Pinnacle Academic Press
Proceedings Series

Vol. 1 2025

Article **Open Access**

Green Supply Chain Management and Firm Performance in the Digital Era

Haoran Li [1,*]

[1] Universiti Sains Malaysia, Jalan Universiti, Gelugor, Pulau Pinang, 11700, Malaysia
* Correspondence: Haoran Li, Universiti Sains Malaysia, Jalan Universiti, Gelugor, Pulau Pinang, 11700, Malaysia

Received: 15 March 2025
Revised: 22 March 2025
Accepted: 09 April 2025
Published: 12 April 2025

Abstract: Against the backdrop of increasing global environmental awareness and the rapid development of the digital economy, green supply chain management (GSCM) has gradually become one of the important means to promote sustainable development and improve corporate performance. This paper explores the role of green supply chain management in promoting sustainable development and improving corporate performance in the digital economy era. This paper focuses on analyzing how digital technologies (such as big data, the Internet of Things, and blockchain) support the application of green supply chain management in enterprises, and explores the specific impact of green supply chain management on corporate financial performance, operational efficiency, and brand reputation. This study aims to analyze how enterprises can improve corporate performance through green supply chain management (GSCM) in the context of the digital economy, focusing on the application of digital technologies in green supply chains and their impact on reducing costs, improving efficiency, brand value, and environmental protection.

Keywords: digital economy; green supply chain management; corporate performance; sustainability; digital technology

1. Introduction

As global environmental issues become increasingly prominent, green supply chain management (GSCM) has become an important strategy for enterprises to seek sustainable development [1]. The advent of the digital economy has brought new opportunities and challenges to the green transformation of corporate supply chains [2]. By leveraging digital technologies enterprises can better improve resource utilization efficiency, reduce environmental impact, and drive profit growth [3]. However, the implementation of GSCM is not just a technical challenge it also requires innovation in corporate management and strategic adjustments. The digital economy provides solid technical support for GSCM, especially through technologies such as big data, the Internet of Things (IoT), blockchain, and artificial intelligence [4]. These technologies enable enterprises to achieve more efficient resource allocation and improved environmental monitoring. Therefore, it is of great significance to explore how the digital economy affects GSCM and its impact on corporate performance. This study aims to enrich the theoretical basis of GSCM in the digital economy era and to clarify the role of digital technology combined with GSCM in improving corporate performance.

2. Literature Review

With the rapid development of the digital economy, the way enterprises operate is undergoing profound changes. The widespread application of technologies such as cloud computing, big data, and the Internet of Things has provided solid technical support for the intelligence and efficiency improvement of supply chain management [5]. Green supply chain management (GSCM) is a strategic model that fully integrates environmental protection concepts into all aspects of the enterprise supply chain, including green procurement, green production, and green logistics. The core of GSCM is to reduce the negative impact of the supply chain on the environment by optimizing resource utilization and reducing waste and carbon emissions [6]. In practical applications, green supply chain management can significantly reduce the operating costs of enterprises. For example, Procter & Gamble (P&G) is a successful case of optimizing resource utilization and reducing production waste through big data analysis [7]. P&G uses a large number of internal and external data sets, real-time data from production lines, market demand data, and supply chain data to optimize its product production processes and supply chain management through big data analysis tools [8]. Specifically, P&G accurately predicts market demand through predictive analysis tools, avoiding resource waste caused by overproduction. In addition, they also use sensors and big data technology to monitor the operation of production equipment in real time, promptly discover and solve potential efficiency problems, thereby reducing resource waste caused by equipment failure [9]. The real-time monitoring capabilities of the Internet of Things technology further optimize the operating efficiency of the supply chain, not only improving logistics efficiency, but also optimizing energy use in transportation [10]. The benefits of this green management practice go far beyond reducing operating costs. It can also significantly improve the environmental performance of enterprises and lay the foundation for achieving sustainable development. In addition, the implementation of GSCM can also enhance the brand value and market competitiveness of enterprises [11]. Through green supply chain management, enterprises can not only reduce environmental burden and obtain economic benefits, but also achieve a win-win situation in terms of ecological performance and social image. This model helps enterprises win the trust and support of consumers and enhance their reputation. More importantly, the implementation of GSCM enables enterprises to quickly identify and respond to potential problems, further reducing resource waste and energy consumption. This comprehensive benefit is an important driving force for enterprises to move towards green transformation and sustainable development.

