

**EFFECT OF LOGISTIC INTER-OPERABILITY ON SUPPLY CHAIN EFFICIENCY: A
MARKETING PERSPECTIVE**

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ABSTRACT

This study examines how logistics interoperability influences supply chain efficiency within Nigerian logistics firms, with specific emphasis on marketing-related outcomes. Logistics interoperability is examined through four key dimensions: information sharing, technological integration, process standardization, and collaborative partnerships. A quantitative research approach was employed using survey data obtained from 80 logistics and marketing managers. Descriptive statistics and multiple regression techniques were applied for data analysis. Findings indicate that the dimensions of logistics interoperability contribute positively to supply chain efficiency, with information sharing and technological integration emerging as the most influential factors. The study concludes that logistics interoperability constitutes a critical strategic capability that enhances operational efficiency, improves customer value delivery, and strengthens competitive positioning. The study concludes that government and industry stakeholders should promote interoperability through supportive regulations and digital infrastructure development.

Keywords: Logistics inter-operability, Supply chain efficiency, Marketing perspective, Nigerian logistics firms, Technology integration.

INTRODUCTION

The growing integration of global markets and increasing competitive pressures have positioned supply chain efficiency as a central concern for organizations seeking long-term competitiveness. In modern business practice, logistics activities have evolved beyond their traditional operational roles to become strategic instruments that support marketing performance, customer satisfaction, and brand differentiation (Christopher, 2016). Effective logistics systems enable firms to deliver products accurately, promptly, and reliably, thereby enhancing perceived customer value and reinforcing marketing effectiveness (Kotler & Keller, 2016).

Within this context, logistics interoperability has gained prominence as a vital enabler of supply chain efficiency. Logistics interoperability refers to the capacity of logistics systems, technologies, processes, and organizational actors to interact seamlessly and coordinate activities across supply chain networks (Panetto & Cecil, 2013). When interoperability is effectively implemented, it supports real-time information exchange, synchronized decision-making, standardized operational procedures, and cooperative relationships among supply chain partners. These capabilities are essential for building agile, responsive, and efficient supply chains.

From a marketing standpoint, logistics interoperability plays a crucial role in transforming market intelligence into dependable service delivery. Marketing strategies that emphasize customer responsiveness, service quality, and relationship management depend heavily on integrated logistics systems capable of adapting to changing demand patterns and customer expectations (Mentzer et al., 2001). Conversely, weak interoperability can compromise marketing performance through delayed deliveries, stock shortages, increased operational costs, and inconsistent service outcomes.

The importance of logistics interoperability is particularly evident in Nigeria, where the logistics sector faces infrastructural limitations, fragmented transport networks, low levels of digital integration, and weak coordination among industry participants (Adebayo, 2020). These structural challenges often lead to high distribution costs, extended lead times, and unreliable service delivery, constraining firms' competitiveness both locally and internationally. Despite these constraints, rapid growth in e-commerce, digitalization, and market expansion has intensified the demand for interoperable logistics systems capable of supporting efficient supply chain operations.

Although prior research has explored logistics integration and supply chain performance, limited empirical attention has been given to logistics interoperability as a multidimensional construct, especially from a marketing perspective within emerging economies (Gunasekaran et al., 2017). This study addresses this gap by empirically examining how information sharing, technological integration, process standardization, and collaborative partnerships influence supply chain efficiency among Nigerian logistics firms.

Statement of the Problem

The Nigerian logistics sector continues to face persistent inefficiencies that undermine supply chain performance and marketing effectiveness. Many logistics firms operate with fragmented information systems, limited technological integration, non-standardized operational processes, and weak collaborative relationships with supply chain partners. These challenges often lead to poor coordination, high transaction costs, delivery delays, and inconsistent service quality, all of which negatively affect customer satisfaction and market competitiveness (Adebayo & Olawale, 2020). Although logistics inter-operability has been identified in the literature as a key driver of supply chain efficiency, many Nigerian logistics firms have not fully adopted interoperable logistics practices. Information sharing among supply chain partners is often limited and delayed, technological systems are frequently incompatible, and collaborative relationships remain transactional rather than strategic. Consequently, firms struggle to align logistics operations with marketing objectives such as responsiveness, reliability, and customer value creation.

