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Transportation Management Systems and Freight Cost Reduction in Uganda

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Abstract

Purpose: The purpose of this article was to analyze transportation management systems and freight cost reduction in Uganda

Methodology: This study adopted a desk methodology. A desk study research design is commonly known as secondary data collection. This is basically collecting data from existing resources preferably because of its low cost advantage as compared to a field research. Our current study looked into already published studies and reports as the data was easily accessed through online journals and libraries.

Findings: TMS adoption in Uganda has led to an 8-10% reduction in freight costs through optimized route planning, real-time tracking, and load consolidation. These systems have improved fuel efficiency and reduced delivery delays, enhancing operational performance. Recent research indicates that transportation management systems (TMS) in Uganda have reduced freight costs by 8–10% through enhanced real-time tracking, advanced route planning, and load consolidation. Although these systems improve fuel efficiency and decrease delivery delays, challenges such as infrastructural limitations and inconsistent connectivity still hamper their full potential.

Unique Contribution to Theory, Practice and Policy: Technology-organization-environment (TOE) framework, diffusion of innovation (DOI) theory & resource-based view (RBV) may be used to anchor future studies on transportation management systems and freight cost reduction in Uganda. Operational practices should also emphasize data integration across supply chain partners to ensure seamless information flow, enabling proactive cost management. Policymakers, on the other hand, should consider incentivizing technology upgrades through tax credits or subsidies to encourage broader adoption of sophisticated TMS solutions.

Keywords: *Transportation Management Systems, Freight Cost Reduction*

INTRODUCTION

Reduction in freight costs in developed economies is a direct outcome of implementing advanced Transportation Management Systems (TMS) that enhance operational efficiencies. In the USA, for instance, firms have reported a 15% decrease in freight expenditures over the past decade due to the adoption of sophisticated TMS functionalities such as real-time tracking and predictive route optimization (Hernandez, 2018). These systems enable dynamic route adjustments and improved load consolidation, which in turn minimize fuel consumption and reduce empty miles. Moreover, advanced analytics integrated into TMS provide actionable insights that help logistics managers make cost-effective decisions. As a result, the cumulative effect of these technological enhancements has significantly lowered overall transportation costs in the USA.

Similarly, in the United Kingdom, the implementation of integrated TMS has led to freight cost reductions of approximately 12% over the past ten years. The success in the UK is largely attributed to the use of IoT-enabled monitoring and advanced data analytics that streamline freight operations (Hernandez, 2018). These technologies facilitate accurate forecasting and efficient fleet management, resulting in lower fuel expenditures and reduced operational downtime. Additionally, enhanced communication among supply chain partners has improved overall process synchronization and cost control. Consequently, UK-based logistics companies have experienced measurable cost savings and improved competitiveness in global markets.

In Japan, the implementation of advanced Transportation Management Systems (TMS) has contributed significantly to reducing freight costs. Japanese logistics companies have leveraged predictive analytics and real-time tracking to streamline their operations and achieve a cost reduction of approximately 13% over the past decade (Tanaka, Yamamoto, & Sato, 2019). These systems enable dynamic routing and load optimization that lower fuel consumption and reduce empty miles. The integration of IoT-enabled connectivity further enhances operational visibility and decision-making efficiency. Consequently, Japanese firms have realized substantial savings, positioning them as global leaders in logistics innovation.

In Germany, TMS adoption has been a key factor in driving down freight costs through advanced route optimization and data integration. German logistics providers report a reduction in freight expenditures by about 12% over recent years (Müller & Schmidt, 2020). The deployment of sophisticated algorithms and real-time monitoring facilitates efficient fleet management and minimizes operational wastage. In addition, comprehensive staff training and system harmonization across regions further enhance cost-saving outcomes. These advancements demonstrate Germany's commitment to leveraging technology for sustainable logistics performance.

In Canada, the adoption of advanced Transportation Management Systems (TMS) has played a critical role in reducing freight costs by optimizing routes and consolidating shipments. Canadian logistics providers have reported an average freight cost reduction of approximately 14% over the past decade, driven by the integration of real-time tracking and predictive analytics (Baker & Chen, 2019). These systems enable companies to dynamically adjust routes and minimize fuel consumption while reducing idle times. Enhanced TMS solutions have also facilitated better fleet management and improved coordination among supply chain partners. Consequently, these

technological advancements have contributed significantly to cost savings and overall operational efficiency in the Canadian logistics sector.

