

System Integration and IT Readiness as Drivers of Logistics Performance in Emerging E-Commerce Markets

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ABSTRACT: The growth of Indonesia's e-commerce sector has accelerated the need for efficient and digitized logistics systems. This study investigates how the implementation of e-logistics particularly IT readiness, system integration, management support, and automation affects logistics performance indicators, including delivery time, cost per shipment, and customer satisfaction. Employing a quantitative approach, Data were collected through structured surveys administered to e-commerce firms and third-party logistics providers. Analysis using multiple linear regression reveals that IT infrastructure and system integration significantly improve delivery accuracy and operational efficiency, while management support enhances service quality. Automation further contributes to logistics cost reduction. The findings highlight regional disparities in logistics infrastructure and emphasize the role of national initiatives, such as Indonesia's National Logistics Ecosystem (NLE), in fostering collaboration and standardization. This research provides a context-specific model for digital logistics transformation in emerging markets, offering actionable insights for both practitioners and policymakers.

Keywords: E-Logistics, System Integration, IT Readiness, Logistics Performance, E-Commerce, Indonesia, Automation.



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INTRODUCTION

Indonesia's e-commerce sector has undergone a remarkable transformation in the past decade, largely driven by increasing internet penetration, mobile technology adoption, and changing consumer behavior. These developments have reshaped consumer behavior, leading to a growing demand for seamless, fast, and reliable logistics services. This shift in logistics requirements has placed significant pressure on existing supply chain infrastructures to modernize and meet the evolving needs of digital commerce. Consequently, the concept of electronic logistics (e-logistics) has emerged as a pivotal solution, aiming to digitize and integrate logistical operations to enhance responsiveness, visibility, and efficiency within e-commerce ecosystems.

E-logistics refers to the incorporation of digital technologies into logistics operations, enabling the end-to-end management of goods through systems that support real-time data access, automated

inventory control, tracking, route optimization, and improved customer communication. It encompasses subsystems such as automated warehousing, transportation management systems (TMS), order management systems (OMS), and data analytics platforms powered by the Internet of Things (IoT), artificial intelligence (AI), and predictive modeling. These capabilities contribute to improved inventory turnover, minimized delivery errors, and accelerated shipping processes, which are increasingly essential in meeting the expectations of modern e-commerce customers (Cichosz et al., 2020; Ha & Chuah, 2023).

Despite the promising advantages of e-logistics, Indonesia's logistics infrastructure remains riddled with inefficiencies. Reports indicate that Indonesia's logistics sector underperforms compared to its ASEAN peers, primarily due to outdated infrastructure, fragmented systems, and regulatory constraints (Ha & Chuah, 2023). A notable indicator of this issue is the country's inland distribution system, where timely delivery rates are estimated at just 20%, with port operations functioning at nearly half the speed of regional peers (Kearney, 2024). These inefficiencies severely constrain the scalability of e-commerce operations and diminish customer satisfaction, highlighting a critical gap between digital demand and logistical readiness.

Projections for the growth of Indonesia's e-commerce and logistics sectors are robust, with estimates forecasting a compound annual growth rate (CAGR) that exceeds global benchmarks. By 2025, Indonesia's e-commerce market is expected to surpass USD 83 billion, making it the largest in Southeast Asia (Haqqoni & Pramana, 2021). In parallel, the logistics industry is anticipated to reach USD 5.27 billion, driven primarily by increasing transaction volumes and the growing need for integrated delivery solutions (Mulya et al., 2023). These trends underscore the urgent necessity for scalable, efficient, and digitized logistics solutions to match the complexity and speed of online retail.

Comparative insights from other emerging economies lend credence to the role of e-logistics as a transformative force. In India and Brazil, the adoption of digital logistics technologies has been correlated with reduced operational costs, improved delivery times, and heightened service quality. These improvements have enabled firms to increase market competitiveness and streamline supply chain operations (Cichosz et al., 2020). Studies reveal that digitally empowered logistics systems also enhance transparency, enabling real-time tracking and customer feedback loops, which are vital in fostering consumer trust and loyalty (Hidayat & Musari, 2021). Such examples reinforce the notion that digital transformation is not only technologically feasible but also economically imperative for logistics modernization.

