

Sustainable Development of Green Supply Chain: A Case Study on Alibaba

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Abstract. The ongoing advancement of global economic integration and the flourishing growth of e-commerce have led to the swift rise of the logistics business. This expansion has concurrently resulted in a range of environmental problems. The heightened utilization of packing materials and the energy expenditure associated with transportation have exerted pressure on the environment. This paper examines Alibaba's green packaging project, focusing on its initiatives in ecologically friendly packaging materials, packaging recycling and reuse, and supply chain optimization. This paper comprehensively examines the beneficial impacts, current issues, and obstacles associated with the execution of Alibaba's green packaging project. This analysis explores the significant influence of supply chain technical innovation, the utilization of environmentally friendly materials, and the integration of green energy with low-carbon transportation on the sustainable development of the supply chain. Moreover, many recommendations are proposed for Alibaba, such as advancing green technological innovation and implementation, fortifying green supply chain management, and augmenting consumers' understanding and engagement in sustainability initiatives.

Keywords: Supply Chain, Technological Innovation, Environmentally Friendly Materials, Green Energy and Low-Carbon Transportation.

1. Introduction

With global economic integration and the rise of e-commerce, the rapid development of the logistics industry has become an important support for economic development. The size of the global logistics market continues to expand, and the volume of goods transported is rising. Take China as an example; e-commerce provides consumers with convenient shopping channels, increases the flow of goods, and promotes the development of logistics. Alibaba's platform transactions, such as "Double 11," are substantial, leading to a significant increase in parcel transportation demands. Alibaba's commercial expansion has broadened the range of goods and sellers, thereby boosting the demand for domestic and cross-border logistics. Additionally, the design of rural e-commerce has led to a more than 50% increase in rural logistics orders. At the same time, e-commerce prompts logistics enterprises to optimize the mode of transport—road, railway, air, and water transport—to meet different needs and improve logistics efficiency. The change in consumer shopping habits has increased the frequency and amount of online shopping; the volume of express delivery has exploded; and the number of packages in a single day during special shopping festivals has exceeded 100 million. This growth has far-reaching implications around the world, with logistics networks moving from cities into rural areas and across borders to form a global system. Diverse modes of logistics transportation, including road, railway, air, and water transportation, collaborate to fulfill diverse transportation needs.

The rapid growth of the logistics business has also put environmental pressure on it. Logistics, including packing, transportation, and warehousing, varies in environmental impact. First, disposable packaging like plastic, foam, and paper dominates traditional logistics. The rapid delivery industry uses a lot of plastic packaging, which is difficult to recycle and pollutes soil, water, and air. Paper waste adds to environmental stress. Second, logistical transportation uses a lot of energy and emits carbon; road transportation uses a lot of fuel and pollutes the air; and air transportation uses a tiny quantity but a lot of energy. Congestion and poor route planning lead to energy waste and air pollution. Finally, building storage facilities uses land; its equipment uses electricity; and the inefficient storage



and management of commodities generates waste and pollution. The government has rules and laws to stimulate green logistics development among businesses. Environmental awareness is rising, and consumers want green products and services. Here, Alibaba and other companies aggressively pursue green package projects, innovate packaging, optimize supply chain processes, reduce logistics' environmental effect, and achieve sustainable supply chain development.

Many scholars have conducted extensive and in-depth research on supply chain development, primarily focusing on sustainable supply chains and logistics. For example, Su Tao Yong's 2023 study focused on the impact of green supply chain integration on the environmental performance of Chinese manufacturing enterprises, verified the advantages and disadvantages of supplier and customer integration, pointed out green innovation and financial performance as transmission channels, and emphasized the synergy of various links [1]. Zhao Lin will study the "green" aspect of e-commerce express packaging in 2022, analyze problems, and put forward suggestions to help the green and sustainable development of the industry [2]. In 2016, Du Wei used Shell Group as an object to confirm the drivers of a sustainable supply chain, evaluate its impact on environmental performance, and fill the gap in empirical analysis. This empirical analysis is crucial for guiding corporate decision-making and promoting sustainable supply chain development [3].

A comprehensive analysis of the above-related studies shows that, although scholars have achieved rich research results in the field of supply chain sustainable development and logistics, there are still some deficiencies and research gaps.

