

The Impact of Green Logistics on the Sustainable Development of Enterprises

Xinyu Ye^{1,a,*}

¹*Business School, Nankai University, Xuefu Street, Tianjin, China*

a. christine.yeah@outlook.com

**corresponding author*

Abstract: This study examines the importance of green logistics for the sustainable development performance of enterprises. It analyzes the connotation and application of green logistics, the significance of corporate sustainable development, and the relationship between the two, to clarify the decisive influence of green logistics in contemporary enterprises. At the same time, it points out the existing problems in the development process of green logistics from multiple perspectives, indicating that the further development of green logistics requires the efforts and cooperation of enterprises, governments, and multiple parties in the supply chain. Following this positioning, several conceptual solutions are proposed, such as the innovation and sustainable utilization of green technology and green management in logistics, and the government's role as a third party in regulating the application of green logistics. The research results have theoretical significance, highlighting the impact of green logistics on corporate sustainable development and the important role of the government in sustainable development. The practical significance includes improving corporate sustainable development performance indicators in the technical and management dimensions, in order to further improve the organization's sustainable operations and behavior.

Keywords: Green Logistics, Sustainable development performance, Challenges.

1. Introduction

The development of human beings and its impact on the natural environment is growing, and the outbreak of environmental disasters such as climate change, smog, and natural resource depletion has become a global concern. In addition, the rapid development of society has raised people's awareness of the necessity and importance of being responsible for nature. Therefore, sustainable development and green growth have increasingly become emerging hot issues that organizations around the world pay attention to. It emphasizes the necessity of simultaneous activities in specific areas of human survival [1]. Achieving sustainable development is not an easy task, and it is affected by various aspects. More specifically, it depends on a country's economy, political stability, cultural aspects, legal aspects, and overall social environment [2]. This requires the establishment and transformation of systems, standards, technologies, management, and a series of business strategies, so that the organizational level can also have sustainable development capabilities, obtain sustainable development performance, and meet new challenges. China is in a new period of economic transformation and development to high-quality. Achieving the "double carbon" goal of peak carbon

dioxide emissions, carbon neutrality, and driving low-carbon green development of the economy have become key drivers of China's economic structure transformation and innovative growth [3].

Another focus of this study is how green logistics affects the sustainable development performance of enterprises. The 12th Sustainable Development Goal "Responsible Production and Consumption" emphasizes the importance of designing modern and future-oriented business systems aimed at sustainable manufacturing. Logistics is a key link in the operation of enterprises, and the overall design of the logistics system will directly affect the performance of enterprises. Green logistics is the embodiment of the digitization and intelligence of traditional logistics, and to a certain extent, it plays an important role in promoting the sustainable development performance of enterprises. As a sustainable logistics model, green logistics has gradually become an important issue in promoting the transformation of modern logistics development, sustainable supply design of enterprises, and sustainable development.

However, some studies have found that there are some problems in the development of green logistics and its role in the sustainable development performance of enterprises. First, in recent years, scholars have paid more attention to the two theoretical perspectives of "green technology innovation" and "green management innovation". Green technology innovation emphasizes a series of innovative activities related to environmental protection and green development with the aim of reducing environmental pollution and improving the ecological environment [4]. Green management innovation emphasizes the integration of environmental protection concepts into new models of enterprise management, especially in the application and practice of digital transformation. Some studies have pointed out that green technology and management innovation are core capabilities in the process of enterprise development, which can greatly improve enterprise performance [5]. However, existing studies have shown that due to the impact of enterprise operating costs and input-output ratios, green technology innovation and green management innovation practices are insufficient and have not achieved significant results in logistics development. Secondly, the purpose of performance indicators is to further evaluate the compliance, policies and programs aimed at achieving organizational goals, including sustainable goals. However, due to some factors, the definition of sustainable indicators is still unclear, and there is a lack of assessment of the overall overview and effect of organizations' operations and behaviors in sustainable practices. Finally, in China, traditional logistics lacks international competitiveness, and the level of smart logistics still lags behind the international first-class level. China lacks corresponding incentives and protection measures for the transformation of logistics structure, and also lacks the introduction of laws, regulations and policies related to the sustainable development practice of enterprises.

In summary, this article reviews the previous literature on green logistics and corporate sustainable development, and based on the latest domestic and international consensus, reviews the impact of green logistics on corporate sustainable development performance. It identifies the existing problems in China's green logistics field to increase understanding of sustainable supply and lays the foundation for future large-sample research on green supply technology and management in China.

2. Connotation of green logistics system

With the increasing demand for raw materials and the growing scarcity of natural resources, the concept of green logistics has been proposed and continuously updated in recent years, attracting widespread attention from scholars. Green logistics refers to the comprehensive logistics activities that use advanced logistics technology, scientifically plan and implement logistics plans, and orderly complete various links such as transportation, storage, loading and unloading, handling, packaging, circulation processing, distribution, and information processing [6]. Compared with traditional logistics, green logistics is based on the development of smart logistics, integrating modern new technologies and new facilities, such as big data, artificial intelligence, cloud computing, and

blockchain. Through resource optimization and integration, it integrates logistics systems and related supporting facilities, achieving further innovation in logistics structure, improving the efficiency of logistics distribution while reducing the environmental impact of logistics activities to a certain extent, and improving issues such as cargo damage, environmental pollution, and resource waste. Green logistics has gradually become an important promoter of China's sustainable growth and a new highlight of green development in recent years.

