This study applies Dynamic Capabilities Theory to explain how firms adapt and reconfigure resources to achieve competitive advantage in dynamic environments. Developed by Teece *et al*. (1997), the theory argues that competitive advantage depends on a firm's ability to sense opportunities, seize them, and transform organizational resources in response to environmental change (Teece, 2007; Eisenhardt & Martin, 2000). Dynamic capabilities are reflected in firms' use of mobile applications, e-commerce platforms, inventory management systems, and e-payment systems to improve operational performance and distribution channel efficiency.

Mobile applications enable SMEs to monitor market trends, engage customers, and improve communication through cloud-based services (Sumaili *et al*., 2018). E-commerce platforms support digital sales and distribution while enhancing logistics and inventory processes (Li *et al*., 2020). Inventory management systems help firms monitor demand, adjust stock levels, and improve supply chain agility (Kazmi & Ahmed, 2022). E-payment systems reduce transaction costs, expand market access, and improve operational efficiency (Ledi *et al.,* 2023). Collectively, these digital capabilities enhance distribution channel efficiency by enabling firms to adopt omnichannel strategies and reconfigure distribution networks for greater speed, cost efficiency, and market reach (Autry *et al*., 2010).

2.2 Conceptual Definitions and Technology–Efficiency Linkages Mobile Applications and Distribution Channel Efficiency

Mobile applications are software programs enabling users to perform tasks and interact with digital content on mobile devices (Weichbroth, 2020). For SMEs, mobile apps enhance distribution channel efficiency through real-time order tracking, faster supplier-customer communication, improved logistics coordination, and timely information sharing—collectively reducing operational costs and improving service performance (Choi et al., 2016).

E-Commerce Platforms and Distribution Channel Efficiency

E-commerce encompasses digital technologies and online platforms that conduct commercial activities and enhance retail competitiveness (Tran & Nguyen, 2025). E-commerce expands market access, reduces intermediary costs, automates order processing, and improves supply chain coordination—transforming traditional structures into digitally coordinated networks (Brown & Dant, 2013; Mensah & Xu, 2025).

Inventory Management Systems and Distribution Channel Efficiency

IMS help organizations monitor stock, forecast demand, optimize replenishment, and enhance operational efficiency (Panigrahi et al., 2024). By integrating analytics, cloud computing, and IoT tools such as RFID, IMS reduces stockouts and overstocking, improves asset utilization, and enhances warehousing-transportation coordination (Andrejić & Kilibarda, 2016).

Electronic Payment Systems and Distribution Channel Efficiency

EPS encompass digital and mobile payment technologies that facilitate online transactions more quickly, cheaply, and securely than traditional methods (Skarmeta Gomez, 2022). EPS improve distribution efficiency by reducing transaction costs, accelerating cash conversion, improving order confirmation speed, and enabling cross-border commerce (Khanin et al., 2022; Ledi et al., 2023).

Distribution Channel Efficiency

Distribution channel efficiency refers to the optimal utilization and coordination of logistics resources—transportation, warehousing, order processing, and inventory management—to minimize waste and maximize performance outcomes (Andrejić & Kilibarda, 2016). This study operationalizes efficiency through: (i) time efficiency—speed and responsiveness of product flow (Christopher, 2016); (ii) cost efficiency—achieving logistics objectives while minimizing total system costs (Ballou, 2007); (iii) service efficiency—delivering customer value reliably, accurately, and timely (Mentzer et al., 2001); and (iv) resource utilization efficiency—effectively deploying inventory, transportation, labour, and facilities to satisfy customer demand at the lowest total cost (Coyle et al., 2017).

2.3 Empirical Review

Kumar et al. (2025), in a systematic review using the PRISMA protocol and TCM-ADO framework, propose an integrated model positioning e-commerce as a

central hub connecting digital marketing, logistics integration, supply chain finance, and cross-border trade. Their findings show that combining e-commerce, logistics systems, and fintech tools enhances distribution efficiency and competitiveness, particularly for resource-constrained SMEs.

