

Cloud-Based Transportation Management System (TMS) Implementation for Distribution Efficiency in National E-Commerce

Kasrim¹, Berilian Ayu Kusuma², Isah Fitriani³

¹Institut Transportasi dan Logistik Trisakti)

² Universitas Islam Indonesia

³ Universitas Indonesia

Email: kasrimandreasss@yahoo.co.id

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ABSTRAK

Penelitian ini bertujuan untuk menganalisis penerapan Transportation Management System (TMS) berbasis cloud dalam meningkatkan efisiensi distribusi pada sektor e-commerce nasional melalui pendekatan Systematic Literature Review (SLR). Penerapan TMS berbasis cloud menjadi bagian integral dari transformasi digital logistik Indonesia yang berorientasi pada efisiensi, transparansi, dan keberlanjutan. Hasil kajian menunjukkan bahwa TMS mampu menurunkan biaya transportasi hingga 15–25%, mempercepat waktu pengiriman, dan mengoptimalkan perencanaan rute berbasis data waktu nyata. Dari sisi ekonomi, sistem ini memperkuat daya saing nasional melalui peningkatan produktivitas dan kolaborasi lintas sektor antara penyedia logistik, pemerintah, dan pelaku usaha e-commerce. Sementara itu, dari perspektif keberlanjutan, TMS berkontribusi terhadap penurunan emisi karbon serta efisiensi energi transportasi, sejalan dengan kebijakan green logistics dan target net-zero emission nasional. Namun, efektivitas implementasi TMS masih bergantung pada kesiapan infrastruktur digital, kompetensi sumber daya manusia, serta kebijakan interoperabilitas data lintas sektor. Penelitian ini menegaskan bahwa keberhasilan adopsi TMS berbasis cloud memerlukan tata kelola kolaboratif dan dukungan kebijakan yang mendorong integrasi teknologi secara inklusif. Dengan demikian, TMS menjadi fondasi strategis bagi penguatan efisiensi distribusi, daya saing industri e-commerce, dan keberlanjutan ekonomi digital Indonesia.

Kata kunci: cloud computing, efisiensi distribusi, e-commerce, transportasi digital

ABSTRACT

This study aims to analyze the implementation of a cloud-based Transportation Management System (TMS) in enhancing distribution efficiency within Indonesia's national e-commerce sector using a Systematic Literature Review (SLR) approach. The adoption of cloud-based TMS has become an integral component of Indonesia's digital logistics transformation, emphasizing efficiency, transparency, and sustainability. The findings indicate that TMS can reduce transportation costs by 15–25%, accelerate delivery times, and optimize route planning through real-time data integration. Economically, the system strengthens national competitiveness by improving productivity and fostering cross-sector collaboration among logistics providers, government bodies, and e-commerce enterprises. From a sustainability perspective, TMS contributes to carbon emission reduction and energy efficiency in transportation, aligning with the nation's green logistics initiatives and net-zero emission targets. Nevertheless, its effectiveness remains dependent on digital infrastructure readiness, human resource competence, and policy support for cross-sector data interoperability. This research highlights that the successful adoption of cloud-based TMS requires collaborative governance and inclusive technological integration policies. Therefore, TMS serves as a strategic foundation for enhancing distribution efficiency, e-commerce competitiveness, and sustainable digital economic growth in Indonesia.



Keywords: *cloud computing, digital transportation, distribution efficiency, e-commerce*

INTRODUCTION

The rapid development of the e-commerce sector in Indonesia in the past decade has created a structural transformation in the national distribution system. This phenomenon not only reflects a change in consumer behavior towards the digitization of transactions, but also creates a new need for high logistics efficiency. Based on a report by Google, Temasek, and Bain & Company (2023), the value of Indonesia's digital economy reaches more than USD 82 billion, making it the largest e-commerce market in Southeast Asia. This surge in transaction activity is pushing companies to optimize the management of transportation and distribution of goods, especially since e-commerce supply chains are dynamic, multi-level, and highly dependent on delivery speeds. In this context, the implementation of cloud-based Transportation Management Systems (TMS) is emerging as a strategic solution to integrate complex distribution operations with cost efficiency and delivery timeliness.

Transportation Management System (TMS) is a digital platform designed to effectively plan, execute, and optimize the movement of goods throughout the supply chain. According to Kumar and Rajesh (2022), modern cloud-based TMS allows companies to manage transportation in real-time with end-to-end visibility into routes, vehicles, and operational costs. This technology also plays a role in strengthening integration between logistics providers, e-commerce platforms, and customers through a transparent centralized data system. In Indonesia, the adoption of cloud-based TMS has been increasing since 2020, especially in large logistics companies such as JNE, SiCepat and Ninja Xpress that have adopted SaaS-based systems (Software as a Service) to manage soaring shipping volumes during the COVID-19 pandemic (PwC Indonesia, 2022). This digital transformation shows that logistics system integration is no longer an option, but a necessity to maintain competitiveness in an increasingly competitive digital economy ecosystem.

