Green Logistics Management Practice: A Path Exploration in the Context of a Low-Carbon Economy

Yingyi Wan, Yiyi Cai, Guoqiu Wu

Shenyang Normal University, Shenyang 110034, Liaoning, China
DOI: 10.32629/memf.v5i6.3359

Abstract: In the context of low-carbon economy, the logistics industry is facing an urgent need for green transformation, and green logistics management has gradually become a key path to achieving sustainable development. This article analyzes the practical path of green logistics management and proposes effective strategies in packaging, transportation, technological innovation, and circular economy system, aiming to improve resource utilization efficiency while reducing carbon emissions. In response to the challenges of cost pressure and technological deficiencies in green logistics management, this article explores the balance between economic and environmental benefits through integrated management and multimodal transport, providing a systematic reference for logistics enterprises' low-carbon transformation.

***Keywords*:** low-carbon economy; green logistics; management strategy; technology innovation; sustainable development

1. Introduction

Under the dual pressures of global climate change and resource scarcity, a low-carbon economy has gradually become the main theme of development across industries. The logistics industry, with its high energy consumption and carbon emissions, faces an urgent need for green transformation. Green logistics management not only involves optimizing transportation methods and improving energy efficiency but also encompasses all aspects from warehousing and packaging to distribution, aiming to systematically reduce resource waste and environmental pollution. However, in practical application, green logistics management encounters challenges such as a lack of technological tools and rising logistics costs. Many logistics enterprises have a superficial understanding of green management, lacking refined process adjustments and the in-depth application of environmental protection technologies. Moreover, green logistics management demands energy savings and emissions reductions without compromising service efficiency. Balancing efficiency with environmental benefits remains a key challenge in current green logistics management practices.

2. Core Issues and Challenges in Green Logistics Management

2.1 Insufficient Understanding of Low-Carbon Concepts

The long-term benefits of green logistics and the importance of low-carbon principles are not yet widely understood within logistics companies, particularly among small and medium-sized enterprises. Many managers, driven by short-term profits, associate environmental protection solely with cost increases, overlooking the potential value of green logistics in enhancing competitive advantage and brand image[1]. They fail to recognize the long-term competitive benefits that green logistics can bring. Additionally, many companies have only a superficial understanding of low-carbon principles, often lacking strategic depth. Faced with rapid market growth, companies tend to focus on reducing operational costs, preventing a top-down low-carbon culture from forming within the organization. This lack of understanding hinders the sustained momentum needed to implement green logistics management comprehensively within the company.

2.2 Deficiencies in Green Technology Application and Technical Foundation

The effective implementation of green logistics relies on advanced technical support; however, in practice, logistics companies face significant technical deficiencies. A lack of informatization and digitalization makes it challenging for many companies to achieve real-time monitoring and process optimization across transportation, warehousing, and distribution stages, resulting in limited visibility of resource consumption and emissions across the logistics chain. Without big data analytics, IoT, and smart technology, companies struggle to collect and analyze energy consumption data effectively, limiting their ability to identify and optimize high-energy-use areas. This not only restricts the practical impact of green management to superficial measures but also hampers genuine green and precise logistics process implementation[2].

2.3 Cost Pressure and Economic Burden of Green Transition

Green logistics management requires capital-intensive investment, including costs for energy-saving equipment, technology upgrades, process optimization, and eco-friendly materials, creating a particularly heavy burden for small and medium-sized logistics companies[3]. During the green transition, companies must invest in new energy vehicles, intelligent management systems, and sustainable packaging materials. Although these measures can reduce operational costs in the long term, they impose considerable short-term financial pressure, especially for low-margin companies. Additionally, green logistics demands energy savings without compromising efficiency, often creating a conflict between these two objectives. In balancing cost-effectiveness, companies may adopt conservative strategies, limiting the full-scale implementation of green logistics and preventing the development of sustainable practices.

3. Practical Pathways for Green Logistics Management

3.1 Implementing an Integrated Green Logistics Management Model

The integrated green logistics management model emphasizes closely connecting each phase of the logistics process to achieve low carbonization through systematic management. Specifically, in packaging, companies can adopt biodegradable or recyclable materials, design packaging sizes rationally, and reduce excessive packaging to minimize environmental impact at the source. In the transportation phase, integrated management helps lower carbon emissions by optimizing transport plans and routes and adopting green transportation methods such as hybrid and new-energy vehicles, enhancing both the environmental and economic efficiency of transportation. This model also improves coordination between warehousing and distribution, allowing for intelligent resource allocation that reduces energy consumption and operating costs, thereby achieving both economic and environmental benefits[4]. Effective integrated management not only conserves energy but also ensures consistency and efficiency in logistics services.

3.2 Efficient Application of Multimodal Transportation

Multimodal transportation plays a crucial role in green logistics by combining multiple transport methods, such as road, rail, and water, to significantly reduce carbon emissions in transportation[5]. For long-distance and large-volume shipments, prioritizing rail or water transportation minimizes energy use and emissions, alleviating the burden on road transport and enhancing overall logistics efficiency. For short-distance urban transportation, low-emission tools like electric or hydrogen-powered trucks are advantageous, meeting environmental needs and reducing noise pollution. Collaborating with third-party logistics platforms enables companies to integrate the strengths of multiple transportation methods, maximizing capacity utilization, avoiding empty trips, and minimizing energy waste. The effective use of multimodal transportation allows companies to increase transport efficiency while achieving a higher standard of environmental protection.

