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Special Issue:
ICMS 2025

Website. :

<http://www.openjournal.unpam.ac.id/index.php/SNH>

Challenges And Opportunities Of Digital Supply Chain Management At Jne In Indonesia

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Abstract The acceleration of global economic digitalization has created a strategic imperative for the logistics sector to transform toward Digital Supply Chain Management (DSCM). This phenomenon underscores the urgency of this research in responding to competitive pressures from digital-native entities and addressing internal structural barriers faced by PT Tiki Jalur Nugraha Ekakurir (JNE). This study aims to analyze JNE's digital maturity gap through a comparative study (benchmarking) against the DHL (Dalsey, Hillblom, and Lynn) Group, grounded in the theoretical frameworks of Logistics 4.0 and Change Management. Employing a descriptive qualitative approach, this study evaluates five crucial technological dimensions—Cloud Computing, Internet of Things (IoT), Big Data Analytics, Customer Interface, and Cybersecurity—to map the disparities between actual operational conditions and global practice standards. The analysis reveals that JNE still operates in the Digital Adopter phase, characterized by functional and reactive approaches, standing in contrast to DHL, which has reached the status of Digital Innovator through strategic orchestration capabilities and proactive risk mitigation. Primary barriers are identified in the complexity of "technical debt" resulting from legacy system fragmentation, infrastructure disparities, and human capital competency gaps. The study concludes that to achieve operational resilience and sustainable competitive advantage, JNE must reorient its strategy from mere infrastructure modernization (digitization) toward comprehensive business process integration (digitalization). This transformation is realized through the development of a National Control Tower Cloud Platform to create a Single Source of Truth, the evolution of the interface into an interactive Super App, and the institutionalization of digital talent development to bridge competency gaps within an increasingly complex logistics ecosystem.

Keywords: *Digital Supply Chain Management (DSCM), Digital Transformation, Logistics 4.0, JNE, Strategic Benchmarking, DHL.*

INTRODUCTION

The current acceleration of globalization and economic digitalization has created a new imperative for the logistics sector to undergo a fundamental transformation toward Digital Supply Chain Management (DSCM) systems. This phenomenon serves as the ontological basis for conducting this research, considering JNE's position as one of the largest logistics entities in Indonesia currently facing significant structural challenges. The complexity of these challenges

manifests in limited inter-branch data integration, disparities in digital infrastructure, and the readiness of Human Capital that requires improvement in operating cutting-edge technologies such as the Internet of Things (IoT), Artificial Intelligence (AI), Big Data, and Cloud Computing. The urgency of this transformation is further exacerbated by aggressive external pressure from digital-native competitors such as J&T and SiCepat. This situation compels JNE to immediately undertake strategic adaptations to remain relevant and competitive amidst market dynamics that demand speed and precision. To dissect the complexity of these issues, this research is grounded in an in-depth literature review regarding DSCM, emphasizing the paradigm shift from traditional, rigid supply chains toward logistics ecosystems that prioritize agility and visibility. Within the Logistics 4.0 framework, the role of enabling technologies is crucial, where IoT functions for real-time asset tracking, Big Data and AI integration are utilized for accurate demand forecasting, and Cloud Computing is employed for inter-branch data centralization. The integration of these technological elements is viewed not merely as operational support tools, but as a strategic foundation for creating sustainable efficiency and high responsiveness to market fluctuations.

In the context of implementation strategy, this research positions DHL as a global benchmark, referring to the company's success in executing "Strategy 2025 – Delivering Excellence in a Digital World." DHL's success provides empirical evidence that planned digital transformation is capable of significantly enhancing distribution flow efficiency and customer satisfaction. However, it is acknowledged that technology adoption does not stand in isolation; therefore, a literature review on Change Management is incorporated to highlight that the success of technology adoption is highly contingent upon organizational culture readiness and human resource competence. Thus, this research becomes essential to map how JNE can adopt and contextualize such global success into the local business climate. Comprehensively, this research aims to analyze the challenges and opportunities of implementing DSCM at JNE by utilizing DHL as the primary benchmark. The analysis will focus on efforts to identify the main challenges faced by JNE, covering aspects of technological limitations, infrastructure inequality, and human resource readiness, while simultaneously analyzing strategic opportunities in leveraging digital technology to enhance supply chain efficiency and transparency. Furthermore, this research will compare DSCM implementation practices between JNE and DHL with a focus on system integration, warehouse automation, and predictive analytics, to evaluate the gap (gap analysis) between JNE's current condition and global standards. Based on this gap analysis, the research culminates in the formulation of a realistic and adaptive digital transformation strategy for JNE to achieve operational efficiency, enhanced data visibility, and sustainable competitive advantage.

