

THE ROLE OF GREEN INNOVATIONS IN BUSINESS LOGISTIC

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Abstract

Green innovations are now a key tactic for businesses looking to lessen the environmental effect of their logistics operations. Transportation, warehousing, and packaging are examples of logistics operations that greatly increase greenhouse gas emissions and environmental deterioration. Businesses are incorporating eco-friendly innovations into their logistics systems as environmental regulations tighten, and consumers demand more sustainable practices. Analysing the function of green innovations in business logistics is the goal of this study. Research aims to analyse the role of green innovations in business logistics based on scientific literature. The study's foundation is an analysis of scientific literature with an emphasis on sustainable supply chain management and green logistics. To determine how green innovations affect logistics performance, eight scholarly studies were examined. The findings demonstrate how innovations like eco-friendly packaging, route optimization systems, electric transportation technologies, and reverse logistics procedures greatly increase operational efficiency and environmental sustainability. The results show that green innovations can lower logistics costs, increase resource efficiency, and give businesses in cutthroat markets a competitive edge.

Keywords: green innovation, green logistics, sustainable supply chain, eco-innovation.

Introduction

Sustainability of the environment has become a significant global corporate concern. Climate change, environmental legislation, and public awareness of sustainability are forcing businesses to reconsider their traditional business strategies.

Logistics operations are crucial to international supply chains, but they can significantly increase greenhouse gas emissions through distribution and transportation. Traditional logistics management has prioritised efficiency and cost reduction. However, modern logistics techniques are increasingly incorporating environmental considerations into company operations. This shift has led to the emergence of green logistics, which focuses on reducing the environmental impact of logistics systems through the adoption of sustainable technologies and practices.

Previous studies have shown that green technologies can improve both environmental sustainability and operational effectiveness. Companies may reduce emissions, optimise resource consumption, and improve their reputation by using sustainable logistics strategies. Analysing the role of green innovations in business logistics is essential to understanding how companies can achieve sustainable development.

Research aim: to analyse the role of green innovations in business logistics based on scientific literature. The following **objectives** have been set to achieve the aim:

1. To identify the main types of green innovations applied in business logistics systems.
2. To analyse the environmental and operational benefits of implementing green innovations in logistics activities.
3. To evaluate how green innovations contribute to improving logistics performance and sustainable supply chain development.

Research object and methods

The object of this study is the role of green innovations in business logistics. The environmental effects of logistics operations have drawn more criticism in recent years, especially with regard to trash production, energy use, and carbon emissions. At the same time, governments, consumers, and global sustainability norms are putting increasing pressure on businesses to lessen their environmental impact. In response to these issues, several companies are integrating green innovations into their logistical processes. These innovations include digital solutions that reduce the environmental impact of logistics systems while maintaining operational performance, eco-friendly technologies, and sustainable management strategies.

The research focuses specifically on understanding how green innovations influence business logistics performance. The study examines the ways in which innovations such as electric transportation technologies, route optimisation systems, eco-friendly packaging solutions and reverse logistics processes contribute to improving environmental sustainability and operational efficiency in logistics systems.

The research attempts to determine the primary categories of green innovations used in logistics and assess their influence on business performance by analysing the body of existing scholarly literature. The connection between sustainable logistics methods and important results like lower emissions, cost effectiveness, and competitive advantage is given special consideration.

This study uses a qualitative research methodology that is grounded in an analysis of scientific literature. Because it enables researchers to methodically examine and compare current scientific knowledge, literature analysis is frequently used in management and logistics research. There were multiple primary phases to the research process. First, international academic databases like Google Scholar, Scopus, and Web of Science were used to find pertinent scholarly articles about green logistics, sustainable supply chain management, and environmental innovation. These databases were chosen because they offer peer-reviewed research in the domains of sustainability and logistics. Second, eight scientific articles were chosen because they were pertinent to the subject of the study. The chosen studies concentrate on different facets of green logistics, such as digital supply chain innovations, circular economy principles, sustainable transportation, and reverse logistics. Both recent studies and well-known foundational research in the field were prioritized. Third, the selected articles were carefully analysed in order to identify the key themes and findings related to green innovations in logistics. The analysis focused on three main dimensions:

- Types of green innovations applied in logistics systems;
- Environmental benefits of these innovations;
- Operational and strategic impacts on logistics performance.

Through this analytical process, the study finds common patterns about the role of green innovations in business logistics by comparing the findings of various researchers. The research results and discussion section, which examines the connections between green innovations, sustainable logistics practices, and logistics performance, summarizes and presents the findings of the literature analysis. This methodological approach enables the research to offer a systematic understanding of how green innovations help traditional logistics systems become more efficient and sustainable supply chains.

Research results and discussion

The examination of the chosen studies shows that green innovations are crucial for enhancing the sustainability and effectiveness of corporate logistics systems. A number of innovations that lessen environmental impact while preserving operational performance are highlighted in the literature.

Sustainable transportation technologies are among the most significant areas of green innovation in logistics. McKinnon (2018) asserts that a sizable portion of supply chain greenhouse gas emissions are caused by freight transport. The author emphasizes that emissions produced by logistics operations can be considerably decreased by implementing low-carbon transportation technologies such as electric vehicles and alternative fuels. This implies that transportation innovation is a crucial component of the shift to sustainable logistics systems.

Digital transformation has also emerged as a key driver of green supply chain efficiency. Liao et al. (2024) demonstrate that digital transformation significantly improves corporate green supply chain performance by promoting green innovation, reducing transaction costs, and alleviating financing constraints. Their findings suggest that the adoption of digital technologies enables firms to optimize supply chain processes, enhance resource allocation, and strengthen overall operational efficiency while simultaneously reducing environmental impact.