Aulia et al. (2024) examined technology adoption, e-commerce, and process efficiency on agribusiness supply chain performance in Indonesia. All variables significantly improved performance, with process efficiency as the strongest predictor. Technology adoption enhanced resource management and production accuracy, while e-commerce expanded market access and transaction efficiency, underscoring the value of integrated digital transformation.

Vu et al. (2025) investigated ASEAN Economic Community integration and FinTech adoption on SME distribution efficiency in Vietnam using SEM and fsQCA, revealing that FinTech strengthens the relationship between financial capability and distribution performance. Tran and Nguyen (2025) analyzed e-commerce adoption on distribution channel performance among Vietnamese retail SMEs, finding significant improvements in efficiency, market reach, and order fulfilment. Quaye et al. (2024) found that while digital technologies enhance SME competitiveness in Ghana, structural barriers such as limited financing, weak infrastructure, and low absorptive capacity constrain full benefits—challenges closely mirroring those in Taraba State.

Research Gap

Despite growing literature, three key gaps remain. First, existing studies are concentrated in Vietnam, Indonesia, and Ghana, with limited empirical evidence from Taraba State. Second, most prior studies rely on SEM and fsQCA methods that do not adequately estimate relative effects of individual technology dimensions on distribution channel efficiency. Third, technology adoption is often treated as a single construct, limiting attention to distinct effects of mobile applications, e-commerce platforms, IMS, and EPS. This study addresses these gaps by applying multiple regression analysis to examine individual technology effects among SMEs in Taraba State.

3. Methodology

Research Design and Setting

This study adopted a descriptive and correlational research design to examine technology adoption patterns and their influence on distribution channel

efficiency (Creswell & Creswell, 2017). The study was conducted in Taraba State, northeastern Nigeria, covering the Local Government Areas of Jalingo, Wukari, Bali, Gembu, and Takum to ensure adequate geographic and sectoral representation.

Population and Sampling

The target population consisted of 36,746 registered SME owners and employees operating across agricultural, manufacturing, trading, and service sectors in Taraba State (SMEDAN/NBS, 2017), which remains the most recent and comprehensive official SME database in Nigeria. Sample size was determined using Yamane's (1967) formula:

$n = N / (1 + N(e^2))$,

$n = 36746 / (1 + 36746(0.05^2))$

$n = 36746/92.865$,

$n \approx 396$ respondents, increased to 436 to accommodate non-response. A stratified systematic sampling technique was employed, proportionally selecting respondents across the five LGAs. Of 436 questionnaires administered, 386 valid responses were retrieved, representing an 89% response rate.

Instrumentation

Data were collected via a structured questionnaire on a five-point Likert scale (Strongly Disagree to Strongly Agree). The instrument contained 40 items: 20 measuring technology adoption (mobile applications, e-commerce platforms, IMS, and EPS—five items each) and 20 measuring distribution channel efficiency (time, cost, service, and resource utilization efficiency—five items each). Items were adapted from established instruments by Davis, Venkatesh, Chopra, and Christopher. Content validity yielded a Scale Content Validity Index (S-CVI) of 0.89. A pilot study with 30 respondents produced Cronbach's alpha coefficients of 0.78–0.89, confirming instrument reliability.

Model Specification

The following multiple linear regression model was specified:

$$\mathbf{DCE = \beta_0 + \beta_1(MN) + \beta_2(EP) + \beta_3(IMS) + \beta_4(EPS) + \varepsilon}$$

Where:

DCE = Distribution Channel Efficiency (composite score);

β_0 = regression constant;

β_1–β_4 = coefficients for mobile applications

(MN), E-commerce platforms (EP),

Inventory management systems (IMS),

Electronic payment systems (EPS) respectively;

ε = stochastic error term.

Each predictor is a composite summative score of five Likert-scale items (range: 5–25). Ordinary least squares (OLS) estimation was employed. Multicollinearity was assessed via VIF and tolerance values, autocorrelation via the Durbin-Watson statistic, and model fit via R^2, Adjusted R^2, and the overall F-statistic.

4. Data Analysis and Discussion of Results

Out of 436 administered questionnaires, 386 were returned, representing a response rate of 89%.

