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Research on the Practice Path and Performance Evaluation of Philips Green Supply Chain in the Netherlands

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ABSTRACT

Driven by the global sustainable development trend, the green supply chain has become the focus of manufacturing enterprise reform. Taking Philips Company of the Netherlands as an example, the green path structure is constructed, the technical measures and process control strategies of key nodes are analyzed, the performance evaluation index system is designed, and the effect of green operation is quantitatively analyzed by fuzzy comprehensive evaluation method. The results show that Philips has performed well in environmental performance and operational efficiency, and the path design is systematic and practical. This study provides method reference and case support for the construction and evaluation of green supply chains in multinational manufacturing enterprises.

KEYWORDS

Netherlands; Philips; Green supply chain; Performance appraisal

1. INTRODUCTION

With the increasingly stringent global environmental regulations and the deepening of the concept of sustainable development, green supply chain management has gradually become the focus of manufacturing transformation and upgrading. As the world's leading manufacturer of electronic products, Philips, the Netherlands, has actively responded to the environmental protection policy, constructed a green supply chain system, and integrated an environment-friendly management model into the procurement, production, logistics, recycling and other aspects, showing a high degree of systematization and foresight. Driven by European green regulations and market pressure, Philips has continuously optimized its resource allocation, promoted the green cooperation between upstream and downstream enterprises, and formed a representative green operation path. Studying its green supply chain construction logic and performance evaluation mechanism will help to deeply understand the practical experience and technical strategies of enterprises in the process of green transformation, and provides a feasible reference for domestic and foreign enterprises to improve their environmental performance and supply chain resilience.

2. THE ANALYSIS OF KEY COMPONENTS OF GREEN SUPPLY CHAIN

2.1. Green Procurement Mechanism Analysis

The green procurement mechanism requires enterprises to introduce the dimension of environmental impact assessment in the process of raw material selection, supplier management and procurement standard formulation, and highlight the concept of life cycle management. Philips' procurement system sets strict environmental performance thresholds for suppliers, including energy consumption intensity, hazardous substance control ability and environmental management system certification, etc., and incorporates these evaluation indicators into their compliance review process. In the process of maintaining supply chain relations, enterprises use differentiated incentive mechanisms to guide suppliers to upgrade their production processes, give priority to enterprises with low carbon emission and controllable waste emission, and strengthen the green binding force of procurement [1].

Philips has built a material evaluation system based on environmental impact factors during the raw material import stage, which performs ecological footprint and recycling performance analysis on each raw material. The system supports multi-dimensional index evaluation, such as material reusability, processing pollution, resource depletion potential, etc., in order to improve the environmental response ability of purchasing decisions. During the stage of contract execution, enterprises realize process control based on periodic audit and environmental data sharing mechanisms to enhance the controllability and transparency of green target implementation.

2.2. Construction of Green Logistics System

Logistics accounts for a large proportion of carbon emissions in the supply chain, which has a direct impact on the overall environment. Philips reconstructs the transportation network structure, optimizes the storage layout and transportation routes, reduces unnecessary long-distance transportation and transit operations, and improves the logistics efficiency of unit products during the construction of the green logistics system. In trunk transportation, enterprises introduce hybrid loading technology and intelligent path planning algorithms to dynamically allocate transportation resources and reduce the no-load ratio and carbon emission intensity. In urban distribution, enterprises turn to new energy vehicles and low noise equipment to reduce environmental pollution and traffic pressure.

Philips uses modular packaging design to improve the space utilization rate and reduce the consumption of packaging materials for individual products. Enterprises has established a recycling and reorganization mechanism of recycled packaging material to promote the reuse of packaging materials in different transportation scenarios. This mechanism combined with a big data monitoring platform can track the packaging turnover and loss, adjusts the packaging strategy in time, and keep the dynamic balance between the green performance and economy of packaging. The capacity building of carbon emission monitoring in the process of logistics is also a key link to improve the maturity of green logistics. Philips has built an integrated carbon emission monitoring system, collecting and analyzes the energy consumption and transportation data of each node in real time, forming a multi-level carbon emission report, which provides quantitative support for the subsequent adjustment of energy saving and consumption reduction strategies.

2.3. Discussion on Information Support Function

Philips has built a green performance-oriented supply chain management platform, which integrates the environmental performance monitoring module, the supplier performance feedback system and the product life cycle traceability function to provide data support for the decomposition, implementation and evaluation of green objectives. The information system plays a key role in the dynamic management of green index. The platform supports multi-source heterogeneous data fusion processing. Product-level environmental impact documents can be generated from raw material attributes, processing energy consumption, transportation emissions and other dimensions to support enterprises to carry out accurate green cost accounting. The information system for collaborative management and control is based on a data visualization interface and an early warning mechanism, which improves the response speed and decision-making efficiency of upstream and downstream supply chains under abnormal environment.

