SUSTAINABILITY TRENDS AND PRACTICES IN THE FREIGHT DISTRIBUTION INDUSTRY

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Summary

The research aims to identify emerging sustainability trends and practices in the freight distribution industry. The objectives include identifying theoretical aspects, conditions, challenges, and providing recommendations for implementing sustainable practices. To achieve these aims, the study employs a combination of literature review and in-depth case studies. The literature review analyzes existing research on sustainability trends and practices in freight distribution, providing insights into drivers, challenges, and opportunities. Complementing this, case studies of specific freight distribution organizations offer detailed insights into effective implementation techniques and best practices. The study highlights key technologies for sustainability in freight transportation, including battery electric vehicles, hydrogen-powered fuel for long-haul trucking, high-speed connectivity, for the deployment of autonomous vehicles and route optimization, as well as alternative fuels, cargo handling equipment and eco-driving. Despite the potential benefits of sustainability practices, challenges persist, including consumer preferences for time and cost over sustainability, lack of demand for energy-efficient procedures, and policy limitations. Addressing these challenges requires collaborative efforts and comprehensive policy approaches tailored to specific economic, political, and social contexts. Overall, the research provides stakeholders in the freight distribution industry with practical advice on achieving sustainable outcomes by integrating emerging technologies and practices effectively.

Keywords: freight distribution, sustainability, alternative fuels, battery electric vehicles, hydrogen-powered fuel, cargo, policy limitations.

Introduction

The freight distribution sector is undergoing significant transformations driven by the new era of emerging technologies and imperativeness to adopt to sustainable practices. The relevance of this paper is paramount in the current context of global efforts to promote sustainability. Given the transportation sector's enormous contribution to greenhouse gas emissions and environmental damage, the emphasis on sustainability in freight distribution has never been more important.

In today's world, when climate change issues are at the forefront of public conversation and governments are progressively enforcing tough rules to reduce environmental consequences, the need for sustainable freight distribution procedures has become an urgent priority. This study tackles this need by looking at emerging trends and strategies that can help the sector transition to a more sustainable future.

The novelty of this paper lies in its comprehensive approach, which combines theoretical analysis with case studies to provide practical insights and recommendations for stakeholders in the freight distribution industry. Additionally, this study investigates not only the motives and prospects for sustainability, but also occurring obstacles and impediments that businesses encounter while implementing sustainable practices. By identifying these challenges, the report provides significant insights into the gap between theory and practice, revealing areas that require more investigation and action.

Research aim: To identify the emerging sustainability trends and practices in freight distribution sector, specifically focusing on freight management and last-mile delivery.

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

1. To identify theoretical aspects of emerging sustainability trends in the freight distribution sector.
2. To determine the conditions of applying sustainable practices in the freight distribution sector.
3. To identify the challenges of sustainable trends implications.
4. To provide recommendations to organizations in freight distribution industry by using sustainability trends.

Research object and methods

Research object: emerging sustainability trends in freight distribution industry.

To achieve the research aim and objectives, researcher has begun with analysing the theoretical background on the topic of emerging sustainability trends in freight distribution industry. Comprehensive analysis of existing research on the emerging sustainability trends and practices of freight distribution will be conducted to provide theoretical explanations, background information, and a foundation for contrasting actual results. This literature review will offer valuable insights into the drivers, challenges, and opportunities associated with sustainability technologies and trends in the freight distribution sector.

To complement the literature review, in-depth case studies of specific freight distribution organizations will be undertaken. These case studies will offer detailed insights into effective implementation techniques, cutting-edge technology adoption, and best practices in digital freight management and last-mile delivery. By examining real-world

examples, the research aims to identify successful strategies and practical solutions that can be replicated across the industry. Overall, by employing a combination of research techniques, including case studies and literature review, this study seeks to provide stakeholders with practical advice on achieving sustainable and effective freight distribution outcomes.

Research results and discussion

Type of sustainability trends and practices implied in freight distribution industry

According to a report from National Transport Authority (2021), there are many technologies that are being implemented to drive sustainability among the freight distribution industry. Such technologies include: Alternative fuels, alternative fuel infrastructure and cargo handling equipment. The article highlights the transportation sector's shift to cleaner energy sources, such as electrified vehicle powertrains, which include battery electric and hydrogen fuel cell technologies. It emphasizes the importance of government actions, such as future restrictions on gasoline and diesel engines, in accelerating this shift. The emphasis is on decarbonization and improved air quality, with measures targeted at combating climate change and improving citizen health. However, the decarbonization process differs across the freight industry, with road haulage posing unique issues due to the prevalence of diesel-fueled Heavy Goods Vehicles (HGVs). Despite coordination among corporate and government partners, decarbonising this sector remains difficult.