Recognizing the importance of digital logistics, the Indonesian government has initiated various policy frameworks aimed at supporting technological adoption in the logistics sector. Chief among these initiatives is the National Logistics Ecosystem (NLE), designed to improve coordination among stakeholders, promote interoperability, and streamline data flows within the supply chain. The NLE integrates public and private sector systems to foster efficiency, reduce regulatory bottlenecks, and improve end-to-end logistics performance (Ramadhan, 2022). However, while promising in scope, the implementation of such initiatives remains inconsistent, hampered by institutional inertia and disparate levels of technological readiness across regions.

Persistent barriers continue to undermine logistics digitalization in Indonesia and Southeast Asia more broadly. Among these are limited access to digital infrastructure, especially in non-metropolitan areas, and varying degrees of digital literacy within logistics workforces. Additionally, many firms exhibit resistance to organizational change, often due to a lack of familiarity with new technologies or concerns over upfront investment costs (Cichosz et al., 2020). Research indicates that these challenges are further compounded by regulatory frameworks that have not kept pace with the evolution of digital logistics solutions, resulting in ambiguous compliance requirements and inconsistent enforcement (Pradipta et al., 2023).

Against this backdrop, the implementation of e-logistics systems in Indonesia remains a complex endeavor. It requires not only financial investment in technology and infrastructure but also organizational commitment to process redesign, staff training, and inter-firm collaboration. The readiness of firms to adopt e-logistics solutions is determined by a combination of internal and external factors, including management support, IT infrastructure, system interoperability, and regulatory alignment. Success in this area is not solely a matter of technological capability but also of strategic vision and ecosystem integration.

The objective of this study is to investigate the influence of key implementation factors namely IT readiness, system integration, management support, and automation on logistics performance outcomes in Indonesia's e-commerce industry. The study aims to provide empirical insights into how these factors affect critical metrics such as delivery time, logistics cost, and customer satisfaction. In doing so, it seeks to bridge the gap between conceptual models of e-logistics and their real-world application in a developing economy context.

The novelty of this study lies in its focus on the Indonesian e-commerce logistics landscape, an area that remains underexplored in academic literature despite its growing economic significance. By combining theoretical constructs with primary data collection, the research contributes a context-specific success model for e-logistics adoption in emerging markets. Furthermore, the study outlines practical implications for firms and policymakers, offering evidence-based recommendations for enhancing logistics efficiency through digital transformation.

In scope, this research limits its analysis to e-commerce companies and third-party logistics providers operating in Indonesia, focusing primarily on quantitative performance metrics as reported by logistics and operations managers. The findings are intended to inform both academic discourse and practical strategy, supporting Indonesia's broader goal of becoming a digitally integrated and globally competitive logistics hub.

METHOD

This chapter outlines the research methodology employed to evaluate the impact of e-logistics implementation on logistics performance in Indonesia's e-commerce sector. The approach integrates quantitative methods, guided by both empirical data collection and established analytical frameworks in logistics research. Emphasis is placed on identifying causal relationships between key e-logistics implementation variables such as IT readiness, system integration, and management

support and dependent performance outcomes, including delivery time, cost per shipment, and customer satisfaction.

The research adopts a positivist paradigm with a deductive reasoning approach, seeking to empirically test theoretical relationships using statistical analysis. A cross-sectional survey method is used to gather primary data from logistics and operations managers across e-commerce companies and third-party logistics (3PL) providers operating in Indonesia. This method facilitates an efficient and scalable approach to data collection from multiple business environments and regions.

This study applies a correlational design to explore the strength and direction of relationships among multiple variables. The dependent variables selected for analysis are quantitative performance indicators: average delivery time (in days), cost per shipment (in IDR), and customer satisfaction scores (measured on a 1–5 Likert scale). The independent variables include IT readiness, system integration, management support, and degree of automation. These are also measured using Likert-type scales, allowing for standardization across diverse respondents.

To address potential confounding influences, a set of control variables is incorporated into the model. These include firm size (based on annual revenue or number of employees), product type (e.g., perishables, electronics, apparel), geographical coverage (e.g., Java vs. non-Java regions), and market competitiveness. The inclusion of control variables helps isolate the specific influence of implementation factors on logistics performance (Ridwan et al., 2024; Yacob et al., 2021).

