DIGITAL EMPOWERMENT AND GREEN TRANSFORMATION: RESEARCH ON THE INNOVATION PATH OF SF EXPRESS IN COMMERCIAL LOGISTICS

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Abstract

E-commerce is developing fast and the supply chain structure is changing a lot. The traditional logistics model faces two big problems: it is hard to improve operational efficiency and it needs to develop in a sustainable way. This paper takes SF Express, a leading Chinese logistics enterprise, as the research object. It uses the single case study method and combines corporate strategic reports and industry public data. It analyzes SF Express's innovative path of commercial logistics from three aspects: technology application, service model and environmental responsibility. The study systematically identifies SF Express's collaborative innovation system of "technology empowerment – model reconstruction – green transformation", which improves operational efficiency, expands service scope and achieves low-carbon development. The study finds that SF Express has improved operational efficiency, expanded service scope and achieved low-carbon development through the collaborative innovation of "technology empowerment - model reconstruction - green transformation". This conclusion gives a practical example for the digital and green transformation of China's logistics industry. It also adds to the theoretical research on logistics sustainable development.

Keywords: SF Express; digital transformation; green logistics; supply chain innovation; sustainable development

Introduction

The digital economy and the "dual carbon" goal (carbon peak and carbon neutrality) are deeply integrated, and this drives China's modern logistics industry into a key period of high-quality development. The 14th Five-Year Plan for Modern Logistics Development clearly sets digitalisation and greening as the core directions of industry transformation (National Development and Reform Commission, Ministry of Transport, 2022). But China's logistics industry still has many prominent problems: the operating costs are high, carbon emissions are intense, and digital technology is not used evenly in different areas (China Federation of Logistics & Purchasing, 2025). Recent studies have looked at how to use digital technology in logistics (Li et al., 2024) and the environmental benefits of green logistics (Zhang & Liu, 2025). Most of these studies only focus on a single aspect, either improving efficiency through digital transformation or creating new green logistics models. They do not analyze how digitalisation and greening work together in a systematic way with case studies, and there is also little in-depth research on leading logistics enterprises that can show the latest industry trends and technology applications. Few studies even use dynamic capability theory and green supply chain management theory to explain how digital technology helps logistics enterprises achieve green transformation (Chen et al., 2024).

This study's new point is building a three-dimensional analysis framework of "technology-model-green". It combines the latest research results of logistics management and sustainable development to fill this research gap and explain the internal logic of digital empowerment for green transformation of logistics enterprises.

The aim of this research is to find the innovative path and internal mechanism of logistics enterprises' digital and green collaborative transformation.

To achieve this aim, three specific research objectives are set:

1. To analyze the core digital transformation measures of SF Express and their actual effects.
2. To analyze the core logic and value creation path of its service model innovation.
3. To explain the practice system of its green transformation and the specific mechanism of digital empowerment.

Part of the text optimization of this study was done with the help of ChatGPT (OpenAI, 2026).

Research object and methods

This paper selects SF Express (SF Holding Co., Ltd.) as the research object for three main reasons. First, it is highly representative of the industry. SF Express is a leading direct-sales express logistics enterprise in China, its business covers all logistics scenarios, and its market share is always in the top tier of the industry. Second, its practices are typical and advanced. It started digital transformation early and invested a lot in related technologies, and its green logistics practices have formed a complete full-process system. It is an industry benchmark with the latest technology applications and model exploration. Third, its research data is complete and available. As a listed company, it regularly releases detailed annual reports and sustainable development reports. This ensures the research data is real and traceable, and also provides reliable empirical support for combining the latest academic research for in-depth analysis.

This paper uses the single case study method, and it is combined with the triangulation method to ensure the research is reliable and valid. This combination is a common and effective method in the latest enterprise case analysis of logistics management (Wang & Zhang, 2024). Research data are all secondary and structured into four categories (Table 1).