The connotation of green logistics can be specifically reflected in: (1) intensive use of resources. Intensive use of resources is the essence of green logistics and one of the main guiding ideologies of the development of the logistics industry. By integrating existing resources and optimizing resource allocation, waste can be reduced and resource utilization increased. (2) Green transportation. Transportation is the primary link in logistics. By reasonably laying out and planning transportation routes, shortening transportation routes, improving vehicle load rates, and reducing the number of vehicle transportations, energy saving and emission reduction can be achieved. (3) Green warehousing. The selection of logistics warehousing sites needs to be reasonable, and the layout needs to be scientific to maximize the available warehouse area and minimize transportation costs. (4) Green packaging. Green packaging is a decisive factor in achieving green logistics. The first is to implement packaging reduction; the second is that packaging is easy to repurpose or recycle, which includes using the least amount of materials to make packaging; the third is the ecological design of packaging, including the use of materials that are harmless to the environment and human health, and the design of packaging that can decompose naturally. (5) Waste logistics. According to actual needs, the items that have lost their original value in economic activities are collected, sorted, processed, packaged, transported, stored, etc., to realize the recycling and reuse of waste. (6) Reverse logistics. It is the reverse sequence of forward logistics, which refers to It includes five material streams: direct resale product stream (recycling → inspection → distribution), reprocessed product stream (recycling → inspection → reprocessing), reprocessed parts stream (recycling → inspection → dismantling → reprocessing), end-of-life product stream (recycling → inspection → dismantling → processing), and end-of-life parts stream (recycling → inspection → dismantling → processing). The American Logistics Management Association believes that reverse logistics is the process of planning, implementing, and controlling the efficient and low-cost flow of information about raw materials, processed inventory, and finished products from the point of consumption to the point of origin [7].

3. Corporate sustainability performance

Elkington et al. (1999) articulated the "triple bottom line" principle of sustainable development, which is that enterprises need to balance the relationship between economic, social and environmental in the process of sustainable development [8]. Currently, there is a general agreement in the academic community that corporate sustainability performance includes three aspects: environmental performance, social responsibility and economic performance [9]. In the modern changeable and ambiguous business environment, this multi-dimensional performance is essential for the success and sustainability of organizations [10].

3.1. Environmental performance

The environmental management system defines environmental performance as: the measurable environmental management system effectiveness achieved by an organization based on environmental policies, objectives and indicators, that is, the comprehensive effectiveness achieved by the organization through strengthening environmental management. The environmental performance of an enterprise is reflected in two indicators: financial and environmental quality.

With the deepening of research, on the one hand, existing studies have confirmed that resource allocation is an important factor affecting the environmental performance of enterprises [11,12]. On the other hand, technological innovation is also an important way to improve the environmental performance of enterprises [13]. In the process of development, enterprises are prone to inertial application of existing technologies, falling into path dependence, affecting the enthusiasm of enterprises for technology research and development, thus affecting environmental performance. On the contrary, it can improve the environmental performance of enterprises. Taking the manufacturing industry as an example, China has entered modernization and gradually set off a wave of digital transformation, which has greatly stimulated green technology innovation, introduced front-end cleaner production technologies, reduced excessive consumption and over-dependence on natural resources, improved product innovation capabilities, and played a positive role in enhancing the environmental performance of sustainable development of enterprises.

3.2. Economic performance

Economics defines it as: the efficiency evaluation of the economy and the use of quotas and resources.

On the one hand, in the era of digital economy, enterprises use digital technologies such as big data and cloud computing to widely mine users' favorite preferences, consumption patterns, and other information accumulated on the Internet platform, so as to improve users' information management systems, in order to strengthen customer understanding, improve operational efficiency, optimize production decisions and designs, and thus increase market share. This is the main way to improve the economic performance of enterprises.

On the other hand, the use and allocation of digital technology resources to improve the business performance of enterprises, in order to achieve higher market acceptance and improve product competitiveness, and create greater value can also effectively improve the economic performance of enterprises [9].

3.3. Social responsibility

Since the 1970s, the concept of social responsibility has been widely spread [14]. Corporate social responsibility can also be analyzed through three latitudes, and its core is also related to the environment, society, and economy. It can be regarded as the core and summary of corporate sustainability performance.

The environmental latitude of corporate social responsibility depends in particular on the organization's perception of the relative importance of the ecological environment and the organization's sustainability assessment of the organization's operations and behaviors to achieve ecological goals [15]. Another important factor is the development of a sense of conservation of nature among the stakeholders of the enterprise as their commitment and responsibility to ethics both inside and outside the enterprise, while also meeting general societal expectations [16,17]. Shareholders and managers play an important role in the coordination of sustainable development goals, such as short-term and long-term goals, social and economic goals, partial and shared goals [18,19].