Distribution efficiency is a key factor that determines the sustainability of the national e-commerce business. According to McKinsey & Company (2024), Indonesia's logistics costs still reach 23–25% of the total Gross Domestic Product (GDP), much higher than the average of other ASEAN countries which ranges from 13–15%. This condition is largely due to supply chain fragmentation, limited transportation infrastructure, and lack of digital integration between distribution actors and logistics service providers. Cloud-based TMS is able to answer these challenges by providing an adaptive and data-driven approach. Through predictive analytics, route algorithms, and integration with Warehouse Management System (WMS), TMS can optimize delivery routes, reduce fuel consumption, and accelerate delivery times. This is in line with the view of Kasrim (2025) who emphasizes that digitalization of logistics based on artificial intelligence and cloud computing can accelerate the transition to a sustainable and efficient supply chain in Indonesia.

In addition to the cost efficiency aspect, the adoption of TMS also has direct implications for operational transparency and accountability. Cloud-based systems provide digital footprints that enable end-to-end tracking of transportation activities, from pickup to receipt by end consumers. Lee and Kim (2023) explain that this system facilitates coordination between logistics actors by providing real-time data that can be accessed by all related parties, including transportation providers, distribution centers, and customers. Thus, TMS not only serves as a technology tool, but also as a governance instrument that drives service reliability and customer trust. In the context of national e-

commerce, where shipping reputation is an important factor in customer experience, the integration of these systems has the potential to strengthen loyalty and increase the company's brand value.

However, the implementation of cloud-based TMS in Indonesia still faces a number of structural and operational obstacles. The main challenge lies in the readiness of the digital infrastructure and the quality of the human resources that manage the system. The World Bank (2023) noted that Indonesia's digital readiness index is still below 0.6 on a scale of 0–1, indicating the need to improve data connectivity and digital literacy in the logistics sector. In addition, many small and medium-sized companies in the e-commerce field do not yet have the financial or technical capacity to fully adopt TMS, so they still rely on manual methods to manage shipments. This creates a gap between large companies and small-scale logistics players in terms of efficiency and competitiveness. Deloitte (2022) emphasizes that to expand the impact of logistics digitalization, public policy support is needed that encourages data standardization, technology investment incentives, and collaboration between the public and private sectors.

The implementation of cloud-based TMS is also closely related to national policies in strengthening digital transformation. The Making Indonesia 4.0 and National Logistics Ecosystem (NLE) programs launched by the government focus on the integration of logistics information systems and data harmonization across sectors. The Ministry of Industry of the Republic of Indonesia (2023) emphasized that digital transformation of logistics is a key component to reduce distribution costs and improve the efficiency of the national supply chain. With strong regulatory support, the implementation of cloud-based TMS is expected to accelerate the achievement of these goals. In addition to supporting economic efficiency, this system also supports environmental sustainability by reducing carbon emissions through route optimization and the use of transportation data for energy consumption analysis.

In a global context, the use of cloud-based TMS has become a major trend in modern supply chain management. Countries such as Japan, Singapore, and South Korea have proven that the integration of digital transportation technology contributes directly to improving operational efficiency and export competitiveness. Nguyen et al. (2024) highlight that East Asian countries have managed to save up to 20% of logistics costs by adopting cloud-based management systems, thanks to higher visibility and AI-based route optimization. The lessons learned from these experiences are relevant to the Indonesian context, where the great growth potential of e-commerce can be maximized through a comprehensive digital logistics transformation.

Thus, it can be concluded that the implementation of cloud-based TMS is a strategic step for national e-commerce in facing the challenges of efficiency, transparency, and sustainability. However, its effectiveness still depends heavily on the readiness of digital infrastructure, cross-sector data integration, and adequate human resource capacity. This is where collaboration between the government, logistics providers, and technology industry players is important to ensure that the implementation of this system runs optimally within the framework of national digital economy development.

Although the development of cloud-based TMS in the national e-commerce sector is showing a positive direction, academic studies on its effectiveness and implementation model in Indonesia are still relatively limited. Most previous research has highlighted aspects of technology and operational efficiency without paying attention to the dynamics of integration between actors in the broader digital ecosystem. For example, Rohman and Widodo (2022) examined the application of cloud-based logistics systems

in national transportation companies, but the focus was only on route efficiency and fuel cost savings, without discussing the integration between e-commerce platforms, logistics providers, and end consumers. In fact, in the context of digital supply chains, distribution efficiency is not only determined by internal factors of the company, but also by collaboration between actors in an integrated information system. This gap indicates the need for a more comprehensive approach to understanding how the implementation of cloud-based TMS can drive cross-sector synergies in improving national logistics efficiency.