3. The Role of the Digital Economy in Promoting Green Supply Chains

Relying on advanced technology, the digital economy provides strong support for promoting and optimizing green supply chains. In this process, the application of technologies such as big data, the Internet of Things (IoT), and blockchain has significantly improved the transparency and traceability of the supply chain. These technologies enable companies to monitor the dynamics of each link in the supply chain in real time, including the production process, transportation routes, and environmental impact, thereby helping companies implement more precise environmental protection measures, such as adopting low-carbon transportation methods and optimizing production processes [12]. In addition, the combination of big data analysis and artificial intelligence (AI) helps companies manage resource allocation more efficiently, predict demand changes, and minimize excess inventory and production waste, thereby effectively reducing energy and resource consumption. By collecting and analyzing real-time data, companies can quickly respond to changes in market demand and fluctuations in environmental conditions, thereby optimizing the management efficiency of the green supply chain [13]. Digital platforms and cloud computing also play an important role in supply chain collaboration. They strengthen communication and information sharing among stakeholders, which not only accelerates the dissemination and application of environmental protection technologies,

but also helps the entire supply chain achieve green development goals [14]. At the same time, these technologies also promote the innovation of green products and services. Companies can meet growing consumer demand for sustainable products through smart design and customized production. In terms of logistics management, the application of digital solutions has significantly reduced carbon emissions during transportation.

In the digital age, the impact of digital technology on the supply chain has far exceeded improving operational efficiency. For example, FedEx is an example of optimizing transportation strategies by introducing IoT sensors into logistics operations [15]. FedEx has deployed IoT sensors in its transportation network to monitor vehicle routes, fuel efficiency, and the transportation status of packages in real time. The data provided by these sensors helps FedEx accurately plan the best transportation routes, thereby reducing unnecessary detours and empty runs, and reducing fuel consumption and carbon emissions [16]. Blockchain technology helps trace the source of raw materials by ensuring data integrity and trust among supply chain participants, providing credible certification support for environmentally friendly products. The digital economy also deeply integrates sustainable development and profitability [17]. Through digital markets and e-commerce platforms, companies can promote green products to consumers around the world, which not only expands the impact of sustainable practices but also meets the growing demand for environmentally friendly consumption. In addition, cloud-based enterprise resource planning (ERP) systems integrate sustainability indicators into daily management, helping companies monitor their carbon footprint and ensure compliance with environmental regulations [18]. In general, the digital economy provides strong technical support for the development of green supply chains, enabling companies to maintain their competitive advantages in the global market while pursuing sustainable development. This is all thanks to improved efficiency, greater transparency, and enhanced collaboration across the supply chain network.