The social latitude of corporate social responsibility depends on the organization's perception of the relative importance of expected social roles and norms in the environment, as well as the organization's assessment of the suitability of organizational operations and behaviors to achieve applicable environmental social principles [15]. The social literature also interprets corporate social responsibility as the extent to which the organization supports social good behavior "beyond corporate interests and legal requirements" ([20], p. 605). The social latitude of corporate social

responsibility is related to social issues or social goals that are worthy of attention and discussion in the current society. For example, the environment expects modern organisms to actively participate in solving pressing social issues such as labor relations, human-to-human relations in society, social development issues, growing demand for energy and food, poverty alleviation and equal development opportunities, etc.

The economic latitude of corporate social responsibility depends on the organization's perception of the relative importance of achieving economic outcomes and economic prosperity, as well as the organization's assessment of the economic adequacy of operations and awe to achieve economic goals [15]. Therefore, organizations understand economic development pragmatically, shifting their original focus from "profit maximization" to "responsible operation" in order to achieve "more sustainable economic outcomes for the organization" [21,22].

4. The role and significance of green logistics for sustainable development performance of enterprises

As the demand of academia and professionals for the economic, social and environmental elements of sustainable development continues to grow, scholars agree that green logistics has obvious potential to promote sustainable development goals [23]. For enterprises, green logistics has attracted more and more attention. In the beginning, the development of green logistics was mainly driven by economic and environmental challenges, which required companies to manage the trade-off between short-term profitability and long-term environmental sustainability [24,25]. As enterprises and society gradually increase their awareness of long-term development, enterprises gradually realize that green logistics system design has a non-negligible role in promoting enterprises to achieve considerable sustainable development performance in the market. This paper will also analyze the impact of green logistics on the three major benefits and competitive advantages from the three angles of enterprise sustainable development performance already mentioned above.

4.1. Environmental benefits

The implementation of green logistics can help enterprises achieve environmental benefits through energy conservation, emission reduction, resource recycling, and improved communication synergies.

First, green logistics focuses on the efficient use of energy and the reduction of pollutant emissions, which can get rid of the dependence of traditional logistics transportation on fuel-powered tools. For example, enterprises can adopt advanced logistics technologies and equipment, such as electric vehicles, intelligent route planning, etc., to reduce dependence on traditional fuel-powered vehicles and reduce energy consumption and carbon dioxide emissions during transportation.

Secondly, green logistics can promote the recycling of resources [26]. Under the traditional logistics model, resources such as packaging materials and transportation equipment are often discarded after only one use, resulting in waste of resources and environmental burden. Green logistics can enable enterprises to use recycled packaging materials and equipment. Such as degradable packaging materials, recycling of renewable resources, etc., to reduce resource consumption and waste generation.

At the same time, green logistics enables enterprises to jump out of the single latitude growth model. In the process of applying the green logistics platform integration to the bilateral market, the communication efficiency and collaborative efficiency between enterprises have been improved, and the supply chain participants have gradually formed a supply chain ecosystem of correlation and interaction, symbiosis and coexistence, which effectively promotes the spillover effect of

communication and coordination, thereby improving the environmental performance of enterprises [27].

4.2. Economic benefits

The implementation of green logistics can help enterprises achieve economic benefits by reducing costs and improving efficiency, as well as increasing brand value and market competitiveness [28].

On the one hand, green logistics is more intelligent, using advanced technology and equipment to improve the efficiency of logistics operations. Traditional logistics is limited by the lack of intelligent scenarios, and it is difficult to achieve an efficient connection between the supply and demand of products and production factors in a short period of time. In this scenario, enterprises usually face the limitations of product flow and capital flow, which affects the economic performance of enterprises [27]. By using intelligent transportation management systems and logistics information platforms, enterprises can better grasp logistics information and manage logistics processes, optimize transportation routes and times [29], and promote the rationalization of transportation structures. Thereby, the energy consumption and transportation costs of commercial and trade enterprises can be greatly reduced, logistics efficiency and accuracy can be improved, and the level of economic performance of enterprises can be improved. On the other hand, as mentioned above, green logistics pays attention to the recycling of resources. For example, the use of degradable packaging materials and the recycling of renewable resources can reduce the waste of resources and waste disposal costs of enterprises. At the same time, green logistics can also reduce inventory costs. By improving the inventory turnover rate, less inventory extrusion and waste can be reduced, thereby reducing the operating costs of enterprises [30].