From a public policy perspective, research that explicitly links the implementation of TMS to the National Logistics Ecosystem (NLE) initiative is also lacking. Although NLE was launched by the Indonesian government in 2021 to improve the efficiency of the national supply chain, integration with cloud-based technology still faces the challenge of inter-agency coordination (Ministry of Finance of the Republic of Indonesia, 2023). Nasution et al. (2023) suggest that many logistics players still operate in siloed systems, where shipping and transportation data are not accessible across platforms, leading to process duplication and time inefficiencies. In fact, one of the main advantages of cloud-based TMS is its ability to connect various operational systems into one integrated digital network. Therefore, this study seeks to bridge the gap between technological innovation and public policy, by examining how the implementation of cloud-based TMS can support distribution efficiency in the context of digital logistics national policies.

In addition, studies on the implementation of TMS in Indonesia also rarely raise the sustainability aspect and social impact of logistics digitalization. Most of the literature focuses on efficiency indicators such as delivery times and cost savings, while the sustainability dimension—especially in the context of carbon emission reduction and energy optimization—is still underpaid. Yap et al. (2023) emphasized that the implementation of digital logistics systems in the ASEAN region has the potential to reduce transportation emissions by up to 18% when combined with AI-based data analytics and route management. However, similar research in Indonesia is still limited and has not resulted in an implementation model that can be adopted nationally. With increasing global pressure on supply chain decarbonization, it is important for national e-commerce to leverage cloud-based technologies as an instrument of economic and environmental sustainability.

Another limitation that appears in the Indonesian literature is the low attention to organizational readiness and human resource factors in adopting TMS. A study by Saputra et al. (2021) shows that 45% of domestic logistics companies do not yet have an information technology team capable of managing cloud-based systems independently, so they still rely on external vendors. This dependency not only increases costs, but also decreases operational flexibility. On the other hand, Kasrim (2025) emphasized that the effective adoption of logistics technology requires institutional readiness that includes human resource training, infrastructure readiness, and alignment between organizational policies and national digital strategies. Thus, this study also highlights the importance of a socio-technical approach that combines digital innovation with human and institutional capacity building as a determining factor for the success of TMS in Indonesia.

From an international perspective, research related to cloud-based TMS in developing countries also still focuses on the scale of large enterprises, while the contribution of the SME sector to the e-commerce ecosystem has not been widely discussed. Chong et al. (2022) observed that large companies tend to adopt TMS systems faster because they have access to capital and adequate digital infrastructure, while SMEs face financial constraints and technical limitations. In fact, in Indonesia, more than 90%

of e-commerce players are SMEs that have an important role in the national supply chain (World Bank, 2023). This shows that there is a digital divide that can widen the competitive distance between large and small players in the national logistics ecosystem. Therefore, this study seeks to examine how the implementation of cloud-based TMS can be designed in an inclusive manner to support equitable distribution of efficiency across all layers of e-commerce players.

From an academic perspective, the novelty of this research lies in its approach that combines systematic analysis of the literature with policy and sustainability perspectives. Unlike previous studies that were technical-operational, this study views TMS as a strategic instrument that functions in three dimensions: economic efficiency, environmental sustainability, and digital justice. Utilizing the Systematic Literature Review (SLR) approach, this study not only presents a conceptual mapping of the implementation of cloud-based TMS, but also identifies the direction of development and thematic gaps in the literature 2015–2025. This approach is in line with the recommendations of Snyder (2019) who emphasized the importance of SLR in developing evidence-based knowledge in the field of management and technology.

Thus, the main objective of this study is to analyze the application of cloud-based Transportation Management System (TMS) in improving distribution efficiency in national e-commerce through a systematic literature review (SLR). Specifically, this study aims to: (1) identify the driving and inhibiting factors of cloud-based TMS adoption in Indonesia's e-commerce sector; (2) examine the relationship between logistics digitalization, public policy, and distribution efficiency; and (3) examine the contribution of TMS to economic and social sustainability in the national digital logistics ecosystem. With this approach, it is hoped that the research results can make a conceptual contribution to the development of digital logistics policies and technology-based transportation management practices in Indonesia, while strengthening the foundation of digital transformation towards an efficient, inclusive, and sustainable national distribution system.

METHODS

This study uses the Systematic Literature Review (SLR) approach to identify, evaluate, and synthesize various studies related to the implementation of cloud-based Transportation Management Systems (TMS) in the national e-commerce context. The SLR approach was chosen because it has the advantage of generating a comprehensive understanding of the evolving phenomenon, while ensuring that research findings are based on credible scientific evidence. As stated by Snyder (2019), the SLR method provides a systematic structure to integrate findings from various previous studies to build a strong conceptual understanding. In this study, the SLR process was carried out following the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) framework as suggested by Page et al. (2021), which involves four main stages: identification, selection, feasibility assessment, and data synthesis. The inclusion criteria include academic articles published between 2015–2025, with a focus on the topics of digital logistics, cloud-based TMS, distribution efficiency, and e-commerce transformation in Indonesia and the Southeast Asia region.