An article by Vienazindiene et al., has focused on revealing a Green Logistics practices seeking development for sustainable development (2021). Authors have identified these influential factors that play a role on freight distribution industry, which includes: green transportation, monitoring of emissions from vehicles, use of biofuels in vehicles, use of alternative or new energy vehicles, reduction of used vehicles, optimization of transport routes, optimization of transport cargo distribution, eco-driving, use of intermodal transport (Vienazindiene et al., 2021). Furthermore, few articles researched for this study emphasize the need of eco-driving training, technical advancements, and responsible contracting in improving energy efficiency and lowering the environmental effect in freight transportation (Vienazindiene et al., 2021; Nkesah S.K., 2023).

Authors stated that by implementing these practices the freight distribution industry can optimize resource utilization, lower operating costs, and boost enterprise competitiveness in both domestic and international markets (Vienazindiene et al., 2021). According to the research, when it comes to green practices, businesses prefer to emphasize economic rewards over strictly environmental concerns (Vienazindiene et al., 2021). While economic gains may be a motivator, the study emphasizes the necessity of understanding the broader impact of Green Logistics practices on sustainability objectives. This analysis highlights the importance of balanced methods that take into account both economic viability and environmental responsibility while promoting sustainable freight distribution practices.

Several initiatives and strategies have been pointed out by different authors for greening vehicle fleets and improving environmental sustainability in logistics operations (Lieb and Lieb, 2010). These include employing cleaner vehicles, alternative fuels, switching to more fuel-efficient modes of transportation, sharing vehicles, regulating speeds, rethinking network architecture, and implementing management measures such as freight consolidation and lowering vehicle idling time. Furthermore, the author emphasizes the importance of Information and Communication Technology (ICT) applications in boosting transportation efficiency through planning, routing, and fleet tracking and tracing capabilities (Marchet et al., 2014).

Founder and CEO of Einride, Flack (2022) states that transportation's shift to electricity is predicted to be swift, owing mostly to the cost parity between electric vehicles (EVs) and internal combustion engine vehicles. Nevertheless, decarbonizing freight transportation remains an urgent challenge due to its large contribution to global greenhouse gas emissions. Alongside with electrification changes stated in the report, there were few key technologies determined for sustainability in freight transportation, they include battery solutions, network and communication means advanced technology (Embracing Technology …, 2022). Battery technology plays a significant role in enabling sustainable freight transportation. Batteries are essential for storing and delivering electrical energy to power electric vehicles efficiently.

High-speed and reliable connectivity solutions, such as 5G networks, are essential for the successful deployment of autonomous vehicles in freight transportation (Embracing Technology …, 2022). Reliable connectivity is crucial for enabling operational capabilities, especially in driverless vehicles.

These technologies, when integrated and deployed effectively, have the potential to optimize route planning, track capacity across vehicle fleets. Moreover, they will ultimately reduce greenhouse gas emissions in freight transportation by up to 90 % (Embracing Technology …, 2022). Additionally, the combination of electrification, battery solutions, and 5G connectivity can reshape the transportation landscape and drive significant advancements towards sustainability in the industry.

Additionally, the report has highlighted the key emerging trends of sustainability in the freight distribution industry, those include battery electric vehicles (BEVs) that are increasingly becoming cost-effective for short-haul freight, but long-haul transportation faces obstacles (Embracing Technology …, 2022). Hydrogen-powered fuel is considered as a solution, providing rapid refilling and increased mileage. Hydrogen is predicted to play an essential role in decarbonizing shipping freight, especially among medium and heavy-duty trucks, with vehicles accounting for around 95% of demand.

Conditions to enhancing sustainability trends in the freight distribution industry

One of the most influential condition and factor on the enhancement of sustainability trends in freight distribution industry was found to be an adoption of new technologies in freight transport. Some of these technologies may include information and communication technology (ICT), big data, vehicle design enhancements, platooning, autonomous driving, and eco-friendly cars (Nkesah, 2023; Marchet et al., 2014).

Moreover, policies introduced by logistics companies or the government can positively influence the sustainability trends in freight distribution industry. Nkesah's (2023) research identifies many factors and solutions for policymaking, management, and stakeholder collaboration in freight transportation networks. These elements include rewarding behavior change, instituting policy measures such as congestion charges and incentives for higher load factors, and enacting laws and interventions such as traffic enforcement and vehicle usage rates (Nkesah, 2023). These policies can enhance sustainability by rewarding actions that reduce greenhouse gas (GHG) emissions and increase energy efficiency in freight transportation. Congestion charges, incentives for better load factors, and vehicle utilization rate laws all help to promote improved transportation practices. Furthermore, measures such as purchase incentives and tax exemptions for electric vehicles (EVs) encourage the use of cleaner technology. In addition, traffic flow restrictions and responsible contracting help to reduce the environmental effect while supporting sustainable practices in the transportation business (Nkesah, 2023). Overall, these policies seek to prevent climate change by lowering greenhouse gas emissions and promoting more sustainable transportation habits.