In addition, green logistics relies on advanced technologies such as the Internet and artificial intelligence to promote the continuous increase of trade opportunities between cities, further expand the market strategic layout, and expand the market scope that enterprises can serve [31], so enterprises can sell more products to a wider market. In the era of increasing emphasis on environmental protection and sustainable development, consumers have higher and higher expectations for the environmental protection image and social responsibility of enterprises, and will be more inclined to choose those enterprises that actively take environmental protection measures. Adopting green logistics measures will help enterprises establish a good brand perception, attract more consumers, gain a wider range of consumer groups, and enhance brand value. A wider target market and a wider range of consumer groups have a direct role in promoting the economic performance of enterprises, helping enterprises to enhance market competitiveness, and laying the foundation for enterprises to obtain long-term economic benefits.

4.3. Social benefits

Enterprises can achieve social benefits by adopting green logistics to improve the industrial environment and urban transportation environment.

First of all, green logistics can improve the working environment and employee welfare of the logistics industry. In the traditional logistics process, problems such as noise and exhaust emissions have a great negative impact on the working environment of logistics practitioners. Adopting green logistics measures such as clean energy vehicles and optimizing distribution routes can reduce noise and pollution, improve the working environment, and provide logistics practitioners with safer and healthier working conditions. At the same time, green logistics requires specialized smart talents, which also increases employment opportunities to a certain extent and promotes economic and social development and stability.

Secondly, green logistics helps to improve the efficiency and convenience of urban transportation. In the traditional logistics process, problems such as congestion and traffic accidents often cause traffic delays and transportation inefficiencies. As mentioned above, through intelligent warehouse management systems and distribution route optimization, green logistics can improve the efficiency of logistics and transportation, shorten transportation time and reduce traffic congestion. This not only reduces the negative impact of transportation on urban transportation, but also improves the response speed and consumer satisfaction of the logistics supply chain.

5. The development challenges of green logistics

5.1. Lack of Further Practice in Green Technology Innovation and Green Management Innovation

5.1.1. Room for Improvement in Green Technology Innovation.

In the past, technological development and related technologies have decisively shaped the development of society [32,33]. Human history is characterized by technological advancements. Therefore, scientists are very concerned about the role and importance of technological development in organizational environmental behavior. From the current development situation of green logistics, modern enterprises' attention to and innovation in green technology are insufficient, resulting in a lack of innovative outcomes that directly affect the construction and optimization of the green logistics system, and also hinder the achievement of sustainable performance and the growth of sustainable advantages for enterprises. The continuous improvement of technology in green logistics, further automation, and intelligence are crucial for leveraging green logistics into a sustainable competitive advantage for enterprises through technological innovation.

Green logistics technology refers to a logistics technology system that can reduce pollution, lower consumption, and improve the ecosystem, consisting of relevant knowledge, capabilities, and material means. Currently, there is still a gap in the development level of green logistics technology in our country. First, our country's technological innovation in biodegradable materials and reusable packaging design has not yet reached a level of widespread application. This limits the application of green packaging in logistics and prevents it from replacing traditional packaging materials on a large scale, thereby reducing environmental pollution. Second, energy-saving and emission-reduction technologies in the logistics transportation link are key to promoting the development of green logistics. However, due to the insufficient research and development and popularization of new energy vehicles and energy-efficient transportation tools, the proportion of green transportation methods in our country's logistics industry remains low. This not only affects logistics costs and efficiency but also limits the overall development of green logistics. Furthermore, the improvement of logistics informatization and intelligence level can effectively enhance logistics efficiency and reduce resource waste. However, our country still needs to strengthen its innovation capabilities in logistics sorting technology, routing and dispatching technology, electronic waybill technology, end distribution technology, logistics informatization technology, and intelligent scheduling systems. Although the level of informatization and intelligence in our country's logistics industry is continuously improving, there are still "bottleneck" technical issues. Many core components of logistics equipment are difficult to produce with existing technologies [34], which leads to a relatively low overall development level of logistics technology in our country.

Researchers in the past have made great efforts to prove that investments in green technology innovation by organizations can improve supply chain performance, and the integration of digital technology into corporate strategy can bring sustainable performance [2]. At the same time, green technology innovation includes new technical processes, innovative green products and services, and

protection of the green environment, making it the best business strategy for enterprises [35]. Some scholars have pointed out that responsible technological innovation is one of the key pillars of sustainability and suggest that empirical research should be conducted to investigate this [36].

5.1.2. Lack of Practice in Green Management Innovation.

Studies have shown that innovation in management processes interacts more with traditional lean and green methods and plays a crucial role in improving performance. Green management refers to the reorganization of existing or the adoption of new management systems, strategies, and policies, and their transformation into environmentally friendly logistics systems to minimize the negative impact of organizational production and management strategies on the environment [4]. Effective green management innovation can promote the rational allocation of resources, achieve energy saving and waste reduction in logistics activities, thereby reducing environmental impact. However, currently, Chinese enterprises lack innovation in supply chain or other operational management fields, and have not closely integrated traditional internal environmental management with green methods, affecting the efficiency of enterprises in achieving sustainable development performance.