This information system is helpful to implement green standards in all aspects of the supply chain. The system uniformly files the green audit results, certification records and rectification schemes, and displays them synchronously in the supplier performance appraisal, forming a closed-loop management logic. In the sub-fields of carbon footprint accounting and green product label generation, the system supports standard-based algorithm models operation, which improves the technical reliability and operational efficiency of green assessment.

3. PHILIPS GREEN SUPPLY CHAIN IMPLEMENTATION PATH

3.1. Path Design and Module Division

Philips green supply chain path construction is a functional reconstruction based on the value chain structure. Based on modular thinking, it divides the supply chain stages and embeds green standards. From supplier management to product delivery, the whole path is divided into five core modules, and each module corresponds to a specific environmental control goal and performance feedback mechanism [3]. In the path design, the information system plays a central role in bridging different modules, transmitting environmental protection information and executing signals, and non-linear conduction exists between each module, but a circular propulsion model is formed based on data feedback.

The green design module focuses on source emission reduction, and based on product structure optimization and material selection, it controls the environmental load during the product life cycle. The green procurement module embeds environmental protection standards in supplier selection, material acceptance, contract management and other aspects, forming a binding mechanism. The cleaner production module focuses on energy efficiency, pollutant control and environmental friendliness of the production process, emphasizing the green transformation at the end of the process. Low-carbon transportation and packaging optimization strategy are introduced into the logistics module to reduce carbon emissions during the transportation. The recycling remanufacturing module embeds a resource recycling mechanism into the after-sales process, forming a closed-loop logistics system. Philips set up an "information trigger point" for the connection between module. Once a node's environmental index exceeds the threshold, it will be automatically fed back to the upstream node and the corresponding strategy adjustment will be activated.

3.2. Key Node Technical Measures

Because of high resource consumption intensity or obvious impact on the environment, some nodes in the path implementation are set as key control points. Around these nodes, Philips deployed a series of technical tools and management mechanisms. The key of green design stage lies in the green reconstruction of the BOM structure. Philips has established a database of design decision according to the environmental characteristics of materials. The system ranks the candidate materials according to the ecological impact coefficient, and guides designers to give priority to the scheme with high reusability and low pollution risk. The enterprise have established a supplier carbon performance evaluation system at the supplier management node. The platform integrates the energy consumption and emission data and historical environmental violation records into an environmental performance documents. When selecting a partner, the purchasing department needs to refer to the scoring results of various indicators of the system, and conduct dynamic tracking and evaluation in the follow-up cooperation [4] For suppliers with low scores, the system will trigger an early warning mechanism to form a rectification plan and include it in the contract execution supervision process.

The production control node deployed an energy consumption monitoring and waste management system to conduct real-time collection and dynamic optimization analysis on the unit energy consumption, emission density and waste generation rate of different processes. Some manufacturing bases have introduced predictive energy-saving model to predict the fluctuation trend of short-term energy consumption according to historical data and process parameters, adjusted the scheduling rhythm and equipment load in advance, and reduced the peak energy consumption. Philips, the logistics node, has deployed a route simulation and transportation resource optimization algorithm based on geographic information system. Based on dynamic scheduling, the idle driving rate and the total length of transport path are reduced. Green packaging standards is also implemented at this node. The packaging scheme needs to achieve a dynamic balance among environmental protection, damage resistance and volume utilization. The recycling node has built a regional distribution and primary dismantling center, which uses the recycling data analysis platform to determine the re-manufacturing value level of the products and precisely divert the subsequent processing flow.

3.3. Implementation of Process Control Strategies

Philips has established a green performance process audit mechanism, whose core is to make the environmental indicators real-time, dynamic and process embedded. The audit mechanism takes the month as the cycle, sets the environmental impact point in the whole process from raw material warehousing to finished product warehousing, and forms a stable feedback chain of process quality in parallel with supporting monitoring equipment and manual spot check mechanism. The information system provides decision-making support for process control. According to the set parameters, the system automatically judges the deviation trend and feeds it back to the responsible node. When the detected data exceeds the threshold value, the processing system can suspend or adjust the task scheduling of the corresponding node to prevent the pollution index from exceeding the standard or the expansion of resource waste.

The enterprise have also implemented a responsibility decomposition mechanism for green tasks. Each key node in the path has its own performance indicator, which are directly linked to the evaluation of the department and the project budget. This mechanism ensures that the task of environmental protection is not lost or weakened, and enhances the green goal consciousness and execution rigidity of the executor. In addition to node management, Philips has set up a Green Process Reengineering Committee to regularly optimize, review, update and adjust the whole path process, improve the adaptability of the path system to market environment and policies changes, and use path module to be clear, key node technology to be refined and process control closed loop. Philips has built a highly integrated and responsive green supply chain operating mechanism.

