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Green Transformation of Manufacturing Supply Chains: A Case Study of Huawei

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Abstract:

With the advancement of modern society and the growing urgency of environmental protection issues, numerous countries are actively promoting sustainable and green development. As a country with a large population and relatively limited per capita resources, China has adopted green supply chain management (GSCM) to address resource constraints and environmental challenges. This approach transcends the limitations of traditional supply chain management, which primarily focuses on economic indicators like cost and quality. However, the implementation pathways for such transformation in leading manufacturing enterprises remain underexplored. To address this gap, this paper conducts a case study of Huawei Technologies Co., Ltd. Instead, it systematically optimizes processes such as design, procurement, processing, and transportation within the supply chain, achieving a dual enhancement of economic benefits and environmental protection. Eco-design requires optimizing resource allocation while minimizing environmental pollution impacts, embedding environmental principles throughout supply chain processes to achieve conservation and foster coordinated economic and environmental development. This paper analyzes Huawei Technologies Co., Ltd. as a case study, examining its entire supplier management model and development trends within the economic era of clean energy and low-carbon development. The study reveals that Huawei's transformation is driven by integrating carbon reduction throughout its supply chain, leveraging digital technologies for transparency, and fostering collaborative partnerships with suppliers. These practices have resulted in significant carbon emission reductions and enhanced brand reputation.

Keywords: Green Development; Supply Chain Management; Green Transition, Huawei

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1. Introduction

1.1 Research Background

Manufacturing enterprises form the backbone of the national economy, transforming market demands into usable tools and materials for people. The supply chain is a crucial component in the formation of the manufacturing sector. In recent years, traditional supply chain management models within manufacturing enterprises have struggled to drive socioeconomic development and adapt to new regulations. Some enterprises face the risk of elimination due to insufficient capital or non-compliance with environmental regulations. Researchers in this field have pointed out that current studies lack a concrete and comprehensive framework to guide enterprises across different industries and regions in optimizing their GLC-SCM strategies [1]. Green supply chains were first proposed in the late 1980s and have since gained global traction. Governments and organizations worldwide promote green development through policy documents, practical initiatives, and guidance. China's government similarly emphasizes green development as a prerequisite for supply chain management and advancement in documents such as the 12th Five-Year Plan, 13th Five-Year Plan, and the "Opinions on Accelerating the Establishment of a Product Carbon Footprint Management System" issued by the National Development and Reform Commission and other departments. Thus, under the framework of green development, the transformation of corporate supply chains has become a critical issue. Huawei Technologies Co., Ltd., established in Shenzhen in 1987, has continuously pursued internal R&D and innovation. As early as the late 20th century, it began collaborating with IBM to develop an integrated supply chain, building a partnership centered on customer and consumer needs. Subsequently, it progressively advanced green logistics and smart logistics, incorporating new energy technologies and artificial intelligence. As global calls for environmental protection and low-carbon initiatives intensify, Huawei has consistently upheld eco-friendly principles over the past two decades. The company actively prioritizes environmental sustainability, ranking among the leaders in China and globally. Therefore, Huawei presents a critical and illustrative case for investigating the strategic transformation of supply chains under the green development paradigm.

1.2 Literature Review and Research Gap

Fan et al. analyze the tripartite game among the government, enterprises, and consumers on the transformation of the green supply chain, as well as the strategic choice of digital cooperation between enterprises of different sizes and development levels in the supply chain [2]. The results show that under the given conditions, the green behavior of the government and consumers can achieve better green transformation of supply chain enterprises.

Zhang et al. found that the implementation of green supply chain management will affect the value enhancement of enterprises, so technological innovation and supply chain concentration are needed under the green and low-carbon logistics development process [3]. The risk-taking level of enterprises can also promote the value of enterprises, thus promoting the progress of society.

Gu found that supply chain digitalization can significantly improve enterprises' level of green energy innovation. In addition, there is a significant positive spillover effect in the city [4]. The digitalization of the supply chain has significantly promoted enterprises' green energy innovation. However, on this issue, it is also believed that there are problems, such as rising prices of clean and green raw materials and rising labor costs, that lead enterprises to face cost control pressure. Due to the uncertainty of today's market, the supply chain is difficult to control and forecast.

Luay analysed 362 responses using a structured questionnaire to collect primary data from Jordanian mining companies by analysing the importance of green supply chain management practices in the SDGs [5]. The research model used was tested using the least squares structural equation modeling (PLS-SEM) method. The results show that all GSCM practices, except green procurement and investment recovery, had a dominant impact on community practices; while all practices, except green procurement, had a positive impact on the environment.