Firstly, many logistics enterprises still focus on cost and efficiency, neglecting the importance of green and environmental protection. The lack of green management philosophy in daily operations leads to insufficient green logistics practice and difficulty in forming an effective green logistics management system. Secondly, the development of green logistics requires the joint efforts of all links in the supply chain. However, currently, our country's integration capacity in green supply chain management is not strong, lacking effective collaboration mechanisms and information sharing platforms, which greatly reduces the effectiveness of green logistics implementation. At the same time, the fierce competition in China's logistics industry and the fact that resource information is a competitive advantage for enterprises, due to the lack of leading enterprises, result in information barriers between enterprises in the logistics industry, preventing the integration and sharing of resources [7].

Finally, there is a lack of exploration of innovative green logistics models in our country. With the development of internet technology, green logistics has more implementation paths and models, such as shared logistics and reverse logistics. However, our country's investment in the research and application of these new green logistics models is limited, lacking systematic exploration and practice.

5.2. Lack of Clear Definition of Sustainable Development Performance Indicators

With the emergence of the vision of sustainable development, researchers and organizations have been developing solutions to assess the impact of current corporate sustainable development practices on the natural and social environment [8,37]. As a result, environmental performance indicators have been established to assess aspects such as emissions, pollution, resource consumption, and natural habitat protection [38,39]. Although some indicators, such as carbon emissions and energy consumption levels, are widely used, differences between industries and the lack of uniform evaluation standards make comparisons difficult within and across industries. Social performance indicators aim to assess the impact of sustainable practices on employees, customers, and communities [40,41]. However, the subjectivity and diversity of indicators such as employee satisfaction and community participation also make definition and assessment complex.

Lastly, economic performance indicators aim to assess the impact on financial indicators such as organizational costs, profits, and investments [22,42]. Although corporate economic performance is relatively easy to quantify, how to effectively combine these economic indicators with environmental protection and social responsibility to achieve true sustainable development remains a challenge.

The academic and practical communities are exploring a sustainable development performance indicator system suitable for our country's national conditions. For example, some studies suggest developing sustainable development performance indicators with Chinese characteristics by combining China's cultural background and socio-economic development characteristics. However, due to the lack of consensus and support, these efforts are often difficult to apply and promote on a wider scale. Therefore, establishing a scientific, rational, and unified corporate sustainable development performance evaluation system is one of the key steps to promote sustainable development in enterprises in our country.

5.3. Lack of Government Policies and Regulations Related to Corporate Sustainable Development

Regulation is often considered an effective way to stimulate corporate sustainable development awareness [43]. Some studies have examined the value of regulation in corporate supply chain management. Corporate responsibility constraints are influenced by national laws, regulations, and policies as well as by the enterprise's own policies. The role of national laws, regulations, and related policies has been proven to promote enterprises towards sustainable development [44].

In the long run, green logistics can bring stable development for enterprises. However, local governments have not put forward clear requirements for corporate low-carbon economy, nor have they established a complete professional system, leaving enterprises lacking executable green logistics policy standards. Taking packaging management in green logistics as an example, the governance of packaging in our country is still in disarray, with unclear responsibilities of governing bodies, weak regulation, low promotion and application rates of new technologies and materials, and unstandardized management. How to achieve the development goals of green packaging for express delivery, promote the basic principles of green packaging to the ground, constrain and regulate from the source, and strengthen end-of-pipe management to achieve the whole-process governance of green packaging has become a difficult problem in the green development of our country's packaging industry [7].

Therefore, we strongly recommend that researchers establish theoretical models to study the specific impact of future government management policies on green logistics and corporate sustainable development [36].

6. Suggestions and countermeasures for the development of green logistics

6.1. Technological Innovation and the Construction of Green Logistics Systems

Technology remains the fundamental driving force for social development, and the growing expectations of society have put forward new requirements for enterprises, namely to engage in sustainable technological innovation and to build green logistics systems to fully support the needs of corporate sustainable development and the resolution of social issues in modern society [15].

In economic practice, enterprises should pay more attention to green technology and resources than before. These technologies not only aid in the renewal of green logistics but also help the enterprises themselves to achieve sustainable development performance and benefits, thereby improving the broader environment.

6.1.1. Establishing a Green Logistics Technology Platform.

Enterprises can establish a technology platform that represents the opportunity to use resources and capabilities for green logistics technological innovation. It can serve as a central hub for technological

innovation, information sharing, resource integration, and standard setting, promoting the efficient operation and continuous development of the green logistics system.

Firstly, the green logistics technology platform can gather R&D resources from both within and outside the industry to promote technological innovation in areas such as green packaging, energy-saving and emission-reducing transportation tools, and efficient energy management systems. At the same time, the platform can accelerate the testing, verification, and promotion of new technologies, enabling green logistics solutions to be implemented quickly.

Secondly, by establishing a unified information platform, various logistics participants can exchange data and share information based on it, improving the visibility and transparency of the logistics process, thereby optimizing logistics routes, reducing resource waste, and enhancing overall transportation efficiency.

