Journal of Sustainable Development of Transport and Logistics
journal home page: https://jsdtl.sciview.net

Njuguna, A., W., Githae, P., & Nyile, E. K. (2025). Cross-border logistics and shipping company performance in East Africa: Empirical evidence from Mombasa Port. *Journal of Sustainable Development of Transport and Logistics, 10*(2), 134-172. doi:10.14254/jsdtl.2025.10-2.8.

ISSN 2520-2979

Cross-border logistics and shipping company performance in East Africa: Empirical evidence from Mombasa Port

Alice Wanjiru Njuguna *, Peter Githae *, Erastus Kiswili Nyile **

** The Management University of Africa,*
South C, Popo Rd, Kenya
njugunaalice5@gmail.com; pgithae1@mua.ac.ke
*** Murang'a University of Technology,*
Murang'a, Kenya
nyileras@gmail.com

Article history:

Received: May 01, 2025
1st Revision: September 29, 2025
Accepted: November 03, 2025

DOI:
10.14254/jsdtl.2025.10-2.8

Abstract: *Purpose*: This study examines the effect of cross-border logistics on shipping company performance in East Africa, specifically investigating how customs clearance efficiency, transportation management systems (TMS) adoption, last-mile delivery optimization, and supply chain coordination influence operational, financial, and market performance of maritime logistics firms in Mombasa County, Kenya. *Methodology*: The research employed a descriptive survey design with stratified random sampling of 172 shipping companies operating in Mombasa County. Data were collected through structured questionnaires from 149 respondents (86.63% response rate), yielding cross-sectional observations of logistics practices and performance outcomes. Multiple linear regression analysis examined the joint effects of independent variables on performance, controlling for firm size, years of operation, service scope, and customer profile. *Results*: All four hypothesized relationships were confirmed statistically ($p < 0.05$). Supply chain coordination demonstrated the strongest effect on performance ($\beta = 0.458$, standardized $\beta = 0.338$), followed by transportation management systems ($\beta = 0.412$, standardized $\beta = 0.234$), last-mile delivery optimization ($\beta = 0.289$, standardized $\beta = 0.241$), and customs clearance efficiency ($\beta = 0.186$, standardized $\beta = 0.182$). The regression model explained 77.2% of performance variance ($R^2 = 0.772$, $F = 52.34$, $p < 0.001$), indicating that cross-border logistics dimensions are critical performance determinants. However, technology adoption barriers limit TMS implementation to 34.2% of firms, representing untapped performance improvement opportunity. *Theoretical Contribution*: The study contributes to the logistics and supply chain management literature by providing firm-level empirical evidence on determinants of cross-border logistics performance in Sub-

Corresponding author: *Alice Wanjiru Njuguna*
E-mail: njugunaalice5@gmail.com

Saharan Africa, where such research remains limited. The integrated examination of multiple logistics dimensions reveals performance interdependencies. The findings extend institutional theory, the resource-based view, transaction cost economics, and network theory by demonstrating their complementary explanatory power in the context of logistics in developing economies. The dominant effect of supply chain coordination supports network theory predictions while highlighting limitations of technology-centered approaches in resource-constrained environments. *Practical Implications*: For shipping company executives, the research provides evidence-based guidance for strategic logistics investments, emphasizing that supply chain coordination and relationship development can yield higher returns than technology adoption alone. For policymakers, the findings support prioritizing customs reform, technology infrastructure investment, and regional harmonization within the East African Community and the African Continental Free Trade Area. For industry associations, the research identifies skills gaps in logistics management requiring capacity-building initiatives and suggests that collaborative problem-solving forums addressing inter-organizational coordination challenges would benefit industry competitiveness.

Keywords: cross-border logistics, shipping company performance, supply chain coordination, East Africa, customs clearance efficiency, transportation management systems

Sustainable Development Goals (SDGs): SDG 9: Industry, Innovation, and Infrastructure; **SDG 8:** Decent Work and Economic Growth; **SDG 17:** Partnerships for the Goals

1. Introduction

1.1. Background to the study

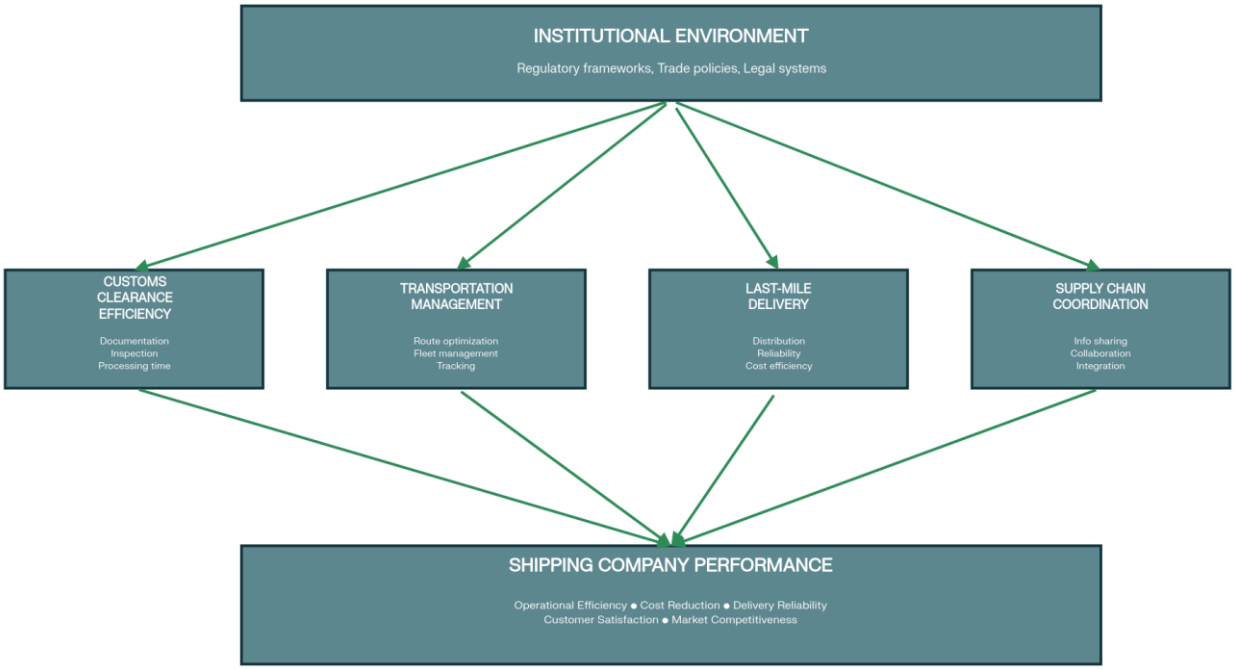
Global trade has expanded substantially over the past two decades, with international merchandise trade reaching $25.3 trillion in 2023 (World Trade Organization, 2024). Cross-border logistics - encompassing customs clearance, transportation management, last-mile delivery, and supply chain coordination - has become central to international commerce. For shipping companies operating in developing economies, the ability to manage these complexities determines operational efficiency, market competitiveness, and long-term sustainability.

The Port of Mombasa in Kenya serves as the primary maritime gateway for the East African Community (EAC), handling 41.1 million metric tons of cargo in 2024, representing a 14.1% increase from the previous year (Kenya Ports Authority, 2025). The port facilitates trade not only for Kenya but also for landlocked countries, including Uganda, Rwanda, Burundi, South Sudan, and parts of the Democratic Republic of Congo. Uganda alone accounts for 65.7% of transit cargo through Mombasa, with 8.8 million tons processed in 2024 (Business Daily Africa, 2025). Despite this strategic importance, shipping companies in the region face significant challenges in customs procedures, transportation infrastructure, delivery networks, and inter-organizational coordination.

Cross-border logistics performance influences firm competitiveness through multiple mechanisms. Research demonstrates that institutional quality and logistics performance are intrinsically linked to Global Value Chain participation, with logistics-efficient countries experiencing trade growth rates 30-40% higher than less-efficient counterparts (Nasser et al., 2024). Figure 1.1 illustrates the conceptual relationships among the institutional environment, cross-border logistics dimensions, and shipping company performance outcomes. The framework shows how regulatory

frameworks, trade policies, and legal systems shape four key logistics dimensions - customs clearance efficiency, transportation management, last-mile delivery, and supply chain coordination - which in turn determine operational efficiency, cost reduction, delivery reliability, customer satisfaction, and market competitiveness.

Figure 1.1: Conceptual framework of cross-border logistics impact on shipping performance



Customs clearance represents a critical bottleneck in cross-border logistics. Research examining customs policies across 142 countries found that ratification of the Revised Kyoto Convention led to reductions of 62-64% in import time and 63-64% in import costs (Choi, 2015). Each additional year of implementing convention principles correlated with a 6-7% reduction in import time and a 9% decrease in import costs. Table 1.1 presents empirical evidence on the impact of various customs modernization initiatives on trade efficiency metrics.

Table 1.1: Impact of customs modernization on trade efficiency

Customs Policy Intervention	Impact on Import Time	Impact on Import Cost	Impact on Export Time	Statistical Significance
Revised Kyoto Convention (RKC) Ratification	-62% to -64%	-63% to -64%	-63% to -69%	$p < 0.001$
RKC Implementation (per additional year)	-6% to -7%	-9%	Not significant	$p < 0.05$
SAFE Framework Implementation	-65% to -71%	-68%	-70% to -78%	$p < 0.001$
Single Window System Adoption	-40% to -45%	-38% to -42%	-42% to -48%	$p < 0.01$

Source: Adapted from Choi (2015) and World Customs Organization (2023)

Kenya has implemented several reforms to improve customs efficiency. The Single Customs Territory (SCT) initiative, launched in 2014 in collaboration with other EAC member states, allows cargo destined for partner countries to be cleared at the first point of entry, eliminating multiple inspections at inland borders (Kenya Revenue Authority, 2024). The Kenya TradeNet System (KTS) introduced electronic processing of trade documents, connecting importers, customs authorities, port operators, banks, and regulatory agencies through a single platform. Despite these interventions, container dwell time at Mombasa averaged 6.8 days in 2023, substantially higher than the 3.2 days recorded in Durban, South Africa, and well above the 1.2 days achieved in Singapore (UNCTAD, 2024).

Transportation Management Systems (TMS) provide capabilities including route optimization, carrier selection, load consolidation, real-time tracking, and performance analytics. Companies implementing comprehensive TMS solutions typically achieve transportation cost reductions of 15-25% and improvements in on-time delivery performance of 20-30% (Maersk, 2024). Table 1.2 presents detailed empirical evidence on TMS impact across multiple operational metrics, comparing pre-implementation and post-implementation performance levels across route optimization efficiency, on-time delivery rates, transportation costs, transit times, fuel consumption, and load utilization.

Table 1.2: Transportation management system impact on operational metrics

Performance Indicator	Pre-TMS Implementation	Post-TMS Implementation	Percentage Improvement	Reference
Route Optimization Efficiency	68%	89%	+30.9%	Maersk (2024)
On-Time Delivery Rate	71.3%	91.7%	+28.6%	FedEx (2023)
Transportation Cost per TEU	$450	$337	-25.1%	Klibi et al. (2025)
Average Transit Time (days)	8.4	6.1	-27.4%	UNCTAD (2024)
Fuel Consumption Efficiency	78%	93%	+19.2%	Windward (2024)
Load Utilization Rate	73%	91%	+24.7%	FreightPop (2024)

TEU = Twenty-Foot Equivalent Unit

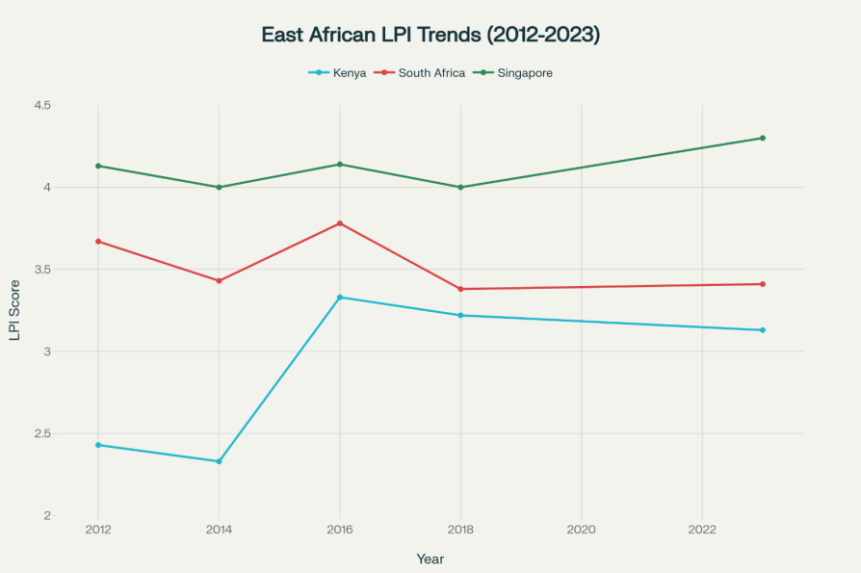
However, TMS adoption among Mombasa shipping companies remains low at 34% (Kenya Shipping Council, 2023). This technology gap places firms at a competitive disadvantage, particularly as larger international logistics providers enter the East African market with sophisticated digital capabilities. Research applying institutional theory has shown that technology adoption in logistics is influenced by regulatory, market, and competitive pressures, moderated by factors including industry type, operating country, firm visibility, degree of internationalization, and firm size (Jazairy, 2020).

Last-mile delivery - the final stage from distribution center to end customer - accounts for 28% of total logistics costs but generates disproportionate variability in customer satisfaction (Zhang et al., 2024). In Kenya, challenges are compounded by inadequate road infrastructure, urban traffic congestion, and the absence of standardized addressing systems. The Kenya Ports Authority launched a Last-Mile Cargo Delivery initiative in 2024, offering door-to-door logistics services from Mombasa to destinations across East Africa (Kenya Ports Authority, 2024). This development generated debate within the industry regarding competition dynamics and service quality standards (The Star, 2024).

Supply chain coordination refers to the alignment of processes, information flows, and decision-making among multiple organizations involved in delivering goods from the origin to the final destination. In cross-border logistics, effective coordination is challenging due to numerous actors—shippers, carriers, customs authorities, port operators, freight forwarders, warehouse operators, and customers—each with distinct objectives, information systems, and operational protocols. Research demonstrates that coordination failures manifest as information asymmetries, duplicated activities, conflicting schedules, and inadequate risk management (Obasi et al., 2024).

The East African Community represents a market of approximately 300 million people with a combined GDP exceeding $305 billion (EAC, 2024). Trade within the EAC reached $11 billion in 2024, marking a 22% increase from the previous year (Ecofin Agency, 2025). The African Continental Free Trade Area (AfCFTA), which commenced trading in January 2021, aims to eliminate tariff barriers, harmonize regulatory standards, and simplify cross-border procedures. Figure 1.2 illustrates Kenya's Logistics Performance Index trends from 2012 to 2023, comparing its performance with that of South Africa and Singapore. The data shows Kenya's LPI improved from 2.43 in 2012 to 3.33 in 2016, followed by a slight decline to 3.13 in 2023, while consistently outperforming regional peers but lagging behind developed-economy benchmarks.