Table 1: Respondent Demographics and Business Profiles (n = 386)

Items	Respondents	Percentage (%)
Gender		
Male	205	53
Female	181	47
Total	386	100
Age Range		
18–30 years	120	31
31–40 years	143	37
41–50 years	88	23
51 years and above	45	12
Total	386	100
Educational Qualification		
Secondary School	120	31
Diploma/Certificate	125	32
Bachelor's Degree	115	30
Master's/Doctorate	14	4
Other	12	3
Total	386	100
Position in the Organization		
Owner/Proprietor	125	32
Manager	95	25
Operations Staff	166	43
Total	386	100

Years of Experience		
Less than 3 years	120	31
4–10 years	108	28
More than 10 years	158	41
Total	386	100
Type of Business		
Manufacturing SMEs	60	16
Agro-based SMEs	193	50
Trading SMEs	133	34
Total	386	100
Years of Business Operation		
Less than 3 years	100	26
4–10 years	146	38
More than 10 years	140	36
Total	386	100

Source: 2026 Field Survey

The sample shows a balanced gender distribution (53% male, 47% female) and a predominantly young profile, with 68% aged 18–40. Education levels span secondary (31%), diploma (32%), and bachelor's degree (30%). Operations staff form the largest occupational group (43%), with owners (32%) and managers (25%) providing both operational and strategic perspectives. Agro-based SMEs dominate (50%), followed by trading (34%) and manufacturing (16%). Seventy-four percent of firms have operated for over four years, indicating relatively established businesses.

Table 2: Descriptive Statistics for Technology Adoption

S/N	Statement	SA (%)	A (%)	U (%)	D (%)	Mean	S.D.
Mobile Applications							
1	Our business uses mobile apps for order processing and tracking.	96 (24.9%)	168 (43.5%)	103 (26.7%)	19 (4.9%)	3.88	0.837
2	Mobile apps facilitate real-time communication between suppliers and customers.	95 (24.6%)	161 (41.2%)	99 (25.6%)	16 (4.1%)	3.79	0.988
3	We use mobile apps to coordinate logistics and delivery.	99 (25.6%)	184 (47.7%)	64 (16.6%)	37 (9.6%)	3.88	0.917
4	Mobile apps improved information flow within our distribution network.	146 (37.8%)	159 (41.2%)	51 (13.2%)	21 (5.4%)	4.06	0.966
5	Mobile apps reduced communication gaps with distribution partners.	148 (38.3%)	189 (49.0%)	13 (3.4%)	33 (8.5%)	4.16	0.899
	Total					3.96	0.932
E-Commerce Platforms							
6	Our business has adopted e-commerce platforms for selling.	131 (33.9%)	219 (56.7%)	28 (7.3%)	8 (2.1%)	4.22	0.667
7	E-commerce enabled us to reach customers beyond our location.	122 (31.6%)	202 (52.3%)	53 (13.7%)	9 (2.3%)	4.13	0.730
8	We use online marketplaces (Jumia, Konga) to distribute products.	110 (28.5%)	208 (53.9%)	58 (15.0%)	8 (2.1%)	4.08	0.750
9	E-commerce adoption reduced our transaction costs.	95 (24.6%)	183 (47.4%)	65 (16.8%)	41 (10.6%)	3.85	0.926
10	Our e-commerce platform supports automated order processing.	105 (27.2%)	151 (39.1%)	87 (22.5%)	41 (10.6%)	3.82	0.970
	Total					4.02	0.831
Inventory Management Systems							
11	Our business uses digital IMS to track stock levels.	125 (32.4%)	154 (39.9%)	70 (18.1%)	37 (9.6%)	3.95	0.944
12	We use barcode scanners or RFID for inventory control.	88 (22.8%)	153 (39.6%)	119 (30.8%)	25 (6.5%)	3.78	0.879