The research made by Nkesah (2023), additionally focuses on strategies implied by stakeholders that may contribute to promoting sustainability in the freight distribution sector, paper discusses numerous critical elements that influence sustainability trends in the freight distribution industry. The need of integrating consumer demands with sustainable practices, as well as the necessity for regulatory pressure and support to encourage environmentally friendly operations among logistics service providers. Moreover, the research shows the importance of corporate sustainability reporting and driver behavior training in meeting sustainability objectives, demonstrating a holistic approach to improving industrial sustainability (Nkesah, 2023).

Challenges in implementing sustainability practices in the freight distribution industry

By implementing the sustainability practices in logistics, specifically in freight distribution industry, many organizations face challenges related to sustainability. These problems include consumers choosing time and cost over sustainability, a lack of shipper demand for energy-efficient procedures, and the absence of sustainability plans in many logistics service providers' goal and vision statements. These challenges emphasize the importance of mandated corporate sustainability reporting among logistics service providers, as well as addressing driver behavior in order to minimize fuel consumption and improve road safety (Abbasi, Nilsson, 2016). Overall, these problems highlight the complicated landscape necessitating collaborative efforts to enhance sustainability in freight distribution.

Existing taxes and policies in states could be considered a challenge. Many researchers point out that strengthening the policies and laws regarding the sustainability in logistics allow freight distribution companies to prefer cost or time effective solutions rather than implementing sustainable technologies and trends (Pereseina et al., 2014; Nkesah, 2023).

The importance of comprehensive policy approaches that use a variety of tools and stakeholder collaboration to effectively solve road freight emissions concerns is proven (Tavasszy and Piecyk, 2018). It emphasizes the importance of taking into account each country's specific economic, political, and social situations when developing and executing such programs.

Congestion, pollution, and cost problems are among the sustainability challenges associated with modality in freight transportation. These issues develop as a result of the important features of flexibility, speed, and time associated with road freight transit, which leads to last-mile reliance on roads. These difficulties affect the proper integration of various forms of transportation as well as efforts to effectively manage emissions and traffic congestion (Tavasszy and Piecyk, 2018).

Recommendations to increase the sustainability practices in the freight distribution industry

Modality challenges discussed earlier could be handled by the idea of "intermodality," which entails combining several modes of transportation and administrative processes for freight shipment (Tavasszy and Piecyk, 2018). This technique is viewed as a suitable compromise for addressing emissions and congestion issues in road freight. Rail and water modal combinations are viewed as supplementary or alternative choices for road freight transportation, particularly when managing international cargoes. However, integrating intermodality presents obstacles such as infrastructure limits, decision support systems, interoperability, and transitional deployment. Authors contend that investments in infrastructure such as railways, jetties, hubs, and freight corridors are critical for successful modality-based interventions (Tavasszy and Piecyk, 2018).

As a recommendation, subsequent research may focus on developing decision support tools to aid the transition and planning process, with policymakers having a crucial role.

Implementing other sustainable transport means for freight distribution is essentially recommended for businesses operating in the industry, i.e. rail freight has a critical role to play in facilitating the shift to more sustainable freight. The Covid-19 outbreak has highlighted the stability and resilience of railway transport, opening up opportunities to collect more diverse freight that would otherwise be transported by road (Enhancing the …, 2021). Additionally, optimizing bulk loading can improve efficiency and productivity. Extended border closures highlight the need for a strong supply chain to efficiently channel demand, improve customer experiences, and enable direct-to-consumer commerce. Railway management must be adaptable and aggressive in reducing waste and adopting new technology.

Conclusion

1. Through comprehensive research and analysis, this study has achieved its objectives of identifying emerging sustainability trends. Sustainability trends in freight distribution include the use of alternative fuels, the optimization of transportation routes, the use of cleaner vehicles, and the adoption of Information and Communication Technology (ICT)

to improve efficiency. The conditions of enhancing sustainability trends were deployment of new technology, such as ICT and eco-friendly vehicles, as well as supporting regulations from logistics businesses and governments. Additionally, research determined that executing sustainability practices in the freight distribution industry encounters challenges that involve consumer prioritization of time and cost over sustainability, insufficient demand for energy-efficient procedures from shippers, and a lack of sustainability strategies within logistics service providers, all of which necessitate collaborative efforts and policy enhancements to effectively address. To sum up, the recommendations found by the researcher were to use intermodality to reduce emissions and congestion, establish decision support tools, invest in infrastructure, and prioritize various sustainable transportation options such as rail freight to improve supply chain efficiency and resilience.

2. Moving forward, further research may focus on empirical study having the foundation of this theoretical research. It may focus on the challenges and recommendations for implication of sustainable trends in freight distribution or logistics sector.

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