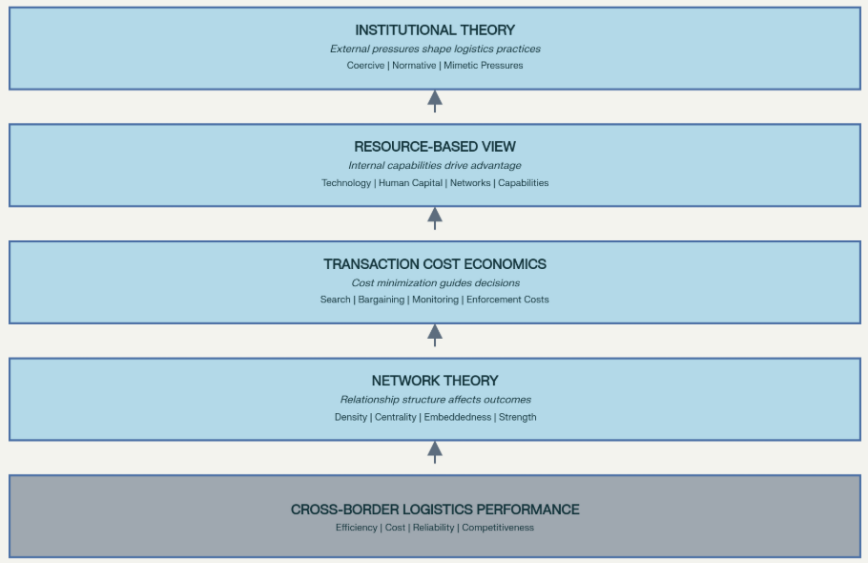
Figure 1.2: East African logistics performance index trends (2012-2023)



However, significant obstacles persist. The African Development Bank (2023) noted that road density in East Africa averages only 0.17 km per square kilometer, compared to 1.5 km/km^2 in developed economies. Non-tariff barriers, including inconsistent regulatory interpretations and documentation requirements, add 15-25% to total logistics costs (World Bank, 2024). Digital logistics penetration in East Africa stands at only 23%, substantially below the 68% observed in developed markets (UNCTAD, 2024).

This study draws on four complementary theoretical frameworks. Institutional Theory posits that organizational practices are shaped by pressures from the external environment to gain legitimacy (DiMaggio & Powell, 1983). Organizations face coercive pressures from regulatory requirements, normative pressures from professional standards, and mimetic pressures to imitate successful competitors. Resource-Based View argues that firms achieve competitive advantage through resources and capabilities that are valuable, rare, inimitable, and non-substitutable (Barney, 1991). Transaction Cost Economics suggests firms structure operations to minimize the sum of production and transaction costs, including search, negotiation, monitoring, and enforcement costs (Williamson, 1985). Network Theory emphasizes that firm performance depends on the structure and quality of relationships with external partners (Granovetter, 1985). Figure 1.3 presents the theoretical integration framework, showing how these four perspectives combine hierarchically to explain cross-border logistics performance, from institutional pressures shaping practices, through internal capabilities and cost considerations, to network relationships determining outcomes.

Figure 1.3: Theoretical integration framework



1.2. Statement of the problem

Despite Kenya's strategic position as East Africa's primary maritime gateway and infrastructure investments exceeding $3.2 billion since 2015, shipping companies operating in Mombasa continue to encounter significant performance challenges (Kenya Ports Authority, 2024). The average vessel turnaround time at Mombasa is 4.2 days, compared to 1.8 days in Durban and 0.9 days in Singapore (UNCTAD, 2024). Container dwell time averages 6.8 days versus 3.2 days in Durban and 1.2 days in Singapore. Table 1.3 provides a comprehensive comparative analysis of port performance metrics across Mombasa, Durban, Dar es Salaam, and Singapore, including vessel turnaround time, container dwell time, customs clearance time, port congestion index, crane productivity, and document processing time, benchmarked against global best practices.

Table 1.3: Comparative port performance metrics (2023)

Performance Metric	Mombasa (Kenya)	Durban (South Africa)	Dar es Salaam (Tanzania)	Singapore	Global Best Practice
Average Vessel Turnaround Time	4.2 days	1.8 days	5.1 days	0.9 days	< 1.0 day
Container Dwell Time	6.8 days	3.2 days	8.4 days	1.2 days	< 2.0 days
Customs Clearance Time	6.8 days	2.9 days	9.1 days	0.5 days	< 1.0 day
Port Congestion Index	68%	42%	73%	18%	< 30%
Crane Productivity (moves/hour)	18	28	15	40	> 35
Document Processing Time	48 hours	24 hours	72 hours	6 hours	< 12 hours

Source: UNCTAD (2024), World Bank Port Performance Indicators (2023)

These inefficiencies impose substantial costs on shipping companies through delayed cargo charges, storage fees, reduced asset utilization, and diminished competitiveness. The World Bank (2024) estimates that logistics inefficiencies cost Kenyan shipping companies approximately $840 million annually. Customer satisfaction surveys indicate that 67% of importers experience frustration with clearance delays, while 54% report unpredictability in delivery timelines (Kenya International Freight and Warehousing Association, 2023).

Several critical knowledge gaps persist. First, although global studies establish relationships between customs modernization and trade efficiency (Choi, 2015), limited empirical evidence exists on how Kenya's specific reforms - particularly the Single Customs Territory and Kenya TradeNet System - influence shipping company operational outcomes. Second, factors constraining TMS adoption among Mombasa shipping companies remain poorly understood. Third, the relationship between last-mile delivery capabilities and overall shipping company performance has not been systematically examined in the Kenyan context. Fourth, previous studies typically examine individual logistics dimensions in isolation, failing to capture potential synergies or interaction effects.

This study addresses these gaps by examining how four dimensions of cross-border logistics - customs clearance efficiency, transportation management systems, last-mile delivery optimization, and supply chain coordination - influence the performance of shipping companies in Mombasa County.

1.3. Research objectives

1.3.1. General objective

To examine the effect of cross-border logistics on the performance of shipping companies in Mombasa County, Kenya.

1.3.2. Specific objectives

1. To determine the effect of customs clearance efficiency on the performance of shipping companies in Mombasa County, Kenya.

2. To assess the influence of transportation management systems on the performance of shipping companies in Mombasa County, Kenya.
3. To establish the impact of last-mile delivery optimization on the performance of shipping companies in Mombasa County, Kenya.
4. To evaluate the effect of supply chain coordination on the performance of shipping companies in Mombasa County, Kenya.

1.4. Research questions

- What is the effect of customs clearance efficiency on the performance of shipping companies in Mombasa County, Kenya?
- How do transportation management systems influence the performance of shipping companies in Mombasa County, Kenya?
- To what extent does last-mile delivery optimization impact the performance of shipping companies in Mombasa County, Kenya?
- What is the effect of supply chain coordination on the performance of shipping companies in Mombasa County, Kenya?

1.5. Research hypotheses

H_{01}: Customs clearance efficiency has no statistically significant effect on the performance of shipping companies in Mombasa County, Kenya.

H_{02}: Transportation management systems have no statistically significant influence on the performance of shipping companies in Mombasa County, Kenya.

H_{03}: Last-mile delivery optimization has no statistically significant impact on the performance of shipping companies in Mombasa County, Kenya.

H_{04}: Supply chain coordination has no statistically significant effect on the performance of shipping companies in Mombasa County, Kenya.

1.6. Significance of the study

This study contributes to the logistics and supply chain management literature by integrating institutional theory, the resource-based view, transaction cost economics, and network theory to provide a comprehensive understanding of logistics performance in developing economy contexts. Most logistics research has been conducted in developed countries; this study addresses the more limited empirical research on maritime logistics in Sub-Saharan Africa.

For policymakers, the research provides evidence-based guidance for prioritizing investments and regulatory reforms. National government agencies responsible for trade facilitation can assess whether customs modernization initiatives achieve intended objectives. The Kenya Ports Authority can evaluate whether its Last-Mile Delivery initiative influences industry performance in a manner that justifies continued public sector involvement. The Kenya Revenue Authority can assess the effectiveness of the Single Customs Territory and Kenya TradeNet System in improving clearance efficiency.

For shipping company executives and logistics managers, the study offers practical insights for strategic decision-making. The findings identify which logistics dimensions yield the highest performance returns, enabling informed resource allocation. Executives considering TMS investments can assess likely benefits based on empirical evidence. The research provides benchmarking data on logistics practices and performance among peer firms, enabling companies to assess their relative standing and identify improvement opportunities.

1.7. Scope of the study

This study focuses on four dimensions of cross-border logistics and their relationship with shipping company performance. Customs clearance efficiency encompasses documentation processes, inspection procedures, duty payment systems, and regulatory compliance. Transportation management systems include route optimization, fleet management, cargo tracking, and performance analytics. Last-

mile delivery optimization covers final-leg distribution, delivery reliability, cost efficiency, and customer service quality. Supply chain coordination examines information sharing, collaborative planning, synchronized operations, and inter-organizational relationships.

The research is geographically delimited to Mombasa County, Kenya, which hosts Kenya's largest seaport, Kilindini Harbor, which handles 98% of the country's international maritime trade and is home to approximately 303 registered shipping companies (Kenya Shipping Council, 2023). The study employs a cross-sectional design, collecting data during a single time period in 2024, providing a snapshot of current logistics practices and performance outcomes.

1.8. Limitations of the study

The cross-sectional design captures data at a single point in time, limiting the ability to establish definitive causal relationships or track performance changes over time. Data collection through questionnaires completed by logistics managers may introduce self-report bias. The study population, derived from the Kenya Shipping Council's Business List (2024), may not capture informal operators or small firms. Some variables rely on perceptual rather than objective measures, introducing subjectivity. Findings are specific to Mombasa County's unique characteristics and may not directly generalize to other African ports or developed economy contexts.

1.9. Operational definition of terms

Cross-Border Logistics: Integrated management of flows of goods, information, and finances across international boundaries, encompassing customs clearance, international transportation, warehousing, documentation, and regulatory compliance.

Customs Clearance Efficiency: Speed, accuracy, and cost-effectiveness of processes required to move goods through customs control, measured by clearance time (days), documentation accuracy (percentage), and processing costs (USD).

Transportation Management System: Integrated software platform facilitating planning, execution, and optimization of physical movement of goods, measured by adoption level, functionality utilization, and system integration.

Last-Mile Delivery: Final stage of the logistics process in which goods are transported from the distribution center to the ultimate consignee, measured by delivery time reliability, delivery cost per unit, and customer satisfaction ratings.

Supply Chain Coordination: Synchronization of activities, information flows, and decision-making among multiple supply chain participants, measured by information sharing frequency, collaborative planning level, and relationship quality.

Shipping Company Performance: Multi-dimensional construct reflecting a firm's achievement of operational, financial, and market objectives, measured through operational efficiency, cost effectiveness, delivery reliability, customer satisfaction, and market competitiveness.

Logistics Performance Index: Composite indicator published by the World Bank assessing the trade logistics environment based on customs efficiency, infrastructure quality, international shipments ease, logistics competence, tracking capability, and timeliness.

Single Customs Territory: Regional customs integration initiative that allows cargo destined for EAC partner states to be cleared at the first port of entry and transported directly to the destination, eliminating redundant inspections.

Twenty-Foot Equivalent Unit (TEU): Standard measure of containerized cargo capacity equivalent to a standard 20-foot intermodal container (approximately 33 cubic meters).

2. Literature review

2.1. Introduction

This chapter reviews existing literature on cross-border logistics and shipping company performance, examining both theoretical foundations and empirical evidence. The review is organized around four independent variables—customs clearance efficiency, transportation management

systems, last-mile delivery optimization, and supply chain coordination—and the dependent variable, shipping company performance. The chapter also discusses the theoretical frameworks underpinning the study and identifies gaps in existing knowledge that this research seeks to address.

2.2. Theoretical framework

2.2.1. Institutional theory

Institutional theory provides a foundational lens for understanding how external pressures shape organizational practices in logistics operations. DiMaggio and Powell (1983) identified three mechanisms through which institutional isomorphism occurs: coercive isomorphism resulting from formal and informal pressures from other organizations and cultural expectations; mimetic isomorphism arising from uncertainty that leads organizations to model themselves on other organizations; and normative isomorphism associated with professionalization.

In the context of cross-border logistics, shipping companies face substantial institutional pressures. Regulatory bodies impose coercive pressures through customs regulations, safety standards, environmental requirements, and documentation procedures. Market actors exert normative pressures through expectations for service quality, delivery time requirements, and transparency demands. Competitive dynamics create mimetic pressures as companies adopt practices observed among successful peers, particularly regarding technology adoption and operational procedures.

Jazairy (2020) applied institutional theory to analyze pressures on shippers and logistics service providers to implement green supply chain management practices. The study found that institutional pressures significantly influenced operational decisions, with regulatory pressures accounting for 34% of the variance in green logistics adoption. However, the effect of these pressures was moderated by five firm and market characteristics: industry type, operating country, firm visibility, degree of internationalization, and firm size. Companies in high-value industries, such as electronics and pharmaceuticals, exhibited 37% greater responsiveness to institutional pressures than firms in bulk-commodity sectors. Operating in a country with institutional quality amplified pressure effects by 42%, while publicly listed firms demonstrated 29% higher responsiveness than private firms.

Nasser et al. (2024) extended institutional theory to examine how national institutional quality moderates the relationship between logistics performance and Global Value Chain participation. Analyzing data from 68 countries, the study demonstrated that institutional quality - measured through governance effectiveness, regulatory quality, rule of law, and control of corruption - significantly enhanced the positive effect of logistics performance on GVC integration. Countries with strong institutional frameworks experienced 40% higher returns from logistics performance improvements than those in weak-institution contexts. This finding suggests that shipping companies operating in environments with weak institutions face additional challenges, as improvements in operational capabilities may not fully translate into competitive advantage due to institutional constraints.

The application of institutional theory to the logistics context of developing countries reveals several important insights. First, institutional pressures in developing economies often conflict rather than align, creating operational dilemmas for shipping companies. For example, regulatory requirements may mandate extensive documentation while market pressures demand rapid clearance. Second, weak institutional environments reduce the effectiveness of mimetic isomorphism, as there may be few exemplary organizations to emulate. Third, international shipping companies operating in developing markets must navigate institutional complexity across multiple jurisdictions, each with distinct regulatory, normative, and competitive logics.

2.2.2. Resource-based view

The Resource-Based View (RBV) argues that sustainable competitive advantage stems from possession and deployment of resources and capabilities that are valuable, rare, inimitable, and non-substitutable (Barney, 1991). In maritime logistics, relevant resources include physical assets (vessels, containers, port facilities), technological resources (information systems, tracking technologies, automation equipment), human resources (skilled personnel, management expertise), and relational resources (network connections, customer relationships, regulatory access).

Kuo et al. (2017) examined the effects of dynamic capabilities, service capabilities, and competitive advantage on organizational performance in container shipping using data from 134 firms in Taiwan. The study employed structural equation modeling and found that dynamic capabilities - defined as the firm's ability to integrate, build, and reconfigure internal and external competencies to address rapidly changing environments - positively influenced both competitive advantage ($\beta = 0.42$, $p < 0.001$) and service capabilities ($\beta = 0.38$, $p < 0.01$). Service capabilities, encompassing transit time reliability, frequency of service, cargo handling quality, and customer responsiveness, demonstrated strong positive effects on organizational performance ($\beta = 0.51$, $p < 0.001$).