RESEARCH METHODOLOGY

This research employs a descriptive qualitative approach to explore in depth the challenges and opportunities of implementing Digital Supply Chain Management (DSCM) at JNE, utilizing DHL as a global benchmark. This approach was selected due to its capability to explain the phenomenon of logistics digital transformation in a comprehensive, contextual, and fact-based manner. Data collection was conducted through literature studies and company documentation, sourced from scientific journals, annual reports, and industry publications related to the implementation of Logistics 4.0 technologies such as IoT, AI, Big Data, and Cloud Computing. The data analysis phase was performed by comparing JNE's actual operational conditions against the best practices implemented by DHL. This analysis focused on identifying gaps (gap analysis) in aspects of structural barriers, technological readiness, and Human Capital capacity. The results of this comparison were subsequently used to map strategic opportunities in order to formulate digital transformation recommendations capable of strengthening JNE's efficiency and competitiveness in both national and global markets.

RESULTS AND DISCUSSION

This discussion aims to map JNE's current technological state and identify gaps (gap analysis) against global standards, in order to formulate strategic recommendations for national logistics development.

Digital Infrastructure Transformation: Cloud Computing Integration

Comparative Analysis: Functional Paradigm versus Strategic Orchestration Analytically, JNE's transition toward a Cloud Computing ecosystem through its partnership with Microsoft Azure represents an initial step on the digital maturity curve. However, its current implementation tends to be limited to the digitization phase—namely, the modernization of physical infrastructure to virtual environments—rather than a comprehensive business process transformation or digitalization. Comparative analysis reveals a fundamental gap in the utilization of this technology; for JNE, cloud computing is primarily utilized passively as a data storage repository and an instrument for server maintenance cost efficiency. This implies the occurrence of latency in information flow between divisions, causing management decisions to often rely on reactive historical data. This stands in diametrical contrast to DHL, which has reached the stage of strategic orchestration through a Global Control Tower based on a Hybrid Multi-Cloud system. In DHL's operating model, cloud technology serves not merely as data storage but integrates predictive analytic functions that enable end-to-end supply chain visibility. This capability gap causes JNE to lag in operational agility, where DHL is capable of proactive intervention against global distribution disruptions within a unified dashboard, while JNE still grapples with basic data synchronization challenges that are not yet real-time.

Implementation Challenges: Fragmentation Complexity and Connectivity Gaps The acceleration of cloud technology adoption within JNE is hindered by structural complexity and "technical debt" rooted in its massive partnership business model. Technological heterogeneity serves as a primary barrier, where thousands of independent agents operate with sharp software disparities and non-standardized legacy systems, creating a "data silo" phenomenon that isolates information at the local level and prevents holistic system integration. This fragmentation causes information asymmetry between headquarters and the field, distorting the accuracy of goods tracking which is crucial for customer satisfaction. The escalation of this challenge is further exacerbated by external factors in the form of the digital divide in Indonesia; the archipelago's topographic constraints and uneven internet infrastructure cause data transmission latency from remote areas, which directly lowers the validity of delivery status. Beyond technical barriers, JNE also faces financial friction in the form of high switching costs for data migration and managerial complexity in standardizing data protocols from highly diverse partner entities, making system integration a multidimensional challenge requiring a phased approach.