The literature search process was carried out through major scientific databases such as Scopus, ScienceDirect, Wiley Online Library, and Emerald Insight using a combination of keywords such as "cloud-based TMS", "digital logistics efficiency", and "Indonesia e-commerce supply chain". All articles that met the criteria were then analyzed using the qualitative thematic synthesis approach to identify dominant themes

and conceptual patterns in the literature. The analysis was carried out by grouping data based on aspects of operational efficiency, technological readiness, and public policies that support the digital transformation of logistics. The validity of the research is maintained through the peer debriefing and inter-rater reliability check process on the results of the thematic categorization. In addition, as explained by Kasrim (2025) in AI-Based Logistics Management, a systematic approach to the literature allows this research to produce conceptual mapping relevant to the needs of national logistics and modern industrial practices. Additional guidance from Tranfield et al. (2020) is used to ensure methodological integrity, particularly in the multidisciplinary process of synthesis and presentation of findings. With the combination of these frameworks, this research is expected to make a significant academic contribution in understanding the dynamics of the implementation of cloud-based TMS and its impact on distribution efficiency in the national e-commerce sector.

RESULT

Digital Transformation of Logistics and the Role of Cloud-Based TMS in National E-Commerce Operational Efficiency

Digital transformation has been a major catalyst in changing the logistics and distribution structure of e-commerce in Indonesia. Changing consumption patterns, technological advancements, and increasing digital connectivity have forced companies to rethink the way they manage transportation and the flow of goods. Based on a report by Google, Temasek, and Bain & Company (2023), e-commerce transactions in Indonesia grew by more than 18% per year during the 2020–2023 period, with a value of USD 82 billion in 2023. This exponential growth drives the need for logistics efficiency, especially in the transportation aspect which is the highest cost point in the digital supply chain. In this context, the implementation of *cloud-based* Transportation Management System (TMS) acts as the heart of logistics digital transformation, enabling real-time data integration between e-commerce players, logistics service providers, and consumers.

Cloud-based TMS is designed to optimize the process of planning, executing, and monitoring transportation activities by leveraging the power of cloud computing and data analytics. This technology allows companies to gain full visibility into shipment status, route performance, and logistics costs directly. According to Kumar and Rajesh (2022), modern TMS systems can improve transportation efficiency by up to 25% by utilizing *machine learning-based* algorithms to choose the optimal route and reduce vehicle waiting times. In the e-commerce sector, where shipping speed is a key competitive advantage, the role of TMS is crucial in ensuring consistency of delivery times without sacrificing costs. In Indonesia, several large companies such as J&T Express and SiCepat have integrated cloud-based transportation management systems to manage thousands of daily deliveries. This integration allows companies to perform *dynamic routing*, monitor vehicles in real-time, and make automatic adjustments to delivery schedules based on traffic conditions or customer demand.

The operational efficiencies generated by cloud-based TMS not only impact transportation costs, but also on sustainability and resource optimization aspects. Based on the results of a study by McKinsey & Company (2024), the implementation of a cloud-based digital logistics system can reduce fuel consumption by up to 12% and reduce transportation carbon emissions by 8–10%. These savings occur because TMS can eliminate *empty miles* and optimize vehicle load through demand data integration. In the Indonesian context, this efficiency is very important given the complex geographical conditions with national logistics costs still reaching 23% of GDP. Thus, the implementation of TMS not only supports economic efficiency, but is also in line with the

government's efforts to realize sustainable logistics as part of the *National Logistics Ecosystem (NLE) agenda*.

In addition, the adoption of cloud-based TMS also improves the company's strategic analysis capabilities through the use of *big data analytics* and *predictive modeling*. Nguyen et al. (2024) emphasized that *the AI-driven cloud platform's TMS system* is capable of transforming transportation data into useful insights for long-term decision-making. For example, companies can predict demand spikes in a given period, analyze the performance of transportation vendors, and design shipping strategies that are adaptive to market conditions. In Indonesia, this ability is an important differentiating factor because most e-commerce companies are still in the early stages of logistics digitalization. The integration of data analytics into the transportation system provides strategic advantages in the form of reduced *lead times*, increased delivery accuracy, and more efficient fleet management.

The digital transformation of logistics facilitated by cloud-based TMS also has implications for increased transparency and accountability between actors in the supply chain. According to Lee and Kim (2023), cloud-based systems allow for decentralized data access so that each party in the supply chain can monitor distribution activities without having to rely on manual reports. This strengthens the operational oversight mechanism and reduces the risk of errors in reporting. In the context of national e-commerce, where the speed and reliability of information are the main added value, the integration of this kind of system builds trust between sellers, logistics service providers, and customers. In other words, TMS not only serves as a tool for technical efficiency, but also as a digital governance instrument that increases transparency across sectors.

