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IMPLEMENTING SUSTAINABLE TRANSPORTATION SOLUTIONS IN LOGISTICS: THE OPPORTUNITIES AND DIFFICULTIES FACED

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Abstract

The logistics industry is a major contributor to global carbon emissions, therefore adopting sustainable transport solutions is essential. The opportunities and difficulties of integrating sustainable mobility solutions into logistics are examined in this study. Secondary data from academic literature, industry reports, and case studies were examined using a qualitative research methodology. The results show that environmentally friendly transportation improves corporate reputation, cost-effectiveness, regulatory compliance, and environmental preservation. However, high upfront investment costs, inadequate infrastructure, and ambiguous rules are barriers to broader implementation. At the same time, innovative company strategies, tax breaks, and environmentally friendly technologies offer logistics options. Therefore, governments and industry participants must work together strategically and provide legislative incentives to address these issues. This study adds to the expanding discourse on sustainable logistics by offering significant suggestions to businesses and decision-makers to expedite the incorporation of sustainable mobility into logistics operations.

Keywords: *s*ustainable logistics, green transport, supply chain sustainability, policy incentives, logistics challenges.

Introduction

Abbasi & Nilsson (2016) pointed out that the growing worries about climate change and environmental sustainability are causing a major environmental catastrophe in the transport and logistics sector. According to Statista (2025) research, global transportation-related carbon dioxide emissions rose 4% to 8.24 billion metric tonnes in 2023, making up 21% of global CO_2 emissions. This made transportation the second-highest polluting sector in the world, after the power sector. Similarly, the environmental effects of energy-intensive transportation, warehousing, and distribution activities are also increased (Khalili et al., 2019). Thus, logistics firms must embrace sustainable methods to contribute to a greener future in this day and age, as sustainability becomes an increasingly important goal.

Faulin et al. (2019) claimed that, in logistics, sustainable transport refers to the application of procedures and technology that considerably lessen the environmental impact of transportation and distribution operations. Similarly, the main objectives of sustainable transportation goals include minimising greenhouse gas emissions, minimising pollution of the air and water, and optimising resource utilisation. At the same time, the development of green logistics is opening the door for more environmentally friendly logistics transportation, which helps the industry stay sustainable. In this transition, for example, businesses such as Across Logistics are taking the lead, fostering a healthy atmosphere and establishing a new benchmark for quality and accountability in the sector (ACROSS LOGISTICS, 2023).

However, initial expenses, poor infrastructure, change aversion, and regulatory and governmental obstacles are some of the obstacles faced by the logistics in adopting sustainable practices. Likewise, the expensive initial investment needed also presents challenges for small and medium-sized businesses, and the absence of alternate fuel supply points and charging stations restricts adoption (Sumbal et al., 2023). Overall, a key component of striking a balance between environmental responsibility and economic growth in the logistics industry is sustainable mobility. In this context, the possibilities and difficulties of implementing sustainable transportation solutions in logistics are examined in this paper. The potential for this study to offer practical insights for logistics firms, legislators, and sustainability advocates makes it relevant. This research adds to the expanding conversation on sustainable logistics by examining current obstacles and determining workable solutions.

Research aim: To explore and propose effective solutions for implementing sustainable transportation in logistics by identifying key opportunities and challenges.

The following **objectives** have been set to achieve the aim:

1. To analyse the major challenges faced in adopting sustainable transportation solutions in logistics.
2. To examine successful case studies and innovative solutions in green logistics.
3. To evaluate the impact of sustainable transport solutions on logistics efficiency and environmental sustainability.
4. To develop practical solutions and policy recommendations for logistics firms and policymakers to facilitate the adoption of sustainable transportation.

Research object and methods. This study employs a secondary data collection method and the qualitative approach. Case studies from logistics firms that have adopted sustainable transport solutions, various reports, and peer-reviewed academic journal articles are used. To find the best methods, obstacles, and legislative measures that have effectively aided in the adoption of sustainable transportation, a comparative study of case studies from businesses including DHL, IKEA, and Maersk was carried out (Lochmiller, 2021).