4. The Impact of Green Supply Chain Management on Corporate Performance

4.1. Improvement of Financial Performance

Green supply chain management not only significantly improves the economic benefits of enterprises by saving costs, but also helps to increase revenue and expand market share, becoming an important strategy for enterprises to gain competitive advantages in the digital economy era [19]. In terms of cost, green supply chain management effectively reduces energy consumption and carbon emissions in the logistics process by optimizing transportation routes. This not only reduces operating costs, but also enhances the company's environmental responsibility image. In addition, through the collaborative management of the supply chain, enterprises can achieve more accurate inventory forecasting and control, reducing waste caused by excess inventory and scrap rates [20]. This efficient resource management model can optimize the company's production and storage processes, fundamentally reduce costs, and increase profit margins for the company. In terms of revenue and market expansion, the role of green supply chain management cannot be ignored. Through green supply chain management, companies can respond to this trend more quickly and launch environmentally friendly products that meet market demand. This can not only attract more environmentally conscious consumers, but also lock in more loyal customer groups, thereby increasing market share. In addition, due to their environmental value and high-quality positioning, green products can usually gain market recognition at a high price, creating higher revenue for the company. For example, leading companies such as Amazon have successfully established a green brand image and won the trust and favor of consumers by developing packaging made of biodegradable materials or producing low-carbon products [21]. By promoting green supply chains, companies can not only establish differentiated competitive advantages in the market, but also enhance their brand's sense of social responsibility and positive image, attracting more investors and business partners.

Driven by the digital economy, green supply chains can also combine advanced technologies such as the Internet of Things, blockchain, and big data analysis to further improve the transparency and efficiency of the supply chain and help companies better meet consumer needs and expectations [22]. In short, green supply chain management is not only a core means for companies to achieve sustainable development, but also an important tool to improve economic benefits, expand market share, and enhance brand competitiveness. By integrating green concepts into corporate operations, companies can not only reduce costs, but also create greater value for themselves, while contributing to global environmental protection, truly achieving a win-win situation of economic and social benefits.

4.2. Optimization of Operational Efficiency

Green supply chain management optimizes the supply chain management process of enterprises through digital technology, which significantly improves the company's operational efficiency. In the implementation of green supply chain, sensors, barcodes, RFID, IoT and other technologies are widely integrated and coordinated in every link of the supply chain, including procurement, manufacturing, transportation, warehousing, sales and other links [23], so that enterprises can quickly and fully obtain all the data needed in the production and sales process. By analyzing the supply chain data through big data, companies can identify operational bottlenecks and optimize processes such as resource utilization. Chen (2015) revealed that when enterprises can efficiently integrate and coordinate data from different links, they can effectively improve the responsiveness of the supply chain [24], thereby eliminating redundant steps and reducing energy consumption, and optimizing inventory management. For example, using IoT (Internet of Things) technology to connect objects in real life to each other and track inventory and transportation information in real time, companies can quickly identify problems such as logistics delays or inventory shortages, thereby reducing waste and uncertainty. It can collect, transmit and analyze various data in real time, so that equipment, systems and processes can be intelligently monitored and managed. This technology not only makes information more transparent, but also greatly improves work efficiency and provides the possibility for optimizing and simplifying complex processes.

With the help of network technology, information in the production process can be monitored in real time, which not only improves the control over the production process, but also makes demand forecasting more accurate [25]. By using real-time monitoring and collaboration platforms, companies can accurately predict demand, improve resource utilization and overall productivity. For example, on the big data platform in the field of new energy, through intelligent processing, power forecasting and resource assessment modules can be built to help supply chain managers make more accurate demand forecasts, thereby better planning and utilizing energy, reducing unnecessary resource waste, and achieving operational efficiency improvements throughout the entire production chain, thereby bringing better firm performance [26].

4.3. Enhancement of Brand Reputation

Green supply chain management emphasizes the transparency requirements of the supply chain. Enterprises need to share all relevant information in the supply chain upstream and downstream, and meet the goals of sustainable development in production, transportation, and sales. In today's digital technology era, the promotion of Internet technology has enabled enterprises' "green information" to spread rapidly on the Internet. If there is any violation of sustainable development, it will have a significant impact on the reputation and image of the enterprise [27].