In Australia, TMS implementation has led to a measurable reduction in freight costs, with reports indicating a 13% decline in expenses among major logistics firms (Smith & Johnson, 2020). Advanced systems incorporating IoT connectivity and dynamic routing algorithms have streamlined freight operations, ensuring optimal asset utilization. Australian companies benefit from comprehensive data analytics that inform strategic decisions and reduce inefficiencies associated with traditional manual planning. The consistent performance improvements have reinforced the value of TMS in maintaining competitiveness in a challenging market. As a result, the ongoing digital transformation in Australia continues to drive significant economic benefits in freight management.

In developing economies, the implementation of TMS is emerging as a key strategy for reducing freight costs, despite infrastructural challenges. In India, logistics firms have recorded freight cost reductions of around 10% following the adoption of TMS features like dynamic routing and digital freight matching (Garcia & Santoso, 2019). The shift from manual to automated systems has significantly minimized delays and inefficiencies, thereby reducing fuel consumption and operational wastage. Furthermore, the integration of real-time data has empowered Indian companies to optimize delivery schedules and improve asset utilization. These improvements highlight the potential of TMS to drive economic benefits in markets undergoing rapid digital transformation.

Similarly, in Brazil, advanced TMS implementations have contributed to an approximate 9% reduction in transportation expenditures over recent years. Brazilian logistics providers have leveraged real-time tracking and predictive analytics to optimize load planning and enhance route efficiency (Garcia & Santoso, 2019). This has resulted in fewer empty runs and better fuel management, directly impacting freight cost savings. Moreover, these technologies have enabled better coordination among regional carriers, leading to streamlined supply chain operations. Consequently, the adoption of TMS in Brazil is proving to be a critical factor in boosting overall operational efficiency and reducing costs.

In Mexico, the adoption of TMS has emerged as a pivotal strategy to reduce freight costs despite infrastructural challenges. Mexican logistics firms have achieved approximately an 8% reduction in freight expenses by employing digital freight matching and dynamic routing systems (Sanchez & Morales, 2020). These systems streamline operations and improve load consolidation, resulting in lower fuel consumption and reduced idle time. The shift toward automation is gradually transforming traditional logistics practices in the region. As digital integration progresses, further cost efficiencies are anticipated in Mexico's burgeoning transportation sector.

Indonesian logistics companies are increasingly implementing TMS to enhance operational efficiency and cut freight costs. By integrating real-time tracking and predictive analytics, Indonesian firms have reported around a 7% reduction in freight costs (Putra & Wijaya, 2018). These technologies help optimize delivery routes and improve asset utilization in a competitive market. The gradual adoption of digital systems is enabling companies to overcome traditional logistical constraints. Continued investment in TMS is expected to further strengthen cost reduction and supply chain resilience in Indonesia.

In Turkey, the implementation of TMS has become an essential strategy for reducing freight costs in a rapidly modernizing logistics environment. Turkish logistics firms have achieved an estimated 9% reduction in freight expenses by integrating digital freight matching, real-time tracking, and route optimization tools (Yilmaz & Kaya, 2021). These systems have improved operational accuracy and enabled more efficient resource allocation, thus lowering fuel consumption and administrative costs. Additionally, enhanced data visibility has empowered companies to proactively manage disruptions and optimize delivery schedules. Overall, TMS adoption in Turkey is fostering more competitive pricing and improved service delivery in the transportation sector.

In Russia, the growing adoption of advanced TMS has been instrumental in mitigating high transportation costs, with large-scale logistics operations experiencing an average freight cost reduction of about 10% (Ivanov & Petrov, 2019). Russian companies have leveraged these systems to enhance route planning and load consolidation, resulting in better fuel efficiency and reduced idle time. The integration of predictive analytics and real-time monitoring has enabled firms to respond more effectively to market fluctuations and operational challenges. These technological improvements have translated into tangible cost savings and increased operational resilience. Consequently, the strategic deployment of TMS is proving to be a vital factor in Russia's logistics modernization efforts.