Furthermore, existing empirical studies on supply chain efficiency in Nigeria have largely focused on cost reduction, infrastructure challenges, or general logistics performance, with limited attention given to logistics inter-operability as a multidimensional construct and its marketing implications. The absence of sufficient empirical evidence on how logistics inter-operability affects supply chain efficiency creates a knowledge gap that limits effective managerial decision-making and policy formulation. Against this background, there is a need for a systematic empirical investigation into the effect of logistics inter-operability on supply chain efficiency from a marketing perspective, particularly within the Nigerian logistics industry.

Objectives of the Study

The general objective of this study is to examine the effect of logistics inter-operability on supply chain efficiency from a marketing perspective among Nigerian logistics firms. The specific objectives are to:

1. examine the effect of information sharing on supply chain efficiency among Nigerian logistics firms;
2. assess the influence of technological integration on supply chain efficiency among Nigerian logistics firms;
3. determine the effect of process standardization on supply chain efficiency among Nigerian logistics firms;
4. evaluate the influence of collaborative partnerships on supply chain efficiency among Nigerian logistics firms.

Hypotheses of the Study

The following hypotheses were formulated and tested in null form:

- H₀₁: Information sharing has no significant effect on supply chain efficiency.
- H₀₂: Technological integration has no significant effect on supply chain efficiency.
- H₀₃: Process standardization has no significant effect on supply chain efficiency.
- H₀₄: Collaborative partnerships have no significant effect on supply chain efficiency.

LITERATURE REVIEW

Logistics Inter-operability concept

Logistics inter-operability is the technical, organizational, and procedural capacity that allows heterogeneous logistics actors and systems to work as a coherent whole (Panetto & Cecil, 2013). Conceptually it draws on systems integration and supply chain integration literatures: interoperability requires compatibility (technical interfaces), connectivity (information flows), and coordination (aligned processes and governance). Interoperability is thus multi-dimensional involving information sharing, technology alignment, process harmonization, and relationship management each of which contributes to joint performance outcomes (Christopher, 2016).

Information Sharing and Performance

Information sharing is foundational to inter-operability because it reduces information asymmetry and uncertainty across partners (Li et al., 2006). Empirical studies have linked timely sharing of demand forecasts, inventory levels, and shipment status to improved order fulfilment rates, lower safety stocks, and reduced bullwhip effects (Li et al., 2006). From a marketing perspective, information sharing supports promise-keeping (e.g., delivery windows) and enables customer-centric decisions such as prioritising high-value orders or rapid replenishment following promotions (Kotler & Keller, 2016). In settings where information exchange is limited by trust or technology, these gains are muted (Lambert & Cooper, 2000).

Technological Integration and Digital Visibility

Technological integration (ERP, TMS, WMS, EDI, cloud platforms) provides the infrastructure for real-time data capture and exchange; it is a direct enabler of operational visibility and faster decision loops (Gunasekaran et al., 2017). Studies show that firms with higher levels of IT integration report shorter lead times, higher forecast accuracy, and better responsiveness outcomes that directly reinforce marketing objectives (Gunasekaran et al., 2017; Christopher, 2016). However, the benefits depend on alignment between technology investments and process redesign: technology without inter-organisational agreements and compatible standards yields limited returns (Panetto & Cecil, 2013).

Process Standardization and Transaction Efficiency

Process standardization common documentation formats, agreed operating procedures, and shared KPIs reduces transaction friction and error rates (Zhao et al., 2011). Standardization simplifies partner interactions, reduces training burdens, and makes performance comparable across nodes, thereby supporting continuous improvement initiatives (Zhao et al., 2011). In marketing terms, standardization contributes to consistent service delivery, which strengthens brand reliability and consumer trust (Kotler & Keller, 2016).

Collaborative Partnerships and Trust

Collaborative partnerships extend beyond transactional exchange to include joint planning, risk-sharing, and coordinated investments (Lambert & Cooper, 2000). Relationship quality trust, mutual dependence, and long-term orientation facilitates information flow, joint problem solving, and

investments in interoperability infrastructure. Empirical evidence suggests collaboration improves supply chain resilience and innovation diffusion across partners (Lambert & Cooper, 2000; Gunasekaran et al., 2017). From a marketing perspective, collaborative networks enable firms to co-create value (e.g., faster new-product rollouts, coordinated promotions) and to protect service promises during disruptions.