4. PHILIPS GREEN SUPPLY CHAIN PERFORMANCE EVALUATION SYSTEM

4.1. Construction of Indicator System

The performance evaluation index system is based on the path structure design of the green supply chain, covering green procurement, clean production, green logistics and product recovery. A three-level index model was established. The first dimension is set as four categories, namely environmental performance, operational efficiency, economic efficiency and coordination ability. The next level is divided into two control areas, mainly consisting of quantitative indicators, which can be calculated into a three-level indicator pool [5]. All the indexes must be available, stable and different, and support the standardization and weight calculation in the subsequent fuzzy evaluation model. Table 1 below shows the performance evaluation index system of the constructed green supply chain.

Table 1. Green Supply Chain Performance Evaluation Indicator System

Level 1 indicators	Secondary indicators	Level 3 indicators
Environmental performance	Energy conservation and consumption reduction capability	Energy consumption per unit product (kWh/unit)
	Pollution control level	Wastewater compliance rate (%)
	Environmental friendliness of materials	Percentage of Renewable Materials (%)
Operational efficiency	Response and scheduling capabilities	Average Order Response Time (Hours)
	Utilization of transportation resources	Transportation loading rate (%)
	Warehousing turnover efficiency	Inventory Turnover Days (Days)
economic benefits	Cost optimization capability	Unit cost of green transformation (yuan)
	Market performance level	Percentage of sales of green products (%)
Synergy ability	Supplier's environmental execution	Supplier Environmental Compliance Rate (%)
	Information coordination level	System access rate (%)
	Customer feedback quality	Customer satisfaction with green recycling (10-point scale)

4.2. Weight Allocation and Model Selection

The weight distribution uses the analytic hierarchy process to construct a judgment matrix, and the supply chain expert group completes the paired comparison of the importance of the indicators. The consistency test shows that the structure of the matrix is reasonable. The environmental performance weight of the first-level index level is 0.35, an operation efficiency is 0.25, an economic benefit is 0.20, and a coordination ability is 0.20. The secondary and tertiary weights are distributed step by step according to the relative influence degree, which is in line with the actual effect of green path performance.

In the process of multi-index comprehensive evaluation, a fuzzy comprehensive evaluation model is adopted. Its advantages is that it is compatible with subjective evaluation and objective data, supports fuzzy reasoning under multi-dimensional input, and is suitable for the fuzzy and uncertain data in the green path. The fuzzy matrix is constructed based on the standardized data and mapped to a four-level evaluation set (excellent, good, medium and poor). Each path module is individually weighted to output a comprehensive membership result. Finally, based on the maximum membership principle, the path performance level is determined, and the error is analyzed and corrected in combination with the internal evaluation results of the enterprise. The combined model has a robust structure, which keeps the interpretability of the whole system and sensitivity to local index differences, and is suitable for enterprises to use repeatedly in the green path practice.

4.3. Evaluation and Analysis of Empirical Data

The data sources include annual operation data of Philips' factories in the Netherlands, the environmental assessment records of suppliers and the results of customer satisfaction survey. Some indicators are collected automatically by the system, while others are revised and standardized through manual measurement. After the forward/reverse standardization conversion is completed, each item of data is included in the fuzzy scoring matrix. The raw data and standardized data of some core indicators are shown in table 2 below.

Based on the standardized data and the weight results, the fuzzy matrix is constructed and calculated. At present, the score of Philips' green path in the dimension of environmental performance is 0.87, its operational efficiency is 0.81, its economic benefit is 0.76, its coordination ability is 0.79, its comprehensive score is 0.82, and its judgment level is "good". The score structure shows that green procurement and logistics control technology are mature and contribute to the overall performance, and the low recycling rate is an important factor affecting the score of the synergy.

Table 2. Philips Green Supply Chain Level 3 Indicators Original Data Sheet

Indicator name	primary data	unit	Indicator attribute	Normalized value
Energy consumption per unit product	0.78	kWh/unit	The smaller the better.	0.84
Wastewater compliance rate	96.5	%	The bigger the better.	0.96
Proportion of renewable materials	41.3	%	The bigger the better.	0.78
Average order response time	12.2	hour	The smaller the better.	0.73
Transport loading rate	88.7	%	The bigger the better.	0.89
Unit cost of green transformation	3.64	Yuan Dynasty (1206-1368)	The smaller the better.	0.67
Proportion of sales of green products	46.8	%	The bigger the better.	0.82
Customer satisfaction with green recycling	8.1	minute	The bigger the better.	0.81

5. CONCLUSION

The research results show that the green supply chain system built by Philips in the Netherlands has clear module division and path logic, green procurement, logistics optimization and information integration and collaborative operation, forming an efficient environment-friendly supply chain structure. Through the quantitative analysis of hierarchical indicators and fuzzy model, the performance evaluation system verifies the effectiveness of the path in terms of environment and operation, sufficient data support, reasonable structural design, and good consistency between technical measures and evaluation methods, which reflects its feasibility and popularization value in the practice of green transformation.

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