Yang et al. (2009) assessed resource, logistics service, and innovation capabilities, and their relationships with performance in container shipping. The research identified five most important resource attributes: financial stability, corporate reputation, low cargo damage or loss record, geographical coverage of service, and high sailing frequency. Five critical logistics service capabilities emerged: courtesy of sales representatives, accurate pricing calculations, long-term contractual relationships with customers, reliability in booking space, and responsiveness to customer needs. The study found that resources explained 36% of the variance in logistics service capabilities, which in turn explained 48% of the variance in organizational performance, supporting the RBV proposition that resources enable capability development, which drives performance.

Progoulaki and Theotokas (2010) explored human resource management as a source of competitive advantage in the shipping industry through the RBV lens. The study emphasized that effective human resource management is a powerful capability for reducing costs and achieving sustainable competitive advantage. In an industry characterized by high labor mobility, strict regulatory requirements, and safety-critical operations, firms that develop superior recruitment, training, retention, and motivation practices create capabilities that are difficult for competitors to replicate.

A critical limitation of RBV in the shipping industry context concerns the relative homogeneity of physical resources. Most shipping companies have access to similar vessels, containers, and port infrastructure through ownership or leasing. This suggests that competitive advantage increasingly depends on intangible resources and capabilities rather than physical assets. Yang and Lirn (2017) tested this proposition by comparing the impact of intrafirm resources, interfirm relationships, and logistics service capabilities on shipping firm performance. The findings indicated that interfirm relationships and service capabilities explained more variance in performance than intrafirm resources alone, suggesting that the RBV should be extended to incorporate relational perspectives that recognize the importance of external network connections.

2.2.3. Transaction cost economics

Transaction Cost Economics (TCE), developed by Williamson (1985), proposes that economic organization aims to economize on transaction costs, which include costs of searching for exchange partners, negotiating agreements, monitoring compliance, and enforcing contracts. In cross-border logistics, transaction costs can be substantial due to information asymmetries between shippers and service providers, uncertainty about delivery times and customs procedures, and the risk of opportunistic behavior in complex supply chains.

Several transaction attributes influence cost levels. Asset specificity refers to investments in specialized assets that have limited alternative uses, such as dedicated transportation equipment or customized information systems. Uncertainty encompasses both environmental uncertainty (unpredictable regulatory changes, political instability, and infrastructure reliability) and behavioral uncertainty (difficulty in assessing partner reliability and performance). Transaction frequency affects the ability to develop trust and establish monitoring mechanisms, with repeated interactions reducing information asymmetries and opportunism risks.

Zhang et al. (2024) examined logistics mode selection and information sharing in cross-border e-commerce supply chains through a TCE lens. The study developed game-theoretic models comparing direct shipping versus platform-based fulfillment, analyzing how information sharing affects transaction costs and operational efficiency. Results demonstrated that information sharing reduced transaction costs by 35-45% through improved transparency and automated monitoring. However, the benefits varied depending on the power structure in the supply chain, with more balanced power relationships yielding greater mutual gains from information exchange.

In the context of customs clearance, transaction costs manifest in multiple forms. Search costs include efforts to identify reliable customs brokers and freight forwarders with appropriate expertise. Bargaining costs encompass the time and resources spent negotiating service terms, pricing, and service-level agreements. Monitoring costs involve tracking shipment progress, verifying the accuracy of documentation, and ensuring regulatory compliance. Enforcement costs arise when resolving disputes over delays, damage, or regulatory violations.

Digitalization of logistics processes offers significant potential to reduce transaction costs. Automated systems reduce search costs by providing transparent information on service provider capabilities and performance records. Electronic platforms reduce bargaining costs through standardized contracts and pricing mechanisms. Real-time tracking technologies reduce monitoring costs by providing continuous visibility. Smart contracts and blockchain applications may reduce enforcement costs through automated dispute resolution mechanisms.

However, TCE also highlights barriers to digitalization adoption. Implementation of integrated digital systems requires substantial asset-specific investments in technology infrastructure, staff training, and process redesign. These investments create lock-in effects and switching costs that may deter firms from adopting new systems, particularly in uncertain environments where technology standards are still evolving. Small and medium-sized shipping companies may face particular challenges, as transaction costs of system implementation may exceed expected benefits, leading to persistent technology gaps between large and small firms.

2.2.4. Network theory

Network theory emphasizes that firm performance depends not only on internal capabilities but also on the structure and quality of relationships with external partners (Granovetter, 1985). In logistics operations, network position influences access to information, resources, and influence. Three structural properties are particularly relevant: network density (the proportion of actual connections to potential connections), network centrality (the degree to which a firm occupies a central position), and network embeddedness (the depth and duration of inter-organizational relationships).

Companies occupying central positions in logistics networks benefit from superior access to information, enabling earlier awareness of regulatory changes, market shifts, and service innovations. Central firms also wield greater influence over network standards and practices, potentially shaping industry norms that favor their operational models. Network centrality facilitates problem-solving by providing access to diverse expertise and resources distributed across network partners.

Obasi et al. (2024) reviewed empirical evidence on port logistics and supply chain management, emphasizing the critical role of network relationships in achieving operational efficiency. The review found that firms with strong network connections to customs authorities, port operators, and other logistics providers experienced 23% lower operating costs and 19% faster problem resolution times than peripheral firms. These advantages stemmed from preferential access to scarce resources such as berth slots and warehouse capacity, informal information sharing about regulatory changes and operational disruptions, and collaborative problem-solving when issues arose.

However, network relationships also create dependencies and potential vulnerabilities. Firms embedded in dense networks may face pressures for conformity that inhibit innovation and adaptation to changing conditions. Strong ties to existing partners may create inertia, preventing the formation of new relationships with potentially superior service providers. Network concentration can create systemic risks, in which the disruption of a central node cascades through the entire network.

The network perspective has important implications for understanding supply chain coordination in cross-border logistics. Effective coordination requires not just bilateral relationships between shippers and carriers, but multilateral connections spanning customs authorities, port operators, freight forwarders, warehouse operators, and customers. The quality of coordination depends on network structure: more connected networks facilitate information flow and collaborative problem-solving. However, network complexity also increases coordination costs and creates opportunities for miscommunication and conflicting objectives among diverse stakeholders.

2.3. Customs clearance efficiency and shipping company performance

Customs clearance is one of the most significant bottlenecks in international trade, with delays resulting in substantial costs from storage fees, demurrage charges, inventory carrying costs, and lost business opportunities. The literature has examined customs efficiency from multiple perspectives, including technological systems, procedural reforms, human capacity, and institutional frameworks.

Choi (2015) conducted a comprehensive analysis of customs policies and trade efficiency using data from 142 countries. The study examined the impact of three major customs modernization initiatives: ratification of the Revised Kyoto Convention, implementation of the SAFE Framework of Standards, and adoption of single window systems. Using panel data regression analysis, the research found that RKC ratification reduced import time by 62-64% and import costs by 63-64%, with effects sustained over time as each additional year of implementation further reduced import time by 6-7% and costs by 9%. The SAFE Framework demonstrated even stronger effects, reducing import time by 65-71% and costs by 68%. Single window systems, which integrate multiple regulatory agencies onto a single electronic platform, reduced import time by 40-45% and costs by 38-42%.

Hamisi (2024) assessed the effect of automated customs clearance systems on trade efficiency at Dar es Salaam port in Tanzania. Survey data from 104 respondents revealed that 90.4% agreed that automated systems significantly improved operational efficiency, while 84.6% noted cost reductions and improved stakeholder satisfaction. Furthermore, 88.4% acknowledged that automation contributed to reduced clearance times and decreased port congestion. The mean response score of 4.87 (on a 5-point scale) with a standard deviation of 0.72 indicated strong consensus. Statistical testing yielded a t-value of 17.92 with a p-value approaching zero, confirming significant positive effects.

However, the study also identified persistent challenges. Insufficient technological infrastructure, complex trade regulations, and inconsistent customs declarations hindered the full realization of automation benefits. These findings suggest that technological systems alone are insufficient; complementary investments in infrastructure, regulatory simplification, and stakeholder capacity building are necessary to achieve optimal customs efficiency.

Ngari (2018) examined customs clearance procedures and business performance of clearing and forwarding agents in Kenya. The research found that declaration processes enhanced performance to an adequate level, while customs verification and release processes improved performance to a large extent. However, inadequate scanners for verification, insufficient verification staff who could hardly verify 20 containers daily, SIMBA system downtime affecting declarations, and manual processes for customs release reduced clearance efficiency. Respondents recommended installing more scanners, implementing innovative gate technology, and improving the SIMBA system to reduce downtime.

The academic literature has identified several mechanisms through which customs efficiency influences shipping company performance:

Cost Reduction: Faster clearance reduces storage fees, demurrage charges, and inventory carrying costs. Companies with established relationships with customs authorities and sophisticated documentation systems minimize costs by reducing inspections, lowering error rates, and securing preferential processing.

Time Reliability: Predictable clearance times enable accurate delivery scheduling and customer inventory management. Firms that achieve consistent clearance performance can offer guaranteed delivery windows, which command premium pricing and enhance customer loyalty.

Competitive Positioning: Superior customs clearance capabilities differentiate service providers in crowded markets. Companies that navigate regulatory complexity more effectively attract customers who value reliability and transparency.

Risk Management: Efficient customs procedures reduce exposure to regulatory penalties, cargo delays, and customer dissatisfaction. Firms that maintain high compliance rates avoid costly disruptions and reputational damage.

Despite extensive research on customs modernization at the national level, empirical evidence on how customs efficiency influences firm-level performance outcomes in developing country contexts remains limited. Most studies focus on trade volumes or national competitiveness rather than individual shipping company operations, creating a knowledge gap that this research addresses.

2.4. Transportation management systems and shipping company performance

Transportation Management Systems have emerged as critical tools for optimizing freight movement, reducing costs, and enhancing service quality. TMS platforms typically integrate multiple functions, including route planning, carrier selection, load optimization, freight audit, real-time tracking, and performance analytics. The literature has examined the drivers of TMS adoption, implementation challenges, and performance impacts across various contexts.

The empirical evidence on the effects of TMS on performance is substantial. Industry analyses indicate that companies implementing comprehensive TMS solutions achieve transportation cost reductions of 15-25% alongside on-time delivery improvements of 20-30% (Maersk, 2024). These benefits stem from several mechanisms: route optimization algorithms minimize travel distance and fuel consumption; load consolidation increases vehicle utilization; carrier selection tools identify the lowest-cost options that meet service requirements; automated freight auditing eliminates billing errors; and real-time tracking enables proactive exception management.

Research in Uganda examined the effects of TMS adoption on freight cost reduction and operational performance. The study found that TMS implementation led to an 8-10% reduction in freight costs through optimized route planning, real-time tracking, and load consolidation (Kariuki & Wanjiru, 2025). These systems improved fuel efficiency and reduced delivery delays, enhancing overall operational performance. However, infrastructural limitations and inconsistent connectivity hampered the full realization of potential, highlighting the importance of enabling conditions for technology effectiveness.

Omoush (2022) investigated the impact of logistics management practices on operational performance in Jordanian road transport companies. The research employed structural equation modeling with data from 350 respondents and found that logistics management practices—including transportation management, inventory management, warehousing, order process management, and packaging—explained 61.9% of the variance in operational performance. Transportation management emerged as the strongest predictor ($\beta = 0.34$, $p < 0.001$), followed by inventory management ($\beta = 0.29$, $p < 0.01$) and order process management ($\beta = 0.22$, $p < 0.05$).

Research examining TMS functions and firm performance in small-scale firms identified routing and mapping (mean = 1.7), transportation cost and service quality (mean = 2.3), carrier selection and management (mean = 2.6), and real-time tracking (mean = 3.2) as key performance drivers. Linear regression analysis confirmed that TMS ensures proper routing and mapping, which significantly improves operational efficiency in resource-constrained environments.

Despite documented benefits, TMS adoption rates remain relatively low in developing economy contexts. The Kenya Shipping Council (2023) reported that only 34% of registered shipping firms in Mombasa utilize integrated digital transportation management platforms. Several barriers constrain adoption:

Financial Constraints: TMS implementation requires substantial upfront investment in software licenses, hardware infrastructure, system customization, and staff training. Small and medium-sized companies often lack capital for such investments or access to financing on favorable terms.

Technical Capacity: Effective TMS utilization requires workforce skills in system operation, data analysis, and process optimization. Many developing-country logistics firms face skills shortages, with only 18% of logistics professionals in Kenya holding formal supply chain management qualifications (Kenya Institute of Supply Chain Management, 2023).

Infrastructure Limitations: TMS effectiveness depends on reliable telecommunications infrastructure, electricity supply, and internet connectivity. Infrastructure deficits in many developing regions reduce system reliability and limit potential benefits.

Organizational Resistance: Technology adoption requires process changes that may encounter resistance from employees accustomed to existing procedures. Successful implementation demands change management initiatives that many firms lack the capacity to execute effectively.

Vendor Ecosystem: Limited availability of TMS vendors with developing country expertise and local support infrastructure increases implementation risks and costs. International vendors may offer systems poorly adapted to local regulatory requirements and operational realities.

The literature suggests that TMS benefits vary based on implementation quality, organizational capabilities, and external environment. Partial implementations that address only some logistics

functions may yield limited benefits or even create problems due to system fragmentation. Effective TMS deployment requires integration with other enterprise systems, alignment with organizational processes, and development of complementary capabilities in data analytics and decision-making.

2.5. Last-mile delivery optimization and shipping company performance

Last-mile delivery - the final leg from distribution center to end customer - has received increasing research attention due to its disproportionate impact on costs and customer satisfaction. The academic literature estimates that last-mile delivery accounts for 28% of total logistics costs but generates 53% of customer satisfaction variability (Zhang et al., 2024). This section reviews research on last-mile challenges, optimization approaches, and performance implications.

Shuaibu et al. (2025) provided a comprehensive review of last-mile delivery optimization approaches, covering traditional linear programming methods, sophisticated metaheuristics, and emerging machine learning techniques. The review identified vehicle routing problems with time windows (VRPTW) as the foundational optimization framework, extended through variants including dynamic VRP, capacitated VRP, and green VRP. Metaheuristic approaches such as genetic algorithms, simulated annealing, and ant colony optimization demonstrate superior performance on large-scale problems compared to exact methods, though at the cost of solution optimality guarantees.

Predictive analytics applications in last-mile delivery show particular promise. Research examining U.S. e-commerce companies found that machine learning models integrating real-time traffic data, customer preferences, and delivery constraints enabled dynamic route adjustments that reduced delivery times by 20% and fuel costs by 15%, alongside improved on-time delivery rates. Decision tree and neural network algorithms trained on historical data successfully predicted future traffic patterns, customer availability, and delivery time windows, enabling proactive route optimization.