On the one hand, the discussion primarily occurs at the theoretical level, with minimal case analysis and experience summaries from actual enterprises. Although there are green supply chain management and logistics practice cases, they are limited to individual industries and enterprises, lack comprehensive coverage and comparative analysis, and are limited in universality and guidance. On the other hand, the research on the cooperation mechanism of all links of the supply chain needs to be strengthened. Sustainable development necessitates the cooperation of all links in the supply chain. However, there is a research gap in establishing an effective mechanism to facilitate information sharing, and cooperation among different enterprises in different regions can be challenging. In summary, while some scholars have conducted research, there remain deficiencies and gaps in practical cases and collaborative mechanisms. Does this study use the circular packaging of Alibaba's green package project as its starting point, aiming to address the issues of reliance on disposable packaging, resource waste, and environmental pollution in the logistics industry and propose an urgent plan for sustainable development? The circular packaging of Alibaba's green package project is typical and leading. It holds positive significance in terms of the environment, industry, and logistics transformation, as it can reduce negative impacts and enhance the industry's sustainability. Studying its impact on the sustainable development of the supply chain can improve the theory and provide suggestions for enterprises to solve logistics problems.

This article will initially use the Alibaba green parcel project as an example, first introducing the project situation and then analyzing the influence, advantages, and disadvantages of different stages of the supply chain. Then, based on the relevant research phenomenon, the impact of the project on the supply chain in different stages of development is deeply analyzed. Finally, combining the results of the analysis, reasonable suggestions are put forward for Alibaba. What specific measures should Alibaba take in the follow-up process to ensure the supply chain achieves long-term sustainable development?

2. Case Description

As global attention to environmental protection continues to increase, Alibaba actively responded by launching the green package project. The project aims to reduce the negative impact of logistics activities on the environment and achieve sustainable supply chain development through innovative packaging methods and optimization of supply chain processes.

Alibaba collaborates with suppliers to develop and promote environmentally friendly packaging materials such as degradable plastic bags and paper packaging, which naturally degrade after use, thereby reducing environmental pollution. Simultaneously, Alibaba promotes lightweight packaging design to minimize material usage and logistics expenses.

A recycling system encourages consumers to return packaging materials for reuse after cleaning and disinfection, thereby achieving resource recycling. It also carried out reuse projects with partners to transform recycled materials into office supplies like environmentally friendly bags and folders, thereby enhancing resource utilization.

Supply chain optimization uses big data analysis and intelligent algorithms to plan the optimal route for express vehicles, improve delivery efficiency, and reduce carbon emissions. Promote co-delivery mode, integrate merchant orders, and reduce the number of vehicles and exhaust emissions.

In order to ensure the smooth implementation of the project, Alibaba has taken various measures. In terms of technological innovation, Alibaba invests a lot of money in the research and development of environmentally friendly packaging materials and technologies, develop intelligent packaging systems, improve environmental performance and recyclability, control packaging quality and environmental standards, improve production efficiency, and reduce costs. In terms of cooperation and communication, cooperate with suppliers, express companies, merchants, etc., establish a mechanism to clarify responsibilities and obligations, and integrate resources to ensure project progress. Strengthen communication and cooperation with government departments and environmental protection organizations, strive for policy support and social resources, and jointly promote the development of environmental protection, such as cooperating to formulate environmental protection policies and carry out environmental protection activities. In terms of publicity and education, environmental publicity activities are carried out to publicize the significance and value of the project to consumers through advertising, social media, and other channels, and to encourage environmental protection actions such as choosing green packages and recycling packaging. Conduct environmental protection training for employees, integrate environmental protection concepts into corporate culture, and create a positive atmosphere.

The implementation of the project has brought positive effects and influences. The project contributes positively to environmental protection by minimizing the use of packaging materials and waste generation, cutting down on millions of tons of packaging materials annually, minimizing plastic waste, lowering energy consumption and carbon emissions in logistics transportation, and actively contributing to climate change mitigation and environmental protection. Resource conservation involves realizing recycling and reuse of packaging materials, improving resource utilization, reducing the demand for new resources, optimizing supply chain processes, improving logistics efficiency, reducing costs, and saving energy and resources. In terms of corporate image, demonstrate social responsibility and environmental awareness, enhance brand image and social reputation, meet consumer environmental protection needs, and improve satisfaction and loyalty. In terms of industry demonstration, it encourages other enterprises to follow suit and promote the sustainable development of the industry.