Research results and discussion

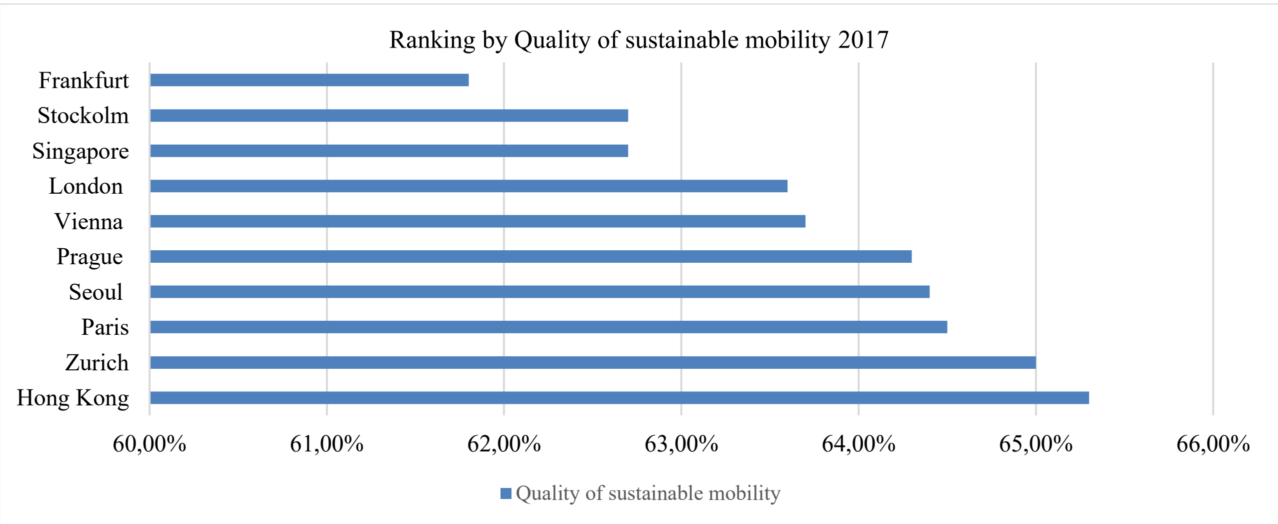
Impact of Sustainable Transportation in Logistics

As per the observation of Ogryzek et al. (2020), one significant advantage of sustainable mobility in logistics is long-term cost-effectiveness. The authors declared that long-term cost-effectiveness in logistics is made possible by sustainable mobility, which helps companies save a lot of money on maintenance and fuel. Similarly, long-term savings for businesses can be achieved through route optimisation and advanced technologies, which can result in large fuel and maintenance cost reductions despite high upfront investment costs (Gružauskas et al., 2018). For example, DHL Express has implemented electric delivery vans in several countries, which lowers fuel usage and maintenance costs. Custom electric cars for last-mile delivery have been developed through its partnership with StreetScooter, which has decreased operating costs in urban logistics. Besides, the first fuel cell-powered electric vehicle, the "H2 Panel Van" offers extra power and a 500-kilometer range (DHL, 2019). For small and medium-sized businesses (SMEs) with limited funding, the upfront cost of investing in green fleets continues to be a deterrent (Ghadge et al., 2017).

Furthermore, Suraharta et al. (2023) remarked that as governments enforce stringent emission laws to address climate change, sustainable transport is essential for regulatory compliance and business image. As per the findings, logistics firms that incorporate green transport solutions are in a better position to comply with environmental regulations like as the UK's Road to Zero policy and the EU's Fit for 55 packages. Similarly, given that customers and business partners are increasingly looking for organisations that practise environmental responsibility, this flexibility is crucial (Ovaere & Proost, 2022; GOV.UK, 2019). For example, Herold & Lee (2017) noted that UPS has pledged to lower its carbon footprint by purchasing advanced technology vehicles and alternative fuels, such as electric, natural gas, and hybrid trucks. Likewise, for over two decades, the company has invested in alternative fuels, growing its global fleet to over 15,600 automobiles, including over 1,000 electric and plug-in hybrid vehicles. Thus, In order to achieve 40% alternative fuel use in ground operations by 2025, this expenditure is essential. Methane-reducing renewable natural gas was among the 162 million gallons of alternative fuels the company bought in 2021, accounting for 26.5% of total ground fuel use (About UPS, 2023).

Moreover, Justavino-Castillo et al. (2023) pointed out that the benefits of sustainable transportation for logistics include enhanced customer loyalty and company reputation. According to the author, sustainability is becoming a top priority for both consumers and businesses and enterprises that show a dedication to green logistics to improve their reputation. For instance, IKEA has incorporated electric trucks into its home delivery service in order to meet its 2030 carbon-neutral target. IKEA products are now delivered emission-free across 20 cities and more than 300 locations using more than 2500 EVs, enhancing the company's reputation and drawing in eco-aware customers. Shanghai was the first city to implement 100% electric vehicle (EV) home deliveries in 2019 (IKEA, 2019; Caballini, & Benzi, 2023).

