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Research on Green Logistics Quality Management: Dilemmas and Optimization Countermeasures

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ABSTRACT

Green logistics quality management focuses on energy-saving, pollution reduction and resource recycling in the whole logistics process. Its management effect directly determines carbon-reduction benefits, enterprise operating costs and sustainability level of supply chains. Based on domestic and foreign research results and industrial reality, this paper sorts out the development status of green logistics in China from three dimensions: market scale and potential, technology application level, as well as equipment input and maintenance. Four prominent constraints restricting green logistics quality management are identified: excessive transformation and operation costs, insufficient government policy support with unsatisfactory implementation effects, poor enterprise management and service capacity, and fragmented market structure. Corresponding countermeasures are put forward from four directions: refined cost control, strengthened policy support and guidance, improved management and service capacity, and region-differentiated operation. The study holds that the sound development of green logistics requires joint participation of the government, enterprises and consumers. A brief prospect for the future of the industry is provided in the end.

KEYWORDS

Green Logistics; Quality Management; Low-carbon Transformation.

1. INTRODUCTION

With the advancement of ecological civilization construction in China, social requirements for environmental protection in commodity circulation keep rising. Pursuing merely speed and low cost can no longer satisfy practical demands. Market participants attach growing importance to energy conservation, emission reduction and resource recycling in logistics activities, and are willing to bear reasonable costs for environmental benefits[1]. Green logistics refers to the logistics mode that minimizes carbon emissions and environmental damage from the production end to the consumption end, and has evolved from conceptual advocacy into an indispensable component of modern sustainable supply chains[2]. Effective green logistics can reduce fossil-energy consumption, lower carbon footprints in circulation links, and mitigate resource waste caused by packaging and obsolete logistics facilities.

China's green logistics industry has achieved rapid development in recent years. The procurement scale of new-energy logistics equipment keeps expanding, green warehouse projects are implemented nationwide, and digital monitoring systems for energy consumption and carbon emissions are gradually extended to each link of supply chains. Governments at all levels have issued a series of documents to encourage enterprises to carry out green upgrading, and relevant standards and specifications for low-carbon logistics are being continuously revised and improved[3].

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Nevertheless, industrial expansion has not eliminated deep-seated practical obstacles. Enterprises face heavy transformation cost burdens; policies are poorly implemented in some regions; management gaps exist between enterprises of different sizes; and the market presents a fragmented spatial pattern. These problems hinder the popularization of green logistics modes and restrict the full release of environmental benefits[4].

Against the above background, this paper takes the practice of green logistics quality management as the research object and explores feasible solutions. It describes the industrial development status, analyzes four core problems, puts forward targeted countermeasures, and discusses respective responsibilities of the government, enterprises and consumers.

2. CURRENT STATUS OF GREEN LOGISTICS MANAGEMENT

2.1. Market Scale and Development Potential

Market Scale

Market demands for green logistics services keep expanding, and market scale as well as industrial investment maintain steady growth. Downstream manufacturers, e-commerce platforms and fresh-product merchants gradually incorporate green indicators into supplier assessment systems, forcing logistics service providers to launch low-carbon distribution, recyclable packaging, energy-saving warehousing and other services. Large-scale logistics enterprises take the lead in setting carbon-reduction targets and expanding green business sectors, and operating revenues related to green logistics keep increasing. More and more small- and medium-sized logistics enterprises carry out partial green transformation under external pressure[5]. On the whole, both supply side and demand side of the green logistics market show an upward trend.

Market Potential

There remains huge room for further development of green logistics in China. China boasts a huge volume of commodity circulation. With the improvement of public environmental awareness, domestic supervision and international trade barriers impose continuous carbon-emission constraints on enterprises, driving growing investment in green logistics. The procurement volume of new-energy delivery vehicles keeps climbing; projects for energy-saving warehousing, photovoltaic warehouse renovation and recyclable packaging continuously attract capital inflow. Cross-border supply chains also set higher requirements for green performance in logistics links, and the industry enjoys long-term growth potential[6].

2.2. Level of Technology Application

Technology application within the industry is uneven. The Internet of Things, big-data analytics and artificial intelligence have been widely adopted in other industries, yet their in-depth integration with low-carbon logistics scenarios remains insufficient[7]. Taking urban distribution as an example, technical shortcomings directly result in low vehicle loading rates, unreasonable route planning and unstable energy-saving effects. Carbon-emission traceability technologies are still in the preliminary application stage in most domestic enterprises. Many logistics enterprises cannot realize real-time monitoring of vehicle energy consumption and warehouse carbon emissions. Intelligent route-optimization tools capable of reducing empty mileage and fossil-fuel consumption have not been popularized. The lack of intelligent energy-control equipment in cargo transshipment and warehousing links causes unnecessary energy waste, and technical deficiencies weaken the actual effects of green logistics transformation[8].