The green logistics technology platform can also attract participants from multiple aspects, such as government, enterprises, and research institutions. Through resource integration and cooperation, it can collectively address common issues in the development of green logistics, such as standard setting, funding, and policy support, forming a strong force to promote the development of green logistics.

Finally, the green logistics technology platform can provide the industry with a standardized framework and reference, helping enterprises assess their green logistics practices and supporting the government in formulating relevant policies and standards.

6.1.2. Promoting the Digitalization of Supply Chain Technology.

Sharma et al.⁴⁶ studied the digitalization of supply chain networks and concluded that it improves company performance [36]. In another study using blockchain technology and its impact on sustainable development performance, the results showed that we are in the Industrial 4.0 era, where the supply chain focuses on digital innovation and operational transformation [45]. Enterprises using blockchain technology can improve sustainable development performance. Therefore, for future research, it is recommended that enterprises integrate emerging technologies into the green logistics system and explore the value of various different technologies, such as blockchain, 3D printing, and additive manufacturing.

Firstly, enterprises can achieve visualization and intelligent management of the supply chain by introducing advanced information technology and IoT technology. This includes using IoT sensors to monitor parameters such as temperature, humidity, and vibration during the transportation of goods in real-time to ensure that goods are transported under environmentally friendly conditions, reducing loss and waste. At the same time, based on big data analysis and artificial intelligence technology, enterprises can optimize the design and operation of the supply chain, reduce energy consumption, decrease waste emissions, and build a green supply chain.

Secondly, technological innovation can also promote the implementation of green packaging and recycling. Enterprises can develop and adopt more environmentally friendly packaging materials, such as biodegradable and recyclable materials, reducing the use of disposable packaging. At the same time, using smart packaging technology, trading enterprises can achieve lightweight packaging design, reducing resource consumption and waste generation.

Furthermore, enterprises can adopt eco-innovation at various levels of the supply chain to share information and promote decision-making throughout the supply chain, develop collaborative relationships among supply chain members, and help each other achieve the construction of green logistics systems and sustainable development performance. All members of the supply chain need to cooperate to a certain extent, and technological innovation becomes a source of developing collaborative capabilities and more effectively implementing corporate strategies to improve corporate performance [2].

Lastly, in the construction of green supply chains, enterprises can also achieve energy-saving, emission reduction, and carbon neutrality goals through technological innovation. For example, using clean energy to power transportation tools, adopting energy-efficient storage facilities, and introducing low-carbon production processes can reduce energy consumption and greenhouse gas emissions in supply chain operations.

6.2. Improving Relevant Policies and Regulations and Increasing Government Support

For the government, first, there should be a policy guidance and incentive mechanism. The government can guide logistics enterprises to actively promote green development and stimulate enterprises to undertake more environmental protection investment behavior by enacting a series of policies and measures, such as environmental protection policies, tax incentives, and energy-saving and emission reduction subsidies [3]. Second, establish green technology standards and evaluation systems, and jointly establish green benchmark enterprises with industry organizations. The government can set green technology standards and evaluation systems to guide logistics enterprises to use sustainable and environmentally friendly technologies, reduce energy consumption and emission levels, and improve corporate sustainable development performance [3]. Third, strict laws, regulations, and related policies can promote enterprises to prioritize sustainable practices in production and operation, such as energy saving, resource recycling, and environmental protection. In this case, non-compliant enterprises will face more severe penalties and public pressure. Therefore, in countries with strict environmental regulation, enterprises tend to show higher sustainable development performance [46]. This is supported by evidence from different countries. Sweden, as a country with a high level of sustainable development, has implemented a series of policies to encourage corporate sustainable practices, including the use of renewable energy, adherence to strict emission regulations, and taxation of non-renewable energy, resulting in a higher proportion of sustainable enterprises in the country [47]. Germany also attaches great importance to sustainable development and has achieved a high level of corporate sustainable development by setting energy-saving building standards and encouraging enterprises to reduce their carbon footprint [48]. Therefore, the government can enact and implement stricter laws, regulations, and related policies to promote all actors, including enterprises, to practice the concept of sustainable development and pursue sustainable development.

7. Conclusion

The study found that with the rapid development of information technology and the increasing emphasis on the environment, the development of corporate green logistics is an inevitable trend for the future and an important direction for achieving a low-carbon economy and sustainable development for all of society. Green logistics currently plays a crucial role in enhancing corporate sustainable development environmental performance, social responsibility, and economic performance. However, there are also issues such as insufficient green technology and management innovation practices, unclear performance indicators, and a lack of government laws and regulations hindering the further development of green logistics. Therefore, in the future, enterprises should adjust their logistics models with green thinking, take the initiative to assume market responsibility, and make significant efforts in green technology and green management. Governments should enact laws and regulations to clarify performance indicators and encourage the development of green logistics. Only in this way can the convenience and efficiency of green logistics be truly improved and the high-quality development of green logistics be achieved.