Strategic Opportunities: Data Centralization and Scalability Efficiency Despite these structural barriers, cloud-based transformation offers a strategic foundation for JNE's future operational resilience and economic efficiency. The most significant opportunity lies in the development of a National Control Tower Cloud Platform, a strategic maneuver to create a Single Source of Truth that guarantees data integrity and consistency for all stakeholders, eliminating inefficiencies caused by duplication or inter-line miscommunication. Furthermore, cloud architecture offers elastic scalability features (auto-scaling) that are highly relevant to the volatile characteristics of the logistics industry. The system's ability to automatically adjust computing capacity during traffic load spikes—such as during Harbolnas (National Online Shopping Day) or Eid al-Fitr—allows JNE to perform resource allocation efficiency by converting expensive infrastructure Capital Expenditure (CAPEX) into variable Operational Expenditure (OPEX). This mechanism not only mitigates the risk of service downtime during peak loads but also provides a competitive advantage in the form of a cost structure that is leaner and more adaptive to the dynamics of the national logistics market.

Supply Chain Visibility: Internet of Things (IoT) Implementation

Comparative Analysis: Passive Tracking versus Multidimensional Monitoring In the dimension of asset visibility, comparative analysis highlights a fundamental divergence between the location tracking approach applied by JNE and global active monitoring standards. Currently,

JNE's tracking architecture is still dominated by passive checkpoint-based methods, where data updates occur only discretely when there is physical interaction between the courier and the package via barcode scanning or fleet GPS signals. This system provides basic transparency regarding location but fails to capture asset condition dynamics during transit. Conversely, DHL has made a technological leap toward an active monitoring paradigm through the implementation of Smart Sensor Technology. This technology transforms visibility from merely answering "where the package is" to "how the package condition is" through continuous monitoring of critical parameters such as temperature, humidity, and shock. These IoT capabilities provide superior quality assurance, particularly in cold chain management for the pharmaceutical and perishable goods sectors, creating service standards that far exceed JNE's current conventional tracking capabilities.

Implementation Challenges: Economic Viability and Competency Gaps The transition toward massive IoT adoption at JNE is confronted with significant financial and operational restrictions, particularly regarding cost structure. The calculation of initial investment (CAPEX) for the procurement of thousands of smart sensors is deemed to lack economic viability if applied generally to the regular shipping segment operating with thin margins. This complexity is compounded by reverse logistics issues related to post-delivery sensor management, which potentially become electronic waste if effective recycling mechanisms are not in place. On the internal side, challenges arise from the technical competency gap (skill gap) of human resources. The readiness of field technicians and couriers to operate, maintain, and troubleshoot advanced IoT devices remains limited. This capability deficit demands substantial resource allocation for extensive and sustainable reskilling programs so that the adopted technology becomes a productive asset rather than an operational burden.

Strategic Opportunities: Premium Service Differentiation and Warehouse Automation Responding to these cost constraints, the strategic opportunity for JNE lies not in burdensome comprehensive adoption, but in a differentiation strategy through service segmentation. JNE can capitalize on IoT sensor technology to develop high-value services targeting specific market segments, such as medical shipments or sensitive electronics, where corporate customers have a higher willingness to pay for real-time condition assurance. Additionally, massive efficiency opportunities exist in the integration of RFID (Radio Frequency Identification) technology at main distribution centers (Gateways). Unlike the limitations of barcodes requiring manual line-of-sight scanning, RFID enables the simultaneous and automatic data acquisition of hundreds of packages. This strategic implementation is projected to cut inbound/outbound process times by up to 40% and significantly mitigate the risk of human error in sorting, drastically increasing warehouse throughput.

Operational Intelligence: Utilization of AI and Big Data

Comparative Analysis: Descriptive Dominance versus Smart Prescription In the landscape of information asset utilization, analysis shows a sharp dichotomy between data management at JNE and DHL. As an entity handling millions of daily transactions, JNE inherently possesses massive Big Data assets; however, current utilization remains concentrated in the realm of descriptive analytics—namely, the use of historical data solely for reporting past performance (hindsight). The implication of this approach is that tactical operational decision-making, such as daily courier routing, still relies heavily on manual intuition and the empirical experience of field staff, rendering it vulnerable to inefficiency. This condition lags behind DHL, which has positioned Artificial Intelligence (AI) as an efficiency driver through the application of Predictive and Prescriptive Analytics. Through this technology, DHL possesses the capability to project potential supply chain disruptions, such as port congestion or weather anomalies, before the events occur. Furthermore, the adoption of Digital Twin technology allows DHL to simulate various operational scenarios in a virtual environment to validate optimal solutions before execution in the field—a methodological leap not yet adopted by JNE.