However, problems and challenges remain. There is a lack of environmental awareness, a low participation rate among consumers and businesses, a reluctance among customers to use environmentally friendly materials or return packaging, and a tendency among businesses to reduce costs by using disposable packaging. In terms of technology and cost, small and medium-sized enterprises find it challenging to bear the high development and production costs of environmentally friendly packaging materials. Additionally, their market share is limited, the price of these materials significantly impacts their promotion and application, and the cost of packaging recycling technology is also high. Policies and regulations are not perfect; China lacks clear policy and regulatory support for the production and use of environmental protection packaging materials, effective supervision and incentive mechanisms, no clear standards and restrictions on carbon emissions and energy consumption during logistics transportation, and a lack of regulatory assessment mechanisms.

It is still necessary for the government, enterprises, and society to work together to strengthen cooperation, increase investment, improve policies and regulations, improve environmental awareness, promote the sustainable development of projects, and achieve sustainable development of the supply chain.

3. Analysis on the Problems

3.1. Supply Chain Technology Innovation

Alibaba has achieved supply chain innovation in the green package project, which has led to the development of a green and sustainable supply chain.

Alibaba's green package project makes extensive use of intelligent technologies, considerably optimizing the packaging process via an intelligent packing algorithm. First, it precisely calculates and optimizes the loading plan, resulting in one that satisfies actual demand while adhering to numerous limits. This not only enhances loading safety and stability but also lowers the danger of cargo damage during transit. Second, the algorithm operates in an autonomous and intelligent manner, requiring the user to input the relevant characteristics and limitations of the goods. This enables the algorithm to automatically compute and optimize the loading method. As more data accumulates and iterates, the algorithm's performance and efficacy will improve. This allows for the continual adjustment and development of the packing process to fit a variety of cargo types and transportation needs.

Simultaneously, the data-driven optimization strategy can provide customers with more personalized and accurate loading solutions to satisfy their diverse needs. Alibaba safeguards the environment and save money by streamlining the packaging process with an intelligent packing algorithm. On the one hand, optimizing the loading scheme can reduce the usage of packing materials, resource waste, and environmental pollution; on the other hand, it can reduce the number of modes of transportation and leasing costs, lowering transportation expenses and improving companies' economic benefits. This method not only saves roughly 15% on packing materials but also enhances packaging efficiency and accuracy [4]. In 2014, Alibaba began gradually replacing traditional paper forms with electronic ones, reducing paper waste and its environmental impact. This decision is a key step toward Alibaba's goal of fostering the digital and intelligent transformation of the logistics industry. This method perfectly matches the circular economy's "reduce" idea, which is to reduce the initial use of resources through technical innovation in order to manage resource consumption at the source and increase supply chain efficiency overall.

This approach coincides with the research and discussion of other scholars, indicating a shared interest in exploring related topics. For example, Diaz and others studied the impact of supply chain technology on supply chain efficiency [4]. They focus on the innovation and application of supply chain technology and analyze the improvement effect of supply chain technology on supply chain efficiency based on empirical research. The results show that the application of supply chain technology improves the efficiency of information transfer, inventory management, and transportation.

3.2. Environmental Protection Materials are Widely Used

Alibaba has made extensive use of environmentally friendly materials in the green package project, so it has achieved green and sustainable development in the supply chain.

Since 2015, Alibaba has proactively led the logistics industry in a green and sustainable direction and profoundly changed the ecology of traditional express packaging through a series of innovative measures. Among them, the widespread introduction of bio-based environmental protection delivery bags marks Alibaba's firm determination in reducing plastic pollution and promoting resource recycling. Statistics indicate that by 2023, the utilization of bio-based environmental protection bags will surpass 10 billion, significantly diminishing reliance on non-renewable resources like oil.

Estimates suggest that Alibaba can cut down on the annual consumption of 112,000 barrels of oil. Simultaneously, its production process offers significant environmental protection advantages; compared to traditional plastic packaging, it reduces pollutant emissions by about 31.2%, demonstrating significant ecological benefits [5].

At the same time, Alibaba is also vigorously promoting non-tape cartons, a revolutionary design that fundamentally solves the environmental problems caused by the use of tape. According to the data, the full implementation of the non-tape carton has resulted in a cumulative reduction of tape use by more than 976 million meters, which is equivalent to a reduction of 32,300 tons of difficult-to-degrade waste into the environment. This not only protects the purity of the soil and water but also contributes to the future of the planet.

These environmental initiatives at Alibaba not only set a benchmark in the industry but also inspired the green transformation of the entire supply chain. Under the leadership of Alibaba, upstream suppliers have increased investment in research and development, explored more innovative environmental protection materials and technologies, and provided downstream enterprises with more diversified and more efficient green packaging solutions. Midstream delivery companies are responding positively, continuously optimizing packaging design and transportation processes to reduce the use of packaging materials and the environmental impact of transportation. Downstream e-commerce platforms actively guide consumers to participate in green consumption and jointly build a green and low-carbon lifestyle through points and rewards, green labels, and other ways.

