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Digital Intelligence Driving Corporate Green Supply Chain Upgrades—A Case Study of Schneider Electric

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Abstract: Schneider Electric actively practices green intelligent manufacturing and has established multiple "lighthouse factories" worldwide. By leveraging digital technologies, the company has built a green and efficient supply chain spanning the entire production process, achieving operational efficiency improvements and sustainable development. Through the application of big data, IoT, cloud computing, and other technologies, the enterprise can precisely monitor resource utilization and environmental impacts across supply chain segments, optimize logistics transportation, and reduce carbon emissions and energy consumption. Meanwhile, digital-intelligent technologies enhance supply chain transparency and compliance, effectively lowering operational risks and costs. The core enterprise drives collaborative technological innovation, guiding upstream and downstream partners to co-create a green industrial ecosystem and realize sustainable development across the entire industry chain. Taking Schneider Electric as a case study, this paper explores the mechanism of digital-intelligent technologies in corporate green supply chain upgrading based on resource orchestration theory. The research indicates that digital-intelligence-driven green transformation undergoes two transitions: progressing from the informatization stage to the intelligent stage, ultimately reaching the ecological stage. This evolutionary process constructs a three-phase pathway from green infrastructure construction to green capability enhancement and finally to green ecosystem establishment.

Keywords: Digital intelligence, green supply chain, resource orchestration theory, schneider electric

1. Introduction

In 2015, China explicitly proposed "building green supply chains" for the first time in its action plan to implement the manufacturing power strategy. Amid the new wave of technological revolution and industrial transformation, digitalization and intelligentization have become key drivers for industrial upgrading and achieving green low-carbon development, as well as crucial support for enhancing competitiveness. Enterprises, as vital microeconomic entities, face the dual tasks of advancing digital-intelligence capabilities and implementing green low-carbon practices. Integrating digitalization with green development not only strengthens corporate competitiveness but also drives high-quality development.

With policy support, green supply chains now integrate production, logistics, and consumption ends, profoundly reshaping traditional supply chain management models and creating new

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opportunities for enterprises. However, challenges persist for many manufacturers in efficiently constructing green supply chains while balancing green development and economic growth [1].

Digital-intelligence technologies play a pivotal role in advancing corporate digital transformation and enhancing global competitiveness [2]. As a sector at the forefront of digital-intelligent development, electronic information enterprises exemplify the application of digital technologies in building and upgrading green supply chains. This paper uses Schneider Electric as a case study to explore pathways through which digital intelligence enables green supply chain development and upgrading, providing references for manufacturing enterprises seeking to leverage these technologies to establish or enhance sustainable supply chains.

2. Literature Review

Digital intelligence refers to the integrated application of digital technologies and intelligent elements such as artificial intelligence, 5G, and the Internet of Things (IoT), representing an advanced stage of digital transformation evolution [3]. The goal of digital-intelligence transformation is to empower production and management through digital and intelligent technologies, gradually cultivating corporate digital-intelligence capabilities to adapt to dynamic environments [4]. Current discussions on digital-intelligence transformation primarily focus on how enterprises leverage digital technologies and tools to optimize processes, reduce costs, enhance efficiency, and innovate business models in conventional contexts. However, there is limited exploration of the dynamic evolution of digital-intelligence transformation across different stages of corporate development [5].

Meanwhile, the integration of digital-intelligence transformation with green supply chains has garnered increasing attention, as the former provides technological support and innovation momentum for the latter. Webb first coined the term "green supply chain," advocating for environmentally responsible enterprises that source raw materials meeting ecological standards and implement recycling and reuse practices [6]. In 1996, Michigan State University's Manufacturing Research Association formally defined the concept of a green supply chain, which embeds environmental protection and resource conservation principles into procurement, production, distribution, and sales processes. This forms a closed-loop system spanning supply, logistics, consumption, and data ends, fostering green circularity and sustainable development. Studies based on the resource-based view explore how enterprises enhance green supply chain integration to achieve sustainable competitive advantages [7]. Regarding green supply chain innovation, green technologies are recognized as critical for improving competitiveness, with technological innovation and green supply chains forming an interdependent "double helix" structure [8]. Due to the varied research contexts, many enterprises are now adopting green supply chain management to achieve their "dual-carbon" goals; however, quantitative and qualitative studies based on corporate data and practical observations are still limited [9].

Digitalization and greenization represent future directions for enterprises. Current research on the synergistic effects of digital intelligence and green supply chains remains sparse. One study, based on resource orchestration theory, analyzes how digital intelligence drives green transformation in manufacturing firms, revealing a progression from "green structuralization" to "green capability enhancement" and finally "green leveraging" [10]. Digital transformation aids in identifying and reducing waste emissions while improving recycling and operational efficiency within supply chains [11]. Against the global backdrop of addressing climate change, greening corporate supply chains holds significant implications for advancing sustainability across entire industrial ecosystems.