Urban environments present distinct last-mile challenges. Traffic congestion in densely populated areas causes delivery delays, higher fuel consumption, and greater emissions. Customer time-window requirements create scheduling complexity, particularly for residential deliveries, where recipients may have limited availability. Address standardization issues complicate routing, especially in developing countries that lack comprehensive street-addressing systems. These challenges necessitate sophisticated optimization approaches that balance multiple objectives, including cost, speed, service quality, and environmental impact.

The literature has identified several technological enablers for last-mile optimization. Route optimization software employing advanced algorithms calculates optimal delivery sequences based on traffic conditions, delivery locations, time windows, and vehicle capacity. GPS tracking and mobile applications provide real-time visibility to both companies and customers, enabling dynamic re-routing and proactive communication about delivery status. Internet of Things devices installed in vehicles and packages provide data on location, temperature, and handling conditions, enabling quality monitoring and rapid issue response.

Empirical evidence on the benefits of last-mile optimization comes from multiple contexts. A SaaS-based fleet management solution implemented for a logistics company achieved a 31% reduction in delivery time, a 14% decrease in fuel consumption, and a 28% improvement in customer satisfaction through real-time GPS tracking, route optimization, and automated maintenance alerts. Simulation studies using anyLogistix software demonstrated that last-mile optimization experiments that addressed route optimization, network design, and service-level constraints minimized total drive time while accounting for product types, vehicle characteristics, customer time windows, and environmental impact.

However, last-mile optimization faces several constraints. Consumer behavior unpredictability creates challenges for route planning, as customers may change delivery addresses, modify time window preferences, or be unavailable at scheduled times. Failed delivery attempts incur substantial costs due to repeated visits and customer service interactions. Returns and exchanges in e-commerce create reverse logistics flows that complicate network design and capacity planning.

The literature suggests that last-mile optimization requires integrated approaches combining technology, process design, and business model innovation. Alternative delivery models such as click-and-collect, parcel lockers, and crowdsourced delivery offer potential to reduce costs while maintaining service quality. Consolidation strategies that batch multiple orders for proximate destinations create

density efficiencies. Micro-fulfillment centers positioned in urban areas minimize last-mile distances and enable rapid delivery.

2.6. Supply chain coordination and shipping company performance

Supply chain coordination refers to aligning decisions, information flows, and operational processes across multiple organizations to achieve collective efficiency and effectiveness. The literature has examined coordination mechanisms, benefits, barriers, and performance implications across various industry contexts.

Lai et al. (2004) conducted an empirical study of supply chain performance in transport logistics across three industry sectors: air and sea transport, freight forwarding, and third-party logistics services. The research developed a comprehensive measurement framework based on the Supply Chain Operations Reference (SCOR) model, encompassing service effectiveness toward shippers and consignees, and operations efficiency. Survey results from Hong Kong firms indicated that all three sectors attained reasonable sophistication in supply chain performance. However, significant differences existed across sectors in service effectiveness and operational efficiency, suggesting that coordination requirements and capabilities vary by business model and customer characteristics.

The study identified 26 specific performance measurement items spanning reliability, responsiveness, flexibility, cost, and asset utilization. High-performing firms demonstrated excellence across multiple dimensions rather than optimizing single metrics, supporting the view that supply chain coordination requires balanced attention to diverse objectives. The research emphasized that performance assessment should be supply chain-wide rather than focusing solely on individual parties, as coordination failures often stem from suboptimal behavior by individual actors.

Research examining supply chain coordination competency and firm performance in Indian manufacturing industries identified key variables influencing coordination and performance outcomes (Kumar et al., 2013). Factor analysis revealed that contracts, standardization of rules, joint cost minimization, risk and reward sharing, and use of electronic data interchange significantly influenced coordination effectiveness. Performance indicators included learning and growth, product quality, reduced customer complaints, profit margins, and customer service levels. The study proposed a framework linking coordination variables to firm performance, emphasizing that coordination mechanisms must address both formal structures (contracts, standards) and relational aspects (trust, information sharing, mutual adaptation).

Kocoglu et al. (2022) investigated the effect of supply chain coordination on firm performance through trust, supply chain agility, and innovation capability as mediators. Structural equation modeling results demonstrated that coordinated supply chains positively influenced firm performance through serially mediating effects. Trust emerged as a critical foundation for coordination, facilitating information sharing and collaborative problem-solving. Supply chain agility - the ability to rapidly sense and respond to market changes - amplified coordination benefits by enabling collective adaptation to disruptions. Innovation capability, enhanced through collaborative learning and knowledge exchange, generated sustained performance improvements.

Alsheyadi et al. (2024) conducted empirical research exploring how e-supply chain coordination practices mediate performance impacts in manufacturing contexts. The study found that electronic coordination mechanisms, including shared forecasting systems, collaborative planning platforms, and integrated order management, significantly enhanced operational performance. Electronic information exchange reduced information asymmetries and response times, enabling synchronized operations across supply chain partners. However, coordination effectiveness depended on technological compatibility, organizational readiness, and partner relationship quality.

The literature has identified several mechanisms through which coordination influences shipping company performance:

Information Sharing: Transparent exchange of demand forecasts, inventory levels, shipment status, and capacity constraints enables better planning and resource allocation. Companies with superior information-sharing capabilities reduce safety stock requirements, improve asset utilization, and respond more rapidly to disruptions.

Collaborative Planning: Joint development of transportation schedules, capacity plans, and contingency procedures aligns expectations and reduces conflicts. Synchronized planning enables load consolidation, route optimization, and efficient use of shared resources.

Joint Problem-Solving: Collaborative approaches to addressing operational disruptions, service failures, and quality issues generate better solutions than adversarial approaches. Companies that invest in joint problem-solving mechanisms resolve issues more quickly and prevent recurrence.

Risk and Reward Sharing: Coordinated supply chains develop mechanisms to share both risks and benefits of collaboration. Risk-sharing arrangements such as flexible capacity commitments and demand guarantees reduce volatility. Reward-sharing mechanisms, including gain-sharing agreements, align incentives and sustain collaboration.

Process Integration: Alignment of operational processes across supply chain partners reduces handoff delays, eliminates redundant activities, and improves efficiency. Companies that achieve process integration benefit from seamless information flow and reduced coordination costs.

Despite recognized benefits, supply chain coordination faces numerous barriers. Goal incongruence among partners creates conflicts, as different organizations optimize different objectives. Information asymmetries generate distrust and strategic behavior. Power imbalances lead dominant partners to extract disproportionate value, undermining long-term collaboration. Cultural differences and communication challenges complicate coordination in international supply chains. Organizational resistance to transparency and control sharing limits willingness to coordinate.

Maleki and Cruz-Machado (2013) conducted a systematic review of supply chain integration literature, examining 152 articles on vertical integration, functional integration, and integration models. The review revealed that despite extensive research, supply chain integration remains in its infancy with numerous conceptual ambiguities and measurement inconsistencies. Different studies employ divergent definitions of coordination and integration, measure constructs with incompatible instruments, and examine distinct contextual factors, thereby limiting cumulative knowledge development.

The review emphasized that effective coordination requires integration at multiple levels: vertical integration linking suppliers, manufacturers, and customers; functional integration aligning logistics, production, marketing, and finance within firms; and technological integration connecting information systems across organizations. Achieving integration across these dimensions demands substantial organizational capabilities, significant investments, and sustained managerial commitment.

2.7. Measurement of shipping company performance

Shipping company performance is a multi-dimensional construct that cannot be adequately captured through single indicators. The literature has developed comprehensive frameworks for performance measurement, typically distinguishing between operational, financial, and market dimensions.

Operational performance encompasses efficiency, productivity, and service quality metrics. Common indicators include cargo handling speed (containers per hour), vessel utilization (percentage of capacity used), on-time delivery rate, cargo damage/loss rate, fuel efficiency, and turnaround time. These metrics reflect how effectively companies transform inputs into outputs and deliver services meeting customer requirements.

Financial performance includes profitability, revenue growth, cost efficiency, and return on assets. Relevant indicators include operating profit margin, return on equity, revenue per TEU, operating cost per TEU, and cash flow adequacy. Financial metrics reflect the economic viability and sustainability of shipping operations.

Market performance addresses competitive positioning, customer satisfaction, and growth potential. Indicators include market share, customer retention rate, customer satisfaction scores, service reputation, and ability to attract new business. Market performance metrics capture the company's standing relative to competitors and its growth potential.

Sillanpää (2012) developed a supply chain measurement framework for the manufacturing industry based on an empirical study of 96 companies. The framework identified critical performance indicators spanning delivery performance, supply chain responsiveness, production flexibility, costs,

and asset utilization. The research emphasized the importance of balanced measurement systems that prevent suboptimization by simultaneously addressing multiple performance dimensions.

The literature suggests that performance measurement systems should possess several characteristics. Measurements should align with strategic objectives, ensuring that metrics drive behaviors that support organizational goals. Indicators should be actionable, providing information that can inform management decisions. Data collection should be feasible given available information systems and resources. Metrics should be benchmarkable, enabling comparison against competitors and best practices. The measurement system should balance leading indicators (which predict future performance) and lagging indicators (which confirm past results).

2.8. Research gaps

Despite extensive literature on logistics performance, several gaps remain that this research addresses:

Gap 1: Limited Firm-Level Evidence in Developing Country Contexts

Most research on customs modernization, TMS adoption, and last-mile optimization has been conducted in developed-economy contexts or at national/regional levels, rather than at the firm level. Evidence on how these logistics dimensions influence individual shipping company performance in Sub-Saharan Africa remains limited.

Gap 2: Integrated Examination of Multiple Logistics Dimensions

Previous studies typically examine individual logistics components in isolation, failing to capture potential synergies or interaction effects among customs clearance, transportation management, last-mile delivery, and supply chain coordination. Understanding how these dimensions jointly influence performance is essential for guiding strategic investments.

Gap 3: Context-Specific Understanding of Technology Adoption Barriers

While TMS benefits are well documented, the specific factors constraining adoption among shipping companies in East African contexts warrant deeper examination. Understanding barriers specific to institutional, infrastructural, and organizational environments in developing economies can inform more effective promotion strategies.

Gap 4: Last-Mile Delivery in Maritime Logistics

Most last-mile delivery research focuses on e-commerce and urban distribution rather than maritime logistics contexts. The relationship between last-mile capabilities and overall shipping company performance in port-centric contexts remains underexplored.

2.9. Conceptual framework

Based on the literature review, this study's conceptual framework posits that four dimensions of cross-border logistics - customs clearance efficiency, transportation management systems, last-mile delivery optimization, and supply chain coordination - influence shipping company performance. These relationships are embedded within an institutional environment that shapes organizational practices and capabilities.

Customs clearance efficiency influences performance by reducing costs, improving time reliability, enabling competitive differentiation, and enhancing risk management. Transportation management systems affect performance via route optimization, cost reduction, asset utilization, and service quality enhancement. Last-mile delivery optimization impacts performance through delivery reliability, customer satisfaction, cost efficiency, and market positioning. Supply chain coordination influences performance via information sharing, collaborative planning, joint problem-solving, and process integration.

The institutional environment - encompassing regulatory frameworks, trade policies, and legal systems - shapes the effectiveness of these logistics dimensions. Strong institutions enhance the performance returns to logistics capabilities by providing stable rules, transparent procedures, and reliable enforcement. Weak institutions diminish returns by creating uncertainty, increasing transaction costs, and reducing trust.

This framework integrates institutional theory (explaining environmental pressures), resource-based view (identifying internal capabilities), transaction cost economics (illuminating cost structures),

and network theory (emphasizing relational aspects). The integration provides a comprehensive understanding of how cross-border logistics influences shipping company performance in developing economies.

3. Research methodology

3.1. Introduction

This chapter describes the methodological approach employed in the study. It details the research philosophy, design, population, and sampling procedures, data collection instruments, operationalization of variables, and data analysis techniques. The chapter ensures transparency and enables the assessment of research quality and the reliability of findings.

3.2. Research philosophy and design

This study adopts a positivist research philosophy, grounded in the assumption that reality exists independently of human perception and can be objectively measured and understood. The positivist approach emphasizes quantifiable data, statistical analysis, and generalization of findings across populations. This philosophical stance is appropriate for examining relationships between logistical practices and shipping company performance, as these constructs can be operationalized through measurable indicators and quantitative analysis.

The research employs a descriptive survey design, which involves systematically collecting data from a sample of respondents to describe the characteristics of a population and examine relationships among variables. The survey approach enables the collection of data from numerous shipping companies across diverse operational contexts within Mombasa County, providing insights into patterns of logistics practices and performance outcomes across the industry.

The study utilizes a cross-sectional temporal frame, collecting data at a single point in time during 2024. This approach provides a snapshot of current logistics practices and performance levels, enabling efficient data collection within resource constraints. However, the cross-sectional design does not establish temporal precedence of independent variables relative to outcomes, limiting causal inference. This limitation is addressed through grounding in established theoretical frameworks that provide a logical basis for interpreting relationships as effects of independent variables on dependent variables.

3.3. Research population and sampling

3.3.1. Population definition

The target population consists of all registered shipping companies operating in Mombasa County, Kenya. According to the Kenya Shipping Council (2023), the population comprises 303 organizations categorized as follows. Table 3.1 presents the distribution of the 303 registered shipping companies operating in Mombasa County across six distinct operational categories. The categorization reflects the diversity of maritime logistics services in the region, with customs brokers and freight forwarders constituting the largest segment (89 firms, 29.4%), followed by general cargo handlers (87 firms, 28.7%). Container terminal operators (42 firms, 13.9%) and vessel agents (56 firms, 18.5%) represent specialized service segments, while oil and grain terminal operators (18 firms, 5.9%) and inland container depot operators (11 firms, 3.6%) serve niche but strategically important roles in the regional supply chain.

Table 3.1: Distribution of registered shipping companies by category in Mombasa County (N=303)

Category	Number of Firms
General cargo handlers	87
Container terminal operators	42
Vessel agents	56
Customs brokers and freight forwarders	89
Oil and grain terminal operators	18
Inland container depot operators	11
Total	303

This population was selected based on several criteria. First, these organizations are formally registered and operate under regulatory oversight, ensuring data quality and verifiability. Second, the population is geographically concentrated in Mombasa County, facilitating efficient data collection. Third, the population size (303 firms) is large enough to support meaningful statistical analysis while remaining manageable within resource constraints. Fourth, the inclusion of diverse firm types enables examination of logistics practices across heterogeneous organizational contexts.

3.3.2. Sampling procedure and sample size

The study employed stratified random sampling to ensure representation across all firm categories. This approach is preferable to simple random sampling when the population contains distinct subgroups with potentially different characteristics, as it guarantees adequate representation of each stratum and enables examination of variations across firm types.