While these studies provide valuable insights into the drivers and effects of GSCM, there remains a scarcity of in-depth case studies that systematically unpack the implementation mechanisms and strategic pathways for leading multinational corporations in the manufacturing sector to achieve a holistic green transformation. This gap motivates our focused examination of Huawei.

1.3 Research Objectives and Paper Structure

The research objectives of this paper are to first examine relevant literature and case studies through methods such as literature review and case analysis. This will explore the transformation pathways and mechanisms of Huawei Technologies Co., Ltd.'s supply chain management under green development. Subsequently, it will investigate the types of resources and energy the company utilizes to optimize its technological efficiency. The study will further examine how the enterprise reduces costs and fosters collaborative development when facing economic crises and financial pressures, ultimately analyzing the resulting issues and impacts. The insights gained from this research aim to contribute to advancing green transformation strategies and sustainable development for Chinese enterpris-

es.

2. Huawei's Green Supply Chain Transformation: An Overview of Current Initiatives

To ground the theoretical discussion in practical reality, this paper selects Huawei as a critical case study due to its prominence and extensive efforts in green supply chain transformation. As a global leader in the ICT industry, Huawei Technologies Co., Ltd. has systematically integrated green principles into its supply chain management. This section outlines its current key initiatives, which can be categorized into four interconnected dimensions: green supplier management, low-carbon operations, sustainable material utilization, and logistics optimization.

First, in terms of green supplier management, Huawei enforces stringent environmental standards throughout its procurement process. The company consistently implements carbon reduction management requirements and selects products with superior environmental performance, sustainability, and recyclability. In supplier selection, it strictly screens for high-quality partners that meet IPE standards. Furthermore, continuous communication with customers and coordination with government environmental agencies have enhanced the transparency and openness of its supply chain process.

Second, Huawei is committed to low-carbon operations by increasing its reliance on renewable energy. The company has increased the use of renewable energy, such as wind and thermal energy, in its own operations and has built photovoltaic power plants to reduce carbon emissions and prevent environmental pollution.

Third, the company prioritizes sustainable material utilization in its product design and manufacturing. Huawei uses high-quality renewable materials to avoid polluting the environment, and nearly 14 kinds of materials are used in its terminal electronic products. This direct sourcing from sustainable sources is an important measure for national environmental protection and economic development.

Fourth, Huawei practices green logistics optimization across transportation modes, routes, and management. Initiatives include using new energy vehicles to reduce emissions, optimizing product packaging to reduce packaging paper usage, and improving overall transportation efficiency.

Collectively, these initiatives reflect Huawei's strategic approach to building a resilient and environmentally responsible supply chain by leveraging digital technology, fostering collaboration, and innovating in material and energy use. However, despite these achievements, the complexity and instability of global economic development mean that geopolitical factors continue to pose challenges to the stability of its supply chain.

3. Strategic Analysis: Drivers, Mechanisms, and Challenges in Huawei's Transformation

Building upon the overview of Huawei's practices, this section delves deeper into the strategic underpinnings of its green supply chain transformation. It analyzes the drivers motivating this shift and the specific mechanisms employed, and it critically evaluates the outcomes alongside the enduring challenges that highlight the complexities of such a transition.

3.1 External Drivers and Internal Strategic Alignment

Huawei's Motivations and Strategies for Transformation in Supply Chain Manufacturing Under Green Development. Huawei's shift toward environmentally sustainable supply chain production stems from multiple motivations, driven by external pressures and conditions. As global market awareness of environmental protection grows, numerous environmental regulations are being enacted, alongside China's "dual carbon" goals: achieving carbon peak by 2030 and carbon neutrality by 2060. The United Nations and global institutions advocate for sustainable development worldwide, calling for poverty eradication, planetary protection, and the advancement of future development. Under this national and policy pressure, numerous enterprises are progressively shifting toward green development. In the tourism sector, destinations are taking leadership roles in energy sustainability [6]. Furthermore, corporate development cannot ignore the expectations of customers, clients, and purchasers. Some buyers and suppliers now prioritize green and low-carbon credentials as selection criteria and thresholds before establishing partnerships. Driven by these external factors, Huawei proactively integrates environmental regulations, natural resource efficiency, and energy-driven efficiency as fundamental standards across every stage—from R&D and operations to procurement, manufacturing, and supply chains—diligently fulfilling its duty to build green development collectively. However, internal management revealed potential cost inefficiencies that fail to deliver long-term economic benefits, alongside numerous risks of supply chain disruptions. Huawei, therefore, established relevant strategic objectives. In other industries, such as aquaculture, green supply chain management encompasses environmentally friendly farming, resource management, distribution, waste management, and biosecurity [7]. Huawei integrates sustainability as part of its overall corporate strategy, continuously refining its development approach toward digital inclusion, security and

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trustworthiness, environmental protection, and ecological harmony. It fully complies with environmental regulations in all its operating regions, engages with communities to understand customer needs, develops appealing products, enhances resource recycling efficiency, and reduces costs.