In addition, Dobers et al. (2023) emphasised that clean fuels and route optimisation are two ways that sustainable transportation lowers greenhouse gas emissions. The authors emphasised that the use of clean fuels and optimised routes reduces air and water pollution and mitigates climate change. Additionally, by reducing harmful emissions like NOx, SOx, and PM10, cleaner technologies and alternative fuels enhance air quality and reduce water pollution. To achieve net-zero emissions by 2040, for instance, the international shipping company Maerskv has pledged to invest in ships that run on methanol and biofuel alternatives. (Maersk, 2025). Another advantage of sustainable transportation is that it promotes the efficient use of resources and renewable energy sources, so conserving finite natural resources. In logistics, sustainable transport also helps to preserve ecosystems and biodiversity by reducing pollution and environmental impact and preserving ecological balance (Kumar and Sharma, 2024). As highlighted in below given figure (fig 1), cities like Hong Kong, Zürich, and Paris lead in sustainable public transport, demonstrating how investments in efficient mobility systems contribute to greener logistics operations.



Source: According to Statista (2017)

Fig. 1. The World's Top Cities For Sustainable Public Transport

The image ranking Hong Kong as the top city for sustainable public transport supports the impact of sustainable transportation in logistics by demonstrating cost efficiency, reduced emissions, and improved mobility.

Challenges in Adopting Sustainable Transport in Logistics.

The adoption of sustainable mobility is significantly hampered by the high upfront costs of green technologies, claim Zhang et al. (2024). The high upfront expenses of green technologies, such as infrastructure for alternative fuels and vehicles that run on electricity and hydrogen, greatly impede the adoption of sustainable mobility. Small and medium-sized logistics companies sometimes struggle to justify these costs because of their poor profit margins. As an example, DHL, a leader in international logistics, has invested heavily in electric delivery trucks and alternative fuel technologies through its GoGreen project (DHL Express IN, 2024). However, the company still has problems because of the long payback times and hefty initial costs, particularly in developing nations. According to Tran et al. (2019), despite the successful introduction of electric fleets in urban areas, long-haul freight operations continue to rely on traditional diesel trucks due to their higher expenses.

Turnheim et al. (2015) also emphasised the operational and infrastructure problems associated with the shift to sustainable transportation, such as the need to invest in car fleets, charging stations, and logistical networks. According to IEA (2024), the absence of "mid-shift" fast charging is impeding the quick commercial adoption of electric trucks in long-distance and regional operations. While most energy needs might be met by off-shift charging, quick and ultra-fast charging is required to increase range and enable battery electric vehicles to carry out diesel-covered tasks with little dwell time. The availability of green fuel sources and high production costs have hindered Maersk's efforts to decarbonise its shipping operations through the use of biofuels and methanol-powered boats (Maersk, 2021; Maersk, 2024).

Similarly, governments around the world have implemented laws to lower carbon emissions in the logistics industry, according to Zhang et al. (2020). Logistics firms are left in the dark by unclear long-term regulations, inconsistent practices, and disparate emissions standards. For example, the EU's Fit for 55 policies, which aims to cut greenhouse gas emissions by 55%, makes it impossible for smaller businesses to comply with the law, while larger companies like DHL and DB Schenker invest in green fleets (DB Schenker, 2024).

Furthermore, Kachilala & Dumba (2022) noted that the logistics industry, which has historically relied on fleets driven by diesel, encounters opposition to implementing sustainable technology mainly due to the concerns of operational disruptions, cost, reliability, and perceived hazards. Adoption of sustainable solutions is sometimes slowed by internal opposition from decision-makers and staff. Similarly, supply chain intricacy and disarray impede the creation of environmentally friendly transportation options. Due to fragmentation and competitive concerns among manufacturers, transportation providers, and politicians, the Green Freight Asia initiative which was started to encourage fuel-efficient freight transportation in Asia failed (Asian Development Bank, 2014). Thus, it was evident that logistics companies were hesitant to cooperate and share data with rivals in spite of substantial environmental backing, underscoring the significance of efficient coordination and collaboration in attaining sustainability in logistics.

Opportunities for Sustainable Logistics

According to Wang et al. (2024), green logistics is a concept that aims to integrate environmentally sustainable practices into supply chains and transportation systems, reducing carbon footprints, minimising waste, and optimising resource efficiency across all logistics activities. For example, DHL has integrated over 20,000 electric delivery vans as part of its GoGreen Plus strategy, while Amazon hydrogen trucks offer a 1,000 km range and reduce CO_2 emissions from long-haul freight (DHL, 2024).