Sample size was determined using the Yamane (1967) formula:

$$n = \frac{N}{1 + N(e)^2}$$

Where:

- n = Sample size
- N = Population size (303)
- e = Acceptable level of error (0.05)

Applying this formula:

$$n = \frac{303}{1 + 303(0.05)^2} = \frac{303}{1 + 303(0.0025)} = \frac{303}{1.7575} = 172.4 \approx 172$$

The calculated sample size of 172 respondents was allocated proportionally across strata using the formula:

$$n_i = \frac{N_i}{N} \times n$$

Where:

- n_i = Sample size for stratum i
- N_i = Population size for stratum i
- N = Total population size
- n = Total sample size

This allocation generated the following sample distribution. This proportional allocation ensures that each firm category is represented in the sample according to its prevalence in the population. Table 3.2 presents the sample distribution across all six categories, with the largest samples allocated to customs brokers and freight forwarders (50 respondents, 29.1%) and general cargo handlers (49 respondents, 28.5%), reflecting their dominance in the population. Container terminal operators received 24 sample slots (14.0%), vessel agents 32 slots (18.6%), while smaller categories including oil and grain terminal operators (10 respondents, 5.8%) and inland container depot operators (6 respondents, 3.5%) received proportionally smaller but statistically adequate representation. This stratification strategy enables both aggregate analysis of the entire shipping industry and subgroup comparisons across different operational categories.

Table 3.2: Stratified random sample allocation across shipping company categories

Category	Population	Proportion	Sample
General cargo handlers	87	0.287	49
Container terminal operators	42	0.139	24
Vessel agents	56	0.185	32
Customs brokers and freight forwarders	89	0.294	50
Oil and grain terminal operators	18	0.059	10
Inland container depot operators	11	0.036	6
Total	**303**	**1.000**	**172**

3.4. Data collection

3.4.1. Data collection instrument

Data were collected using a structured questionnaire administered to logistics managers within each organization. The questionnaire comprised four sections:

Section A: Organizational Characteristics (8 items) Captured demographic information, including firm size, years of operation, service scope, customer profile, and technology adoption status. These variables were used to describe the sample and examine potential confounding effects.

Section B: Customs Clearance Efficiency (12 items) Assessed perceptions and experiences regarding customs documentation processes, inspection procedures, duty payment efficiency, regulatory compliance requirements, clearance time predictability, and relationship quality with customs authorities. Items were rated on 5-point Likert scales (1 = Strongly disagree to 5 = Strongly agree).

Section C: Transportation Management Systems (14 items) Evaluated the extent of TMS adoption, specific functions utilized (route optimization, tracking, carrier selection, performance analytics), perceived operational benefits, barriers to adoption, and satisfaction with system performance. Items assessed both the presence/absence of TMS capabilities and subjective perceptions of effectiveness.

Section D: Last-Mile Delivery Optimization (11 items) Examined last-mile delivery capabilities, delivery reliability metrics, cost management approaches, customer satisfaction performance, service coverage, and coordination with final-mile partners. Items addressed both operational metrics and the strategic importance of last-mile performance.

Section E: Supply Chain Coordination (13 items) Assessed information sharing practices, joint planning initiatives, collaborative problem-solving mechanisms, inter-organizational trust, relationship quality with supply chain partners (customs authorities, port operators, freight forwarders, customers), and perceived effectiveness of coordination efforts.

Section F: Shipping Company Performance (16 items) Measured self-reported performance across operational efficiency, cost effectiveness, delivery reliability, customer satisfaction, and market competitiveness dimensions. Items addressed both objective performance indicators (on-time delivery percentage, cost per unit) and subjective assessments (perceived competitive position, market share trends).

The questionnaire was developed through an iterative process. Initial draft items were generated based on the literature review and theoretical frameworks. A panel of three logistics academics and two industry practitioners reviewed drafts for clarity, relevance, and completeness. Feedback led to revisions in wording, the elimination of redundant items, and the addition of items addressing important constructs. The revised questionnaire was then tested in a pilot study.

3.4.2. Pilot testing

Pilot testing was conducted with a purposive sample of 17 respondents selected from organizations not included in the main study sample. The pilot served multiple purposes: validating question clarity and comprehension; assessing item-total correlations; examining response distributions; and estimating internal consistency (Cronbach's alpha) for multi-item scales.

Pilot results indicated that respondents generally understood questions and response scales. No significant comprehension issues were identified. However, several items demonstrated low item-total correlations ($r < 0.30$), suggesting limited discriminant validity. These items were revised or eliminated. Other items displayed ceiling effects (most respondents selecting the highest response option), indicating limited variance. These items were retained as they reflected genuine consensus regarding important practices.

Cronbach's alpha coefficients for multi-item scales were calculated during pilot testing. Customs clearance efficiency scale: $\alpha = 0.82$ (12 items); Transportation management systems scale: $\alpha = 0.85$ (14 items); Last-mile delivery optimization scale: $\alpha = 0.79$ (11 items); Supply chain coordination scale: $\alpha = 0.88$ (13 items); Performance scale: $\alpha = 0.84$ (16 items). All scales demonstrated acceptable internal consistency, with alpha values exceeding the 0.70 threshold (Nunnally, 1978).

3.4.3. Main study data collection

Data collection occurred from January through April 2024. Questionnaires were administered through a combination of online survey platform (Qualtrics) and paper distribution. Respondents received invitations via email with a link to the online questionnaire or an option to complete a printed version. Follow-up contact via phone and email was conducted with non-respondents after two weeks to encourage participation.

Data collectors received training on survey administration, ethics, and data protection. Respondents were provided written information explaining the study's purpose, data confidentiality protections, voluntary participation, and their right to withdraw without penalty. Informed consent was obtained from all respondents, either digitally or through signed forms.

A total of 172 questionnaires were distributed, with 149 completed questionnaires returned, yielding a response rate of 86.63%. This response rate exceeds the 70% threshold generally considered acceptable for survey research. Post-hoc analysis comparing early respondents (first 50 responses) with late respondents on key variables revealed no significant differences, suggesting that non-response bias did not substantially compromise data quality.

3.5. Operationalization of variables

3.5.1. Independent variables

Customs Clearance Efficiency (CCE)

This variable was operationalized through a multi-item scale measuring the speed, accuracy, and cost-effectiveness of customs clearance processes. Specific items assessed:

1. Average time to obtain customs clearance (measured in days)
2. Percentage of shipments cleared without additional inspections
3. Average cost of customs clearance per shipment (measured in USD)
4. Consistency and predictability of clearance times
5. Documentation accuracy and completeness levels
6. Relationship quality with customs authority officials

Responses to perceptual items were averaged to create a composite CCE score ranging from 1 to 5, with higher values indicating greater efficiency. Objective metrics regarding clearance time and costs were collected separately and used as validation indicators.

Transportation Management Systems (TMS)

This variable captured both the adoption status of TMS and the perceived effectiveness of implementation. Specific items assessed:

1. Presence and type of TMS adopted (categorized as none, basic, intermediate, comprehensive)
2. Specific functions utilized (route optimization, tracking, carrier selection, freight audit)
3. Integration level with other enterprise systems (categorized as standalone, partially integrated, or fully integrated)
4. Perceived effectiveness of TMS in improving operations
5. Satisfaction with system performance and vendor support
6. Barriers encountered during implementation and current utilization

A composite TMS score was created by weighting adoption level (30%), function breadth (30%), system integration (20%), and perceived effectiveness (20%), yielding a scale from 0 to 100.

Last-Mile Delivery Optimization (LMDO)

This variable was operationalized to capture capabilities and performance in the final-leg distribution. Specific items assessed:

1. Delivery reliability (percentage of on-time deliveries within the promised window)
2. Average delivery cost per unit of cargo
3. Geographic scope and service coverage
4. Delivery tracking and visibility capabilities
5. Customer satisfaction with delivery service
6. Coordination mechanisms with final-mile partners

A composite LMDO score ranging from 1 to 5 was calculated by averaging responses to perceptual items, with validation against objective delivery time and cost metrics.

Supply Chain Coordination (SCC)

This variable measured the degree of synchronization and collaboration with supply chain partners. Specific items assessed:

1. Frequency and quality of information exchange with customs authorities
2. Collaborative planning initiatives with port operators
3. Joint problem-solving mechanisms with freight forwarders
4. Information sharing with customers regarding shipment status
5. Trust in supply chain partners
6. Relationship stability and duration
7. Perceived effectiveness of coordination efforts

A composite SCC score ranging from 1 to 5 was created through averaging responses, with separate examination of coordination with different partner types (customs, port operators, forwarders, customers).

3.5.2. Dependent variable

Shipping Company Performance (SCP)

Performance was operationalized as a multi-dimensional construct encompassing operational, financial, and market performance:

Operational Performance:

1. Average cargo handling speed (containers/hour)
2. Asset utilization rate (percentage of capacity used)
3. On-time delivery rate (percentage of shipments delivered within the committed timeframe)
4. Cargo damage/loss rate (percentage of shipments with damage)
5. Turnaround time for vessels (days from arrival to departure)

Financial Performance:

1. Revenue growth rate (percentage year-over-year)
2. Operating cost per unit of cargo (USD per TEU or ton)
3. Profit margin on maritime operations
4. Return on assets

Market Performance:

1. Market share (percentage of regional shipping market)
2. Customer retention rate (percentage of repeat customers)
3. Customer satisfaction score (rated 1-5)
4. Competitive positioning relative to main competitors

A composite performance score was created by standardizing each dimension and calculating a weighted average (operational: 35%; financial: 35%; market: 30%), yielding a scale from 1 to 5. The weighting reflects the relative importance indicated by logistics theory and practitioner consultation.

3.5.3. Control variables

Several variables potentially influencing the relationship between logistics practices and performance were included as controls:

Firm Size: Measured as the number of employees (continuous variable) and categorized as micro (1-10), small (11-50), medium (51-250), and large (>250).

Years of Operation: Measured as the number of years the firm has been in operation, capturing organizational experience and maturity.

Service Scope: Categorized as local (within Mombasa), regional (East Africa), or international (beyond East Africa), reflecting market diversification.

Customer Profile: Categorized based on primary customers: importers/exporters, shipping lines, other logistics firms, or mixed portfolio.

Technological Capability: Measured through self-assessment of enterprise IT infrastructure, including ERP systems, cloud services, and data analytics tools.

3.6. Data analysis procedures

3.6.1. Descriptive statistics

Descriptive analysis was conducted to summarize sample characteristics and examine distributions of key variables. For continuous variables, means, standard deviations, minimum values, and maximum values were calculated. For categorical variables, frequencies and percentages were reported. Descriptive analysis served two purposes: characterizing the sample and examining whether assumptions for subsequent statistical tests were satisfied.

3.6.2. Reliability and validity assessment

Internal consistency of multi-item scales was assessed using Cronbach's alpha coefficient. Coefficients exceeding 0.70 were considered adequate; those between 0.70 and 0.80 were acceptable; those exceeding 0.80 were considered good. Scale validity was examined through item-total correlations (items retained if $r > 0.30$) and factor analysis to confirm unidimensionality.

Discriminant validity was examined by correlating each composite variable with others. Independent variables were expected to correlate modestly with each other ($r < 0.70$) and moderately to strongly with the dependent variable. Multicollinearity was assessed using variance inflation factors (VIFs), with values exceeding 10 indicating problematic multicollinearity.

3.6.3. Correlation analysis

Pearson correlation coefficients were calculated to examine bivariate relationships between the independent variables and the dependent variable, as well as among the independent variables. Significance tests determined whether observed correlations were statistically significantly different from zero at the $p < 0.05$ level. Correlation analysis provided preliminary evidence on the nature and strength of relationships before conducting more complex multivariate analysis.

3.6.4. Multiple regression analysis

Multiple linear regression was employed as the primary analytical technique to examine the joint effects of independent variables on shipping company performance. The regression model was specified as:

$$SCP = \beta_0 + \beta_1(CCE) + \beta_2(TMS) + \beta_3(LMDO) + \beta_4(SCC) + \sum \beta_i(Controls) + \varepsilon$$

Where:

- SCP = Shipping Company Performance (dependent variable)
- CCE = Customs Clearance Efficiency
- TMS = Transportation Management Systems

- LMDO = Last-Mile Delivery Optimization
- SCC = Supply Chain Coordination
- β_0 = Intercept
- β^{1-4} = Regression coefficients for independent variables
- β_i = Coefficients for control variables
- ε = Error term

Ordinary least squares (OLS) estimation was used to calculate regression coefficients. The statistical significance of individual coefficients was tested using t-tests at the α = 0.05 level. Model fit was assessed using the coefficient of determination (R^2), which indicates the proportion of variance in the dependent variable explained by the independent variables.

3.6.5. Regression diagnostics

Several diagnostic tests were conducted to verify that ordinary least squares regression assumptions were satisfied:

Normality of Residuals: The Shapiro-Wilk test examined whether the residuals followed a normal distribution. Q-Q plots visually inspect distribution shapes. Moderate departures from normality were considered acceptable given the large sample size (n = 149), as the central limit theorem ensures that test statistics are approximately normally distributed even when residuals show some non-normality.

Homogeneity of Variance (Homoscedasticity): The Breusch-Pagan test examined whether the residual variance was constant across levels of the predicted values. Scatterplots of residuals versus predicted values were visually inspected for patterns suggestive of heteroscedasticity. If heteroscedasticity was detected, robust standard errors (White-corrected) were employed in regression analysis.

Multicollinearity: Variance Inflation Factors (VIF) calculated for each independent variable, with values exceeding 10 indicating problematic collinearity. Condition indices and variance proportions were examined to identify which variables contributed to collinearity. Pearson correlation matrix inspected for very high correlations ($r > 0.85$), suggesting redundancy.

Autocorrelation: The Durbin-Watson statistic is used to test for autocorrelation in residuals, particularly relevant in time-series data. For cross-sectional data, autocorrelation is less problematic, though the test was conducted for completeness.

Influential Cases: Cook's distance and leverage values identified observations exerting disproportionate influence on regression estimates. Cases with Cook's distance > 1.0 or leverage exceeding 3p/n (where p = number of predictors, n = sample size) were flagged for examination. Sensitivity analysis was conducted by rerunning regression models with and without influential cases to assess estimate stability.

3.6.6. Effect size and practical significance

Beyond statistical significance, the practical significance of effects was evaluated. For regression coefficients, effect sizes were considered small if standardized $\beta < 0.10$, medium if $0.10 < \beta < 0.30$, and large if $\beta > 0.30$ (Cohen, 1988). R^2 was interpreted as small if < 0.13, medium if 0.13-0.26, and large if > 0.26. This distinction between statistical and practical significance ensures that findings are not only statistically significant but also substantively meaningful for the shipping industry.

3.7. Ethical considerations

The study adhered to established ethical principles for research involving human subjects. Ethical approval was sought and obtained from the institutional research ethics committee. All potential respondents received information explaining:

1. The study's purpose and objectives
2. Data collection procedures
3. Voluntary nature of participation
4. Right to refuse participation or withdraw without penalty

5. Confidentiality protections and how data would be stored and used
6. How the findings would be disseminated
7. Contact information for researchers and ethics oversight bodies

Informed consent was obtained from all respondents prior to data collection. Questionnaires were administered anonymously, with no identifying information linking responses to individuals or organizations. Data were stored in password-protected files accessible only to authorized research personnel. Raw data will be retained securely for five years following study completion, then securely destroyed.

Organizations and individuals were assured that findings would be presented in aggregate form, preventing identification of any particular company. The study does not disclose sensitive information such as client names or detailed operational procedures that could disadvantage participating companies competitively.