3.2 Implementation Mechanisms: Technological and Operational Innovations

Huawei's ICT technologies and infrastructure rank among the world's best. Guided by its technological capabilities, the company consistently upholds principles of openness, collaboration, and altruism. It continuously refines its approach to achieve global sustainable development, setting an example for nations worldwide. Within its overall supply chain management strategy, Huawei fully integrates carbon reduction concepts, deepening cooperation with suppliers to accelerate the decarbonization of its supply chain. The company persistently explores cleaner, more energy-efficient innovations, working alongside customers and partners to contribute to society's zero-carbon transition. Taking HarmonyOS 5 as an example, Huawei commits over 10% of its annual sales revenue to developing low-carbon products in product manufacturing. It consistently selects high-quality recyclable materials, minimizes direct sourcing from mineral origins, and utilizes 14 renewable natural raw materials, including gold, copper, aluminum, cobalt, and tin. This approach extends the lifespan of products like smartphones, tablets, and Bluetooth devices while reducing resource consumption. They have even established a 500-square-meter environmental laboratory accredited by CNAS to analyze products' environmental health impacts. Each item undergoes a carbon footprint assessment to minimize emissions. Regarding packaging, transitioning from fossil fuels to green energy is crucial for sustainable development and promoting eco-friendly environments. Huawei leads globally in this field, now utilizing genuinely eco-friendly paper materials certified as compostable internationally and capable of degrading in industrial composting. Next, in the printing process, Huawei innovatively introduced 100% biodegradable soy-based ink technology. This ink uses non-GMO soybean oil as its core solvent and holds the U.S. Soy Environmental Certification (oil content ≥40%). Its biodegradation rate is 300% faster than traditional petroleum-based inks. This ink eliminates chemical pollution risks during packaging material degradation at the source, achieving dual breakthroughs in environmental performance and print quality. Furthermore, to enhance transportation sustainability, Huawei has committed to replacing conventional vehicles with new energy options like electric trains. The company also utilizes clean-energy cargo ships powered by electricity, methanol, and hydrogen, reducing annual carbon emissions by over 450 tons. Finally, regarding product after-sales maintenance, Huawei launched a one-stop replacement service in China starting in 2021. This initiative informs consumers that accidentally damaged or worn-out yet still functional products can be recycled by Huawei to offset the purchase of new items. In recent years, Huawei has recycled nearly one million old devices. This concept enhances product reuse efficiency and reduces the environmental impact of electronics. Huawei's entire series of process innovations is designed to benefit the entire planet while maintaining profitability.

3.3 Outcomes and Persistent Challenges

So far, the transformation of Huawei's supply chain under green development has been very effective. The 2024 hosted the fourth conference on carbon reduction in supply chains, which was attended by more than 1,000 suppliers from around the world, the chairman of the Huawei Group and President of Global Purchasing Certification Management attended the conference and said that if the environmental data of the industry chain were open, transparent and more accurate, the carbon emissions of products would be reduced again. In the 2024 annual report, Huawei consistently emphasizes quality and ecological sustainability as core corporate principles. Huawei Yun, Peng, Shengteng, and Hongmeng are growing fast, with 2024 Peng and Shengteng systems having 6.65 million developers and more than 8,500 partners. Huawei has always believed that technological innovation is an effective way to promote green development, and will continue to use ICTs to reduce its carbon footprint in line with global development [8]. By the end of last year, Huawei's digital energy sector had saved about 81.8 billion kilowatt hours of electricity and 710 million tons of carbon dioxide emissions, the equivalent of planting 970 million trees. These huge numbers represent the continuing efforts of corporate Huawei over the years. These efforts to consolidate its image in the industry as a whole enhance the brand awareness and reputation. That's why more and more customers are choosing Huawei products.

4. Strategic Recommendations and Implementation Pathways

Based on the critical analysis of challenges faced by Huawei, namely data fragmentation, collaborative complexity, and high investment costs, this section proposes targeted strategic recommendations. These recommendations aim to transform these challenges into opportunities for building a resilient and sustainable green supply chain.