Furthermore, switching goods from road to rail is a practical method of lowering emissions in logistics, according to de Miranda Pinto et al. (2017). Higher capacity and greater energy efficiency make rail transport an extremely sustainable choice for high-volume logistics. With zero emissions, quicker refuelling times, and greater range than electric vehicles, hydrogen fuel cells are also a viable technology for sustainable logistics, according to Singh et al. (2015). The logistics industry stands to gain a great deal from this clean, scalable option as hydrogen refuelling infrastructure advances.

Similarly, Cherwoo et al. (2023) found that in place of traditional fossil fuels, fuel alternatives which comprise bioethanol and biodiesel are currently being used. These renewable energy sources have the potential to lower emissions from a variety of transportation vehicles, such as trucks, ships, and aircraft. Likewise, by integrating sustainable energy sources like solar or wind, these vessels can improve sustainability even further without sacrificing logistical efficiency.

Likewise, Barman et al. (2021) noted that governments are encouraging sustainable logistics by means of carbon pricing schemes, tax breaks, and subsidies. For instance, The European Green Deal provides financial incentives, including tax breaks and money for charging infrastructure, to encourage the adoption of green fleets (IEA, 2022). According to the California Energy Commission (2024), the Clean Freight Initiative, which offers financial incentives to switch from diesel fleets to electric or hydrogen-powered vehicles, also requires zero-emission trucks by 2045.

Moreover, Liu et al. (2023) added that to increase sustainability, logistics firms are adopting digital technologies, shared logistics networks, and the concepts of the circular economy. For example, by using a closed-loop system to fill empty truck slots with recyclable materials, IKEA's Circular Logistics Model collects used furniture, reduces waste, and optimises transportation routes. Additionally, fleet operations are being optimised, fuel consumption is being decreased, and route planning is being improved via automation and artificial intelligence. For example, UPS' ORION system has improved delivery efficiency and reduced emissions by saving 10 million gallons of fuel yearly (Holland et al., 2017).

However, significant investments in data infrastructure and cybersecurity concerns are necessary for AI-based logistics optimisation (Bécue et al., 2021).

Conclusions

The results made clear that there are advantages and disadvantages to incorporating sustainable transport options into logistics. Although sustainable transport improves long-term cost reduction, regulatory compliance, and company reputation, expensive upfront investment costs, insufficient infrastructure, and regulatory uncertainty prevent its widespread adoption.

Additionally, the logistics operations of corporations like DHL, IKEA, and Maersk are more sustainable thanks to effective initiatives like investing in alternative fuel vehicles, streamlining routes, and using digital technologies. However, due to operational restrictions, financial constraints, and varying policies across regions, the transition continues to be difficult.

Green technology developments, more infrastructure spending, and carefully thought-out government incentives can further hasten the transition to sustainable logistics. Overcoming these obstacles and easing the shift to ecologically friendly logistics methods require strategic cooperation between governments, corporations, and industry players. A more sustainable future can be achieved by the logistics industry by proactively addressing these problems and successfully striking a balance between economic growth and environmental responsibility.

Recommendations for Enhancing the Adoption of Sustainable Transport Solutions in Logistics

The following suggestions are put forth to improve the logistics industry's adoption of sustainable transport solutions, based on the examination of case studies and literature.

Manage upfront investment: The development of green transport infrastructure should be a top priority for the sector by utilising the government and private fund that will help to build infrastructure for electric vehicle (EV) charging stations, hydrogen refuelling stations, and green freight corridors. Also, logistics companies should also be encouraged to switch to low-emission fleets by introducing financial incentives including tax exemptions, subsidies, and carbon credits. Here, the fund from governments in the for of applying subsidies and loan from private entities can help to overcome the fund constraints (Le Pira et al., 2017).

Improve inadequate infrastructure: Public-Private Partnerships (PPPs) are an essential means of collaboration because they allow governments and logistics companies to work together to speed alternative fuel research and infrastructure development (Miller et al., 2024).

Manage regulatory uncertainty: In addition, reducing emissions and empty truck runs can also be achieved by promoting shared freight networks and route optimisation (Konstantakopoulos et al., 2021). Additionally, the integration of digital technologies like blockchain and AI-driven transport management systems (TMS) can guarantee carbon footprint transparency, optimise fuel use, and improve logistical efficiency (Samsun et al., 2022). This will reduce complications and complexities from authorities in the form of regulations and ban. Moreover, programs for sustainability awareness and worker training should be put in place to inform staff members about environmentally friendly logistics techniques. Public awareness initiatives and certification programs for green logistics specialists help accelerate the shift to sustainable logistics by striking a balance between economic efficiency and environmental responsibility (Wojewnik-Filipkowska & Węgrzyn, 2019).

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