Despite its significant benefits, the process of digital transformation of logistics through the implementation of cloud-based TMS also faces a number of systemic barriers. The World Bank (2023) identified three main challenges in logistics digitalization in Indonesia, the first is the gap in data infrastructure between big cities and regions, the second is low digital literacy among small business actors, and the last is the limitation of interoperability between logistics platforms. These challenges have led to most logistics SMEs not being able to adopt TMS effectively, despite the increasing demand for e-commerce. On the other hand, Kasrim (2025) emphasized that the successful implementation of logistics technology such as TMS is highly dependent on the readiness of the digital ecosystem, which includes data connectivity, human resource capabilities, and supportive incentive policies. Without proper policy interventions, digitalization has the potential to create a gap between large companies and small business actors in the national digital logistics ecosystem.

In a regional context, the experience of ASEAN countries such as Singapore and Malaysia shows that the adoption of cloud-based TMS systems can increase cross-border distribution efficiency by up to 20% and reduce logistics administration costs by 15% (ASEAN Secretariat, 2024). This success is achieved through regulatory support and integration between public and private logistics systems. This learning is relevant for Indonesia, which is trying to strengthen the role of digital logistics in supporting domestic and international e-commerce expansion. With the growing digital infrastructure and the support of industry 4.0 transformation policies, the implementation of cloud-based TMS has great potential to accelerate distribution efficiency while increasing national competitiveness in the digital economy era.

Overall, the results of this literature review show that the digital transformation of logistics through the implementation of cloud-based TMS has become a key strategy in achieving national e-commerce operational efficiency. These systems not only offer cost and time efficiency, but also improve transparency, sustainability, and enterprise

analytics capabilities. However, in order for the benefits to be optimized in an inclusive manner, policy support is needed that focuses on equitable access to technology, increasing digital literacy, and integrating data across sectors. Thus, the implementation of cloud-based TMS can serve as a key driver in building an efficient, adaptive, and sustainable national distribution ecosystem.

Cloud-Based TMS Integration in National E-Commerce Supply Chains: Collaboration Between Actors and Implementation Challenges

The implementation of a cloud-based Transportation Management System (TMS) in the national e-commerce supply chain is not only a technological innovation, but also a structural transformation that demands cross-sector collaboration. TMS integration requires integration between various actors, namely the government, logistics providers, e-commerce platforms, technology providers, and consumers operating in an interdependent digital ecosystem. In traditional logistics systems, information and coordination between actors are often fragmented, leading to delays, process redundancy, and wasted costs. However, with the implementation of cloud-based TMS, operational information can now be synchronized in real-time through a single, integrated platform that connects all stakeholders. According to Bakker and Boonstra (2021), data-driven collaboration is key to creating collective efficiencies as it allows for transparency and faster decision-making across the supply chain.

In Indonesia, collaboration between actors in the digital logistics ecosystem is starting to grow along with the emergence of national platforms such as *the National Logistics Ecosystem* (NLE), which is designed to integrate public and private logistics systems. This program is the foundation for the adoption of cloud-based TMS because it allows for the harmonization of data between businesses, governments, and customs agencies. The Ministry of Finance of the Republic of Indonesia (2023) emphasizes that NLE functions as a "digital bridge" between e-commerce systems, port logistics, and land transportation services. However, the implementation of this integration still faces a number of obstacles. One of them is the limited data interoperability between private TMS systems and government systems, which leads to reporting inconsistencies as well as difficulties in tracking cross-platform shipments. Nasution et al. (2023) found that more than 60% of logistics companies in Indonesia still use stand-alone transportation management systems without full integration capabilities, thus missing out on opportunities to improve supply chain efficiency through digital collaboration.

Effective collaboration in the implementation of a cloud-based TMS requires clear trust and data governance. In the context of national e-commerce, where many logistics players compete fiercely, sharing operational data is considered sensitive because it can affect business strategies. Tan et al. (2022) emphasized that digital *trust* is a crucial factor in building system integration across organizations. Therefore, policies that ensure data security, privacy protection, and ethical use of information are needed to encourage cross-sector participation. In some ASEAN countries, such as Singapore and Malaysia, the successful implementation of cloud-based logistics systems is supported by a *data governance framework* policy that ensures system interoperability without compromising security. Indonesia has begun to adopt a similar policy through Law Number 27 of 2022 concerning Personal Data Protection (PDP), which is expected to strengthen public trust in cloud-based digital logistics systems.

In addition to policy factors, infrastructure and human resource readiness are also important prerequisites in supporting TMS integration. The World Bank (2023) shows that only 54% of logistics companies in Indonesia have adequate digital connectivity to support cloud-based transportation management systems. This low readiness is mainly

due to the disparity in network infrastructure between regions and the high initial investment costs. Meanwhile, Saputra et al. (2021) highlighted the limited competence of human resources in the field of logistics technology as a factor that slows down the adoption of the system. Small and medium-sized logistics actors (LSPs/SMEs) often have difficulty understanding the mechanisms of TMS and lack the technical capabilities to operate digital platforms efficiently. In this context, Kasrim (2025) emphasized the importance of *sustainable capacity building* so that national logistics actors can adapt quickly to technological changes. According to him, the adoption of smart technologies such as TMS requires not only digital devices, but also the transformation of organizational culture based on data and innovation.