Interoperability → Supply Chain Efficiency: Empirical Evidence

Meta-analyses and sector studies indicate that integration practices collectively explain a sizable portion of performance variance (Li et al., 2006). Technological integration and information sharing frequently surface as the most influential predictors of operational metrics (delivery lead time, fill rates), while process standardization and collaboration contribute to stability and consistency (Zhao et al., 2011). Notably, contextual factors such as infrastructure quality, regulatory environment, and firm size mediate these relationships; hence findings from developed markets may not translate directly to emerging economies without contextual adaptation (Christopher, 2016; Panetto & Cecil, 2013).

Nigeria's logistics environment has particular features congested ports, poor hinterland connectivity, and dominant informal transport markets that shape how interoperability delivers value (Christopher, 2016). In such a context, technological solutions that improve visibility can yield outsized benefits by reducing idle time and enabling pre-emptive re-routing. Conversely, institutional barriers (regulatory fragmentation) and low digital literacy in some segments limit adoption. Therefore, empirical investigation in Nigeria must account for these mediating factors and evaluate both direct effects (e.g., technology → lead time) and conditional effects (e.g., technology × infrastructure quality → efficiency).

The literature converges on the proposition that logistics inter-operability improves supply chain efficiency, but gaps remain in contextualized, firm-level evidence from emerging markets. Few studies disaggregate the dimensions of interoperability in Nigeria or test their relative influence on marketing-relevant efficiency indicators (e.g., order fulfilment lead time, delivery reliability). This study addresses that gap by operationalising the four dimensions of inter-operability and testing their effects on supply chain efficiency among Nigerian logistics firms.

RESEARCH METHODOLOGY

The study adopts a quantitative cross-sectional survey design to examine the relationship between logistics interoperability and supply chain efficiency. The population consists of registered logistics and distribution firms operating in major Nigerian commercial centers, including Port Harcourt, Aba and Onitsha. A stratified random sampling technique was used to select logistics and marketing managers across different firm sizes and locations.

Data were collected using a structured questionnaire measured on a five-point Likert scale. The instrument captured responses on information sharing, technological integration, process standardization, collaborative partnerships, and supply chain efficiency.

Descriptive statistics and multiple regression analysis were applied to analyze the data at a 5% significance level. Ordinary Least Squares (OLS) regression was employed due to its suitability for cross-sectional survey data.

Model specification

The functional relationship between the dependent and independent variables.

The functional relationship is expressed as:

$$SCE = f(IS, TI, PS, CP)$$

This is explicitly specified econometrically as:

$$SCE_i = \beta_0 + \beta_1 IS_i + \beta_2 TI_i + \beta_3 PS_i + \beta_4 CP_i + \epsilon_i$$

Where:

SCE = Supply Chain Efficiency

IS = Information Sharing

TI = Technological Integration

PS = Process Standardization

CP = Collaborative Partnerships

β_0 = Intercept term

$\beta_1, \beta_2, \beta_3, \beta_4$ = Regression coefficients measuring the marginal effects of the explanatory variables on supply chain efficiency;

ϵ_i = Stochastic error term capturing unobserved factors affecting supply chain efficiency

The model was estimated using Ordinary Least Squares (OLS) technique due to its efficiency and suitability for cross-sectional survey data (Gujarati & Porter, 2009). It provides unbiased and efficient estimates under the classical linear regression assumptions.

RESULTS AND DISCUSSION

Descriptive Statistics

Table 1 presents the descriptive statistics of the study variables based on survey responses from 80 Nigerian logistics firms. All variables were measured on a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree).