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3. Case Study: Schneider Electric's Intelligent Green Supply Chain

As a global leader in electrical and automation solutions, Schneider Electric is dedicated to tackling climate challenges and advancing the green economy. The company implements its proprietary green supply chain management system to enhance supply resilience and accelerate low-carbon transformation amid growing uncertainties. Utilizing leading-edge digital technologies and sustainability expertise, Schneider Electric has established an end-to-end green supply chain.

3.1. Green Production

In green production, Schneider Electric promotes its "5S" green intelligent manufacturing framework (Sort, Set in Order, Shine, Standardize, Sustain) and has established the EcoStruxure™ Green Intelligent Manufacturing Architecture. This architecture leverages IoT to achieve seamless connectivity across three layers: product interconnectivity, edge control, and application analysis/services.

In product R&D and design, Schneider provides end-to-end lifecycle consulting and technical support. During manufacturing, the company replaces traditional manual inspections and monitoring with AI-driven information technologies, accelerating factory digital transformation and enabling lean production. In 2022, Schneider launched a fully integrated closed-loop digital power distribution system for comprehensive scenarios to strengthen energy consumption monitoring in industrial parks.

Furthermore, Schneider advocates for efficient resource utilization, implementing circular economy strategies such as on-site recycling or partnering with responsible suppliers to maximize waste recovery and reuse, thereby eliminating landfill disposal. The company also undertakes biodiversity conservation and restoration initiatives across all office sites. In water-stressed regions, Schneider's facilities implement both short- and long-term water conservation programs to address resource scarcity.

3.2. Supplier Management

In supplier management, Schneider Electric launched its "Zero Carbon Program", establishing a comprehensive supplier screening framework based on three modules: the Supplier Approval Module (SAM), Supplier Qualification Module (SQM), and Supplier Performance Module (SPM). This system employs technologies such as carbon trajectory definition, carbon footprint analysis, and carbon emission statistics to monitor and evaluate suppliers' decarbonization performance and emission reduction data in real time. Data visualization tools facilitate knowledge sharing among suppliers, enabling collaborative learning of carbon reduction strategies.

Through on-site visits, experience-sharing workshops, and technical empowerment initiatives, Schneider collaborates with suppliers to identify decarbonization opportunities and jointly reduce Scope 1 and Scope 2 emissions (which correspond to Schneider's Scope 3 emissions). This approach enhances supply chain synergy and accelerates full supply chain decarbonization.

Additionally, Schneider has defined green material requirements for key raw materials such as aluminum, copper, and plastics. Its procurement team rigorously sources compliant materials, aiming to ensure that green materials constitute over 50% of Schneider's product composition by 2025.

3.3. Green Logistics

In green logistics, Schneider Electric has established seven logistics centers in China, including facilities in Beijing, Shanghai, and Wuhan. Notably, in 2019, the Schneider Electric (China) Co., Ltd. Shanghai Branch Logistics Center (DCSH) underwent a digital transformation to become a smart

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logistics hub, integrating an Operational Control Tower System and a Transportation Control Tower System. This upgrade enabled end-to-end supply chain management with full transparency, making DCSH Schneider's second global benchmark for smart logistics centers.

To minimize environmental impact, Schneider prioritizes electric vehicles (EVs) and clean-energy fleets, such as new-energy trucks and hybrid trucks, for transportation. Real-time data collection, transport status monitoring, and resource management systems are deployed to optimize fleet operations. Big data algorithms dynamically plan optimal routes to reduce energy consumption, while real-time interventions enable agile resource allocation.

By 2025, Schneider plans to build a green transportation network covering over 50 cities and pilot autonomous truck delivery. The company employs lean transportation route optimization through big data analytics, consolidating full-truckload (FTL) and less-than-truckload (LTL) shipments. In high-demand core regions, Schneider establishes regional hubs to shorten transportation distances and reduce delivery frequencies, further lowering carbon footprints.

3.4. Green Recycling

In green recycling initiatives, Schneider Electric has established a comprehensive recycling system based on the "5R" principles (Reduce, Reuse, Recycle, Recover, Repair) through collaborations with third parties alongside its in-house capabilities. During product recycling, Schneider utilizes an integrated mobile service management platform to arrange disassembly, reverse logistics, and refurbishment for non-compliant products, achieving 100% recycling and reuse. For aging or obsolete products, Schneider leverages its global UPS-es Refurbishment Center Network to extend product lifecycles. The company employs cutting-edge technologies to upgrade products and offers end-of-life product recycling services to customers, ensuring non-hazardous disposal and zero landfill waste. Additionally, Schneider recycles paper and wood packaging materials for secondary use in internal operations. These practices reduce resource waste, mitigate overconsumption, foster employee awareness of sustainability principles, and enhance proactive engagement in sustainable development efforts.