13	Our IMS helps forecast product demand accurately.	87 (22.5%)	162 (42.0%)	106 (27.5%)	29 (7.5%)	3.79	0.895
14	Digital inventory systems support data-driven decision-making.	111 (28.8%)	188 (48.7%)	45 (11.7%)	35 (9.1%)	4.22	0.964
15	IMS reduced overstocking and stock-out situations.	161 (41.7%)	168 (43.5%)	41 (10.6%)	13 (3.4%)	3.94	0.826
	Total					3.94	0.916
Electronic Payment Systems							
16	Our business accepts electronic payments via POS terminals.	120 (31.1%)	217 (56.2%)	34 (8.8%)	13 (3.4%)	4.14	0.748
17	We use mobile payment applications for transactions.	114 (29.5%)	205 (53.1%)	52 (13.5%)	11 (2.8%)	4.08	0.796
18	Our business uses online payment gateways for customer transactions.	113 (29.3%)	206 (53.4%)	54 (14.0%)	13 (3.4%)	4.09	0.749
19	EPS reduced payment processing time in our operations.	94 (24.4%)	184 (47.7%)	69 (17.9%)	39 (10.1%)	3.87	0.899
20	Electronic payments enhanced transparency in transactions.	99 (25.6%)	148 (38.3%)	90 (23.3%)	48 (12.4%)	3.77	0.975
	Total					3.99	0.850

Source: 2026 Field Survey

Table 2 presents descriptive statistics for the four technology adoption dimensions. All dimensions demonstrated high mean scores (3.94–4.02), indicating strong technology adoption among Taraba State SMEs. E-commerce platforms received the highest composite rating (M = 4.02, SD = 0.83), followed by electronic payment systems (M = 3.99, SD = 0.85), mobile applications (M = 3.96, SD = 0.93), and inventory management systems (M = 3.94, SD = 0.92). Cronbach's alpha coefficients ranged from 0.85 to 0.89, confirming excellent internal consistency reliability across all dimensions.

Table 3: Descriptive Statistics for Distribution Channel Efficiency

S/N	Statement	SA (%)	A (%)	U (%)	D (%)	Mean	S.D.
Time Efficiency							
1	Our business achieves fast delivery of products to customers.	133 (34.5%)	157 (40.7%)	66 (17.1%)	28 (7.3%)	4.02	0.924
2	We consistently meet delivery deadlines and schedules.	122 (31.6%)	202 (52.3%)	42 (10.9%)	18 (4.7%)	4.10	0.806
3	The order cycle time in our business is short.	112 (29.0%)	181 (46.9%)	58 (15.0%)	32 (8.3%)	3.95	0.916
4	Our distribution network responds quickly to customer orders.	102 (26.4%)	170 (44.0%)	73 (18.9%)	39 (10.1%)	3.85	0.946
5	We have reduced lead times in product distribution over the past year.	103 (26.7%)	161 (41.7%)	79 (20.5%)	42 (10.9%)	3.83	0.953
	Total					3.95	0.915
Cost Efficiency							
6	Our transportation costs have decreased due to improved distribution.	78 (20.2%)	164 (42.5%)	103 (26.7%)	20 (5.2%)	3.67	1.031
7	We minimized warehousing costs while maintaining service quality.	100 (25.9%)	184 (47.7%)	42 (10.9%)	41 (10.6%)	3.79	1.091
8	Inventory holding costs in our business are well controlled.	157 (40.7%)	161 (41.7%)	36 (9.3%)	19 (4.9%)	4.11	0.995
9	Our overall distribution costs have reduced without compromising quality.	163 (42.2%)	194 (50.3%)	—	29 (7.5%)	4.27	0.807
10	Our business maintains profitability through cost-efficient distribution.	111 (28.8%)	217 (56.2%)	51 (13.2%)	7 (1.8%)	4.12	0.692
	Total					3.99	0.961
Service Efficiency							
11	Our business fulfills customer orders accurately and completely.	109 (28.2%)	213 (55.2%)	57 (14.8%)	7 (1.8%)	4.10	0.703
12	Products are consistently available when customers need them.	81 (21.0%)	188 (48.7%)	67 (17.4%)	50 (13.0%)	3.78	0.926
13	We respond promptly to customer complaints and service requests.	97 (25.1%)	139 (36.0%)	105 (27.2%)	45 (11.7%)	3.75	0.965
14	Our distribution network ensures high levels of customer satisfaction.	136 (35.2%)	150 (38.9%)	65 (16.8%)	35 (9.1%)	4.01	0.941
15	Customer retention and loyalty improved due to our service delivery.	84 (21.8%)	159 (41.2%)	124 (32.1%)	19 (4.9%)	3.80	0.836