Table 1. Research Data Sources and Structure

Data Type	Specific Sources	Data Characteristics
Corporate Reports	SF 2024 Annual Report; 2024 Sustainable Development Report	Authoritative, detailed, traceable.
Industry Data	State Post Bureau; China Federation of Logistics & Purchasing	Macro-industry benchmark
Academic Literature	Core journals (2023–2026) on digital/green logistics	Theoretical support
Strategic Materials	SF official public strategy announcements	Practical path evidence

All the research data used are secondary data, which mainly include four types: SF Holding 2024 Annual Report and 2024 Sustainable Development Report (SF Holding Co., Ltd., 2025a; 2025b); industry white papers and statistical data released by the State Post Bureau and China Federation of Logistics & Purchasing (State Post Bureau, 2023; China Federation of Logistics & Purchasing, 2025); relevant theoretical research papers on logistics digitalisation and green transformation in core journals, especially the latest papers published in the past three years; official strategic public materials released by SF Express itself. The paper uses the content analysis method to code and analyze all these materials. It sorts out SF Express's innovative path and implementation mechanism in a systematic way, and at the same time makes in-depth discussion and analysis by combining the latest academic views in the field.

Research results and discussion

The research results show that SF Express has completed full-process digital–intelligent transformation with four core technical measures and quantified effects (Table 2). Its technology application practices are highly in line with the latest research conclusions on logistics digitalisation (Li et al., 2024). It has taken four core technical measures to achieve this transformation: first, it built a data middle platform covering all business processes, broke the data isolation between different links, and realized intelligent order prediction and dynamic route optimization, with the order prediction accuracy over 95% during peak shopping periods and a total reduction of invalid transportation mileage by more than billions of kilometers; second, it built fully automatic intelligent sorting centers in national core hubs, with the sorting efficiency of core hubs over 100,000 pieces per hour and the mis-sorting rate less than one in 100,000, reaching the international advanced level of logistics intelligent sorting (Zhao et al., 2023); third, it built an intelligent terminal distribution system with UAVs and unmanned vehicles, which effectively solves the distribution problems in remote rural areas and urban terminals, and is an important exploration of intelligent logistics equipment application in the latest industry development; fourth, it realized the full life cycle visual tracking of goods through Internet of Things (IoT) technology, making the cargo damage rate of cold chain logistics drop to the lowest level in the industry, which proves that IoT technology can effectively improve the operational quality of cold chain logistics as suggested in the latest research (Li, Zhao, & Sun, 2025).

Table 2. SF Express Core Digital Technology Measures and Effects

Technical Measure	Core Practice	Key Performance Effect
Data Middle Platform	Full-process data integration; dynamic route optimization	Peak order prediction accuracy >95%; billions of km invalid mileage reduced
Intelligent Sorting Centers	Fully automatic hub sorting	Efficiency >100,000 pieces/h; mis-sorting rate <1/100,000
Intelligent Terminal Distribution	UAVs + unmanned vehicles	Solve rural/urban terminal distribution pain points
IoT Visual Tracking	Full-life cycle cargo monitoring	Cold chain cargo damage rate: industry lowest

Combining the dynamic capability theory (Teece et al., 1997) and its latest development in the digital economy era (Teece, 2023) for discussion, we can see that through continuous investment and application of digital technology, SF Express has realized the effective integration and reconstruction of enterprise resources. It has formed a dynamic operational ability to adapt to market changes, and fundamentally broken the efficiency bottleneck of the traditional logistics model. This dynamic digital capability not only directly improves the enterprise's daily operational efficiency, but also provides solid core technical support for its subsequent service model innovation and green transformation. This conclusion is also consistent with the research result of Chen et al. (2024) that digital dynamic capability is the core driving force for the transformation and upgrading of logistics enterprises.

Based on the solid digital capability built by full-link digital reconstruction, SF Express has carried out in-depth service model innovation, and its model innovation path is in line with the latest development trend of the global logistics industry (World Bank, 2024). The core change of this innovation is that SF Express has completely changed its role from a traditional logistics "transporter" to a professional "integrated supply chain service provider". It has taken four key steps to realize this transformation and expand the boundary of logistics service value (Table 3): first, it created customized end-to-end supply chain solutions for 3C electronics, high-end manufacturing, pharmaceutical and other key industries, the solutions cover all links from raw material transportation to terminal distribution, and help cooperative enterprises shorten inventory turnover days by more than 30%, which effectively proves that integrated supply chain services can significantly improve the operational efficiency of the industrial chain as proposed in the latest research (Huang et al., 2025); second, it built a

three-level logistics system of "county-township-village", realized full coverage of "express delivery to villages", and opened a smooth two-way channel for industrial products to go to the countryside and agricultural products to go to the city, which is an important practical exploration for logistics enterprises to serve rural revitalization in the new era (Liu & Wang, 2024); third, it expanded diversified businesses such as cold chain, international logistics and same-city express delivery, and built a complete full-scenario logistics service ecosystem, which can well meet the diversified and personalized logistics service needs of the market in the digital era (Zhang & Liu, 2025); fourth, it created a digital reverse logistics solution to support the recycling and reuse of recyclable packaging, which is an important link connecting supply chain services and green development, and also a key research direction of the latest green supply chain research (Li & Wang, 2024).