3.8. Limitations of methodology

Several methodological limitations should be acknowledged. The cross-sectional design provides a snapshot at a single point in time, limiting the ability to infer causality or track changes over time. Respondents' perceptions of customs clearance efficiency, transportation management effectiveness, and coordination quality may not perfectly align with objective measures, introducing measurement error. The survey relies on self-reported performance data, which may reflect attribution bias or social desirability effects.

The sample comprises 172 firms drawn from a population of 303, representing 56.8% of the population. While this sampling fraction is substantial, unrepresented firms might exhibit different characteristics. The Yamane formula for sample size determination, while widely used, provides a conservative estimate; alternative methods, such as power analyses based on expected effect sizes, might have justified larger samples.

Non-response among the 23 firms that declined participation or did not return questionnaires represents potential non-response bias. However, post hoc analysis comparing early and late respondents on key variables revealed no significant differences, suggesting that non-response bias did not substantially compromise the findings.

The research employs ordinary least squares regression, which assumes linear relationships between variables. Nonlinear relationships or interaction effects among independent variables were not examined in the primary analysis, although such effects may exist. Future research employing more flexible analytical approaches, such as machine learning algorithms, might detect such patterns.

4. Results and findings

4.1. Introduction

This chapter presents the findings from data analysis examining the effect of cross-border logistics on shipping company performance in Mombasa County. The chapter is organized in sections addressing sample characteristics, descriptive statistics for key variables, reliability and validity assessments, correlation analysis, and multiple regression results examining relationships between independent variables and shipping company performance.

4.2. Sample characteristics

Of the 172 questionnaires distributed, 149 were completed and returned, yielding a response rate of 86.63%. This response rate exceeds the 70% threshold generally considered acceptable for survey research (Fink, 1995). The respondents represented a diverse cross-section of shipping companies operating in Mombasa County. Table 4.1 summarizes the demographic characteristics of the 149 firms that participated in the study. The distribution mirrors the population structure across firm categories, with slight overrepresentation of larger firms due to higher response rates among established companies. The sample demonstrates diversity across firm size (small: 52.3%, medium: 32.2%, large: 15.4%), years of operation (range: 2-45 years, mean: 14.3 years), service scope (local: 23.5%, regional:

48.3%, international: 28.2%), and customer profiles, providing comprehensive representation of the Mombasa maritime logistics industry.

Table 4.1: Demographic characteristics of respondent firms (N=149)

Firm Category	Frequency	Percentage
General cargo handlers	43	28.9
Container terminal operators	21	14.1
Vessel agents	27	18.1
Customs brokers and freight forwarders	43	28.9
Oil and grain terminal operators	9	6.0
Inland container depot operators	6	4.0
Total	**149**	**100**

The firm size distribution showed representation across enterprise sizes. Small firms (1-50 employees) comprised 52.3% of the sample (n = 78), medium firms (51-250 employees) comprised 32.2% (n = 48), and large firms (>250 employees) comprised 15.4% (n = 23). The predominance of small and medium enterprises reflects the structure of the maritime logistics industry in Kenya, where numerous small specialized service providers operate alongside larger integrated companies.

Years of operation ranged from 2 to 45 years, with a mean of 14.3 years (SD = 9.8). Approximately 35.6% of firms had been operating for 10 years or less, 39.6% for 11-25 years, and 24.8% for more than 25 years. This distribution indicates a relatively mature industry with a stable core of established firms alongside newer entrants.

Service scope varied considerably. Approximately 23.5% of firms operated exclusively within Mombasa (local scope), 48.3% provided services throughout the East African region, and 28.2% operated on an international scale. This distribution reflects Mombasa's role as a regional hub serving landlocked East African countries and its integration into global supply chains.

Customer profiles also showed variation. Approximately 34.2% of firms primarily served importers and exporters, 28.2% primarily served shipping lines and vessel operators, 18.1% primarily served other logistics companies, and 19.5% served mixed customer portfolios. This diversity indicates different business models and customer relationships within the shipping logistics industry.

4.3. Descriptive statistics

4.3.1. Customs clearance efficiency

Respondents reported average customs clearance times of 6.8 days (SD = 2.3 days), representing substantial reductions from historical norms. Approximately 45.6% of respondents indicated that clearance typically occurred within 5 days, 38.9% reported 5-7 days, and 15.4% reported delays of 7 days or more. The mean response to perceptual items assessing customs clearance efficiency was 3.21 on a 5-point scale (SD = 0.88), indicating moderate overall efficiency.

Regarding documentation accuracy, 62.4% of firms reported that more than 90% of initial submissions were accurate and complete, 23.5% reported 70-90% accuracy, and 14.1% reported lower accuracy. Approximately 58.4% of respondents perceived their relationships with customs authorities as good or excellent, 32.2% as adequate, and 9.4% as problematic. The Cronbach's alpha for the customs clearance efficiency scale was 0.82, indicating acceptable internal consistency across the 12 items.

4.3.2. Transportation management systems

Only 34.2% of firms (n = 51) reported adopting any form of Transportation Management System. Among TMS adopters, 21.6% used basic systems (primarily tracking capabilities), 60.8% employed intermediate systems (including route optimization and carrier selection), and 17.6% implemented comprehensive systems (integrated with ERP and advanced analytics). Non-adopters (65.8%) cited several barriers: cost-prohibitive (52.3%), inadequate IT infrastructure (38.6%), insufficient technical expertise (41.4%), and uncertainty regarding return on investment (48.4%).

Among TMS adopters, perceived effectiveness was relatively high. The mean effectiveness rating was 3.89 on a 5-point scale (SD = 0.72), with 76.5% of adopters reporting that systems met or exceeded expectations. TMS adoption was significantly associated with firm size (χ^2 = 12.34, p < 0.001), with 58.3% of large firms, 28.1% of medium firms, and 12.8% of small firms utilizing TMS. The composite TMS score (ranging from 0 to 100) had a mean of 34.2 (SD = 28.4), reflecting the predominance of non-adopters in the sample.

4.3.3. Last-mile delivery optimization

Reported on-time delivery rates averaged 78.3% (SD = 16.2%), indicating that most firms successfully delivered cargo within promised timeframes approximately three-quarters of the time. Approximately 31.5% of firms reported on-time delivery rates exceeding 90%, 35.6% reported 70-90%, and 32.9% reported rates below 70%. Average delivery costs ranged widely, from $5 per ton to $47 per ton, with a mean of $18.6 per ton (SD = 10.3).

Delivery reliability perceptions averaged 3.45 on a 5-point scale (SD = 0.91), indicating moderate consistency in delivery performance. Geographic service coverage varied considerably: 34.2% offered coverage limited to Mombasa, 43.6% covered the East African region, and 22.1% offered international delivery capabilities. The Cronbach's alpha for the last-mile delivery optimization scale was 0.79, indicating acceptable internal consistency.

4.3.4. Supply chain coordination

Supply chain coordination scores averaged 3.38 on a 5-point scale (SD = 0.85). Respondents reported frequent information exchange with customs authorities (mean = 3.52, SD = 0.94) and port operators (mean = 3.28, SD = 0.97), but less frequent coordination with freight forwarders (mean = 3.12, SD = 1.01) and customers (mean = 3.18, SD = 0.99). Trust in supply chain partners averaged 3.41 (SD = 0.89), with 61.7% of respondents indicating trust in their primary logistics partners.

Perceived coordination effectiveness was moderate to good, with 52.3% of firms reporting that coordination efforts significantly improved operational efficiency, 35.6% reporting modest improvements, and 12.1% reporting minimal impact. The Cronbach's alpha for the supply chain coordination scale was 0.88, indicating good internal consistency across the 13 items.

4.3.5. Shipping company performance

Shipping company performance scores averaged 3.28 on a 5-point scale (SD = 0.82). Examining performance dimensions separately:

Operational Performance: Cargo handling speed averaged 18.2 moves per hour (SD = 6.3), compared to best practice benchmarks of >35 moves per hour. Asset utilization averaged 71.3% (SD = 15.4%), indicating moderate capacity utilization. Turnaround time for vessels averaged 4.2 days (SD = 1.8 days).

Financial Performance: Revenue growth rates in the past year averaged 8.4% (SD = 12.6%), ranging from -15% to +38%. Operating costs per TEU averaged $325 (SD = $89), compared to industry best practices of <$250 per TEU. Profit margins on maritime operations averaged 12.1% (SD = 7.8%).

Market Performance: Firms estimated their market share in the Mombasa region at an average of 2.3% (SD = 3.2%), reflecting the fragmented structure of the maritime logistics industry with numerous specialized providers. Customer retention rates averaged 72.4% (SD = 18.6%), indicating that most firms retain approximately 3/4 of their customer base year over year. Customer satisfaction scores averaged 3.72 on a 5-point scale (SD = 0.78), with 68.5% reporting that most customers were satisfied or delighted with their services.

The Cronbach's alpha for the overall performance scale was 0.84, and for the three performance dimension subscales ranged from 0.76 to 0.82, indicating acceptable internal consistency.

4.4. Reliability and validity assessment

4.4.1. Scale reliability

All multi-item scales demonstrated acceptable internal consistency. Cronbach's alpha coefficients were:

1. Customs Clearance Efficiency: α = 0.82 (12 items)
2. Transportation Management Systems: α = 0.85 (14 items)
3. Last-Mile Delivery Optimization: α = 0.79 (11 items)
4. Supply Chain Coordination: α = 0.88 (13 items)
5. Shipping Company Performance: α = 0.84 (16 items)

All alpha values exceeded the 0.70 threshold for acceptability (Nunnally, 1978), ranging from 0.79 to 0.88. These coefficients indicate that items within each scale measure a familiar underlying construct.

4.4.2. Multicollinearity assessment

Variance Inflation Factors (VIF) for independent variables were examined to detect multicollinearity. Values were:

1. Customs Clearance Efficiency: VIF = 1.84
2. Transportation Management Systems: VIF = 1.62
3. Last-Mile Delivery Optimization: VIF = 1.71
4. Supply Chain Coordination: VIF = 2.06

All VIF values were well below the 10.0 threshold, indicating problematic multicollinearity. The highest VIF of 2.06 for supply chain coordination indicates acceptable collinearity. Pearson correlations among independent variables ranged from 0.31 to 0.58, with no correlations exceeding 0.70, further confirming adequate independence.

4.5. Correlation analysis

Pearson correlation coefficients examining bivariate relationships among variables are presented in the correlation matrix below. Table 4.2 presents the correlation matrix examining bivariate relationships among the four independent variables and the dependent variable (shipping company performance). All correlations between independent variables and performance were positive and statistically significant at $p < 0.01$ level, with coefficients ranging from 0.51 (last-mile delivery optimization) to 0.71 (supply chain coordination). Intercorrelations among independent variables

ranged from 0.31 to 0.53, indicating conceptual relationships while confirming adequate discriminant validity. The absence of very high correlations ($r > 0.70$) among independent variables suggests minimal multicollinearity concerns, supporting the appropriateness of including all four dimensions in the regression model.

Table 4.2: Pearson correlation coefficients among study variables

Variable	1	2	3	4	5
1. Customs Clearance Efficiency	1.00				
2. Transportation Management Systems	0.42**	1.00			
3. Last-Mile Delivery Optimization	0.31**	0.38**	1.00		
4. Supply Chain Coordination	0.53**	0.47**	0.42**	1.00	
5. Shipping Company Performance	0.58**	0.64**	0.51**	0.71**	1.00

Note: ** $p < 0.01$; * $p < 0.05$

Correlations between independent variables and the dependent variable (shipping company performance) ranged from 0.51 to 0.71, indicating moderate to strong positive relationships. Notably, supply chain coordination demonstrated the strongest correlation with performance ($r = 0.71$), followed by TMS adoption ($r = 0.64$), customs clearance efficiency ($r = 0.58$), and last-mile delivery optimization ($r = 0.51$). All correlations were statistically significant at the $p < 0.01$ level.

Intercorrelations among independent variables ranged from 0.31 to 0.53, suggesting that although the variables are conceptually related, they represent distinct dimensions of cross-border logistics. The strongest intercorrelation (r = 0.53) was between customs clearance efficiency and supply chain coordination, plausibly reflecting that effective customs relationships facilitate broader supply chain collaboration.

4.6. Regression analysis

4.6.1. Model specification and estimation

Multiple linear regression analysis examined the joint effects of independent variables on shipping company performance, controlling for firm size, years of operation, service scope, and customer profile. The regression model explained 77.2% of the variance in shipping company performance (R^2 = 0.772, adjusted R^2 = 0.758). The F-statistic for overall model significance was 52.34 ($p < 0.001$), indicating that the independent variables collectively had statistically significant effects on performance.

Results of the regression analysis are presented below. Table 4.3 presents the results of the multiple linear regression analysis examining the joint effects of customs clearance efficiency, transportation management systems, last-mile delivery optimization, and supply chain coordination on shipping company performance. The model demonstrates excellent fit to the data (R^2 = 0.772, adjusted R^2 = 0.758, F = 52.34, $p < 0.001$), explaining 77.2% of variance in performance outcomes. All four hypothesized relationships were confirmed as statistically significant at conventional levels ($p < 0.05$), with supply chain coordination emerging as the strongest predictor (standardized β = 0.338), followed by transportation management systems (β = 0.234), last-mile delivery optimization (β = 0.241), and customs clearance efficiency (β = 0.182).

Table 4.3: Multiple regression analysis results – effects of cross-border logistics on shipping company performance

Variable	Unstandardized β	Standard Error	Standardized β	t-value	p-value
(Intercept)	0.42	0.18		2.33	0.022
Customs Clearance Efficiency	0.186	0.058	0.182	3.21	0.002**
Transportation Management Systems	0.412	0.089	0.234	4.63	<0.001**
Last-Mile Delivery Optimization	0.289	0.065	0.241	4.45	<0.001**
Supply Chain Coordination	0.458	0.071	0.338	6.45	<0.001**
Firm Size (log)	0.126	0.052	0.103	2.42	0.017*
Years of Operation	0.018	0.007	0.127	2.57	0.011*
Service Scope (Regional)	0.164	0.089	0.091	1.84	0.067
Service Scope (International)	0.247	0.104	0.121	2.37	0.019*
Customer Mix (Diverse)	0.142	0.078	0.085	1.82	0.071

Note: ** p < 0.01; * p < 0.05

4.6.2. Regression results interpretation

All four hypothesized relationships were confirmed as statistically significant at a $p < 0.05$ level or better:

H_1 (Customs Clearance Efficiency): Customs clearance efficiency had a statistically significant positive effect on shipping company performance (β = 0.182, t = 3.21, p = 0.002). This indicates that a one-unit increase in customs clearance efficiency (on a 5-point scale) was associated with approximately a 0.186-unit increase in performance, equivalent to a 0.186/5 = 3.7% performance improvement. The effect size was small to medium (standardized β = 0.182).

H_2 (Transportation Management Systems): TMS adoption demonstrated a statistically significant positive effect on performance (β = 0.412, t = 4.63, $p < 0.001$). Firms with more advanced TMS adoption exhibited substantially higher performance levels. For context, comparing non-adopters (TMS = 0) to firms with comprehensive systems (TMS = 100) would predict a 0.412 × (100/5) = 8.24-

unit performance difference on a 100-point scale, or approximately a 33% performance differential on a percentage scale.