In addition to technical and institutional readiness, the success of TMS integration also depends on the ability of actors to build strategic synergies to create *co-created value*. A study by Chong et al. (2022) showed that companies that implement digital collaboration with logistics partners through cloud-based systems were able to increase cost efficiency by up to 17% and reduce administrative errors by 22%. This effect occurs due to better coordination between transportation planning, warehouse capacity management, and distribution scheduling. In Indonesia, the potential for added value is starting to be seen in collaborations between national logistics providers such as JNE and technology platforms such as Klik Logistics, which develops API-based data integration systems to facilitate cross-vendor TMS. This collaboration model shows that digital integration not only increases efficiency, but also strengthens the competitiveness of the national logistics industry in the face of the dominance of global players.

However, cloud-based TMS integration also brings challenges in terms of technology access equity and data monopolization risk. Large companies with strong digital resources tend to dominate the logistics ecosystem, while small players face obstacles to participate in *subscription-based systems*. The OECD (2023) warns that without inclusive policy interventions, logistics digitalization can create a "two-tier economy" where large actors enjoy high efficiency while small actors lag behind. In this context, government support is needed to encourage collaborative business models that allow SMEs to access TMS technology through subsidized financing schemes or strategic partnerships. This kind of approach not only enhances digital inclusivity, but also ensures that the benefits of distribution efficiency can be felt equally across the national supply chain.

Overall, the integration of cloud-based TMS in the national e-commerce supply chain presents a great opportunity to improve distribution efficiency, but it also requires structural reforms involving technology, regulation, and human resources. Collaboration between actors is a key element to ensure that the adoption of this system is effective and inclusive. In the long term, the implementation of TMS will not only strengthen the competitiveness of Indonesia's logistics industry, but also support the country's strategic goals in building an efficient, sustainable, and adaptive digital economy ecosystem to global changes.

Economic and Sustainability Implications of Cloud-Based TMS Implementation on National E-Commerce Competitiveness

The implementation of a *cloud-based* Transportation Management System (TMS) has significant economic implications for the efficiency and competitiveness of the national e-commerce sector. In the era of the digital economy, the speed and reliability of distribution are key elements that determine a company's competitive position in both domestic and global markets. The implementation of TMS not only plays a role as a technological innovation, but also as a strategic instrument to reduce logistics costs,

improve supply chain performance, and strengthen competitiveness based on operational efficiency. According to McKinsey & Company (2024), digitizing logistics through cloud-based systems can reduce distribution costs by up to 15% and accelerate freight delivery times by 20–25%. This efficiency contributes directly to the increase in profit margins of e-commerce companies and strengthens their capacity in the face of high market demand fluctuations.

Macroeconomically, the implementation of cloud-based TMS also contributes to increasing Indonesia's national productivity and global competitiveness. The logistics sector is one of the largest contributors to economic costs in Indonesia, with a proportion of 23% of GDP (Ministry of Industry of the Republic of Indonesia, 2023). The use of data-driven transportation management technology and automation has the potential to significantly lower these costs, especially in the *last mile delivery component* that absorbs the largest costs. The World Bank (2023) noted that strengthening logistics digital infrastructure can reduce inter-regional shipping costs by up to 18% in developing countries, including Indonesia. In this context, the implementation of cloud-based TMS can be understood as a strategic investment in the development of a digital economy that not only benefits the private sector, but also has a positive impact on the efficiency of the national trading system.

Another economic impact of TMS adoption lies in value *creation* through collaborative innovation between logistics providers, e-commerce platforms, and digital financial institutions. New data-driven business models enable companies to design dynamic pricing strategies, forecast demand more accurately, and make optimal use of transportation capacity. Chong et al. (2022) highlighted that companies that integrate cloud-based TMS systems in their business strategies experienced a 19% increase in productivity and a 14% decrease in operational costs. This impact also strengthens the position of SMEs operating in the e-commerce sector, as cloud-based systems provide access to modern logistics infrastructure at a more affordable cost than conventional systems. Thus, TMS not only increases the efficiency of large companies, but also expands the inclusivity of the digital economy for small and medium enterprises in Indonesia.

In addition to the economic implications, the implementation of cloud-based TMS has an important sustainability dimension, especially in the context of reducing carbon emissions and efficient energy use. Yap et al. (2023) show that the integration of digital technology in transportation management is able to reduce logistics carbon emissions by up to 10–15% through route optimization, fuel consumption monitoring, and the use of environmentally friendly fleets. In Indonesia, this is becoming increasingly relevant because the transportation sector accounts for more than 28% of total national carbon emissions (ASEAN Centre for Energy, 2023). By using cloud-based TMS, e-commerce companies can more accurately measure and manage their operational carbon footprint, in line with the Indonesian government's net-zero emission target by 2060. This technology also plays a role in encouraging companies to adopt the principles of *green logistics*, which combines economic efficiency with environmental responsibility.