Respondents were selected using purposive sampling, focusing on organizations actively engaged in e-commerce operations with measurable levels of digital logistics integration. A total of 120 valid responses were obtained, representing firms across Java, Sumatra, and Sulawesi regions, ensuring adequate representativeness. Criteria included minimum transaction volume, logistics system complexity, and strategic importance of e-logistics. Data were collected through structured online questionnaires distributed to logistics decision-makers. The questionnaire items were developed based on validated instruments from prior literature, such as the Logistics Service Quality scale (Demo et al., 2018) and SIPA (Service Integration and Performance Assessment) framework (Masudin et al., 2022).

The questionnaire comprised three sections: (1) firm and respondent profile; (2) implementation characteristics of e-logistics (e.g., systems used, degree of automation, integration levels); and (3) performance outcomes. Pilot testing was conducted with ten logistics managers to ensure item clarity and reliability.

Quantitative data were analyzed using multiple linear regression (OLS) to assess the influence of independent variables on logistics performance outcomes. Regression was chosen for its ability to estimate the magnitude and direction of causal relationships while controlling for external factors. Model validity was evaluated using standard diagnostics: multicollinearity tests (VIF), heteroskedasticity (Breusch–Pagan test), and model fit indicators (adjusted R-squared).

In addition to OLS, this study considers future application of Structural Equation Modeling (SEM) for validating latent constructs, and Data Envelopment Analysis (DEA) to assess relative efficiency among logistics units. SEM is widely used to examine causal paths among complex, multi-

dimensional constructs (Zhang et al., 2019), while DEA can highlight best-performing firms within comparable operating contexts (Rachbini, 2023). While these models were not implemented in this phase, they inform and strengthen the analytical framework of the study.

The measurement scales for each variable were adapted from established research. IT readiness was operationalized based on system availability, user access, digital literacy, and IT infrastructure reliability. System integration measured the extent of API-based interoperability between e-commerce platforms, warehouses, and 3PL systems, following SIPA metrics (Masudin et al., 2022). Management support was assessed through indicators such as leadership involvement, resource allocation, and digital strategy alignment.

Automation was captured through binary or ordinal responses indicating the presence of robotic warehousing, automated sorting, and real-time tracking systems. Dependent variables included both objective measures (e.g., delivery time, shipping cost) and perceptual measures (e.g., customer satisfaction), consistent with e-logistics studies that emphasize service-level outcomes (Kawa & Światowiec-Szczepańska, 2021).

To ensure construct validity, the questionnaire was based on well-established scales and theories. Face validity was verified through expert review, while content validity was addressed through alignment with the conceptual framework. Cronbach's alpha values were calculated for each variable cluster to test internal consistency, with acceptable thresholds (>0.7) achieved across constructs.

The study followed ethical research guidelines. Informed consent was obtained from all participants. Data confidentiality was assured, with identifying information removed during processing. The research was approved by the institutional ethics review board.

In conclusion, this chapter has outlined a rigorous methodological framework grounded in established logistics performance models and supported by validated measurement tools. The analytical design facilitates empirical testing of how e-logistics implementation influences logistics performance, with the findings intended to inform both academic understanding and managerial practice in Indonesia's digital commerce sector.

RESULT AND DISCUSSION

This chapter presents the empirical findings of the study in two parts: (1) descriptive analysis of the e-logistics adoption landscape among Indonesian e-commerce firms and (2) regression analysis examining the impact of selected implementation factors on key logistics performance indicators. These results are supported and interpreted with reference to contemporary literature.

Descriptive Analysis

Adoption of E-Logistics Subsystems

The current adoption landscape of e-logistics technologies in Indonesia reflects growing digital maturity within the logistics sector. Survey results and secondary data show that over 60% of medium to large e-commerce firms in Indonesia have adopted at least one e-logistics subsystem, including Order Management Systems (OMS), Warehouse Management Systems (WMS), and Transportation Management Systems (TMS). Of these, OMS and WMS are the most prevalent due to their direct impact on inventory management and order accuracy, while TMS adoption is steadily increasing as firms recognize the importance of transport coordination and visibility (Rahman & Sensuse, 2024).

Table 1: Adoption of E-Logistics Subsystems in Indonesia

Subsystem	Adoption Rate	Common Use Cases
OMS	>60%	Order processing and tracking
WMS	>55%	Inventory management and warehouse operations
TMS	~45%	Transportation visibility and route planning

Performance Differences in Integrated vs. Non-Integrated Systems

Comparative analysis reveals significant disparities in logistics performance between firms with integrated systems and those operating siloed logistics functions. Firms employing fully integrated e-logistics systems demonstrate improved delivery accuracy, faster order fulfillment, and higher cost efficiency. According to Deshpande & Pendem, (2023), integrated systems can reduce operational costs by up to 30% and deliver a 15–20% increase in delivery accuracy.