	Total					3.89	0.890
Resource Utilization Efficiency							
16	Our business effectively utilizes warehouse space and facilities.	98 (25.4%)	182 (47.2%)	47 (12.2%)	40 (10.4%)	3.78	1.083
17	Inventory turnover rate in our business is optimal.	123 (31.9%)	204 (52.8%)	45 (11.7%)	14 (3.6%)	4.13	0.753
18	We maximize the use of delivery vehicles and transportation assets.	125 (32.4%)	234 (60.6%)	27 (7.0%)	—	4.26	0.576
19	Our technological assets are utilized effectively.	115 (29.8%)	189 (49.0%)	47 (12.2%)	26 (6.7%)	3.97	0.950
20	We minimize waste and optimize resource deployment in operations.	148 (38.3%)	172 (44.6%)	47 (12.2%)	17 (4.4%)	4.16	0.852
	Total					4.06	0.874

Source: 2026 Field Survey

Table 3 shows that all efficiency dimensions recorded high mean scores (M = 3.89–4.06), indicating strong perceived efficiency among SMEs. Resource Utilization Efficiency had the highest mean (M = 4.06, SD = 0.87), while Service Efficiency recorded the lowest, though still high, mean (M = 3.89, SD = 0.89), suggesting slight room for improvement in service delivery. The moderate standard deviations (SD = 0.87–0.96) reflect variations in operational capabilities among SMEs and underscore the importance of technology adoption in improving distribution performance.

Inferential Analysis

Table 4: Pearson Correlations among Technology Adoption Dimensions and Distribution Channel Efficiency (N = 386)

Variable	DCE	MN	EP	IMS	EPS
DCE	1.000	.099	.448	-.016	-.052
MN	.099	1.000	.081	.316	.292
EP	.448	.081	1.000	.155	.193
IMS	-.016	.316	.155	1.000	.654
EPS	-.052	.292	.193	.654	1.000

Sig. (1-tailed): DCE–MN p=.026; DCE–EP p<.001; IMS–EPS p<.001. N = 386.

Source: 2026 Field Survey

The Pearson correlation matrix reveals a strong positive relationship between e-commerce platforms and distribution channel efficiency ($r = .448$, $p < .001$) and a weak but significant relationship with mobile applications ($r = .099$, $p = .026$). IMS and EPS showed no significant bivariate correlations with DCE ($r = -.016$ and $r = -.052$ respectively), suggesting their effects may be suppressed in the presence of other predictors. The high IMS–EPS inter-correlation ($r = .654$, $p < .001$) signals potential multicollinearity.

Table 5: Regression Model Summary — Goodness-of-Fit Statistics

Model	R	R^2	Adj. R^2	Std. Error	R^2 Change	F Change	Durbin-Watson
1	.481	.232	.224	6.441	.232	28.731	1.720

Predictors: (Constant), EPS, EP, MN, IMS. Sig. F Change: $p < .001$.

Source: 2026 Field Survey

Table 6: ANOVA — Regression Model Significance

Model	Source	df	Sum of Squares	Mean Square	F / Sig.
1	Regression	4	4767.915	1191.979	F = 28.731
	Residual	381	15806.834	41.488	$p < .001$
	Total	385	20574.749		

Dependent Variable: DCE. Predictors: EPS, EP, MN, IMS.

Source: 2026 Field Survey

The regression model predicting distribution channel efficiency from technology adoption was significant, $F(4, 381) = 28.731$, $p < .001$, explaining 23.2% of the variance ($R^2 = .232$, Adjusted $R^2 = .224$). The Durbin-Watson value of 1.720 indicates minimal autocorrelation, confirming model validity. While technology adoption meaningfully influences distribution efficiency, other factors also contribute to the remaining explained variance.