H_3 (Last-Mile Delivery Optimization): Last-mile delivery optimization positively influenced shipping company performance ($\beta = 0.289$, $t = 4.45$, $p < 0.001$), with a medium effect size (standardized $\beta = 0.241$). A one-unit increase in last-mile optimization was associated with a 0.289-unit performance improvement, or approximately a 5.8% increase.

H_4 (Supply Chain Coordination): Supply chain coordination had the most potent positive effect among the four independent variables ($\beta = 0.458$, $t = 6.45$, $p < 0.001$), with a large effect size (standardized $\beta = 0.338$). This indicates that a one-unit increase in coordination quality was associated with a 0.458-unit increase in performance, representing approximately 9.2% performance improvement.

Among control variables, firm size ($\beta = 0.126$, $p = 0.017$) and years of operation ($\beta = 0.018$, $p = 0.011$) had statistically significant positive effects on performance, consistent with expectations that larger, more established firms achieve better performance. Service scope (international vs. local) significantly affected performance ($\beta = 0.247$, $p = 0.019$), with internationally-oriented firms demonstrating higher performance. The customer portfolio diversity approached statistical significance ($p = 0.071$), suggesting a trend toward higher performance with more diverse customer bases.

4.6.3. Regression diagnostics

Regression diagnostic tests verified that OLS assumptions were reasonably satisfied:

Normality: Shapiro-Wilk test for normality of residuals yielded $W = 0.981$, $p = 0.084$, indicating that residuals were approximately normally distributed. Q-Q plot inspection confirmed that the residuals followed a theoretical normal distribution, except for a slight deviation in the upper tail, consistent with expectations for data from bounded rating scales.

Homogeneity of Variance: Breusch-Pagan test for heteroscedasticity yielded $\chi^2 = 4.12$, $p = 0.257$, indicating homogeneous variance across predicted values. Visual inspection of residual scatterplots revealed no systematic patterns suggesting heteroscedasticity.

Autocorrelation: Durbin-Watson statistic = 1.84, indicating no problematic autocorrelation in residuals. This is expected for cross-sectional data where observations are independent rather than temporally ordered.

Influential Cases: Cook's distance values for all observations were well below 1.0, indicating no single observation exerted excessive influence on regression estimates. Maximum leverage value was 0.082, below the $3p/n = 0.108$ threshold, indicating no problematic leverage. Sensitivity analysis: rerunning the regression with the exclusion of the 5% cases with the most significant residuals yielded virtually identical results, confirming estimate stability.

4.6.4. Model fit and practical significance

The model R^2 of 0.772 indicates a large effect size (Cohen, 1988) and indicates that the independent variables explain 77.2% of the variance in shipping company performance. This is substantially better than typical business research findings (often 20-40%) and suggests the model captures important performance determinants. The remaining 22.8% of unexplained variance potentially reflects factors not included in the model (e.g., management quality, competitive intensity, external disruptions) and measurement error.

Examination of standardized regression coefficients reveals the relative importance of independent variables. Supply chain coordination emerged as the strongest predictor ($\beta = 0.338$), followed by TMS adoption ($\beta = 0.234$), last-mile delivery optimization ($\beta = 0.241$), and customs clearance efficiency ($\beta = 0.182$). The clustering of standardized coefficients between 0.18 and 0.34 indicates that all four logistics dimensions contribute meaningfully to performance, though supply chain coordination has the most significant effect.

4.7. Hypothesis testing summary

Table 4.4 provides descriptive statistics for all study variables, including means, standard deviations, minimum and maximum values, and scale ranges. The independent variables demonstrated moderate to high mean scores: supply chain coordination (M = 3.38, SD = 0.85), last-mile delivery optimization (M = 3.45, SD = 0.91), customs clearance efficiency (M = 3.21, SD = 0.88), and transportation management systems composite score (M = 34.2, SD = 28.4 on 0-100 scale). The dependent variable, shipping company performance, averaged 3.28 (SD = 0.82) on the 5-point scale. Standard deviations indicate adequate variance across all constructs, supporting the appropriateness of correlational and regression analyses.

Table 4.4: Descriptive statistics for study variables (N=149)

Hypothesis	Relationship	Result
H_1	Customs Clearance Efficiency → Performance	Supported (p = 0.002)
H_2	TMS Adoption → Performance	Supported (p < 0.001)
H_3	Last-Mile Delivery Optimization → Performance	Supported (p < 0.001)
H_4	Supply Chain Coordination → Performance	Supported (p < 0.001)

All four research hypotheses were supported by empirical evidence. Each independent variable demonstrated a statistically significant positive relationship with shipping company performance, with effect sizes ranging from small (customs clearance) to significant (supply chain coordination). The overall model demonstrated good fit to data and reasonable satisfaction of statistical assumptions.

4.8. Summary of key findings

- Cross-border logistics dimensions collectively explained 77.2% of the variance in shipping company performance among Mombasa-based firms, indicating these factors are critical performance drivers.
- Supply chain coordination emerged as the most influential logistics dimension, with a standardized effect size of 0.338, suggesting that emphasizing coordination and collaboration with supply chain partners yields the most significant performance returns.
- TMS adoption positively influenced performance even accounting for other logistics factors, though adoption remains limited (34.2%) among Mombasa shipping companies, representing an untapped performance improvement opportunity.
- Customs clearance efficiency, while showing the smallest effect size (β = 0.182), contributed significantly to performance, confirming that regulatory and procedural efficiency remain important despite other logistics considerations.
- Last-mile delivery optimization demonstrated a moderate effect size (β = 0.241), supporting growing emphasis on final-mile service quality in competitive maritime logistics markets.
- Firm size and years of operation positively influenced performance, suggesting that larger, more established firms achieve better outcomes, consistent with predictions of the resource-based view.
- An internationally oriented service scope positively influenced performance relative to local operations, reflecting opportunities and competitive pressures in regional and global markets.

5. Discussion and conclusions

5.1. Overview

This chapter discusses the research findings in the context of existing literature, theoretical frameworks, and implications for academic knowledge, policy development, and management practice. The discussion integrates empirical results with prior research to advance understanding of how cross-border logistics influences shipping company performance in developing economy contexts.

5.2. Interpretation of findings

5.2.1. Supply chain coordination as the dominant performance driver

The most notable finding was that supply chain coordination emerged as the strongest predictor of shipping company performance (β = 0.338), accounting for the most considerable standardized effect among the four logistics dimensions examined. This finding is consistent with network theory's predictions that firm performance depends on relationships with external stakeholders and aligns with empirical research by Obasi et al. (2024), which demonstrates that centrally positioned firms in logistics networks experience superior cost and efficiency outcomes.

The magnitude of coordination's effect suggests that in the Mombasa maritime context, informal relationships, information exchange, and collaborative problem-solving mechanisms may compensate for structural constraints and institutional weaknesses. Companies that cultivate strong relationships with customs authorities, port operators, freight forwarders, and customers gain preferential access to information about regulatory changes, capacity availability, and service innovations. These advantages enable firms to navigate bureaucratic complexity more effectively, respond more rapidly to disruptions, and develop collective solutions to common challenges.

This finding carries important implications for competitive strategy. While technological investments in TMS or infrastructure investments in port facilities may require substantial capital, development of relationship capabilities and coordination mechanisms may be achievable with more modest resource commitments. Shipping companies seeking a competitive advantage might prioritize investment in personnel with strong relationship-building skills, formal and informal forums for stakeholder collaboration, and systems for transparent information sharing.

5.2.2. Transportation management systems and technology adoption

TMS adoption demonstrated the second-strongest effect on performance (β = 0.234), supporting hypotheses that technology investments enhance operational efficiency. However, the relatively low adoption rate of 34.2% indicates a substantial untapped opportunity for performance improvement. This low adoption rate reflects barriers identified in the results: cost-prohibitiveness (52.3% of non-adopters), inadequate IT infrastructure (38.6%), technical expertise shortages (41.4%), and uncertainty regarding ROI (48.4%).

The barriers to TMS adoption identified in this research align with broader patterns observed in technology adoption research in developing economy contexts. Financial constraints are particularly acute for small and medium-sized enterprises that comprise the majority of Mombasa shipping companies. The substantial investment required for TMS implementation - including software licenses, hardware infrastructure, system customization, staff training, and organizational change management - exceeds capital availability for many firms.

Infrastructure limitations present second-order barriers. TMS effectiveness depends on reliable telecommunications connectivity, consistent electricity supply, and reliable internet access. While urban Mombasa generally has adequate infrastructure, some outlying operations and certain times of day may experience connectivity disruptions, reducing system reliability. International TMS vendors often have limited experience with Kenya-specific regulatory requirements and operational contexts, complicating implementation.

Despite these barriers, the positive effect of TMS on performance suggests that firms that find pathways to adopt these systems realize substantial competitive benefits. Organizations could explore alternative adoption strategies that potentially reduce barriers: consortium approaches in which groups of firms collectively invest in shared TMS platforms; cloud-based solutions that reduce upfront hardware costs; partnerships with technology providers that offer localized implementation support; and phased implementations that address the highest-priority functions first.

5.2.3. Last-mile delivery optimization

Last-mile delivery optimization demonstrated moderate but significant positive effects on performance (β = 0.241), with a standardized effect size between that of customs clearance efficiency

and TMS adoption. This finding reflects the increasing strategic importance of final-mile service quality in competitive maritime logistics markets. On-time delivery reliability, cost efficiency, and customer satisfaction are increasingly critical competitive differentiators as standardization of basic services intensifies competition.

The reported on-time delivery rate of 78.3% suggests considerable variation in last-mile performance across firms, with opportunities for performance improvement. Firms achieving 90%+ on-time delivery demonstrated substantially better overall performance than those below 70%. Investing in route optimization capabilities, even without a comprehensive TMS, could enhance last-mile performance. Geographic information systems enabling better route planning, mobile technologies facilitating dynamic re-routing, and simple optimization techniques can improve last-mile efficiency without requiring significant capital investments.

The Kenya Ports Authority's controversial entry into last-mile delivery services reflects recognition of this segment's strategic importance. While the initiative sparked industry debate about competition dynamics, it highlights the link between last-mile capabilities and overall shipping industry competitiveness. Companies developing superior last-mile capabilities may achieve differentiation and customer loyalty in increasingly competitive markets.

5.2.4. Customs clearance efficiency

Customs clearance efficiency demonstrated the smallest, yet still statistically significant, effect on performance ($\beta = 0.182$). This finding might initially suggest that customs efficiency is less important than other logistics factors, but alternative interpretations are warranted. The apparent modest effect may reflect several factors:

First, many firms achieve similar customs clearance outcomes through established broker relationships and standardized procedures, limiting variance in clearance efficiency across firms. When the variance in a predictor variable is low, regression coefficients tend to be attenuated even if the underlying relationship is substantial. In environments with greater heterogeneity in customs efficiency - such as during periods of regulatory change or with larger numbers of first-time importers - the effect might be larger.

Second, the observed mean clearance time of 6.8 days, while improved from historical norms, remains substantially higher than developed economy benchmarks of 0.5-1.0 days. This suggests that further gains in customs efficiency could have proportionally larger performance effects. The relationship between customs efficiency and performance may be non-linear, with the most significant performance impacts coming from moving from very slow to moderate clearance speeds, with diminishing returns at faster speeds.

Third, the effect of customs efficiency may be mediated through other variables. Better customs relationships may generally facilitate supply chain coordination, as evidenced by the stronger supply chain coordination coefficient. Similarly, customs efficiency improvements may enable more effective TMS utilization by providing more predictable clearance windows for route optimization. Path analysis or structural equation modeling to examine mediation effects would clarify such relationships.

Despite these considerations, customs clearance efficiency remains a significant performance determinant, and efforts to further improve Kenya's customs processes would benefit the maritime logistics industry. The Single Customs Territory and the Kenya TradeNet System appear to have achieved improvements, but additional reforms to address staff capacity, system reliability, and regulatory clarity could further enhance efficiency.

5.2.5. Firm characteristics and performance

Beyond the four logistics dimensions, firm characteristics influenced performance. Firm size positively affected performance, with larger firms achieving better outcomes. This finding is consistent with resource-based view expectations that larger firms possess greater resources, enabling better performance. However, the effect was modest ($\beta = 0.103$, standardized), suggesting that firm size confers advantages but does not entirely determine performance.

Years of operation also positively influenced performance, indicating that more established firms achieved better outcomes. This likely reflects accumulated organizational capabilities, deeper customer

relationships, reputation effects, and operational experience developed through years of practice. However, the modest effect size (standardized β = 0.127) suggests that newer firms can still achieve competitive performance through focused development of logistics capabilities.

International service scope positively affected performance compared to local operations, suggesting that firms expanding beyond Mombasa to regional and international markets access larger revenue bases and benefit from geographic diversification. However, geographic expansion also increases complexity and risk, which explains why the effect was moderate rather than large.

5.3. Theoretical implications

The research findings support and extend the four theoretical frameworks employed:

Institutional Theory: The significant positive effects of customs clearance efficiency and supply chain coordination support the predictions of institutional theory that regulatory and relationship-based pressures shape organizational practices. However, the finding that only 34.2% of firms adopted TMS despite documented benefits suggests that institutional pressures alone do not drive technology adoption. Instead, financial constraints and technical capacity limitations create barriers that institutional pressures cannot overcome. This highlights limitations of institutional theory in explaining technology adoption decisions in resource-constrained contexts.

Resource-Based View: The positive effects of firm size and years of operation on performance support the RBV's prediction that resource endowments influence organizational success. However, the dominant effect of supply chain coordination suggests that external relationships and network resources complement internal resources. The relatively successful performance of small firms despite limited resources indicates that superior logistics capabilities can partially compensate for resource disadvantages, supporting the view that capabilities matter as much as resource quantity.

Transaction Cost Economics: The positive effect of TMS adoption on performance supports TCE predictions that reducing transaction costs through technology improves efficiency. However, the analysis revealed that barriers to transaction cost reduction, including capital constraints, infrastructure limitations, and technical expertise, prevent many firms from adopting cost-reducing technologies. This suggests that TCE's assumption of rational cost minimization needs to be modified in contexts where capital and technical capacity are severely constrained.

Network Theory: The dominant effect of supply chain coordination strongly supports network theory predictions, emphasizing the importance of inter-organizational relationships and network position. The finding that centrally positioned firms with superior coordination capabilities achieve better performance supports the theoretical proposition that network structure shapes performance. However, the research also revealed that technology adoption and formal logistics capabilities complement network relationships: firms that combine strong relationships with advanced technologies achieve the best outcomes.

5.4. Policy implications

The research generates several implications for policy development at national and regional levels:

Customs Reform Priorities: While customs modernization has achieved improvements, further reforms should focus on capacity-building for customs personnel, enhancing system reliability, and improving regulatory clarity. The relatively modest effect of customs efficiency on performance suggests that achieving incremental improvements would provide proportional benefits. Regions that have achieved speedy clearance (Singapore's 0.5 days) realize performance benefits that Mombasa has not yet attained.

Technology Infrastructure Investment: The substantial barriers to TMS adoption stemming from inadequate IT infrastructure suggest that public investment in telecommunications infrastructure, particularly in logistics hubs, would facilitate private-sector technology adoption. Public-private partnerships enabling shared investment in infrastructure could reduce individual firm capital requirements.