Table 2: Performance Differences by Integration Level

Performance Metric	Integrated Systems	Non-Integrated Systems
Delivery Accuracy	>95%	75–80%
Operational Cost Reduction	Up to 30%	Minimal
Return Rate Reduction	Up to 25%	Negligible

Delivery Time and Shipping Cost Patterns

The study also examined logistics performance across different geographic regions. In urban centers such as Jakarta and Surabaya, average delivery times ranged from one to three days, while in rural and remote regions, delays extended delivery windows to five to seven days. Cost per shipment varied accordingly, with urban deliveries costing between IDR 10,000–30,000, compared to over IDR 50,000 for rural regions (Trần, 2023).

Table 3: Delivery Time and Cost by Region

Region	Avg. Delivery Time	Avg. Cost per Shipment (IDR)
Urban (Java)	1–3 days	10,000–30,000
Rural Areas	5–7 days	>50,000

Regional Infrastructure Disparities

A closer examination of logistics infrastructure reveals stark regional disparities. Java Island hosts the majority of logistics assets, including fulfillment centers, transportation hubs, and IT networks. In contrast, non-Java regions Sumatra, Kalimantan, Sulawesi face infrastructural deficits that hinder efficient logistics operations.

Table 4: Regional Logistics Infrastructure Distribution

Region	Infrastructure Readiness	Logistics Capacity
Java	High	Centralized
Sumatra	Medium	Limited
Kalimantan	Low	Scattered
Sulawesi	Low	Underdeveloped

Regression Analysis

Effect of IT Readiness on Logistics Performance

Regression results confirm a statistically significant positive relationship between IT readiness and logistics performance ($\beta = 0.42$, $p < 0.05$). Firms with robust IT infrastructure, higher user access, and streamlined digital operations recorded shorter delivery times and lower shipping costs.

Impact of System Integration on Delivery Accuracy and Return Rates

System integration was found to significantly enhance delivery accuracy while reducing product return rates. Firms with integrated OMS, WMS, and TMS achieved delivery accuracy rates exceeding 95%.

Role of Management Support in KPI Improvement

Managerial support emerged as a statistically significant predictor of improved operational KPIs. Firms with active managerial involvement reported better customer satisfaction and delivery performance.

Automation and Logistics Cost Reduction

The regression analysis further confirmed that automation adoption correlates positively with logistics cost reduction. Firms employing robotic warehousing and predictive routing achieved higher throughput rates and reduced labor costs.

Table 5: Summary of Regression Outcomes

Variable	Performance Metric Affected	Effect Description
IT Readiness	Delivery Time, Cost	Strong positive effect
System Integration	Delivery Accuracy, Return Rate	Significant positive correlation
Management Support	Customer Satisfaction, Delivery Time	Moderately positive
Automation	Cost Reduction	Strong positive effect

In sum, the regression results validate the hypothesized relationships between e-logistics implementation factors and logistics performance outcomes. IT readiness, system integration, managerial support, and automation each contribute uniquely to enhancing delivery speed, reducing costs, and improving service quality in Indonesia's e-commerce logistics landscape.

The findings of this study affirm the critical role of e-logistics implementation in enhancing operational performance within Indonesia's e-commerce sector. The significant effects observed for IT readiness, system integration, management support, and automation on delivery time, logistics cost, and customer satisfaction align closely with existing success models of digital logistics adoption in developing countries. These results emphasize that e-logistics systems are not only enablers of operational efficiency but also foundational components of digital transformation strategies for emerging economies.

Success models in the context of developing countries highlight a combination of internal and external factors that influence e-logistics outcomes. The E-Logistics Success Model, as proposed by Rahman and Sensuse (2024), emphasizes IT readiness, user satisfaction, and top management support as core components of successful adoption. This model complements the findings of this study, particularly in confirming that organizational commitment to technology and adequate system integration result in quantifiable performance gains. Similarly, the Integrated Logistics Systems (ILS) approach described by Behera et al. (2024) reinforces the value of both vertical and horizontal integration across logistics functions something that was shown in this study to strongly affect delivery accuracy and return rates.

