The Implementation of Green Supply Chain Management

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Abstract. With China's rapid development, energy shortages, insufficient ecological resources, environmental pollution and a series of resource and environmental constraints are increasingly apparent, China's export industry has been threatened. How to enhance the competitiveness of China's manufacturing enterprises in the international market and how to deal with international trade barriers under the new situation? Under the background of "double carbon", enterprises must start the research on green supply chain management. As a necessary strategy for enterprises to obtain sustainable competitiveness, green supply chain management aims to realise the goal of sustainable social and economic development and pursue a win-win situation regarding economic performance and environmental performance. The article starts from the connotation of supply chain management, analyzes the essential links of green supply chain management, explains the role of implementing green supply chain management, analyzes the problems of implementing green supply chain management in China's manufacturing enterprises, and then puts forward the strategies of implementing green supply chain management in China's manufacturing enterprises.

Keywords: China's export industry, supply chain management, sustainable social and economic development

1 Introduction

With global warming, environmental problems have become more and more prominent, and the development of social economy and ecological civilization has been greatly affected, which makes green sustainable development become the focus of more and more scholars. As an important part of enterprise management, the development of the supply chain has brought pollution and environmental damage. For this reason, more and more enterprises begin to incorporate environmental factors into supply chain operation management to minimize environmental pollution and promote the sustainable and healthy development of enterprises. Under this circumstance, green supply chain management has emerged. In recent years, with the increase of social concern, green supply chain management has become an important research direction in academia, and its management practice helps enterprises to establish competitive advantages, expand market demand, bring economic and environmental benefits to enterprises, and promote the sustainable development of the whole society.

ICEMME 2023, November 17-19, Beijing, People's Republic of China

DOI 10.4108/eai.17-11-2023.2342656

The new crown epidemic is raging all over the world, and the global supply chain has encountered great challenges. The green supply chain management model is a modern management model incorporating the concept of environmental protection, which starts from the perspective of sustainable development of society and enterprises, and comprehensively considers different issues in each link. At the present and every stage in the future, the world economy and society are undergoing a great change that has not been seen in the past hundred years, and China's economic and social development is faced with not only important opportunities but also a lot of difficulties and problems. This paper analyzes the internal and external factors of a green supply chain and establishes a green supply chain model under the background of "dual-carbon", through "green positioning of materials", "green management of suppliers" and "green distribution of suppliers". It is of great practical significance to redefine and reconstruct the green supply chain through the three dimensions of "green positioning of materials", "green management of suppliers" and "green distribution of suppliers" to create a green supply chain that is "smart, efficient and zero-carbon" [1].

2 Analysis of green supply chain management

2.1 Definition

Green supply chain management (GSCM) is an approach that combines elements of environmental management and supply chain management. GSCM integrates environmental thinking into supply chain management, from product design to end-of-life management [2]. Green supply chain management (GSCM) builds on the traditional supply chain management framework by integrating environmental thinking into supply chain management, from product design to end-of-life management, and is a potentially effective mechanism to help companies become more socially responsible, reduce reputational risk, minimize waste, and increase flexibility in responding to new environmental regulations. As a result, more and more manufacturing companies are implementing green supply chain management strategies internally and extending them to their external supply chain partners [3].

2.2 Green supply chain management versus traditional supply chain management

With the wave of globalization, digitalization, and informatization, most enterprises have realized that the traditional supply chain system of "supplier-retailer-consumer" is no longer sufficient, and nowadays a complex supply chain ecosystem including government, ecology, and even society is needed [4]. Nowadays, there is a need for a complex supply chain ecosystem that includes government, ecology and even society [5]. Green supply chain management integrates the concept of "green" into the whole process of the product life cycle, such as planning, purchasing, production, logistics, and return of products in the supply chain, and it pays more attention to the evaluation of environmental impacts while satisfying the evaluation of product life cycle in traditional supply chain management. Therefore, there are certain differences between traditional supply chain and green supply chain management in terms of operation activities, manufacturing mode and development objectives [6]. Figure 1 shows the difference between the two.