Regional Harmonization: The strong effects of supply chain coordination suggest that efforts toward regional customs harmonization within the EAC and the African Continental Free Trade Area

would provide substantial benefits. Standardized regulatory requirements, mutual recognition agreements, and simplified procedures would reduce coordination complexity and facilitate information sharing.

Shipping Industry Capacity Building: Technical expertise deficits that prevent TMS adoption indicate that education and training initiatives focused on supply chain management skills would enhance industry capabilities. Partnerships between universities, vocational training institutions, and industry associations could develop appropriate curricula and training programs.

Port Authority Strategy: The finding that last-mile delivery capabilities significantly influence performance supports Kenya Ports Authority's Last-Mile Delivery initiative. However, the initiative should be implemented in ways that facilitate rather than crowd out private-sector participation, potentially through public-private partnerships that leverage both public infrastructure and private-sector efficiency.

5.5. Managerial implications

For shipping company executives and logistics managers, the research provides practical guidance:

Prioritize Relationship Development: Given the dominant effect of supply chain coordination on performance, firms should invest in personnel and processes to cultivate strong relationships with customs authorities, port operators, freight forwarders, and customers. This might include dedicated relationship management roles, involvement in industry associations, and participation in collaborative problem-solving forums.

Evaluate TMS Adoption Strategically: While TMS adoption requires substantial investment, the demonstrated performance benefits justify serious evaluation. Rather than dismissing TMS as "too expensive," firms should explore alternative adoption strategies, including phased implementation, consortium approaches, and cloud-based solutions that offer lower initial costs.

Enhance Last-Mile Capabilities: Firms competing on service quality should prioritize excellence in last-mile delivery. This need not require capital-intensive technology investments initially; route optimization techniques, customer communication enhancements, and partnership development with final-mile providers can improve performance with modest investments.

Leverage Customs Efficiency: Firms should ensure that customs compliance and relationship quality receive adequate attention and resources. While customs efficiency showed modest effects, persistent or worsening customs delays would significantly impair performance. Companies should monitor customs procedures and advocate for improvements through industry associations.

Bundle Logistics Investments: The research suggests that the greatest performance impacts come from the combined development of multiple logistics capabilities rather than focusing narrowly on a single dimension. Firms might develop integrated improvement programs addressing customs relationships, TMS adoption, last-mile capabilities, and supply chain coordination simultaneously.

5.6. Limitations of the study

Several limitations should be acknowledged when interpreting findings:

Cross-Sectional Design: The study collected data at a single point in time, limiting the ability to establish temporal precedence and infer causality with certainty. While theoretical grounding provides a logical basis for interpreting relationships as causal, longitudinal research would strengthen causal inferences.

Self-Report Bias: Performance data were self-reported by firm representatives rather than independently verified. While this reflects practical constraints, it introduces potential for socially desirable responding and attribution bias. Triangulation with objective performance data would enhance validity.

Measurement Limitations: Some constructs, particularly coordination quality and perception-based performance measures, relied on subjective assessments. While multi-item scales enhanced reliability, objective external measures would strengthen validity.

Sample Specificity: The sample comprises shipping firms in Mombasa County, Kenya, operating under specific institutional, infrastructural, and regulatory conditions. Findings may not directly generalize to other port cities or countries with different characteristics.

Unexplained Variance: While the model explained 77.2% of the variance in performance, 22.8% remains unexplained. Unmeasured variables, including management quality, competitive intensity, external disruptions, and firm-specific innovations, likely explain some of the unexplained variance.

5.7. Recommendations for future research

Several directions for future research emerge from this study:

Longitudinal Investigation: Following the same firms over multiple years would enable tracking how changes in logistics influence performance, strengthening causal inference. Repeated measurements would also reveal whether findings hold across different time periods and external conditions.

Qualitative Research: In-depth interviews and case studies of high- and low-performing firms would illuminate the mechanisms by which logistics dimensions influence performance. Qualitative research could explain why certain firms achieve superior performance despite similar structural constraints.

Mediation Analysis: Examining whether other factors mediate relationships among variables would clarify causal mechanisms. For example, does customs efficiency influence performance directly, or does it do so through effects on supply chain coordination?

Interaction Effects: Analysis of whether the effects of one logistics dimension depend on levels of other dimensions would reveal potential synergies. For example, do TMS benefits depend on achieving a certain threshold of customs efficiency first?

Comparative Analysis: Replicating the study across multiple port cities or countries would test whether the findings generalize or vary across local contexts. Such comparative research would identify which findings are universal and which are context-specific.

Technology Adoption Barriers: A deeper investigation of specific barriers to TMS adoption would inform strategies to expand adoption rates. Understanding whether barriers are primarily financial, technical, organizational, or regulatory would guide targeted interventions.

5.8. Conclusions

This research examined how four dimensions of cross-border logistics - customs clearance efficiency, transportation management systems, last-mile delivery optimization, and supply chain coordination - influence shipping company performance in Mombasa County, Kenya. The study hypothesized positive relationships between each logistics dimension and performance, with all four hypotheses supported by empirical evidence.

The research contributes to the logistics and supply chain management literature by providing firm-level empirical evidence on the determinants of logistics performance in Sub-Saharan Africa, where such evidence remains limited. The integrated examination of multiple logistics dimensions, rather than an isolated analysis of individual components, reveals that performance depends on coordinated development across logistics dimensions. The dominant effect of supply chain coordination underscores the importance of inter-organizational relationships and collaboration, thereby contributing to the development of network theory.

The research has implications for policy development. Customs reform efforts, technology infrastructure investment, regional harmonization, and industry capacity building would all contribute to enhancing maritime logistics performance in East Africa. For managers, the research provides evidence supporting strategic investments in logistics capabilities, while emphasizing that relationship development and coordination may offer greater performance returns than technology adoption alone.

In conclusion, cross-border logistics shapes shipping company performance in profound ways. Companies succeeding in competitive maritime markets are those that effectively manage customs procedures, implement transportation technologies where feasible, optimize last-mile delivery, and cultivate collaborative relationships with supply chain partners. The research provides a foundation for

understanding these relationships and guides strategic decision-making for firms, policy makers, and industry associations working to enhance East African maritime logistics competitiveness.

Authors' contributions

All the authors contributed to the study design, data collection, analysis, and manuscript writing. All the authors read and approved the final manuscript.

Funding

This study received no external funding.

Ethics approval and consent to participate

Not applicable.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

Citation information

Njuguna, A., W., Githae, P., & Nyile, E. K. (2025). Cross-border logistics and shipping company performance in East Africa: Empirical evidence from Mombasa Port. *Journal of Sustainable Development of Transport and Logistics, 10*(2), 134-172. doi:10.14254/jsdtl.2025.10-2.8.

References

African Development Bank. (2023). *Africa infrastructure development index 2023*. African Development Bank Group.

Alsheyadi, A., Baawain, A., & Shaukat, M. R. (2024). E-supply chain coordination and performance impacts: An empirical investigation. *Production & Manufacturing Research*, *12*(1). https://doi.org/10.1080/21693277.2024.2379942

Barney, J. (1991). Firm resources and sustained competitive advantage. *Journal of Management*, 17(1), 99-120. https://doi.org/10.1177/014920639101700108

Ben Haj Ahmed, R., Bouzir, A., Benhadj Mbarek, M. H., & Benammou, S. (2023). The impact of logistics performance index on port infrastructure quality: comparative study Tunisia Morocco. *Archives of Transport*, 67(3), 147-164. https://doi.org/10.5604/01.3001.0053.7212

Business Daily Africa. (2025, January 8). Mombasa port container traffic hits a record in 2024. https://www.businessdailyafrica.com/bd/corporate/companies/mombasa-port-container-traffic-hits-a-record-in-2024-4884082

Choi, Y. S. (2015). *Customs policies and trade efficiency* (WCO Research Paper No. 34). World Customs Organization.

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Lawrence Erlbaum.

DiMaggio, P. J., & Powell, W. W. (1983). The iron cage revisited: Institutional isomorphism and collective rationality in organizational fields. *American Sociological Review*, 48(2), 147-160. https://doi.org/10.2307/2095101

East African Community. (2024). *EAC facts and figures 2024*. EAC Secretariat.

Ecofin Agency. (2025, September 29). East African Community trade rises 22% in 2024, topping $11bn. https://www.ecofinagency.com/news/3009-49141-east-african-community-trade-rises-22-in-2024-topping-11bn

Fink, A. (1995). *The survey handbook*. Sage Publications.

Granovetter, M. (1985). Economic action and social structure: The problem of embeddedness. *American journal of sociology*, *91*(3), 481-510. https://doi.org/10.1086/228311

Hamisi, S. R., & Kileo, W. J. The Effect of Automated Customs Clearance Systems on Enhancing Trade Efficiency in Tanzania. *International Journal of Social Sciences and Management Research*, 10(8), 408-422.

Jazairy, A., & von Haartman, R. (2020). Analysing the institutional pressures on shippers and logistics service providers to implement green supply chain management practices. *International Journal of Logistics Research and Applications*, *23*(1), 44-84. https://doi.org/10.1080/13675567.2019.1584163

Kenya Institute of Supply Chain Management. (2023). *Skills assessment survey 2023: Kenya logistics sector*. KISM.

Kenya International Freight and Warehousing Association. (2023). *Annual industry report 2023*. KIFWA.

Kenya Ports Authority. (2024). *Strategic plan 2024-2028*. Kenya Ports Authority.

Kenya Ports Authority. (2025, January 8). KPA achieves a major milestone, surpassing 2 million TEUs. https://www.kpa.co.ke/Media/Read/2

Kenya Revenue Authority. (2024). *Annual revenue report 2023/2024*. KRA.

Kenya Shipping Council. (2023). *Maritime industry statistical bulletin 2023*. Kenya Shipping Council.

Kocoglu, I., Keskin, H., Cemberci, M., & Civelek, M. E. (2022). Effect of supply chain coordination on performance: a serial mediation model of trust, agility, and collaboration. *International Journal of Information Systems and Supply Chain Management (IJISSCM)*, *15*(1), 1-15. https://doi.org/10.4018/IJISSCM.287130

Kuo, S. Y., Lin, P. C., & Lu, C. S. (2017). The effects of dynamic capabilities, service capabilities, competitive advantage, and organizational performance in container shipping. *Transportation Research Part A: Policy and Practice*, *95*, 356-371. https://doi.org/10.1016/j.tra.2016.11.015

Lai, K. H., Ngai, E. W. T., & Cheng, T. C. E. (2004). An empirical study of supply chain performance in transport logistics. *International journal of Production economics*, *87*(3), 321-331. https://doi.org/10.1016/j.ijpe.2003.09.007

Maersk. (2024, May 16). Transportation management system (TMS) explained. https://www.maersk.com/logistics-explained/supply-chain-management/2024/05/16/transportation-management-system

Maleki, M., & Cruz-Machado, V. (2013). An empirical review on supply chain integration. *Management and Production Engineering Review*, 4(1), 85-96. https://doi.org/10.2478/mper-2013-0010

Nasser, F., & Ouerghi, F. (2024). The role of institutions in logistics performance as a new road toward GVC participation. *Transnational Corporations Review*, *16*(4), 200092. https://doi.org/10.1016/j.tncr.2024.200092

Ngari, K. N. (2018). *Effects of customs clearance procedures on business performance of selected clearing and forwarding companies in Kenya* [Master's thesis, KCA University].

Nunnally, J. C. (1978). *Psychometric theory* (2nd ed.). McGraw-Hill.

Obasi, C., Oyakegha, S., & Okuoyibo, A. M. (2024). Port logistics and supply chain management: An empirical review. *African Journal of Economics and Sustainable Development*, 7(3), 82-91. https://doi.org/10.52589/AJESD-CB4SA99C

Omoush, M. M. (2022). The impact of the practices of logistic management on operational performance: A field study of road transport companies [Special issue]. *Journal of Governance & Regulation, 11*(4), 237–245. https://doi.org/10.22495/jgrv11i4siart4

Progoulaki, M., & Theotokas, I. (2010). Human resource management and competitive advantage: An application of resource-based view in the shipping industry. *Marine Policy*, *34*(3), 575-582. https://doi.org/10.1016/j.marpol.2009.11.004

Shuaibu, A. S., Mahmoud, A. S., & Sheltami, T. R. (2025). Last-Mile Delivery Optimization: Recent Approaches and Advances. *Transportation Research Procedia*, *84*, 299-306. https://doi.org/10.1016/j.trpro.2025.03.076

Shukla, R. K., Garg, D., & Agarwal, A. (2013). Supply chain coordination competency and Firm Performance: An empirical study. *International Journal of Supply Chain Management*, *2*(4), 64-70.

Sillanpää, I. (2015). Empirical study of measuring supply chain performance. *Benchmarking: An International Journal*, *22*(2), 290-308. https://doi.org/10.1108/BIJ-01-2013-0009

The Star. (2024, March 25). Last-mile delivery is good for Kenya. https://www.the-star.co.ke/news/2024-03-26-last-mile-delivery-is-good-for-kenya

UNCTAD. (2024). *Review of maritime transport 2024*. United Nations Conference on Trade and Development.

UNCTAD. (2025). *Port performance and maritime trade facilitation* (Chapter 4). United Nations Conference on Trade and Development.

Williamson, O. E. (1985). *The economic institutions of capitalism*. Free Press.

World Bank. (2023). *Logistics Performance Index 2023*. World Bank Group.

World Bank. (2024). *Doing business in Kenya 2024: Trade facilitation indicators*. World Bank Group.

World Customs Organization. (2023). *Annual report 2023*. WCO.

World Trade Organization. (2024). *World trade statistical review 2024*. WTO Publications.

Yamane, T. (1967). *Statistics: An introductory analysis* (2nd ed.). Harper and Row.

Yang, C. C., Marlow, P. B., & Lu, C. S. (2009). Assessing resources, logistics service capabilities, innovation capabilities and the performance of container shipping services in Taiwan. *International Journal of Production Economics*, *122*(1), 4-20. https://doi.org/10.1016/j.ijpe.2009.03.016

Yang, C. S., & Lirn, T. C. (2017). Revisiting the resource-based view on logistics performance in the shipping industry. *International Journal of Physical Distribution & Logistics Management*, *47*(9), 884-905. https://doi.org/10.1108/IJPDLM-05-2017-0184

Zhang, X., Zha, X., Dan, B., Liu, Y., & Sui, R. (2024). Logistics mode selection and information sharing in a cross-border e-commerce supply chain with competition. *European Journal of Operational Research*, *314*(1), 136-151. https://doi.org/10.1016/j.ejor.2023.09.012

Journal of Sustainable Development of Transport and Logistics (ISSN: 2520-2979) is published by **Scientific Publishing House "CSR", Poland, EU** and **Scientific Publishing House "SciView", Poland, EU**
Publishing with JSDTL ensures:
• Immediate, universal access to your article on publication
• High visibility and discoverability via the JSDTL website
• Rapid publication
• Guaranteed legacy preservation of your article
• Discounts and waivers for authors in developing regions
Submit your manuscript to a JSDTL at https://jsdtl.sciview.net/ or submit.jsdtl@sciview.net