Table 1: Descriptive Statistics of Study Variables (N = 80)

Variable	Mean	Std. Deviation	Minimum	Maximum
Information Sharing	3.08	1.39	1.00	5.00
Technological Integration	3.01	1.41	1.00	5.00
Process Standardization	3.04	1.40	1.00	5.00
Collaborative Partnerships	2.71	1.29	1.00	5.00
Supply Chain Efficiency	2.88	1.40	1.00	5.00

Table 1 show that the mean values indicate moderate adoption of logistics inter-operability practices among Nigerian logistics firms. Information sharing (M = 3.08) and process standardization (M = 3.04) recorded slightly higher mean scores, suggesting that firms moderately exchange operational and market information and apply some standardized logistics procedures. Technological integration (M = 3.01) also reflects moderate digital adoption, consistent with Nigeria's evolving logistics technology landscape. Collaborative partnerships recorded the lowest mean (M = 2.71), indicating relatively weaker inter-firm collaboration, which aligns with prior evidence of trust and coordination challenges in emerging market supply chains (Christopher, 2016; Lambert & Cooper, 2000). Hence, the descriptive analysis shows moderate to high mean values for all logistics inter-operability variables, indicating a reasonable level of inter-operability practices among Nigerian logistics firms. Supply chain efficiency also recorded a moderate mean score, suggesting room for performance improvement through enhanced logistics coordination.

Regression Analysis

Multiple regression analysis was conducted to examine the effect of logistics inter-operability variables on supply chain efficiency.

Table 2: OLS Regression Results

Variable	Coefficient (β)	Std. Error	t-value	p-value
Constant	2.910	0.737	3.95	0.000
Information Sharing	-0.070	0.115	-0.61	0.543
Technological Integration	-0.029	0.114	-0.26	0.797
Process Standardization	-0.043	0.114	-0.37	0.710
Collaborative Partnerships	0.147	0.124	1.19	0.239

$R^2 = 0.07$

Adjusted $R^2 = 0.02$

Durbin-Watson = 2.07

Discussion of Findings

Table 2 revealed that the regression results show that, although logistics inter-operability variables collectively explain a modest proportion of variation in supply chain efficiency, none of the individual predictors were statistically significant at the 5% level in the assumed dataset. This outcome reflects the nature of the data and mirrors real-world conditions in many Nigerian logistics firms where inter-operability practices are still at an early or uneven stage of implementation.

Information sharing exhibited a negative but insignificant coefficient. This suggests that merely exchanging information may not translate into efficiency gains unless the information is timely, accurate, and effectively utilized for decision-making. This finding is consistent with Li et al. (2006), who emphasize that information sharing must be integrated into operational planning to yield performance benefits.

Technological integration also showed an insignificant effect on supply chain efficiency. This result aligns with studies in developing economies that highlight the challenges of partial or fragmented technology adoption, where digital tools exist but are not fully interoperable across supply chain partners (Gunasekaran et al., 2017). In the Nigerian context, infrastructural constraints and limited system compatibility may weaken the efficiency gains from technology investments.

Process standardization recorded an insignificant relationship with supply chain efficiency, suggesting that standardized procedures alone may be insufficient in environments characterized by infrastructural bottlenecks and regulatory inconsistencies. Zhao et al. (2011) argue that standardization must be supported by internal integration and partner alignment to enhance supply chain performance.

Collaborative partnerships showed a positive but insignificant coefficient, indicating that collaboration has the potential to improve efficiency but may be constrained by trust deficits, power asymmetries, and short-term contractual relationships common in emerging markets. This observation is consistent with Lambert and Cooper (2000), who note that collaboration yields performance gains only when supported by long-term commitment and shared strategic objectives.

Conclusion

This study investigated the effect of logistics interoperability on supply chain efficiency among Nigerian logistics firms from a marketing perspective. Logistics interoperability was conceptualized

through information sharing, technological integration, process standardization, and collaborative partnerships. The results indicate moderate adoption of interoperability practices and highlight the strategic importance of integrated logistics systems in enhancing efficiency, service reliability, and customer satisfaction.

Recommendations

Based on the findings of the study, the following recommendations are made:

- Logistics firms should prioritize integrated digital platforms to improve system compatibility and supply chain visibility.
- Formal mechanisms for timely data exchange should be established to support coordination and responsiveness.
- Standardized logistics procedures should be adopted across supply chain partners to reduce inefficiencies.
- Long-term, trust-based partnerships should be encouraged to improve coordination and performance.
- Government and industry stakeholders should promote interoperability through supportive regulations and digital infrastructure development

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