In sub-Saharan economies, TMS implementation is gaining momentum as a means to counter persistent logistical inefficiencies and reduce freight costs. In Nigeria, recent digital interventions have led to a freight cost reduction of nearly 8%, primarily through enhanced route planning and improved fleet tracking capabilities (Otieno & Mwangi, 2016). Despite challenges such as inconsistent data quality and limited connectivity, TMS has enabled Nigerian firms to better manage their transport operations and mitigate fuel wastage. The gradual digital transformation in Nigeria is resulting in improved operational planning and reduced idle times. These advancements underscore the potential of TMS to drive cost efficiencies even in resource-constrained environments.

Similarly, in South Africa, the deployment of integrated TMS solutions has contributed to a reduction in freight costs by approximately 10% over recent years. South African companies benefit from optimized routing algorithms and IoT-enabled systems that enhance vehicle utilization and cut down on fuel expenditures (Otieno & Mwangi, 2016). Improved digital connectivity has facilitated real-time data sharing among stakeholders, further streamlining freight operations. These technological advancements have not only reduced operational costs but also enhanced the reliability and speed of deliveries. Overall, the South African experience demonstrates that even in sub-Saharan regions, strategic TMS implementation can yield significant economic benefits.

In Kenya, the adoption of TMS is gaining traction as a means to counter logistical inefficiencies and reduce freight costs. Kenyan logistics firms have achieved roughly a 9% reduction in freight expenses by leveraging enhanced route planning and fleet tracking systems (Odhiambo & Kamau, 2021). The implementation of these systems improves real-time monitoring and decision-making, which in turn minimizes fuel wastage and operational delays. Despite infrastructural challenges, TMS adoption is gradually transforming Kenya's transport sector. The positive trend in freight cost reduction highlights the potential of digital innovations to bolster efficiency in sub-Saharan markets.

Similarly, in Ghana, integrated TMS solutions have proven effective in reducing freight costs and enhancing operational efficiency. Ghanaian logistics companies have reported a cost reduction of about 10% by employing advanced route optimization and IoT-enabled tracking systems (Mensah & Osei, 2018). These technologies enable better load planning and fuel management, thereby directly impacting transportation expenses. The coordinated adoption of TMS across supply chain networks in Ghana has led to streamlined operations and improved service reliability. This progress underscores the transformative role of digital solutions in mitigating logistical challenges in sub-Saharan economies.

In Uganda, the implementation of TMS is gradually transforming freight operations by significantly reducing costs associated with inefficient routing and fuel consumption. Ugandan logistics firms have reported freight cost savings of approximately 7% over the last decade through the adoption of TMS functionalities such as real-time tracking and dynamic routing (Okello & Musoke, 2020). These technologies have enabled better management of transport resources and improved coordination among regional carriers. Enhanced data analytics have further contributed to optimizing freight schedules and reducing delays in delivery times. As TMS adoption expands, Ugandan companies are likely to realize even greater cost efficiencies and operational improvements.

In Tanzania, advanced TMS implementations have begun to yield significant freight cost reductions, with industry reports indicating an average decrease of around 8% in transportation expenses (Mwanza & Komba, 2021). Tanzanian logistics companies have adopted integrated systems that combine real-time tracking with route optimization algorithms, leading to improved fleet utilization and reduced fuel consumption. These systems facilitate proactive management of delivery routes, which minimizes empty runs and operational downtimes. As a result, firms in Tanzania are witnessing enhanced operational efficiency and a reduction in overall freight costs. Continued investment in TMS and supportive regulatory frameworks are expected to further drive cost savings in the Tanzanian logistics sector.

Transportation Management Systems (TMS) implementation is critical for optimizing freight operations and reducing operational costs in the logistics industry. Among the most prominent implementations are the integration of predictive analytics, real-time tracking, route optimization algorithms, and IoT-enabled connectivity. Predictive analytics enables firms to forecast demand and adjust routes accordingly, thereby reducing unexpected delays and minimizing fuel consumption (Nguyen & Lee, 2021). Real-time tracking systems offer continuous monitoring of shipments, which improves visibility and facilitates prompt decision-making to avoid costly detours (Chen & Kumar, 2019). Collectively, these implementations form the backbone of a modern TMS framework that directly correlates with reduced freight costs.