In addition, other studies have further confirmed the key role of environmentally friendly materials in improving the green and sustainable development of the supply chain. For example, Lavanya Meherishi points out in her article that sustainable packaging is essential to reduce the negative environmental impact of the supply chain [6]. While traditional packaging often generates large amounts of waste, which puts enormous pressure on natural resources, sustainable packaging can reduce the environmental footprint of the supply chain by using biodegradable materials, reducing material consumption, and improving recycling rates. This indicates that the use of environmentally friendly materials can effectively enhance the green and sustainable development level of the supply chain.

3.3. The Combination of Green Energy and Low-Carbon Transport

In the green package project, Alibaba combines new energy vehicles (such as hydrogen freight trucks) and logistics route optimization technology, which greatly reduces carbon emissions in the process of logistics transportation, so as to achieve the green and sustainable development of the supply chain. In the journey of exploring the green transformation of the logistics industry, Alibaba has the courage to take the lead in deploying the widespread application of hydrogen energy and electric logistics vehicles in some pilot cities. This initiative is not only a profound innovation of the traditional logistics mode, but also a solid practice of environmental protection commitment. Through the refined operation of the intelligent path planning system, the carbon emissions in the logistics and transportation process have been significantly reduced by up to 30% in some pilot cities, which not only highlights the power of technological innovation, but also sets a new benchmark for the green development of the industry.

The popularity of new energy logistics vehicles is an important part of Alibaba's green supply chain strategy. These vehicles are driven by clean energy such as electric energy, and their operating costs are effectively controlled compared to traditional fuel logistics vehicles. As a relatively stable and low-cost form of energy, electric energy effectively reduces the energy consumption cost of vehicle operation, and brings real economic benefits to logistics enterprises. More importantly, new energy logistics vehicles produce almost no or only a very small number of pollutants in the operation process, fundamentally cutting off the negative impact of logistics links on the environment, greatly improving the environmental benefits of the supply chain, and actively responding to the national carbon peak and carbon neutrality grand goals.

This series of initiatives of Alibaba not only benefits itself, but also has a far-reaching demonstration effect in the industry. It inspires and guides many enterprises in the upstream and downstream of the supply chain to re-examine environmental issues and actively seek the road of green transformation. Upstream suppliers begin to pay attention to the environmental protection of product packaging and production, midstream logistics companies accelerate the replacement of new energy vehicles and the optimization of logistics processes, and downstream e-commerce platforms promote consumers' preferences and choices for environmentally friendly products through green consumption guidance. This green supply chain synergy from point to point and from top to bottom is gradually building a more environmentally friendly, efficient and sustainable industry ecology.

In his article, Zhang deeply analyzed the dual role of low-carbon economic model in promoting economic growth and environmental protection [7]. It is pointed out that with technological innovation and industrial upgrading, the development of low-carbon industries such as renewable energy and energy efficiency improvement can reduce carbon emissions and create new economic growth points and employment opportunities [7].

4. Suggestions

4.1. Update Green Technology Innovation and Application

With increasing global awareness of environmental protection, it is increasingly critical for companies to invest in green technology innovation and application. Alibaba can enhance the innovation and application of green technology from the following angles:

To promote new energy vehicle logistics, it is essential to draw insights from JD and establish a comprehensive procurement and replacement timetable. The program must incorporate a 15% yearly substitution of conventional fuel vehicles with new energy vehicles, in addition to logistical and customized models. Partnerships with manufacturers can diminish expenses and enhance operational effectiveness. Concerning the enhancement of clever packing algorithms, examine Amazon's methodology. Allocate funding for research and development to implement sophisticated models, such as machine learning algorithms. This would provide dynamic optimization based on the dimensions, mass, and weight characteristics of products, thereby minimizing packaging material usage and alleviating the danger of transportation damage. In the advancement and advocacy of eco-friendly packaging materials, draw inspiration from SF Express, enhance research and development initiatives to lower expenses, and collaborate with suppliers to facilitate large-scale manufacturing and implementation. Collaboratively create innovative eco-friendly products, extensively disseminate them throughout the logistics network, implement incentive structures to motivate suppliers and merchants to use them, and provide preferential policies together with promotional support.

4.2. Strengthen the Green Supply Chain Management

In order to achieve the goal of sustainable development, it is imperative to strengthen green supply chain management.