References

- [1] Aldona Małgorzata Dereń, Jan Skonieczny. *Green Intellectual Property as a Strategic Resource in the Sustainable Development of an Organization*. *Sustainability* 2022, 14(8), 4758.
- [2] Syed Abdul Rehman Khan,¹ Zeeshan Ahmad,² Adnan Ahmed Sheikh,² and Zhang Yu^{3,4}. *Digital transformation, smart technologies, and eco-innovation are paving the way*. *Sci Prog.* 2022 Oct-Dec; 105(4): 00368504221145648.
- [3] Li Ying, Yang Hangzheng. *Research on the influence mechanism of environmental responsibility constraints on the green performance of logistics enterprises [J]*. *Business Economics Research*, 2024 (4): 95-98
- [4] Zhao Xicang, Jiang Mei. *Research on the impact of intellectual property protection on green technology innovation: a quasi-natural experiment based on intellectual property demonstration cities [J/OL]*. *Soft Science*, 2023:1-19 [2023-09-28] [2023-12-12].
- [5] Fang Wenlong, Nie Wann, Lai Dan. *Enterprise digital transformation, resource allocation and green innovation capability [J]*. *Accounting and Accounting Monthly*, 2023 [13]: 139-145.
- [6] Shao Anchun. *Research on the role of green logistics in the sustainable development of logistics enterprises[A]*. *Business Research*. 2096-3157(2023)20-0016-04.
- [7] ZHANG Ming-li¹ WANG Yu-fei² ZHAO Wei-kai¹ WANG Jin-shun¹. *A review of green logistics research*. *Chinese Standardization*. 2021(11)
- [8] ELKINGTON J, ROWLANDS I H. *Cannibals with Forks: The Triple Bottom Line of 21st Century Business [J]*. *Alternatives Journal*, 1999, 25 (4): 42.
- [9] Jia Guangyu, Duan Huijuan. *Digital transformation, green innovation and corporate sustainability performance - based on manufacturing Empirical research on industry listed companies [J/OL]*. *Operation and management*.
- [10] Chun Liangyao¹, Li Yuanwang^{2,3}. *Corporate sustainable development performance through top management team's transactive memory*. *Science Direct*.
- [11] SHAPIRO J S, WALKERR. *Why is pollution from US manufacturing declining? The roles of environmental regulation, productivity, and trade [J]*. *American economic review*, 2018, 108 (12): 3814 - 3854.
- [12] Han Chao, Wang Zhen, Tian Lei. *The mechanism of environmental regulation driving emission reduction: pollution treatment behavior and resource reallocation effect [J]*. *World Economy*, 2021, 44 (8): 82 -105.
- [13] Hu Hanhui, Shen Jie. *Digital economy, green innovation and "dual carbon" goals - the perspective of "emission reduction" and "efficiency enhancement" [J]*. *Journal of Nanjing University of Finance and Economics*, 2023 (4): 79-88.
- [14] Aguinis, H. *Organizational Responsibility: Doing Good and Doing Well*. In *APA Handbook of Industrial and Organizational Psychology*; Zedeck, S., Ed.; American Psychological Association: Washington, DC, USA, 2011; Volume 3, pp. 855 - 879.
- [15] Vojko Potocan. *Technology and Corporate Social Responsibility*. *Faculty of Economics and Business, University of Maribor, Razlagova 14, 2000 Maribor, Slovenia*. *Sustainability* 2021, 13(15), 8658.
- [16] Shen, J.; Benson, J. *When CSR Is a Social Norm. How Socially Responsible Human Resource Management Affects Employee Work Behavior*. *J. Manag.* 2016, 42, 1723 - 1746.
- [17] Kish-Gephart, J.; Trevino, L.; Chen, A.; Tilton, J. *Behavioral Business Ethics: The Journey from Foundations to Future*. In *Business Ethics, Business and Society 360*; Wasieleski, D., Weber, J., Eds.; Emerald: Bingley, UK, 2019; pp. 3 - 34.
- [18] Friedman, M. *The Social Responsibility of Business Is to Increase Its Profits*. *N.Y. Times Mag.* 1970, 13, 122 -124.
- [19] Gregory, P.; Stuart, R. *Comparing Economic Systems in the Twenty-First Century*; South Western: Mason, OH, USA, 2004.
- [20] McWilliams, A.; Siegel, D. *Corporate Social Responsibility and Financial Performance: Correlation or Misspecification? Strategies*. *Manag. J.* 2000, 21, 603 - 609.
- [21] Crifo, P.; Forget, V. *The Economics of Corporate Social Responsibility: A First-Level Perspective Survey*. *J. Econ. Surv.* 2015, 29, 112 - 130.
- [22] Kitzmueller, M.; Shimshack, J. *Economic Perspectives on Corporate Social Responsibility*. *J. Econ. Lit.* 2012, 50, 51 -84.
- [23] Tchokogué, A (Tchokogue, Andre)¹; Nollet, J (Nollet, Jean)¹ ; Merminod, N (Merminod, Nathalie)²; Paché, G (Pache, Gilles)²; Goupil, V (Goupil, Veronique)³. *Is Supply's Actual Contribution to Sustainable Development Strategic and Operational? . Business Strategy and the Environment*, 2018: 336-358.
- [24] Hsueh, 2015 C.F. *Hsueh A bilevel programming model for corporate social responsibility collaboration in sustainable supply chain management*.
- [25] Wu and Pagell, 2011 Z. Wu, M. Pagell *Balancing priorities: Decision-making in sustainable supply chain management*.
- [26] Li Zongwei. *Research on the development path of rural green logistics under the rural revitalization strategy [J]*. *Agricultural Technology and Equipment*, 2023 (08): 97-99.