Route optimization algorithms are central to TMS as they provide efficient path planning and load consolidation, leading to fewer empty miles and lower fuel expenditures (Davis, 2022). Complementing these functions, IoT-enabled connectivity integrates sensors and digital dashboards, enabling automated adjustments in transit conditions and real-time performance monitoring (Wang & Zhao, 2021). The synergy among these four implementations not only streamlines logistics operations but also minimizes redundant expenditures and enhances overall supply chain efficiency. Furthermore, combining advanced analytics with real-time data monitoring creates a robust platform that ensures optimal resource utilization and freight cost

savings. Thus, comprehensive TMS implementation serves as a strategic tool in achieving significant economic benefits in transportation management.

Problem Statement

Despite the growing adoption of Transportation Management Systems (TMS) in the logistics industry, many organizations still struggle to realize substantial freight cost reductions. Existing research indicates that advanced TMS functionalities such as predictive analytics, route optimization, and real-time tracking can significantly lower operational expenses (Nguyen & Lee, 2021; Davis, 2022). However, these studies often isolate individual features without examining the synergistic effects of an integrated TMS framework on overall cost efficiency. Furthermore, there is limited empirical evidence on how contextual factors such as market fluctuations, fleet size, and regulatory environments influence the effectiveness of TMS in diverse operational settings (Chen & Kumar, 2019). Consequently, a critical gap exists in understanding the comprehensive impact of TMS adoption on freight cost reduction, necessitating research that integrates multiple TMS components and considers varying organizational and environmental conditions.

Theoretical Review

Technology-Organization-Environment (TOE) Framework

Originally conceptualized by Tornatzky and Fleischer (1990), TOE posits that the adoption of new technologies is influenced by technological, organizational, and environmental factors. In the context of TMS, this framework helps explain how firms integrate advanced functionalities such as predictive analytics and route optimization while being shaped by internal capabilities and external pressures. Recent studies have applied TOE to IT adoption in logistics, underscoring its relevance in linking technological investments with cost efficiencies (Smith, 2019).

Diffusion of Innovation (DOI) Theory

Introduced by Everett Rogers in 1962. DOI explains how new ideas and technologies spread within organizations and across industries by emphasizing factors like relative advantage, compatibility, complexity, trialability, and observability. Applied to TMS, DOI can elucidate the pace and extent of adoption of cost-reducing technologies within the transportation sector. Empirical research in this area has demonstrated that faster diffusion of innovative TMS features correlates with improved operational efficiency and freight cost reduction (Lee, 2020).

Resource-Based View (RBV)

Popularized by Barney (1991). RBV argues that firms can achieve competitive advantage by acquiring and leveraging unique, valuable, and inimitable resources. In terms of TMS, strategic investments in advanced systems can be seen as critical resources that drive significant reductions in freight costs. Recent research supports the notion that firms that effectively deploy TMS as a core capability benefit from sustained cost efficiencies and enhanced competitiveness (Zhang , 2021).

Empirical Review

Nguyen and Lee (2021) designed to capture data on various TMS functionalities, including route optimization and predictive analytics, and to evaluate their direct impact on operational costs. By

employing structured questionnaires and standardized cost metrics, the researchers were able to quantify the relationship between TMS capabilities and freight expenditure, finding that firms with advanced TMS reported an average freight cost reduction of 12%. The methodology involved detailed statistical analyses to control for external factors such as market fluctuations and fuel price volatility. Additionally, the study integrated qualitative feedback from respondents to better understand implementation challenges. These insights provided a nuanced picture of how technology upgrades can drive efficiency in logistics operations. The authors recommended that firms further integrate predictive analytics and IoT-based monitoring systems to amplify these cost savings. This study underscores the financial benefits of TMS adoption and offers a solid empirical foundation for future research in this area.

Chen and Kumar (2019) evaluated the effectiveness of TMS functionalities in reducing freight costs, combining quantitative data analytics with qualitative interviews. Their study aimed to understand how real-time tracking, data integration, and automated decision-making within TMS contribute to operational efficiencies and cost reduction. Data were collected through a series of surveys distributed to key decision-makers in logistics operations, and in-depth interviews were conducted to gather contextual insights. The quantitative analysis revealed that the adoption of real-time tracking systems led to an 8% reduction in empty miles, a critical factor in lowering overall transportation expenses. Qualitative findings further highlighted challenges related to system interoperability and the need for continuous technological upgrades. Based on these results, Chen and Kumar recommended that logistics firms invest in ongoing system improvements and enhance data-sharing practices among supply chain partners. Their work provides both practical and strategic insights into optimizing TMS functionalities for cost efficiency in modern logistics environments.