On the contrary, if enterprises implement green supply chains, actively demonstrate their environmental responsibilities to the public through green certification or public environmental reports, it will increase public awareness of the enterprise [28]. This helps the

enterprise establish a positive image in the field of environmental protection [29]. This image building can attract more environmentally friendly consumers. Enterprises can show the public their commitment to sustainable development by sharing practical actions such as reducing waste, adopting renewable energy, and using environmentally friendly packaging. At the same time, it is also important to maintain operational transparency. For example, disclosing environmental data such as greenhouse gas emissions, water consumption, and energy consumption in the supply chain can help stakeholders more clearly understand the efforts and progress of the enterprise in environmental protection goals [30]. In addition, in the process of green supply chain management, companies can disclose their sustainable development initiatives to stakeholders, especially competitors and consumers, such as the creation of green supply chain policies by the European Union [31]. This not only establishes the company's leading position in sustainable business practices, but also helps it gain a more favorable negotiating position in cooperation with suppliers and partners. It also attracts investors and other stakeholders, creating broader economic benefits for the company [32]. It can also win the favor of consumers with strong environmental awareness and enhance brand reputation [33]. In an era of globalization and information transparency, consumers are more inclined to establish long-term relationships with socially responsible companies. Green supply chain management improves consumer trust and customer loyalty by implementing environmental measures and transparent supply chain processes [34]. As digital media spreads the message that companies have adopted green supply chain management, companies can not only attract old customers to continue patronizing, but also attract more new consumers, thereby improving the company's operating performance.

5. Conclusion

In the digital economy era, companies need to combine digital technology with green supply chain management to manage mailboxes, which can not only achieve environmental protection goals, but also improve overall operational efficiency and performance. This study provides a theoretical basis and practical path for management innovation and strategic adjustment of corporate profit-making methods, which will help companies achieve sustainable development during the green transformation process. It is clear from the research that green supply chain management has a significant positive impact on corporate performance. Digital technologies such as big data, the Internet of Things, and blockchain provide tremendous technical support for enterprises to achieve green supply chain management, enabling enterprises to achieve the dual goals of environment and economy at lower costs and higher efficiency. Green supply chain management not only helps improve corporate financial performance, operational efficiency and brand reputation, but also builds sustainable competitive advantages for companies in a highly competitive market. In the future, with the further development of the digital economy and technological innovation, corporate green supply chain management will continue to develop, and its role in promoting corporate performance will become increasingly important.

References

1. R. A. Rupa and A. N. M. Saif, "Impact of green supply chain management (GSCM) on business performance and environmental sustainability: Case of a developing country," *Bus. Perspect. Res.*, vol. 10, no. 1, pp. 140–163, 2022, doi: 10.1177/2278533720983089.
2. N. Saini, K. Malik, and S. Sharma, "Transformation of supply chain management to green supply chain management: Certain investigations for research and applications," *Cleaner Mater.*, vol. 7, p. 100172, 2023, doi: 10.1016/j.clema.2023.100172.
3. D. Hariyani, P. Hariyani, S. Mishra, and M. K. Sharma, "Leveraging digital technologies for advancing circular economy practices and enhancing life cycle analysis: A systematic literature review," *Waste Manag. Bull.*, 2024, doi: 10.1016/j.wmb.2024.06.007.
4. S. Chauhan, R. Singh, A. Gehlot, S. V. Akram, B. Twala, and N. Priyadarshi, "Digitalization of supply chain management with industry 4.0 enabling technologies: A sustainable perspective," *Processes*, vol. 11, no. 1, p. 96, 2022, doi: 10.3390/pr11010096.
5. H. Nozari, M. Fallah, H. Kazemipoor, and S. E. Najafi, "Big data analysis of IoT-based supply chain management considering FMCG industries," *Bizinform. (Eng.)*, vol. 15, no. 1, pp. 78–96, 2021, doi: 10.17323/2587-814X.2021.1.78.96.