Table 3. SF Express Service Model Innovation Path

Innovation Dimension	Specific Practice	Value Creation
Customized Supply Chain Solutions	End-to-end services for 3C, pharma, manufacturing	Inventory turnover shortened by >30%
County-Township-Village System	Full coverage of “express to villages”	Two-way channel for industrial/Agri products
Full-scenario Ecosystem	Cold chain, international, same-city delivery	Meet diversified market demands
Digital Reverse Logistics	Recyclable packaging recycling	Connect supply chain and green development

This model innovation based on digital capabilities has brought two important results for SF Express. On the one hand, by deeply participating in the upstream and downstream of the industrial chain, it has greatly expanded the scope of logistics service value and realized the enterprise's transformation from "scale-driven" to "value-driven" development (Huang & He, 2015). On the other hand, this new integrated supply chain service model also provides a practical commercial way for the enterprise to carry out green transformation in an all-round way. In this process, a positive cycle is formed: advanced digital technology supports the innovation and operation of the new service model, and the new model in turn brings more market demand and resource input, which feeds back the further upgrading of digital technology. This positive cycle is an important sustainable development mechanism for logistics enterprises, and it also has important reference significance for the transformation and upgrading of small and medium-sized logistics enterprises in China (China Federation of Logistics & Purchasing, 2025).

With the support of digital technology and the carrier of the new integrated supply chain service model, SF Express has built a complete full-life cycle green logistics system covering "packaging-transportation-storage-recycling", with digital technology deeply integrated into each link of green practice. Its green practices and digital empowerment effects are systematically summarized (Table 4), achieving remarkable environmental benefits (Zhang & Liu, 2025).

Table 4. SF Express Full-life Cycle Green Logistics Practices

Green Link	Core Practice	Digital Empowerment Role	Environmental Benefit
Green Packaging	Feng BOX; electronic waybills; slim tape	Digital recycling management	Feng BOX used >500 million times
Green Transportation	New energy vehicles; big data routing	NEV penetration >90%; empty load rate ↓20%	Transport carbon reduction
Carbon Management	Full-link carbon footprint system	Data monitoring & accounting	Launch “zero-carbon delivery”
Green Infrastructure	PV stations; zero-carbon parks	Energy consumption digital control	Park energy efficiency improved

The specific practices of this green system are reflected in four aspects: first, it independently developed the recyclable express box "Feng BOX", with a cumulative delivery of more than 10 million units and a cumulative recycling use of more than 500 million times, and it has fully promoted electronic waybills, slimming tape and other environmental protection consumables to reduce resource consumption from the source (SF Holding Co., Ltd., 2025b), the application effect of these green packaging materials has reached the advanced level of the global express industry (Universal Postal Union, 2024); second, it has vigorously promoted new energy transport vehicles, with the penetration rate of new energy vehicles in terminal delivery over 90%, and it has reduced the empty driving rate of vehicles by more than 20% through big data route optimization, which proves that digital technology can effectively improve the energy efficiency of logistics transportation as proposed in the latest research (Wang et al., 2024); third, it built the first full-link carbon footprint accounting system in the industry and launched a "zero-carbon delivery" service, realizing the refined management and control of carbon emissions in the whole logistics process, this is an important practice for logistics enterprises to actively respond to the national "dual carbon" goal, and its carbon accounting method is in line with the latest international carbon accounting standards for the logistics industry (ISO, 2023); fourth, it promoted rooftop photovoltaic power stations and energy-saving transformation in logistics parks across the country to build a benchmark for zero-carbon parks, which is a key exploration of green energy application in logistics infrastructure construction (Sun et al., 2025).

Combining the green supply chain management theory (Wang et al., 2005) and its latest development in the digital era (Zhu & Sarkis, 2023) for discussion, we can find that SF Express's green transformation is not a simple and single environmental protection measure. It is a deep integration of sustainable development concepts into the whole process of the enterprise's commercial operation. Digital technology plays a core supporting role in this process: it provides accurate

data and technical support for carbon footprint accounting, energy consumption optimization and logistics route planning. This integration of digital technology and green practice not only realizes the joint creation of economic value and environmental value for the enterprise, but also effectively solves the long-standing industry problem of "environmental protection and efficiency cannot coexist". This problem is also the core content that the latest green logistics research is trying to solve (Li et al., 2024). SF Express's practical experience fully proves that digitalisation is the key to effectively combining green logistics development with enterprise economic benefits.