Firstly, establish green supplier certification and incentive mechanisms. If Apple conducts strict environmental assessments on its suppliers, Alibaba should do the same, covering production energy consumption, waste disposal, and other aspects. Suppliers who have successfully completed the certification process are eligible for priority cooperation, price concessions, and regular reviews of their environmental performance. Serious violations can result in suspension of cooperation or disqualification.

Secondly, formulate a clear green procurement policy. Similar to Ikea's selection of environmental protection products and its prioritization of environmental goods in its schedule, Alibaba should establish clear environmental standards and indicators, prioritize environmental protection products, and gradually phase out environmental protection products. This could involve increasing the

proportion of green packaging materials purchased, fostering communication and cooperation with suppliers, and providing support and training to facilitate its transformation.

Finally, optimize the green logistics process. Referring to FedEx, Alibaba can use centralized distribution, joint distribution, and other models to reduce transportation distances and carbon emissions, optimize packaging designs, use recyclable materials, and achieve green logistics.

4.3. Enhance Consumer Awareness and Participation in Green

Consumers play an important role in promoting green development, and it is critical to increase their green awareness and participation.

Initially, this research should leverage Alibaba's platform traffic benefits to implement initiatives aimed at promoting and educating about green consumption. The Little Red Book imparts knowledge about environmental protection and advocates for a sustainable lifestyle. Alibaba may orchestrate green consumption events, exhibit eco-friendly products and brands, provide promotional incentives, and publish guides on sustainable consumption. These guides seek to establish environmental protection standards and certification systems that aid consumers in recognizing eco-friendly items.

Furthermore, the implementation of a point-based reward system for sustainable consumption is essential. Starbucks incentivizes customers by awarding points for using environmentally sustainable cups. Alibaba might adopt this model by granting points to clients who participate in sustainable consumption, enabling them to exchange these points for coupons, products, and other rewards. It may incentivize consumers with points and acknowledge engaged consumers via the leaderboard, cultivating a constructive atmosphere.

Thirdly, to enhance communication with the consumer. It is encouraged that customers to engage in environmental preservation initiatives and to share their ideas and suggestions through both online and offline activities. Questionnaire surveys are administered to comprehend demand expectations, offer insights for sustainable development, and address problems via social media interactions to improve engagement and satisfaction. These initiatives can augment consumer identification and accountability while collectively advancing green development.

5. Conclusion

The fast advancement of the logistics business, within the framework of global economic integration and the proliferation of e-commerce, has exerted significant strain on the environment. This research examines the influence of Alibaba's green package initiative on the sustainable advancement of the green supply chain. By conducting a comprehensive examination of Alibaba's green packaging initiative, this paper investigates efficient methods for attaining sustainable supply chain development. Initially, it presents the escalation of logistics demand and the environmental issues arising from the advancement of e-commerce, governmental promotion, and consumer consciousness regarding environmental conservation. It also underscores the practical instances and inadequate cooperation channels in scholarly research. Subsequently, it delineates the project initiatives, their impacts, and the obstacles they encounter. It examines the practice and correlation from three viewpoints: technical innovation, environmentally protective materials, and renewable energy. The study ultimately presents many proposals designed to improve technological innovation, strengthen supply chain management, and increase consumer awareness. These recommendations seek to provide businesses with the essential resources to attain sustainable development of the green supply chain and promote the industry's green transformation. This article concludes that the sustainable growth of the supply chain necessitates collaborative efforts among firms, government, and society.

This study thoroughly examines Alibaba's sustainable development strategies within its green supply chain and offers practical directives for firms to choose eco-friendly packaging materials, implement recycling systems, and enhance supply networks. The paper utilizes case analysis and literature review to examine previous research, uncover deficiencies, and deploy the Alibaba Project as a case

study to substantiate its compelling conclusion. Nonetheless, there are also deficiencies. The study approach primarily emphasizes corporations, governments, and consumers, while neglecting social groups and scientific research institutes. In the future, the viewpoint may be broadened to encompass the involvement of other stakeholders. Conversely, although the research offers a comprehensive analysis of the project, it fails to explore in depth the development of environmental protection materials, cost control, and other pertinent topics. It merely suggests improving research and development and partnering with suppliers, without addressing the exact technical approach and cost reduction method. In the future, comprehensive analysis may be undertaken to furnish additional operational solutions for enterprises, advance the sustainable development of the green supply chain, and enable more enterprises to leverage Alibaba's practical experience while collectively contributing to environmental protection efforts.

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