6. M. Birasnav, R. Chaudhary, J. H. Dunne, J. Bienstock, and C. Seaman, "Green supply chain management: A theoretical framework and research directions," *Comput. Ind. Eng.*, vol. 172, p. 108441, 2022, doi: 10.1016/j.cie.2022.108441.
7. A. Raihan, "A review of the potential opportunities and challenges of the digital economy for sustainability," *Innov. Green Dev.*, vol. 3, no. 4, p. 100174, 2024, doi: 10.1016/j.igd.2024.100174.
8. L. Tan, Z. Yang, M. Irfan, C. J. Ding, M. Hu, and J. Hu, "Toward low-carbon sustainable development: Exploring the impact of digital economy development and industrial restructuring," *Bus. Strat. Environ.*, vol. 33, no. 3, pp. 2159–2172, 2024, doi: 10.1002/bse.3584.
9. L. Xia, S. Baghaie, and S. M. Sajadi, "The digital economy: Challenges and opportunities in the new era of technology and electronic communications," *Ain Shams Eng. J.*, vol. 15, no. 2, p. 102411, 2024, doi: 10.1016/j.asej.2023.102411.
10. S. Taj, A. S. Imran, Z. Kastrati, S. M. Daudpota, R. A. Memon, and J. Ahmed, "IoT-based supply chain management: A systematic literature review," *Internet of Things*, vol. 24, p. 100982, 2023, doi: 10.1016/j.iot.2023.100982.
11. Y. Yang, J. Chen, P. K. Lee, and T. C. E. Cheng, "How to enhance the effects of the green supply chain management strategy in the organization: A diffusion process perspective," *Transp. Res. Part E: Logist. Transp. Rev.*, vol. 175, p. 103148, 2023, doi: 10.1016/j.tre.2023.103148.
12. E. K. S. Wong, H. Y. Ting, and A. F. Atanda, "Enhancing supply chain traceability through blockchain and IoT integration: A comprehensive review," *Green Intell. Syst. Appl.*, vol. 4, no. 1, pp. 11-28, 2024, doi: 10.53623/gisa.v4i1.355.
13. J. Yi, S. Dai, L. Li, and J. Cheng, "How does digital economy development affect renewable energy innovation?" *Renew. Sustain. Energy Rev.*, vol. 192, p. 114221, 2024, doi: 10.1016/j.rser.2023.114221.
14. B. Li, C. Xu, Y. Wang, Y. Zhao, Q. Zhou, and X. Xing, "Digital transformation, supply chain collaboration, and enterprise growth: Theoretical logic and Chinese practice," *Eur. Res. Manag. Bus. Econ.*, vol. 30, no. 2, p. 100249, 2024, doi: 10.1016/j.iedeen.2024.100249.
15. M. Zheng and C. Y. Wong, "The impact of digital economy on renewable energy development in China," *Innov. Green Dev.*, vol. 3, no. 1, p. 100094, 2024, doi: 10.1016/j.igd.2023.100094.
16. J. Dian, T. Song, and S. Li, "Facilitating or inhibiting? Spatial effects of the digital economy affecting urban green technology innovation," *Energy Econ.*, vol. 129, p. 107223, 2024, doi: 10.1016/j.eneco.2023.107223.
17. X. Ma, X. Feng, D. Fu, J. Tong, and M. Ji, "How does the digital economy impact sustainable development?—An empirical study from China," *J. Clean. Prod.*, vol. 434, p. 140079, 2024, doi: 10.1016/j.jclepro.2023.140079.
18. P. Agarwal and A. Gupta, "Harnessing the power of enterprise resource planning (ERP) and customer relationship management (CRM) systems for sustainable business practices," *Int. J. Comput. Trends Technol.*, vol. 72, no. 4, pp. 102–110, 2024, doi: 10.14445/22312803/IJCTT-V72I4P113.
19. F. Liao, Y. Hu, M. Chen, and S. Xu, "Digital transformation and corporate green supply chain efficiency: Evidence from China," *Econ. Anal. Policy*, vol. 81, pp. 195–207, 2024, doi: 10.1016/j.eap.2023.11.033.