3.5. Green Packaging

In green packaging initiatives, Schneider Electric adopts the EcoDesign Way (Ecological Design Methodology) during product design to implement a sustainable development strategy, starting with packaging material reduction. To enhance packaging efficiency, Schneider developed a pre-packaging optimization algorithm, increasing box utilization to 80% or higher. This approach reduces the consumption of packaging boxes, bubble cushioning materials, and transportation resources, while improving customer experience and advancing environmental goals.

By redesigning packaging methods, Schneider has eliminated traditional packaging materials and implemented circular recycling systems. For instance, the company introduced foldable, plastic, reusable containers for logistics distribution, replacing conventional materials such as cardboard boxes, plastic fillers, plastic strapping, plastic sealing tapes, and plastic shrink wrap. These containers are equipped with RFID technology for tracking and recovery. Additionally, Schneider focuses on developing and applying green packaging materials to replace single-use plastics. By collaborating with partners, the company has developed sustainable alternatives such as plant-fiber strapping, paper-based sealing tape, paper cushioning materials, and paper packing list pouches to replace plastic products.

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4. Mechanism of Digital Intelligence Technologies in Green Supply Chain Transformation

Based on the case study of Schneider Electric and coded through the lens of Resource Orchestration Theory, this section elaborates on the process and mechanisms by which digital intelligence drives corporate green supply chain transformation, addressing the core question about how digital intelligence facilitates green supply chain upgrading.

4.1. Digitalization Phase: Foundation Building

The first stage of digital intelligence-driven green supply chain transformation is digitalization. In this phase, enterprises leverage digital technologies to collect, cleanse, and consolidate data, enabling the digital transformation of all supply chain components and processes. Standardized workflows are established to build corporate digital capabilities, laying the groundwork for a green transition.

4.2. Intelligentization Phase: Efficiency and Synergy

The second stage, intelligentization, marks the first leap in green supply chain development. Digital intelligence technologies integrate information flow across all stages, coupling digital resources to dismantle information silos and interconnect supply chain nodes. This achieves physical-virtual interconnectivity, enhancing supply chain efficiency, sustainability, and security. Automated production lines and intelligent decision-making systems synergize multi-scenario data, enabling seamless collaboration across supply chain activities—including design, procurement, production, and logistics—to strengthen green competencies.

4.3. Ecosystemization Phase: Collaborative Sustainability

The third stage, ecosystemization, represents the second leap. Enterprises leverage their digital resources and technologies to achieve cross-boundary resource synergy. Through end-to-end intelligent supply chain management, low-carbon transformation practices are extended to upstream and downstream partners, driving large-scale green upgrades across the ecosystem. This fosters a dual convergence of a digital intelligence ecosystem and a green sustainability ecosystem, amplifying systemic environmental impact.

5. Conclusion

This study, based on a case analysis of Schneider Electric, explores the intrinsic mechanisms by which digital intelligence drives corporate green supply chain transformation, revealing the catalytic role of digital technologies across all stages of sustainable supply chains. From the perspective of dynamic evolution, the green supply chain development of electronics and information enterprises undergoes two critical leaps: "from digitalization to intelligentization" and "from intelligentization to ecosystemization". These transitions are evident in the convergence of digital technologies that enable lean production, the application of digital twins that foster cross-scenario collaboration, and the implementation of end-to-end intelligent management to create a green sustainability ecosystem.

The application of digital technologies at each stage directly influences subsequent phases, forming a layered progression that achieves holistic digital-green integration across the entire supply chain. Regarding intrinsic mechanisms, the empowerment of digital intelligence technologies in green production, supplier management, packaging, logistics, and recycling collectively reduces supply chain carbon emissions, enhances corporate decarbonization capabilities, and ultimately accelerates green supply chain upgrading.

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However, this study relies on literature review and a single case analysis, lacking primary data and empirical validation. Future research could employ empirical methods to analyze key factors influencing digital intelligence-driven green supply chain transformation.

The findings provide a phased framework for electronics firms to align digital investments with sustainability goals. Practitioners can prioritize technology-context fit—deploying IoT for real-time emission monitoring in early stages, then advancing to blockchain-enabled traceability and AI-powered circular logistics in mature phases. Policy-makers should incentivize ecosystem-level digital infrastructure to accelerate industry-wide green transitions.

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