The research that has been examined also heavily emphasizes the idea of reverse logistics. Govindan et al. (2015) explain that reverse logistics systems allow businesses to collect used goods, packaging materials, and other resources for recycling or remanufacturing. This process helps reduce waste and supports the application of circular economy principles in supply chain management.

Geissdoerfer et al. (2017) provide additional analysis of the relationship between circular economy practices and sustainable logistics. According to their research, businesses can significantly improve resource efficiency and reduce environmental pressure associated with production and distribution activities by integrating circular economy strategies into logistics operations.

Furthermore, Sarkis et al. (2011) emphasize the importance of green supply chain management as a strategic approach to improving environmental performance. Their research indicates that companies adopting sustainable logistics practices often enhance their corporate reputation and gain a competitive advantage in environmentally conscious markets.

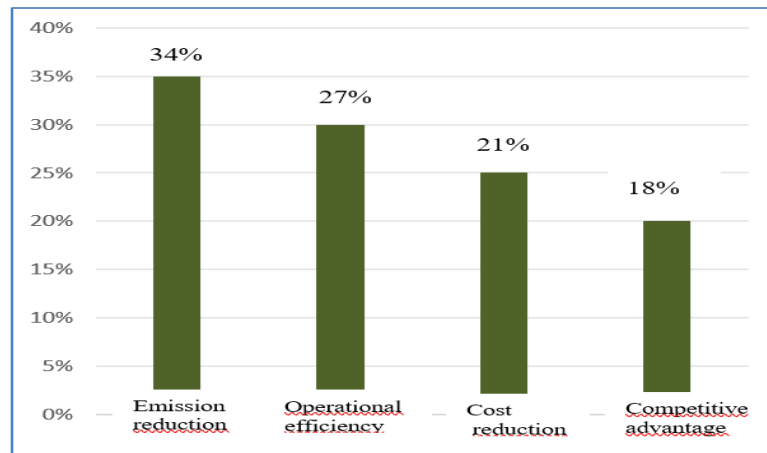
The importance of digital transformation in sustainable supply chains is also highlighted by recent studies. Centobelli et al. (2023) note that digital technologies improve transparency and enable businesses to better monitor logistics operations. Improved information sharing across supply chains supports better decision-making and helps identify opportunities to reduce environmental impact.

Porter and van der Linde (1995) suggest that environmental innovations can provide businesses with a competitive advantage from a strategic perspective. Their theory indicates that investments in eco-friendly technologies often lead to improvements in productivity and innovation capacity.

The findings of Srivastava (2007) also support the idea that integrating green logistics practices into supply chain management can generate both economic and environmental benefits. Businesses can improve operational efficiency and reduce environmental risks by adopting sustainable logistics solutions.

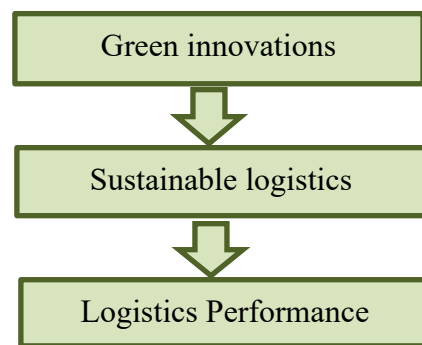
The primary categories of green innovations used in logistics systems and their effects on operational and environmental performance are shown in Table 1, which summarizes the findings of the literature review. The main performance outcomes associated with the implementation of green innovations in logistics operations are also illustrated in Figure 1.

Overall, the reviewed studies indicate that green innovations contribute to sustainable logistics development through several mechanisms, including emission reduction, improved operational efficiency, cost optimisation, and enhanced competitive advantage.



Source: Mckinnon (2018); Liao et al. (2024); Srivastava (2007); Sarkis et al (2011).

Fig. 1. Impact of green innovations on logistics performance



Source: Govindan et al. (2015); Sarkis et al. (2011); Srivastava (2007).

Fig 2. Conceptual Framework of green innovations in business logistics

The main types of green innovations identified in the literature are presented in Table 1. These innovations represent the most common sustainability practices implemented in logistics systems

Table 1. Green innovations in business logistics identified in literature

Years	Reference	Green innovation	Description	Main impact on logistics
2018	A.Mckinnon 2018	Electric and low-emission transport	Use of electric vehicles and alternative fuels in freight transport	Reduction of CO ₂ emissions in logistics operations
2024	Liao et al. (2024)	Digital transformation in supply chains	Use of digital technologies, data analytics, and digital platforms to improve supply chain operations	Improved green supply chain efficiency, lower transaction costs, and optimized logistics performance
2015	K. Govindan et. al, 2022	Reverse logistics systems	Collection and reuse of products and materials after consumption	Waste reduction and resource recovery
2011	J. Sarkis et al.2011	Green supply chain management	Integration of environmental practices across supply chains	Improved sustainability and operational performance

Source: compiled by the author based on A. McKinnon (2018); Liao et al. (2024); K. Govindan et al. (2015); J. Sarkis et al. (2011)

As shown in Table 1, different types of green innovations influence logistics performance through emission reduction, improved operational efficiency and resource optimisation.

Conclusions

1. The research revealed various essential categories of green innovations being implemented in logistics systems, such as digital route optimization systems, green packaging, electric vehicles technology, reverse logistics, and more. Recent developments demonstrate the strategies used most frequently by companies to mitigate environmental impact in logistics.

2. According to the analysis, the implementation of green technologies can offer significant operational and environmental benefits. The things which are better waste management in logistics systems, lower fuel use, less carbon emissions, and more efficient resource use.

3. The results of this study indicate that going green would also help sustain supply chains. By implementing these eco-friendly practices and technologies in their logistics operations, companies can enhance their competitive position and reduce their environmental impact.

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