On the basis of the above research on technology, model and green dimensions, the study further finds that SF Express's innovation path is not the separate and independent development of the three dimensions. Instead, the three dimensions interact with each other and form a closely coordinated system of "technology empowerment - model implementation - green closed loop". This coordination mechanism is also in line with the latest research conclusion on the combined development of digitalisation and greening in the logistics industry (Chen et al., 2024): digital technology is the core technical support of green transformation, model innovation is the core practical way to realize technological value and green value, and green transformation in turn promotes the continuous upgrading of digital technology and the further optimization of service models.

This three-dimensional coordination system has brought great and comprehensive development results to SF Express at three different levels. At the business level, the enterprise's operating income has maintained an annual compound growth rate of over 20% from 2017 to 2024, and its customer satisfaction has ranked first in the industry for many consecutive years (SF Holding Co., Ltd., 2025a), achieving steady and high-quality business development. At the industry level, SF Express's innovative practices have provided a replicable and reference model for the digital and green transformation of the whole logistics industry, and also promoted the formulation and improvement of relevant industry standards, especially the green logistics and intelligent logistics standards of the express industry (State Post Bureau, 2023), driving the overall development of the industry. At the social level, the enterprise has achieved a cumulative carbon emission reduction of more than 2 million tons through a series of green practices, making important contributions to the national rural revitalization strategy and the "dual carbon" goals (SF Holding Co., Ltd., 2025b). Its social value creation practices have important reference significance for the high-quality development of China's logistics industry as a whole (China Federation of Logistics & Purchasing, 2025).

Conclusions

1. The study concludes that SF Express has completed the full-link digital reconstruction of its logistics business by building a full-business-process data middle platform, intelligent sorting centers, intelligent terminal distribution systems and IoT-based goods tracking systems. These core technical measures have achieved remarkable practical effects: the order prediction accuracy is over 95% during peak periods, the sorting efficiency of core hubs is over 100,000 pieces per hour, and the cold chain cargo damage rate is the lowest in the industry. Digital transformation has not only directly improved SF Express's daily operational efficiency, but also formed a stable digital dynamic ability for the enterprise to adapt to market changes, laying a solid and reliable technical foundation for the enterprise's subsequent model innovation and green transformation.

2. The core logic and value creation path of SF Express's service model innovation is to take the digital capabilities built by full-link digital transformation as the solid foundation, and break through the traditional "transporter" positioning to transform into a professional integrated supply chain service provider. Its value creation path is reflected in four specific aspects: providing customized supply chain solutions for key industries to improve the overall operational efficiency of the industrial chain, building a county-township-village three-level logistics system to actively serve rural revitalization, expanding diversified logistics businesses to build a full-scenario service ecosystem, creating digital reverse logistics solutions to connect supply chain services with green development. This value creation path has successfully made the enterprise realize the transformation from "scale-driven" to "value-driven" development, and at the same time provided a practical and operable commercial carrier for the enterprise to carry out all-round green transformation.

3. For the objective of explaining SF Express's green transformation practice system and digital empowerment mechanism, the study concludes that SF Express has built a complete full-life cycle green logistics practice system covering packaging, transportation, storage and recycling, with digital technology deeply integrated into each specific link of green practice. The digital empowerment mechanism of green transformation is reflected in the core supporting role of digital technology in all aspects of green practice: it provides accurate data and technical support for promoting green packaging materials, applying new energy transport vehicles, carrying out full-link carbon footprint accounting and using green energy in logistics parks. This digital empowerment effectively solves the long-standing industry problem of "environmental protection and efficiency cannot coexist", and helps the enterprise realize the coordinated creation of both economic and environmental value.

4. The three dimensions of technology, model and green are not isolated, but interact with each other and form a closely coordinated system of "technology empowerment – model implementation – green closed loop". This three-dimensional coordination mechanism is the key for logistics enterprises to break through traditional development bottlenecks and achieve high-quality development. It can help logistics enterprises not only gain good business benefits and realize their own sustainable development but also drive the overall transformation and development of the logistics industry, and create important social value for the society at the same time.

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