Comparative insights from other countries further contextualize Indonesia's progress. China and Singapore present instructive examples of e-logistics transformation. China's advancements under the "Made in China 2025" initiative illustrate how extensive infrastructure development, coupled with digital technologies, can significantly streamline supply chains and reduce costs (Ma et al., 2021). Meanwhile, Singapore's success is attributed to proactive public-private collaboration and regulatory agility that allows for rapid technological experimentation and scale-up (Yu et al., 2017). Compared to these cases, Indonesia's logistics modernization has been more fragmented. Although digital investment and platform integration have improved, persistent infrastructural bottlenecks, uneven regional development, and limited state investment continue to constrain full-scale transformation. The difference in state commitment and investment between Indonesia and its peers serves as a critical factor differentiating their performance levels.

One of the more understated yet vital components of successful e-logistics adoption is workforce training. As revealed by Nurlia et al. (2023), AI and digital literacy training initiatives significantly boost employee readiness and system interaction efficiency. This is echoed by Hamby & Smock (2024), who underscore that training programs cultivate organizational adaptability, which is essential for navigating technological shifts. The current study supports these assertions; firms that reported stronger management support also indicated higher system utilization rates suggesting that investment in people, not just systems, yields better outcomes. Additionally, case-based observations by Esan et al. (2024) demonstrate that comprehensive employee training results in better alignment with system processes and reduced operational friction. These findings emphasize that digital transformation is as much a human challenge as it is a technical one.

Equally important is the role of national logistics ecosystems in enabling collaboration and standardization. Indonesia's National Logistics Ecosystem (NLE) aims to unify stakeholders including e-commerce firms, logistics providers, customs authorities, and regulators under a shared digital platform. Salawu & Ghadiri (2022) note that such ecosystems encourage transparency and cooperative behavior by offering a central infrastructure for data exchange and operational monitoring. In practice, the NLE helps harmonize documentation, track shipments, and reduce regulatory redundancies. Kulik et al. (2021) and Talib et al. (2021) further argue that standardized logistics protocols contribute to smoother inter-organizational collaboration and faster delivery processing. In the Indonesian context, while the NLE's adoption is still maturing, its strategic framework aligns with the study's findings that integration and ecosystem collaboration are key performance levers.

Taken together, the evidence suggests that Indonesia's path to optimizing e-logistics lies in a multidimensional strategy. Technical systems such as OMS, WMS, and TMS must be supported by managerial commitment, workforce training, and public-private coordination. Lessons from regional peers suggest that top-down infrastructure development and bottom-up capacity building should be pursued simultaneously. This study not only confirms theoretical constructs on the determinants of e-logistics success but also offers empirical validation tailored to the Indonesian environment.

In conclusion, the successful implementation of e-logistics in developing countries, particularly Indonesia, hinges on the alignment of technology, people, and policy. Adaptive success models, informed by both global benchmarks and localized conditions, must guide stakeholders in shaping digital logistics strategies. The synthesis of managerial leadership, infrastructure investment, workforce empowerment, and national ecosystem support is imperative to fully realize the transformative potential of e-logistics in Indonesia's digital economy.

CONCLUSION

This study demonstrates that e-logistics implementation significantly enhances logistics performance within Indonesia's rapidly expanding e-commerce sector. Quantitative analysis confirms that IT readiness, system integration, management support, and automation collectively drive improvements in key performance indicators, including delivery time, cost efficiency, and customer satisfaction. Firms with strong digital infrastructure and integrated logistics platforms achieve higher operational accuracy and lower return rates, while managerial support and workforce training foster effective system utilization and service quality enhancement.

Despite these advances, Indonesia's logistics digitalization remains constrained by infrastructural disparities, limited digital literacy, and inconsistent policy execution. Compared to regional leaders such as China and Singapore, Indonesia's progress is hindered by lower public investment and fragmented coordination mechanisms. However, the National Logistics Ecosystem (NLE) provides a strategic pathway for improving interoperability, regulatory alignment, and stakeholder collaboration, representing a promising framework for national logistics transformation.

The findings contribute to a context-specific e-logistics success model for emerging economies, emphasizing the alignment of technology, human resources, and policy. Sustainable improvement in logistics performance will require continued investment in digital infrastructure, managerial commitment to innovation, and cohesive governance mechanisms. As Indonesia's digital economy continues to evolve, e-logistics will remain a vital foundation for enhancing competitiveness, efficiency, and resilience in the country's e-commerce landscape.

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