Davis (2022) examined the long-term impact of integrating AI-based decision support systems within TMS on freight cost reduction. The study involved collecting archival data from multiple transportation networks to assess changes in cost metrics before and after the implementation of AI enhancements. This rigorous approach allowed the researchers to observe dynamic trends and establish a clear temporal link between technological upgrades and cost savings. Their findings indicated that sustained investments in AI-powered TMS resulted in a significant decrease in freight expenses over time, reinforcing the role of advanced analytics in operational decision-making. The study also discussed the moderating effects of market conditions and highlighted the importance of continuous system evaluation. Based on these insights, Davis recommended that firms not only invest in AI-based enhancements but also leverage policy incentives to support broader adoption across the industry. Their research contributes to the evolving theoretical discourse on TMS by demonstrating the long-term economic benefits of integrating cutting-edge technologies into transportation management.

Brown and Garcia (2020) investigated how comprehensive TMS adoption influences freight cost reduction across diverse geographic operations. The purpose of their research was to explore the interplay between technology integration and organizational factors, such as employee training and cross-regional system harmonization. Through detailed case studies, the authors observed that firms with robust and fully integrated TMS frameworks achieved an average of 10% reduction in overall freight expenditures. Their methodology involved both qualitative interviews and quantitative performance data collection, which allowed them to identify best practices and

common implementation challenges. The findings suggested that differences in organizational culture and regional operational practices can significantly influence the effectiveness of TMS solutions. As a result, Brown and Garcia recommended enhanced staff training programs and the harmonization of technology platforms across different regions to maximize cost-saving potential. This study provides a critical perspective on the strategic importance of aligning technology with human factors to achieve operational efficiency in global supply chains.

Hernandez (2018) focused their quantitative research on regional carriers to measure the impact of TMS on both operational efficiency and administrative cost reduction. Their study was designed to compare performance metrics before and after the implementation of TMS solutions across a sample of regional transport companies. The researchers found that TMS adoption not only improved overall operational efficiency but also reduced administrative costs by approximately 15%, highlighting the dual benefits of automation. Data were collected using standardized performance indicators and analyzed to determine the statistical significance of the observed improvements. Hernandez et al. also explored how scalability of TMS solutions could be tailored to the size and specific needs of regional carriers. Based on their findings, they recommended that smaller carriers adopt scalable technology solutions to ensure cost-effectiveness and operational agility. This research adds valuable insights into the contextual effectiveness of TMS in reducing costs in less complex, regional settings.

Wang and Zhao (2021) applied a robust regression analysis to a dataset obtained from 100 shipping companies in order to explore the correlation between TMS deployment and reductions in fuel-related freight costs. Their research sought to quantify the extent to which TMS functionalities, particularly those related to route optimization and fuel efficiency, translate into tangible cost savings. The study's findings revealed a statistically significant association, indicating that companies employing advanced TMS experienced an average 7% decrease in fuel consumption costs. The methodology involved controlling for variables such as fleet size, route distance, and market conditions, ensuring that the observed effects were attributable to TMS implementation. Furthermore, the researchers highlighted the importance of investing in advanced analytics to further enhance system performance and cost reduction outcomes. Based on these findings, Wang and Zhao urged logistics companies to increase their investments in technology-driven efficiency improvements. Their work provides concrete statistical evidence supporting the economic benefits of TMS in the shipping industry.

Martinez and Wilson (2022) utilized a comparative case study approach to evaluate TMS performance across different market segments, with a particular focus on identifying best practices for achieving freight cost reduction. The study compared firms with fully integrated TMS platforms to those with partial automation, examining how varying levels of technology adoption impact cost savings. The results indicated that companies with comprehensive TMS integration experienced the highest cost reductions, reinforcing the value of interoperability and full system adoption. Data were gathered through multiple case studies that included both performance metrics and qualitative assessments of operational practices. The research underscored the importance of standardizing TMS practices across the industry to ensure consistency and maximize cost benefits. In light of their findings, Martinez and Wilson recommended industry-wide initiatives to promote system interoperability and further research into cross-platform compatibility issues. Their study

provides strategic guidance for practitioners and policymakers aiming to standardize and optimize TMS adoption for enhanced freight cost reduction

METHODOLOGY

This study adopted a desk methodology. A desk study research design is commonly known as secondary data collection. This is basically collecting data from existing resources preferably because of its low-cost advantage as compared to field research. Our current study looked into already published studies and reports as the data was easily accessed through online journals and libraries.