The implementation of cloud-based systems also expands opportunities for the creation of a logistics ecosystem that is adaptive and resilient to global disruption. The COVID-19 pandemic has demonstrated the vulnerability of traditional supply chains to physical disruption and mobility restriction policies. Rahman et al. (2023) emphasized that companies that have adopted cloud-based TMS systems show the ability to recover supply chains up to 30% faster than conventional companies. The flexibility of the cloud-based system allows companies to *dynamically re-route* and adjust transportation capacity based on actual demand in the field. In the context of national e-commerce that

is highly dependent on delivery speeds, this flexibility is a key differentiating factor that strengthens supply chain resilience and maintains service sustainability.

However, the achievement of economic and sustainability benefits of cloud-based TMS cannot be separated from the challenges of policy and institutional readiness. The OECD (2023) warns that the adoption of advanced technology without adequate digital governance can pose new risks, such as data monopolization by large companies, technology access gaps, and inequality of competitiveness between regions. Therefore, the logistics digitalization strategy needs to be accompanied by inclusive policies that ensure equitable distribution of economic and environmental benefits. In this context, Kasrim (2025) emphasizes the importance of the government's role in encouraging responsible innovation through environmentally friendly technology incentive mechanisms, human resource training, and regulations that encourage data interoperability between platforms. A collaborative approach between the public and private sectors is key in ensuring that digital logistics transformation not only benefits the economy, but also supports sustainable development nationally.

The successful implementation of cloud-based TMS also has strategic implications for Indonesia's position in the Southeast Asian regional supply chain. With increasing economic integration in the region, Indonesia's ability to provide an efficient and sustainable logistics system will determine export competitiveness as well as domestic supply resilience. Lee et al. (2022) show that countries that adopt digital-based transportation systems have a higher competitive advantage because they are able to reduce export costs and improve supply reliability. Therefore, strengthening TMS infrastructure in Indonesia is not only relevant for domestic e-commerce, but also part of a long-term strategy in strengthening national economic competitiveness in the era of ASEAN digital economy integration.

Overall, the implementation of cloud-based TMS provides a significant economic impact through increased efficiency, productivity, and competitiveness, while supporting environmental sustainability goals. However, the successful implementation of this system requires synergy between public policy, technological innovation, and institutional readiness. Effective integration between economic efficiency and environmental sustainability is a crucial element in creating a resilient, inclusive, and adaptive national logistics system to global dynamics. With the right policy direction and strong cross-sector collaboration, cloud-based TMS can be a key pillar in strengthening the foundation of Indonesia's digital economy towards a competitive and sustainable future.

CONCLUSION

This study emphasizes that the implementation of a cloud-based Transportation Management System (TMS) is a crucial element in the digital transformation of national logistics, especially in the e-commerce sector which is the main motor of Indonesia's digital economy. The results of the literature review show that the adoption of this system is able to improve distribution efficiency through route optimization, real-time monitoring, and significant reduction in operational costs. More than just a technology tool, cloud-based TMS serves as a strategic infrastructure that strengthens integration between actors in the supply chain, creates data transparency, and accelerates decision-making processes. The economic implications include increasing national productivity, decreasing logistics costs, and expanding digital inclusivity for small and medium-sized businesses. From a sustainability perspective, the system also contributes to the reduction of carbon emissions and more efficient use of energy, in line with the national commitment to a green economy. Thus, cloud-based TMS is not only an operational

solution, but also a fundamental pillar in strengthening national e-commerce competitiveness amid the dynamics of the global digital economy.

Strategically, the successful implementation of cloud-based TMS requires cross-sector synergy involving governments, logistics providers, technology platforms, and digital financial institutions. The government needs to strengthen data governance policies, expand digital infrastructure, and provide incentives for companies that implement green and efficient transportation technology. Meanwhile, the private sector needs to improve digital literacy and technical capabilities of human resources so that the digital transformation of logistics can be adopted evenly across all levels of industry. Continued public-private collaboration is key to ensuring the economic and environmental benefits of the system are felt inclusively. As emphasized by Kasrim (2025), the integration of logistics technology based on artificial intelligence and cloud computing will only be effective if it is accompanied by the readiness of a digital ecosystem that includes policies, infrastructure, and human competence. Therefore, strengthening technology-based collaborative governance is a strategic step towards an efficient, sustainable, and globally competitive national logistics system.