4.1 Forging a Collaborative and Transparent

Supply Chain Ecosystem

In today's development landscape, traditional manufacturing enterprises' supply chain models face significant challenges, making green transformation no longer an option but a necessity. Isolated greening of individual segments can no longer drive holistic progress; instead, coordinated transformation across the entire chain—encompassing procurement, production, transportation, sales, and other processes—is required. First, enterprises must strengthen management of environmental, economic, and policy risks inherent in their processes. Second, they should enhance green and appropriate collaboration with suppliers. Much research on supply chain network design focuses solely on the "greenness" trade-offs of products, neglecting vertical cooperation models and their environmental impacts [9,10]. Therefore, enterprises must bolster management and collaboration, with all departments contributing to mutual development and driving the widespread adoption of green supply chain management.

Huawei continuously explores and innovates in supplier collaboration. However, challenges persist: despite its scale, Huawei manages an excessively large supplier base, particularly small-to-medium suppliers at secondary and tertiary levels. These suppliers face significant production and service compliance challenges. Thus, Huawei should initially assess suppliers' financial health and manufacturing capabilities during selection. After selection, Huawei must establish a comprehensive management system, conducting regular audits of suppliers' products and efficiency. Non-compliant suppliers should be terminated. Deep integration of digital technologies is essential to enhance transparency and build a timely, reliable procurement system capable of swift risk response. The Schaeffler environmental compliance incident nearly disrupted service to countless Shanghai customers due to a supplier failing regulatory requirements. To support Huawei's leadership, it is crucial to establish strong partnerships with suppliers and share the benefits of collaboration.

4.2 Innovating Cost-Effective Green Business Models

To address the high-cost dilemma, Huawei should pioneer green supply chain finance instruments. For instance, the company could partner with financial institutions to provide low-interest loans or preferential financing to suppliers who achieve predetermined green certification standards. This approach directly lowers the financial barrier to green transformation for SMEs, aligning economic incentives with environmental goals and sharing the burden of upfront investment. By issuing relevant news and holding green product experience activities, People can create a green and environmentally friendly consumption environment, so as to promote the sustainable development of each supply chain link. In short, the supply chain transformation of manufacturing enterprises under green development is not a simple problem; it requires the coordination and cooperation of all aspects and common progress and development. In the manufacturing, production, packaging, transportation, and other aspects of the supply chain, enterprises need to strengthen their own supervision. In cooperation with suppliers, it is necessary to organize their training at any time and set up the corresponding reward and punishment mechanism. The most important thing is to have a clear goal, regularly publish relevant data and information on official websites or platforms, and accept the supervision of the government and citizens.

5. Conclusion

This case study on Huawei Technologies Co., Ltd. elucidates the strategic pathways and operational practices for manufacturing enterprises to achieve green transformation of their supply chains. The findings demonstrate that under the dual drivers of external policy and market pressures, coupled with internal strategic needs, a comprehensive green overhaul from product design to end-of-life recycling is not only feasible but also beneficial for brand building and long-term competitiveness. Facing stringent global environmental regulations and internal operational risks such as cost volatility and supply chain disruptions, forward-thinking enterprises like Huawei are compelled to integrate sustainability into their core strategy. Under this influence, Huawei has also turned pressure into momentum, making the sustainable development of its supply chain part of its overall strategy. Millions of users have loved HarmonyOS 5 over the past few years, and it is the ultimate in manufacturing, packaging, shipping, recycling, and more. It integrates the concept of carbon reduction into its supply chain management and works with suppliers to accelerate decarbonization. Huawei is still using its leading ICT technologies to help move the supply chain towards zero carbon. As a world leader, Huawei is exploring innovative products and technologies in the green supply chain transformation, and exploring its supply chain management transformation strategy under the concept of environmental protection, which can provide reference for the development of other manufacturing enterprises, and help colleagues clearly understand the path and method of green supply chain transformation. Beyond serving as a practical blueprint, this study contributes to the theoretical discourse on Green Supply Chain Management (GSCM) by illustrating the synergistic integration of corporate strategy, technological innovation, and supplier collaboration. This will promote the entire production industry in the supply chain development process of environmental protection efforts to build a better home.

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This study has several limitations. Firstly, as a single-case study, its findings, while in-depth, may have limited generalizability across diverse manufacturing contexts. A comparative analysis with other leading firms would offer a more comprehensive understanding. Secondly, the reliance on publicly available data restricts the ability to conduct longitudinal analysis or access granular operational details. Lastly, the qualitative methodology, primarily based on case analysis, could be complemented by future research employing quantitative models and empirical data to enhance the robustness of the findings.

Future research should be extended in several directions. First, comparative studies involving multiple manufacturers from different industries or regions could identify universal success factors and context-specific challenges. Second, employing quantitative methods to analyze the correlation between specific green practices (e.g., renewable material usage) and performance metrics (e.g., carbon reduction, cost savings) would yield more generalizable results. Finally, investigating the role of emerging digital technologies like AI and blockchain in enhancing the transparency and efficiency of green supply chains represents a promising avenue.

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