Implementation Challenges: Talent Gap and Data Integrity The fundamental transition toward AI-based logistics at JNE faces a dual structural barrier: human capital gaps and data quality. The national logistics industry currently experiences a deficit of competent Data Scientists capable of translating raw data into strategic insights, forcing JNE to compete strictly with technology companies in the talent war for these specialists. On the technical side, a crucial challenge lies in data integrity and validity, specifically regarding address formats in Indonesia which are highly heterogeneous and unstructured. This variability presents high complexity for Machine Learning algorithms in performing accurate geocoding and coordinate mapping. Therefore, data cleansing and standardization processes become absolute prerequisites that consume significant time and resources before artificial intelligence models can be implemented effectively.

Strategic Opportunities: Dynamic Route Optimization and Precision Forecasting Despite these challenges, data transformation offers strategic opportunities for JNE to evolve toward a smart logistics paradigm. The main priority lies in the development of an AI Routing System capable of dynamically calculating the most efficient delivery routes by integrating stochastic variables such as real-time traffic conditions, weather, and customer delivery time windows. The implementation of this system has direct implications for fuel cost reduction and increased productivity per courier. Additionally, the utilization of Big Data for precise demand forecasting enables proactive capacity management. With the ability to accurately predict package volume surges in specific regions, JNE can allocate fleet and warehouse labor before busy periods occur, effectively mitigating the risk of bottlenecks and ensuring smooth distribution flow.

Digital Service Ecosystem: Applications and Customer Experience

Comparative Analysis: Transactional Paradigm versus Customer Empowerment In reviewing digital interaction, comparative analysis reveals fundamental philosophical differences between the "MyJNE" application and DHL's digital ecosystem. Currently, MyJNE operates effectively within a functional corridor as a transactional instrument, facilitating basic needs such as rate checking, receipt tracking, and agent location. However, the communication pattern established remains one-way (uni-directional) and informational, positioning the customer as a passive recipient. Conversely, DHL has revolutionized its service interface through a philosophy of customer empowerment with the On-Demand Delivery (ODD) feature. This feature gives recipients full autonomy to actively intervene in the logistics process, such as changing delivery schedules or rerouting delivery locations independently and in real-time. This capability transforms the customer's role from a mere object of delivery into an active participant in the supply chain, a flexibility standard not yet fully accommodated by the JNE platform.

Implementation Challenges: Operational Rigidity and Ecosystem Fragmentation Adopting a level of service flexibility equivalent to DHL confronts JNE with ingrained operational rigidity. JNE's traditional logistics model is generally based on static route planning established at the start of the workday. Transitioning toward a dynamic model—where delivery routes can change ad-hoc in response to customer intervention—demands radical Business Process Reengineering of Standard Operating Procedures (SOP) and a transformation of the courier work culture in the field. Beyond internal barriers, JNE also faces external complexity in the form of SME ecosystem fragmentation in Indonesia. Seamlessly integrating systems with thousands of merchants using highly heterogeneous and non-standardized technology platforms becomes a massive technical challenge, differing from developed markets which tend to be more consolidated.

Strategic Opportunities: Super App Evolution and Last-Mile Cost Efficiency Although operational challenges loom, digitalization opens a strategic corridor for JNE to revitalize its customer interface into a "Logistics Super App." By integrating interactive two-way features—such as live chat with couriers or self-rescheduling options—JNE has the potential to mitigate one of the largest inefficiencies in last-mile logistics: failed delivery attempts. Reducing delivery failures will directly impact operational cost reduction. Furthermore, a seamless API (Application Programming

Interface) integration strategy with various e-commerce platforms and SME order management systems will strengthen JNE's position as a key enabler in the digital economy ecosystem. This step not only increases operational efficiency through data automation but also functions as an effective retention mechanism to increase customer stickiness amidst increasingly fierce competition.