20. G. Sun, J. Fang, J. Li, and X. Wang, "Research on the impact of the integration of digital economy and real economy on enterprise green innovation," *Technol. Forecast. Soc. Change*, vol. 200, p. 123097, 2024, doi: 10.1016/j.techfore.2023.123097.
21. J. Dian, T. Song, and S. Li, "Facilitating or inhibiting? Spatial effects of the digital economy affecting urban green technology innovation," *Energy Econ.*, vol. 129, p. 107223, 2024, doi: 10.1016/j.eneco.2023.107223.
22. M. Javaid, A. Haleem, R. P. Singh, and A. K. Sinha, "Digital economy to improve the culture of industry 4.0: A study on features, implementation and challenges," *Green Technol. Sustain.*, vol. 100083, 2024, doi: 10.1016/j.grets.2024.100083.
23. T. Nguyen, Z. H. O. U. Li, V. Spiegler, P. Ieromonachou, and Y. Lin, "Big data analytics in supply chain management: A state-of-the-art literature review," *Comput. Oper. Res.*, vol. 98, pp. 254–264, 2018, doi: 10.1016/j.cor.2017.07.004.
24. D. Q. Chen, D. S. Preston, and M. Swink, "How the use of big data analytics affects value creation in supply chain management," *J. Manag. Inf. Syst.*, vol. 32, no. 4, pp. 4–39, 2015, doi: 10.1080/07421222.2015.1138364.
25. W. Jiang, "An intelligent supply chain information collaboration model based on internet of things and big data," *IEEE Access*, vol. 7, pp. 58324–58335, 2019, doi: 10.1109/ACCESS.2019.2913192.
26. M. Seyedan and F. Mafakheri, "Predictive big data analytics for supply chain demand forecasting: methods, applications, and research opportunities," *J. Big Data*, vol. 7, no. 1, p. 53, 2020, doi: 10.1186/s40537-020-00329-2.
27. J. Mageto, "Big data analytics in sustainable supply chain management: A focus on manufacturing supply chains," *Sustainability*, vol. 13, no. 13, p. 7101, 2021, doi: 10.3390/su13137101.
28. T. K. Eltayeb, S. Zailani, and T. Ramayah, "Green supply chain initiatives among certified companies in Malaysia and environmental sustainability: Investigating the outcomes," *Resour., Conserv. Recycl.*, vol. 55, no. 5, pp. 495–506, 2011, doi: 10.1016/j.resconrec.2010.09.003.
29. X. Yang, Y. Xu, A. Razzaq, D. Wu, J. Cao, and Q. Ran, "Roadmap to achieving sustainable development: Does digital economy matter in industrial green transformation?" *Sustainable Development*, vol. 32, no. 3, pp. 2583–2599, 2024, doi: 10.1002/sd.2277.
30. M. M. Fritz, "A supply chain view of sustainability management," *Cleaner Prod. Lett.*, vol. 3, p. 100023, 2022, doi: 10.1016/j.clpl.2022.100023.
31. H. Jafari, S. R. Hejazi, and M. Rasti-Barzoki, "Sustainable development by waste recycling under a three-echelon supply chain: A game-theoretic approach," *J. Clean. Prod.*, vol. 142, pp. 2252-2261, 2017, doi: 10.1016/j.jclepro.2016.11.051.

32. I. Olajos and S. Pálfay, "Integration of the Crisis Rules Created by COVID-19 into the European Common Agricultural Policy and Hungarian Agricultural Legislation," *Int'l J. Changing World*, vol. 3, p. 105, 2024, doi: 10.54934/ijlcw.v3i1.92.
33. S. Chen, Y. Song, and P. Gao, "Environmental, social, and governance (ESG) performance and financial outcomes: Analyzing the impact of ESG on financial performance," *J. Environ. Manag.*, vol. 345, p. 118829, 2023, doi: 10.1016/j.jenvman.2023.118829.
34. D. Hariyani, P. Hariyani, S. Mishra, and M. K. Sharma, "A literature review on green supply chain management for sustainable sourcing and distribution," *Waste Manag. Bull.*, 2024, doi: 10.1016/j.wmb.2024.11.009.