2.3. Equipment Input and Maintenance

The performance and daily maintenance of green equipment largely determine whether enterprises can reach energy-saving and carbon-reduction goals. However, numerous enterprises are confronted with obsolete equipment and inadequate routine maintenance[9]. Green logistics equipment such as new-energy vehicles, energy-saving warehousing facilities and recyclable turnover containers require large-scale capital input. To cut short-term expenditure, many small- and medium-sized enterprises continue to adopt high-emission outdated facilities. Obsolete equipment features high energy consumption and unstable operation, and cannot meet low-carbon operation requirements. Daily maintenance is equally critical. Even advanced new-energy vehicles and green warehouses will suffer performance degradation and frequent breakdowns without regular inspection and maintenance, bringing higher energy consumption and extra repair costs. In practical operation, quite a few logistics enterprises simplify maintenance procedures due to tedious work, which impairs the effects of green transformation.

3. PROBLEMS EXISTING IN GREEN LOGISTICS QUALITY MANAGEMENT

3.1. Excessively High Transformation and Operation Costs

High-cost pressure constitutes the most direct bottleneck restricting the development of green logistics. Traditional fuel-powered trucks and ordinary warehouses cannot satisfy low-carbon operation requirements. New-energy logistics vehicles, energy-saving warehouses, recyclable packaging, carbon-emission monitoring information systems all require substantial capital investment. Green logistics costs run through the whole chain of pre-construction procurement, intermediate operation and maintenance, and post-period technology iteration. Enterprises of different sizes bear distinctly different cost pressures[10].

Table 1. Comparison of main transformation cost components of logistics enterprises of different scales (Unit: Ten thousand RMB)

Cost Category	Large-scale Logistics Enterprises	Small- and Medium-sized Logistics Enterprises
Green equipment procurement (vehicles, turnover appliances)	800-3000	50-200
Green warehouse renovation and photovoltaic supporting construction	1000-5000	80-300
Deployment of carbon-monitoring and intelligent dispatching information system	200-800	15-60
Annual operation and equipment maintenance cost	120-400	10-40
Comprehensive transformation capital pressure	Affordable with phased investment	Prominent pressure and large capital gap

3.2. Limited Government Support and Deficient Policy

Although governments attach growing importance to green logistics and issue a series of supporting policies, multiple deficiencies exist in implementation. First, support is insufficient in depth and coverage. Grass-roots and remote regions lack stable fiscal funds for green logistics infrastructure construction. Second, policy implementation varies across regions. Even with formal policy

documents, regions with weak economic foundations and scattered logistics demands can hardly achieve expected objectives. Third, communication channels between government and enterprises are inadequate. Some policy measures deviate from actual business conditions of enterprises and reduce practical policy effectiveness.

3.3. Unsatisfactory Management and Service Levels

Shortcomings in management and service run through multiple links of logistics chains. (1) The whole green logistics system lacks unified and standardized management. Links of transportation, warehousing, packaging and distribution are loosely connected. Energy-consumption data cannot circulate among different entities, resulting in inefficient resource allocation that fails to adapt to rapidly-changing demands for low-carbon services. (2) Service quality varies greatly in the market. Unified service standards have not been popularized, and few enterprises can provide customized green logistics solutions. Diversified low-carbon service demands from clients cannot be fully satisfied. (3) The industry faces an obvious shortage of specialized talents. Many practitioners only master traditional logistics operational skills and lack professional knowledge of carbon accounting, new-energy equipment operation and maintenance, as well as green supply-chain management. Any management negligence in logistics operation will trigger extra energy consumption and carbon emissions, bringing economic losses and reputational damages to enterprises[11].

3.4. Fragmented Market Structure

Market fragmentation is another fundamental obstacle for the high-quality development of green logistics. Demands for green logistics services exist nationwide, yet huge gaps lie in regional economic levels, customer density and industrial foundations, forming a spatially scattered pattern. Green logistics resources, advanced enterprises and supporting facilities are mostly concentrated in large- and medium-sized cities and suburban areas, while rural and remote regions lag far behind. Nevertheless, rural e-commerce and agricultural-product circulation generate real and urgent demands for green logistics, and insufficient local supporting resources lead to the mismatch between supply and demand.

From a national perspective, central and western regions feature vast territory, sparse population and widely-distributed clients. Limited project market returns further restrain local green logistics upgrading.

4. OPTIMIZATION COUNTERMEASURES FOR GREEN LOGISTICS QUALITY MANAGEMENT

4.1. Implementing Refined Cost Control

Cost governance relies on two forces: government guidance and enterprise self-management. On the government side, local competent departments give full play to organizational and information advantages, collect local green logistics industrial data, learn from advanced domestic regions and mature foreign practices, and compile implementable development plans, clarifying reference standards for facility construction and cost allocation for local enterprises. Governments can also engage management experts to design general implementation schemes adapting to conditions of local enterprises, providing references for enterprises' green transformation.