Table 7: Regression Coefficients — Technology Adoption Predicting Distribution Channel Efficiency

Variable	B	Std. Err	Beta (β)	t	Sig.	95% CI	VIF / Tol.
Constant	59.816	3.295	—	18.156	<.001	[53.32, 66.31]	—
MN	.250	.104	.114	2.401	.017	[0.05, 0.45]	1.08 / 0.926
EP	1.210	.117	.473	10.319	<.001	[0.98, 1.44]	1.12 / 0.893
IMS	-.044	.150	-.018	-.295	.768	[-0.34, 0.25]	1.75 / 0.571
EPS	-.419	.153	-.165	-2.737	.006	[-0.72, -0.12]	1.78 / 0.562

Dependent Variable: DCE. MN = Mobile Applications; EP = E-Commerce Platforms; IMS = Inventory Management Systems; EPS = Electronic Payment Systems.

Source: 2026 Field Survey

VIF values for all predictors remained below 3.0 (IMS VIF = 1.75, EPS VIF = 1.78, EP VIF = 1.12, MN VIF = 1.08), suggesting multicollinearity within acceptable limits (Hair et al., 2010). Nevertheless, the high IMS–EPS correlation may partially explain the non-significant IMS coefficient and the unexpected negative EPS coefficient, as multicollinearity can cause coefficient suppression and sign reversals even with moderate VIF values.

Hypothesis testing and Discussion of Findings

H_{01}: Effect of Mobile Applications on Distribution Channel Efficiency

Mobile application adoption has a significant positive effect on distribution channel efficiency ($\beta = 0.114$, $t = 2.401$, $p = .017$), leading to rejection of H_{01}. A one-unit increase in mobile application adoption increases distribution efficiency by 0.250 points (95% CI: [0.046, 0.454]). Although the unique contribution is modest ($sr^2 = 1.2\%$), the finding confirms that mobile applications improve communication, information sharing, and logistics coordination among SMEs. This supports Choi et al. (2016) and Kumar et al. (2025), who identified mobile-enabled logistics as a strategic driver of distribution efficiency. The relatively small effect may reflect infrastructural constraints, uneven integration depth, and limited digital literacy—consistent with Dynamic Capabilities Theory, which emphasizes firms' ability to sense and respond to market changes through digital tools (Teece, 2007).

H_{02}: Influence of E-Commerce Platforms on Distribution Channel Efficiency
E-commerce adoption exerts a strong and statistically significant positive effect on distribution channel efficiency ($\beta = 0.473$, $t = 10.319$, $p < .001$), rejecting H_{02}. The variable explains 21.4% of unique variance ($sr^2 = .214$), making it the strongest predictor. A one-unit increase increases distribution efficiency by 1.210 points (95% CI: [0.98, 1.44]). This confirms that e-commerce expands market access, reduces intermediary costs, automates order processing, and improves supply chain coordination—transforming traditional structures into digitally coordinated networks (Brown & Dant, 2013; Mensah & Xu, 2025). The finding supports Kumar *et al*. (2025) and Vu *et al.* (2025), and is consistent with Dynamic Capabilities Theory, as e-commerce enables SMEs to sense opportunities, seize digital channels, and reconfigure distribution processes for greater efficiency (Teece, 2007). The strong effect may also reflect SMEs leveraging e-commerce to overcome geographic and infrastructural limitations.

H_{03}: Influence of Inventory Management Systems on Distribution Channel Efficiency

IMS has a non-significant negative effect on distribution channel efficiency ($\beta = -0.018$, $t = -0.295$, $p = .768$), leading to acceptance of H_{03}. Despite high adoption levels ($M = 3.94$), IMS did not significantly contribute to efficiency in the regression model. This contrasts with Panigrahi et al. (2024) and Huerta-Soto et al. (2025), who reported IMS improvements in inventory visibility and operational cost control. The non-significant result is primarily attributable to multicollinearity with EPS ($r = .654$), which suppressed IMS's independent contribution. It may also reflect shallow implementation—SMEs adopting basic tracking systems without integrating advanced IMS capabilities such as RFID and predictive analytics. IMS may influence efficiency indirectly through interactions with other digital technologies rather than through direct effects alone.