System Resilience: Cybersecurity

Comparative Analysis: Perimeter Defense versus Proactive Cyber Resilience In the dimension of information security, comparative analysis shows a significant divergence in approach between JNE and DHL. Currently, JNE adopts a defense mechanism oriented toward network perimeters, with the implementation of industry standards such as firewalls, data encryption, and strict access controls to protect consumer data. While regulatorily adequate, this approach tends to be defensive-reactive. Conversely, DHL has surpassed these standards by shifting toward a proactive Cyber Resilience paradigm. DHL operates a Security Operations Center (SOC) active 24/7 to detect anomalies and potential threats early before escalation occurs. Furthermore, DHL is conducting strategic experimentation with Blockchain technology to create an immutable distributed ledger, guaranteeing data transparency and integrity that is immune to manipulation by internal or external parties—a security layer not yet adopted in JNE's system architecture.

Implementation Challenges: Cost Escalation and Human Factor Vulnerability Efforts to enhance the cybersecurity posture at JNE are faced with resource allocation dilemmas. JNE faces significant security cost escalation in line with the increasing complexity of cyber threats, particularly ransomware variants targeting the logistics industry. However, risk analysis indicates that the greatest vulnerability in the JNE ecosystem is not merely in technological gaps, but in the human factor. With thousands of operational employees and agent partners spread widely, the disparity in digital security literacy (cyber hygiene) becomes a critical issue. Low awareness regarding security protocols makes field personnel the "weakest link," highly vulnerable to social engineering attacks such as phishing. This confirms that technology investment without accompanying security culture transformation will result in fragile protection.

Strategic Opportunities: Security as Competitive Differentiation Amidst the prevalence of national data leak incidents eroding public trust, JNE possesses a strategic opportunity to reposition cybersecurity from a mere cost center into a source of competitive advantage. By developing a "JNE Cyber Secure Platform," JNE can build a brand image as the most secure and trustworthy logistics provider, a highly valuable differentiation in the eyes of consumers. More specifically, limited exploration of Blockchain technology opens market penetration opportunities in the high-value goods segment, such as legal documents, jewelry, or luxury items. This premium service offers a transparent and unforgeable digital audit trail guarantee, a value proposition that is highly attractive to the corporate (B2B) segment demanding strict data integrity and auditability standards in their supply chains.

CONCLUSION

A comprehensive synthesis of the research findings indicates that while PT Tiki Jalur Nugraha Ekakurir (JNE) has initiated the transformation toward Digital Supply Chain Management (DSCM), its current implementation status remains concentrated within the functional adoption phase (Digital Adopter). This demonstrates a significant technological maturity disparity when benchmarked against the DHL (Dalsey, Hillblom, and Lynn) Group, which has attained the status of Digital Innovator. Comparative analysis confirms the existence of a fundamental operational gap; wherein JNE still grapples with sectoral data fragmentation resulting from siloed legacy systems, thereby triggering a management approach that tends to be reactive. Conversely, DHL has successfully achieved global supply chain orchestration based on a Cyber-Physical Systems ecosystem, enabling real-time visibility and the utilization of predictive analytics to mitigate risks

before they occur. To convert these structural challenges into a competitive and sustainable value proposition, this research formulates four pillars of strategic intervention. First, the development of a "National Control Tower Cloud Platform" is a strategic imperative to dismantle inter-branch data silos and consolidate national data architecture into a Single Source of Truth. Second, accelerating the transition from manual intuition toward data-driven decision making must be prioritized through the integration of an "IoT Command Dashboard" and AI Routing algorithms. This step is crucial for transforming raw data into strategic assets to optimize cost efficiency and delivery time precision. Recognizing that technology is a dependent variable on user capability, the institutionalization of a "JNE Digital Academy" is required to align human capital competency with digital ecosystem demands, while simultaneously building an adaptive culture of innovation. Finally, the internalization of "Green & Smart Logistics" principles will ensure that operational modernization proceeds linearly with global sustainability standards and energy efficiency. The implementation of this holistic strategy is projected to be capable of repositioning JNE from a conventional logistics entity into an adaptive, efficient, and transparent digital logistics market leader within Indonesia's increasingly complex digital economy ecosystem.

ACKNOWLEDGEMENTS

The authors fully express sincere gratitude to the University of Pamulang - UNPAM Tangerang Selatan, Banten, which has given us the opportunity to develop this paper. The authors also are very appreciative to Dr. Taswanda Taryo, M.Sc. who has reviewed and given guidance and hence this paper can finally submitted to and present at the International Conference on Management and Science 2025. The authors finally expected this PKM research will be very worthwhile for the related-matter community in Indonesia.

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