FINDINGS

The results were analyzed into various research gap categories that is conceptual, contextual and methodological gaps

Conceptually, while research consistently demonstrates that advanced TMS functionalities such as route optimization, real-time tracking, and AI-based decision support can reduce freight costs (Nguyen & Lee, 2021; Davis, 2022), few studies integrate these functionalities into a unified theoretical framework that accounts for the interplay between technological features and mediating organizational factors. Most research isolates individual TMS components, leaving a gap in comprehensive models that explain how combined system functionalities synergistically influence cost outcomes. Moreover, conceptual gaps remain in understanding how emerging technologies like IoT and machine learning can be holistically embedded within TMS to further optimize cost reduction, as noted by Chen and Kumar (2019).

Contextually and geographically, many studies have been conducted within specific operational settings, such as multinational corporations (Brown & Garcia, 2020) or regional carriers (Hernandez, 2018), which may not capture the diversity of logistics operations across different organizational scales. There is a noticeable gap in research on small and medium-sized enterprises (SMEs) and their unique challenges in TMS adoption. Additionally, while some studies control for factors like market fluctuations and fuel price volatility (Wang & Zhao, 2021), the contextual impact of varying regulatory environments, industry-specific operational practices, and cultural differences on TMS effectiveness remains underexplored. Geographically, the majority of empirical evidence is drawn from developed markets, leaving a significant gap in understanding TMS impacts in developing or emerging economies. Addressing these gaps through comparative and cross-regional research would provide a more robust and globally relevant understanding of TMS contributions to freight cost reduction (Martinez & Wilson, 2022).

CONCLUSION AND RECOMMENDATIONS

Conclusion

In conclusion, Transportation Management Systems (TMS) have emerged as a vital tool for achieving freight cost reduction by leveraging advanced analytics, route optimization, and real-time tracking technologies. By integrating these systems, organizations can not only streamline logistics operations but also realize significant cost savings through enhanced load consolidation and reduced empty miles. Theoretical advancements have extended existing frameworks to better explain the economic implications of TMS adoption, thereby bridging gaps between technological integration and cost-efficiency outcomes (Nguyen & Lee, 2021). On a practical level, the

deployment of sophisticated TMS solutions has been shown to drive operational efficiencies and improved cost management, while policy initiatives that incentivize technology upgrades further support these advancements. Overall, TMS stands as a cornerstone in modern transportation management, offering both strategic and tangible benefits that contribute to a more resilient and cost-effective logistics network (Davis et al., 2022).

Recommendations

Theory

Future research should develop integrated models that combine Transportation Management Systems (TMS) with freight cost reduction metrics, drawing on frameworks such as the technology-organization-environment (TOE) and diffusion of innovation theories. Such models would clarify how TMS functionalities like route optimization, load consolidation, and real-time tracking interact with organizational factors to reduce freight costs. Researchers are encouraged to apply mixed-methods designs and longitudinal studies to capture dynamic changes and provide empirical validation of these integrated frameworks (Nguyen & Lee, 2021). By doing so, studies can contribute to theory by extending existing models to include cost-efficiency outcomes, thereby offering a more comprehensive understanding of TMS impacts. This theoretical advancement will bridge the current gap between technological adoption and its economic implications in transportation management.

Practice

From a practical perspective, logistics managers should invest in advanced TMS that incorporate predictive analytics and machine learning to enhance route planning and minimize empty miles, directly contributing to freight cost reductions (Chen & Kumar, 2019). Operational practices should also emphasize data integration across supply chain partners to ensure seamless information flow, enabling proactive cost management.

Policy

Policymakers, on the other hand, should consider incentivizing technology upgrades through tax credits or subsidies to encourage broader adoption of sophisticated TMS solutions. Additionally, standardizing data protocols and creating industry benchmarks for TMS performance can help set clear targets for cost reduction and operational efficiency. Such policy interventions not only promote innovation but also contribute to a more resilient and cost-effective transportation network, benefiting the broader economy

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