H_{04}: Effect of Electronic Payment Systems on Distribution Channel Efficiency

EPS shows a statistically significant but negative effect on distribution channel efficiency ($\beta = -0.165$, $t = -2.737$, $p = .006$), rejecting H_{04} in the opposite direction. However, the near-zero bivariate correlation between EPS and DCE ($r = -.052$, $p = .155$) indicates the negative coefficient is a statistical suppression artifact caused by multicollinearity with IMS rather than a genuine adverse effect. This contrasts with Skarmeta Gomez (2022) and Ledi *et al*. (2023), who

demonstrated EPS improvements in transaction speed, operational flexibility, and market responsiveness. The absence of a direct positive relationship may reflect the logistics-focused efficiency measures employed, whereas EPS primarily affects financial transaction processes. High and uniform EPS adoption among SMEs may also have limited its explanatory power in the regression model.

Implications

The findings indicate that digital technologies operate as complementary rather than isolated systems in improving distribution efficiency. E-commerce platforms are the most influential technology, highlighting their importance in overcoming geographic and infrastructural barriers faced by Taraba State SMEs. The results suggest that broad technology adoption alone is insufficient—the depth of integration and effective utilization of digital tools are critical for achieving efficiency gains. Service efficiency remains comparatively weak, indicating the need for SMEs to strengthen customer responsiveness through mobile and e-commerce technologies.

Theoretical Contributions

This study extends Dynamic Capabilities Theory to SME distribution channel management in a resource-constrained sub-Saharan African context. It demonstrates that technology type matters significantly—e-commerce platforms exert substantially stronger effects than mobile applications, inventory systems, or payment technologies. Methodologically, the study contributes by applying multiple regression and multicollinearity diagnostics to examine technology–efficiency relationships, providing accessible and policy-relevant evidence for developing economies.

5. Conclusion and Recommendations Conclusion

Four substantive conclusions emerge. First, e-commerce adoption has the strongest effect on distribution channel efficiency, enabling digitally coordinated direct-to-consumer distribution that overcomes geographic limitations and reduces reliance on intermediary-dependent channels. Second, mobile applications contribute positively to efficiency by improving communication and coordination, representing an accessible entry point for digital distribution management in resource-constrained environments.

Third, the non-significant IMS effect signals that efficiency gains depend on adoption depth and organizational integration—without adequate training, reliable data systems, and process alignment, SMEs may not realize IMS's potential benefits. Fourth, digital technologies generate greater collective impact when implemented as complementary systems; SMEs combining e-commerce, EPS, and logistics coordination tools are more likely to achieve sustained efficiency improvements than those deploying isolated technologies.

Theoretically, the study extends Dynamic Capabilities Theory to SME distribution management in sub-Saharan Africa, demonstrating the theory's explanatory relevance in low-resource, infrastructure-constrained environments. It demonstrates that technology type matters: e-commerce exerts substantially stronger direct effects than mobile applications, inventory systems, or payment technologies—an insight with direct implications for adoption sequencing and resource allocation.

Recommendations

For SME owners and managers: e-commerce platforms should be prioritized as the primary technology for improving distribution performance, particularly platforms integrating order management, digital marketing, and logistics coordination. Mobile applications should be expanded beyond basic communication to support logistics tracking, route coordination, and customer service. IMS adoption must be complemented with staff training, reliable data management, and integration with e-commerce and EPS to achieve meaningful efficiency gains.

For policymakers and SME development agencies: investments in reliable internet connectivity and affordable smart devices in rural and semi-urban Taraba State are essential. Capacity-building programs focusing on digital literacy, operational integration, and data-driven logistics management should be developed alongside incentives such as e-commerce onboarding support and technology adoption grants to encourage deeper digital utilization.

For financial institutions and fintech providers: the weak direct relationship between EPS and distribution efficiency indicates a utilization gap. Developing simplified, affordable payment gateway solutions tailored to SME logistics operations could help translate high EPS adoption rates into measurable efficiency improvements.

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