- [27] Zhang Shushan, Gu Cheng. *Smart logistics and sustainable enterprise development - two-factor authentication based on economic performance and environmental performance*[A]. *Industrial Economics Research*. 1671-9301(2024) 01-0042-14
- [28] Wen Peng, Ma Yali, Ma Kezhen et al. *Analysis of green logistics management in a low-carbon economy* [J]. *China Logistics and Procurement*, 2023 (20): 103-104.
- [29] Liu Meihong. *Research on the impact of green logistics on the sustainable development of commercial and trade enterprises*[C]. *China Shipping Weekly*. 2024(06)
- [30] Bao Mingjie. *Research on Green Logistics Management Strategies in Low-Carbon Economy*[A]. *Modern Logistics*. 2023(11).
- [31] DONALDSON D. *Railroads of the raj: estimating the impact of transportation infrastructure* [J]. *American economic review*, 2018, 108 (4 /5): 899 - 934.
- [32] Hansson, S. *Technology and the Notion of Sustainability*. *Technol. Soc.* 2010, 32, 274 - 279.
- [33] Cooper, R.; Foster, M. *Sociotechnical Systems*. *Am. Psychol.* 1971, 26, 467 -474.
- [34] YANG Jie. *Research on the development of smart logistics in a green environment*[A]. *Logistics Sci-Tech*. March, 2024
- [35] Ahmed, R., R., Streimikiene, D., & Zheng, X. (2021). *The Impact of Proactive Environmental Strategy on Competitive and Sustainable Development of Organizations*. *Journal of Competitiveness*, 13(4), 5–24.
- [36] Sharma M, Kumar A, Luthra S., et al. *The impact of environmental dynamism on low-carbon practices and digital supply chain networks to enhance sustainable performance: an empirical analysis*. *Bus Strateg Environ* 2022; 31:1776 - 1788.
- [37] Healy, S. *Science, Technology and Future Sustainability*. *Futures* 1995, 27, 611 - 625.
- [38] Joung, C.; Carrell, J.; Sarkar, P.; Feng, S. *Categorization of Indicators for Sustainable Manufacturing*. *Ecol. Indic.* 2013, 24, 148 - 157.
- [39] Bisong, P.; Apologun, S. *Technology Can Save the Environment*. *Int. J. Humanit. Manag. Soc. Sci.* 2020, 3, 11 - 19.
- [40] Carroll, A.; Shabana, K. *The Business Case for Corporate Social Responsibility: A Review of Concepts, Research and Practice*. *Int. J. Manag. Rev.* 2010, 12, 85 - 105.
- [41] Aguilera, R.V.; Rupp, D.E.; Williams, C.A.; Ganapathi, J. *Putting the S Back in Corporate Social Responsibility: A Multilevel Theory of Social Change of Organizations*. *Acad. Manag. Rev.* 2007, 32, 836 - 863.
- [42] Minton, E.; Khaled, L. *Belief Systems, Religion, and Behavioral Economics*; *Business Expert Press*: New York, NY, USA, 2014.
- [43] Ji et al., 2014G. Ji, A. Gunasekaran, G. *Yang Constructing sustainable supply chains under double environmental media regulations*.
- [44] DU X Q, JIAN W, ZENG Q, DU Y. *Corporate environmental responsibility in polluting industries: Does religion matter?* [J]. *Journal of business ethics*, 2013, 124 (3): 485-507.
- [45] Xu, XY (Xu, Xiaoyan)1; Chung, SH (Chung, Sai-Ho)1; Lo, CKY (Lo, Chris K. Y.)2; Yeung, ACL (Yeung, Andy C. L.)3. *Sustainable supply chain management with NGOs, NPOs, and charity organizations: A systematic review and research agenda*. *Transportation Research Part E-Logostocs And Transportation Review*. Volume:164.
- [46] LOZANO R. *A holistic perspective on corporate sustainability Drivers* [J]. *Corporate social responsibility and environmental Management*, 2015, 22 (1): 32-44.
- [47] THEWS B, HÖJDING P, JANSSON B. *Swedish Environmental Law: An Introduction to the Swedish Legal System for Environmental Protection* [R]. Stockholm: Naturvårdsverket, 2017.
- [48] BECHBERGER M, REICHE D. *Renewable energy policy in Germany: pioneering and exemplary regulations* [J]. *Energy for sustainable development*, 2004, 8 (1): 47-57.