On the enterprise side, refined management shall serve as the core. Combined with government guidelines and self-development plans, enterprises decompose transformation and operating costs item by item, control various expenditures directly, cut non-essential spending, and keep financial pressure within a tolerable range. Improve the utilization ratio of existing equipment and warehouses, reduce repeated investment and lower comprehensive cost burdens.

4.2. Strengthening Policy Support and Guidance

Multiple policy instruments including tax and fee reduction, land-use preference and special-fund subsidies shall be adopted. Competent authorities shall introduce tax relief and fiscal subsidy policies to encourage enterprises to invest in green logistics infrastructure. Optimize land policies to reduce land costs for green logistics projects. Set up special funds to support R&D of green-logistics-related technologies and accelerate industrial upgrading. The core logic of policies is to lower comprehensive costs for enterprises to carry out green-logistics practices via institutional means.

Meanwhile, implement differentiated policy inclination for under-developed regions. Build regular communication mechanisms between government and enterprises, dynamically collect feedback from market entities and adjust policy contents to improve practical effectiveness.

4.3. Improving Enterprise Management and Service Levels

Management and service capacity determine the overall operational performance of green logistics systems, and multi-dimensional improvements shall be promoted simultaneously.

First, popularize data-driven refined management modes. Many logistics enterprises still adopt traditional management modes without the support of carbon-monitoring information platforms, which leads to high operating costs, poor service quality and slow responses. Enterprises shall increase investment in information systems and build platforms for energy-consumption statistics and carbon-emission monitoring.

Second, strengthen coordination among links of transportation, warehousing, packaging and distribution. Promote unified industrial standards, break information silos between nodes, realize reasonable resource allocation, and avoid extra carbon losses caused by disconnected business links.

Third, enhance customer-oriented service capacity. Facing intensified market competition and diversified low-carbon demands, build professional service teams, develop personalized green logistics solutions and improve customer satisfaction and loyalty.

Fourth, address the talent shortage problem. Green logistics is highly specialized. Enterprises shall perfect internal training mechanisms, introduce compound talents with expertise in logistics operation, carbon management and digital technology, and raise the overall professional level of the industry.

4.4. Carrying out Region-Differentiated Operation

Development conditions vary among different regions; differentiated management strategies shall be implemented under the premise of guaranteeing service coverage to suit local realities. For central and western provinces with sparse population and scattered demands, a corridor-based operation mode is worthy of promotion. Local government departments act as hubs and build comprehensive service stations along major transportation arteries. The stations can provide temporary energy-saving warehousing services for local commodities; during idle periods, warehousing resources can be open to commercial leasing in the market.

Local governments can release information on local green logistics capacity and demands through official websites and new-media channels, realize information sharing between logistics enterprises and clients, and facilitate business cooperation. Smooth information circulation optimizes industrial management and operational efficiency and lays a solid foundation for local green logistics development.

5. CONCLUSION

Green logistics quality management is a complex systematic project requiring joint efforts of the government, enterprises and consumers.

For the government, industrial support shall be enhanced: increase fiscal input and set up special funds for infrastructure construction; broaden investment channels to attract participation of social capital; accelerate the formulation and revision of industrial standards, perfect operation specifications for new-energy vehicles and construction standards for green warehouses, and provide unified operation guidelines and clear evaluation benchmarks for the whole industry. Implement targeted fiscal, tax and financial support such as tax relief and encourage credit support from financial institutions to ease capital constraints on enterprises.

For enterprises, internal management shall be improved, service quality and operational efficiency shall be upgraded, comprehensive costs shall be controlled, and core competitiveness shall be fostered. Employ professional consultants to optimize management systems and staff-training schemes, and formulate clear operation specifications for green-logistics businesses. Technologically, actively adopt and develop green logistics equipment and information systems to realize whole-process traceability of energy consumption. Support the development of third-party green-logistics service providers to achieve rational resource allocation. Measures including intelligent management, transportation-route optimization and higher facility-utilization rates can reduce operating costs and raise profit margins.

Consumers are not passive participants. Improved public environmental-protection awareness and market preference for qualified green logistics services will generate external pressure to push continuous industrial improvement. Higher market expectations for low-carbon circulation will motivate enterprises to optimize services.

No single stakeholder can accomplish industrial upgrading independently. Green logistics is closely related to ecological protection, commodity-circulation efficiency and high-quality economic development. Only with collaborative efforts from the government, enterprises and consumers, together with steady improvement of service quality and operational efficiency, can the green logistics industry achieve genuine high-quality development in the future.

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