REFERENCES

1. ASEAN Centre for Energy. (2023). *Southeast Asia Energy Outlook 2023*. Jakarta: ACE.
2. ASEAN Secretariat. (2024). *Green Logistics Action Plan 2024–2030*. Jakarta: ASEAN.
3. Bakker, E., & Boonstra, A. (2021). Data-driven collaboration and digital transformation in supply chain management. *International Journal of Operations & Production Management*, 41(9), 1435–1458. <https://doi.org/10.1108/IJOPM-07-2020-0469>
4. Chong, A. Y. L., Lo, C. K. Y., & Weng, X. (2022). Cloud computing adoption in supply chain management: Drivers, barriers, and outcomes. *International Journal of Production Economics*, 247, 108428. <https://doi.org/10.1016/j.ijpe.2022.108428>
5. Deloitte. (2022). *Digital transformation in logistics and supply chain 2022*. London: Deloitte Insights.
6. Google, Temasek, & Bain & Company. (2023). *e-Conomy SEA 2023: Southeast Asia's Digital Decade*. Singapore: Google Asia Pacific.
7. Kasrim, AMTrU., S.E. (2025). *Manajemen Logistik Berbasis AI: Konsep, Aplikasi, dan Masa Depan*. Yogyakarta: Deepublish.
8. Kementerian Keuangan Republik Indonesia. (2023). *Laporan Implementasi National Logistics Ecosystem (NLE)*. Jakarta: Direktorat Jenderal Bea dan Cukai.
9. Kementerian Perindustrian Republik Indonesia. (2023). *Peta Jalan Industri 4.0 dan Ekosistem Logistik Nasional*. Jakarta: Kemenperin.
10. Kumar, S., & Rajesh, R. (2022). Cloud-based transportation management systems for efficient supply chain networks. *International Journal of Logistics Management*, 33(4), 915–934. <https://doi.org/10.1108/IJLM-04-2021-0209>
11. Lee, C., Tan, H., & Park, J. (2022). Resilient supply chains in ASEAN: The role of digital collaboration. *Asia Pacific Journal of Business Administration*, 14(3), 221–238. <https://doi.org/10.1108/APJBA-11-2021-0482>
12. Lee, J., & Kim, S. (2023). Enhancing logistics visibility through cloud-based transportation systems. *Journal of Supply Chain Management*, 59(3), 45–61. <https://doi.org/10.1111/jscm.12295>
13. McKinsey & Company. (2024). *The Future of Logistics in ASEAN: Building Smart and Sustainable Supply Chains*. Singapore: McKinsey Global Institute.

14. Nasution, D., Sari, N., & Rahman, A. (2023). Integration of digital logistics ecosystem for sustainable distribution: Evidence from Indonesia. *Journal of Business Logistics*, 44(1), 112–128. <https://doi.org/10.1111/jbl.12312>
15. Nguyen, D. T., Lim, S., & Park, J. (2024). Smart logistics and AI-based route optimization in East Asia. *Asia Pacific Journal of Operations Research*, 41(2), 234–251. <https://doi.org/10.1142/S0217595924500127>
16. OECD. (2023). *Southeast Asia Economic Outlook 2023: Greening Growth*. Paris: OECD Publishing. <https://doi.org/10.1787/9789264292671-en>
17. Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., ... & Moher, D. (2021). The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. *BMJ*, 372, n71. <https://doi.org/10.1136/bmj.n71>
18. PwC Indonesia. (2022). *Digital logistics and transport technology in Indonesia*. Jakarta: PwC Indonesia.
19. Rahman, F., Prasetyo, A., & Darma, S. (2023). Data-driven collaboration in Indonesia's logistics sector: Toward sustainable efficiency. *Asia Pacific Journal of Management and Innovation*, 11(2), 89–106. <https://doi.org/10.1108/APJMI-09-2023-009>
20. Rohman, F., & Widodo, T. (2022). Implementasi sistem logistik berbasis cloud untuk efisiensi distribusi di Indonesia. *Jurnal Logistik dan Transportasi Indonesia*, 5(3), 145–160.
21. Saputra, I., Hartono, B., & Nugraha, D. (2021). Assessing organizational readiness for logistics digitalization in developing countries. *Sustainability*, 13(9), 5194. <https://doi.org/10.3390/su13095194>
22. Snyder, H. (2019). Literature review as a research methodology: An overview and guidelines. *Journal of Business Research*, 104, 333–339. <https://doi.org/10.1016/j.jbusres.2019.07.039>
23. Tan, K. H., Lim, C. P., & Lau, H. (2022). Digital trust and collaborative logistics systems. *Computers & Industrial Engineering*, 169, 108291. <https://doi.org/10.1016/j.cie.2022.108291>
24. Tranfield, D., Denyer, D., & Smart, P. (2020). Towards a methodology for developing evidence-informed management knowledge by means of systematic review. *British Journal of Management*, 31(2), 253–269. <https://doi.org/10.1111/1467-8551.12304>
25. World Bank. (2023). *Digital Readiness Assessment for Indonesia*. Washington, D.C.: World Bank Group.
26. Yap, W. Y., Wong, C. Y., & Lam, J. S. L. (2023). Greening maritime logistics in Southeast Asia: Policy and practice. *Transport Reviews*, 43(3), 370–392. <https://doi.org/10.1080/01441647.2022.2155017>