3.3 Technological Innovation and Intelligent Management

Technological innovation is decisive in green logistics management. By leveraging IoT, big data, and artificial intelligence, companies can monitor logistics processes in real-time, identify high-energy consumption areas, and optimize resource allocation to improve efficiency. For example, GPS technology enables dynamic route adjustments, reducing empty mileage and fuel consumption[6]. Additionally, big data analytics helps companies accurately forecast logistics demand, allowing for more scientific planning of vehicles and warehouse resources to prevent excessive energy consumption. Intelligent management systems also enhance coordination across various logistics stages, effectively reducing carbon emissions in actual operations. Through technological innovation, green logistics management can transition from traditional methods to a more flexible, efficient, and low-carbon intelligent model.

3.4 Building a Circular Economy System

In green logistics, establishing a circular economy system is a key strategy for minimizing resource waste and extending resource lifecycle. By implementing a reverse logistics system, companies can recycle and reuse packaging materials, logistics equipment, and waste, thereby reducing reliance on single-use materials and easing environmental pressure. Modular packaging designs enable easy dismantling, recycling, and reuse, creating a sustainable packaging chain. Furthermore, by strategically planning reverse logistics routes and setting up collection points, companies can achieve closed-loop resource utilization without compromising logistics efficiency. This approach aligns with green logistics principles and helps companies reduce long-term packaging and waste disposal costs, fostering a sustainable operational model and providing ongoing support for the company's low-carbon development.

4. Dual Support of Policy Guidance and Talent Development

The advancement of green logistics depends on both a supportive policy environment and a skilled talent pool[7]. On the policy level, establishing clear green logistics standards and environmental certification systems enables companies to more effectively implement green logistics strategies in their operations. A well-defined policy framework provides direction for the industry, helping logistics companies outline pathways to achieve green objectives and strengthening their commitment to energy conservation and emission reduction. Furthermore, policy support that alleviates the financial burden of transitioning to low-carbon practices—such as tax incentives or subsidies for green initiatives—makes green logistics practices more feasible and attractive, especially for small to medium enterprises facing tight budgets.

On the talent side, there is an urgent need for multidisciplinary professionals in green logistics. Beyond core logistics management skills, these individuals must have a deep understanding of low-carbon technologies and environmental principles. Within daily operations, companies can enhance their workforce's green logistics capabilities through technical exchanges, cross-departmental collaboration, and knowledge-sharing initiatives. This approach fosters a culture of innovation, enabling technical staff to propose novel low-carbon solutions aligned with operational goals. Moreover, partnerships between universities and companies can create specialized training programs to cultivate talent with both logistical expertise and a strong low-carbon mindset, ensuring that green logistics management is implemented effectively and can evolve with new industry advancements.

5. Conclusion

Against the backdrop of a low-carbon economy, green logistics management has become a vital pathway for the logistics industry to achieve sustainable development. Through practical approaches such as integrated management, multimodal transportation, technological innovation, and the establishment of a circular economy system, green logistics can effectively reduce carbon emissions while enhancing resource efficiency and competitiveness for enterprises. Although technical support and awareness challenges remain significant at the operational level, these obstacles will gradually be overcome as companies gain a deeper understanding of low-carbon principles.

The essence of green logistics management lies in balancing economic and environmental benefits for enterprises. By optimizing resource allocation and precisely controlling processes, it achieves both energy savings and improved service quality. Green logistics represents not only an environmentally friendly management model but also a future-oriented trend. Its advancement will bring new opportunities for the logistics industry, enabling companies to differentiate themselves in a competitive market and meet consumer demand for environmentally friendly services. In the future, driven by technological advancements and talent support, green logistics management will continue to evolve, fostering the industry’s green transformation and achieving a win-win outcome for both the economy and the environment.

Acknowledgments

This paper was supported by the following fund projects:

Liaoning Province Natural Science Doctoral Initiation Fund: Research on Balanced Optimization Method of Regional Logistics Network Layout Considering Low Carbon Constraints, 2022-BS-230, Hosted.

Liaoning Province Social Science Planning Fund: Research on Balanced Optimization of Multi level Regional Logistics Hub System for Low Carbon Requirements, L23BGL007, Chair.

Basic Research Project of Higher Education Institutions of Liaoning Provincial Department of Education, Research on Balanced Optimization of Low Carbon Urban Logistics Network Based on Digitalization, JYTMS20230996.

References

[1] Land List Exploration of Green Logistics Management and Technical Strategies in Low Carbon Economic Environment [J] Volkswagen Standardization, 2024, (17): 95-97.

[2] Zhu R . Exploring innovative strategies for green logistics management in the context of low-carbon economy [J]. Academic Journal of Business & Management, 2023, 5 (25).

[3] Bao Mingjie Research on Green Logistics Management Strategies under Low Carbon Economy [J] Railway Procurement and Logistics, 2023, 18 (11): 52-54.

[4] Wen Peng, Ma Yali, Ma Kezhen, etc Analysis of Green Logistics Management in Low Carbon Economic Environment [J] China Logistics and Procurement, 2023, (20): 103-104.

[5] Setyadi A ,Akbar K Y ,Ariana S , et al. Examining the Effect of Green Logistics and Green Human Resource Manage-

ment on Sustainable Development Organizations: The Mediating Role of Sustainable Production [J]. Sustainability, 2023, 15 (13).
[6] Berberoglu Y ,Kazancoglu Y ,Sagnak M . Circularity assessment of logistics activities for green business performance management [J]. Business Strategy and the Environment, 2023, 32 (7): 4734-4749.
[7] Beatrice M ,Simone Z . Technical note on “Inventory management in supply chains with consideration of Logistics, green investment and different carbon emissions policies” [J]. Computers & Industrial Engineering, 2023, 175.