Characteristic	Traditional SCM	Green SCM
Objectives and values	Economic	Economic and ecological
Ecological optimization	High ecological impact	Integrated approach Low ecological impacts
Supplier selection criteria	Price switching suppliers quickly Short-term relationship	Ecological aspect (and price) Long- term relationship
Cost pressure and prices	High cost pressure Low prices	High cost pressure High prices
Speed and flexibility	High	Low

Figure 1. Difference between the conventional and green SCM

2.3 Analysis of the internal and external environment of green supply chain management

External Drivers.

Dual-carbon development of the supply chain is an important requirement of dual-carbon policy in the context of carbon neutrality. At the international level, to jointly cope with climate change, 197 member states met in Paris in 2015 and adopted the Paris Agreement, which aims to significantly reduce the release of greenhouse gases (GHGs) globally. In 2017, the Guidelines on Green Supply Chain Management for Green Manufacturing Manufacturing Enterprises issued by the National Committee of Standardization Administration (NCSAC) put forward the requirement of "collecting information on GHG emissions of the enterprise and suppliers". The Guidelines on Green Supply Chain Management for Green Manufacturing Enterprises issued by the Standardization Administration of China in 2017 require "the collection of information on greenhouse gas emissions of the enterprise and its suppliers. Thus, as one of the sources of carbon emissions of production enterprises, the development of green supply chain carbon reduction is in line with the macro policy background of the low-carbon transition. In 2014, APEC approved the "Initiative on Establishing APEC Green Supply Chain Cooperation Network", which determines that green supply chain construction will be jointly promoted in the APEC region. The green and low-carbon supply chain management of enterprises is playing an increasingly important role in international cooperation and the implementation of the concept of sustainable development. With the deepening of the global sustainable management theory, countries will pay more attention to the impacts of enterprise supply chains, which will have more demand for enterprise supply chain management systems [7].

Internal Drivers.

A green supply chain covers the whole process of the commodity life cycle from the supply side, logistics side and consumption terminal, which will change the traditional supplier management and operation methods greatly, and the establishment of a green supply chain is an inevitable need for the company's high-quality development under conditions of enterprise's sustainable development. In terms of cost management, the establishment of a green supply chain can reduce the consumption of resources, raw materials and pollution of hazardous substances, thus reducing the cost and risk of the enterprise. In terms of product management, the company can improve its competitiveness by building a green supply chain system and enriching its product portfolio. In terms of corporate image, building a green enterprise will help the company establish a new low-carbon corporate brand to meet the new requirements of the international market for low-carbon enterprises, create corporate value, and maintain market influence and

vitality. In the course of operation, the customer's demand often fluctuates, and product planning needs to be adjusted. In this case, the agility of the manufacturer is tested [8].

3 Green Supply Chain Management (GSCM) issues

Nowadays, when many manufacturing enterprises initially implement green supply chain management, they still stand on the traditional supply chain management perspective, aiming at economic benefits and pursuing profits above all else. However, green supply chain management focuses on reducing the negative external effects caused by environmental problems and pursues social benefits, and in the process of implementation, it will lead to an increase in the cost of the whole supply chain including labour cost, asset cost, information cost and logistics cost, and it is not known whether these upfront costs can create the expected income for the enterprises. For manufacturing enterprises with insufficient capital accumulation and low marketization in China, the objective difficulty of balancing costs and benefits in implementing green supply chain management is the first issue that should be considered [9].

Due to the large investment in the initial stage of green industry chain development, the cost saving realized by the implementation of a green supply chain to improve the efficiency of resource utilization can't offset the excess expenditure caused by the increase in purchase cost and the increase of recycling and disposal cost in the short term, and the international projects can't enjoy all the domestic supportive policies, and the negative financial effect caused by the implementation of green supply chain management further increases the cost pressure of the international projects, which leads to the lack of motivation for "going out" enterprises, which prefer to choose the green supply chain management. Enterprises "going out" are not motivated enough and are more inclined to choose the management mode with direct effect [10].

In recent years, to pursue the rapid transformation of green benefits, capital has been massively influx into the new energy field represented by "wind, water, electricity and hydrogen", and the green supply chain system has been rapidly formed. From the perspective of supply chain structure, a green supply chain of the energy sector helps enterprises to realize the goal of rapid emission reduction, but the procurement of raw materials and the recycling and disposal of waste materials such as terminal batteries and photovoltaic panels have not yet formed a closed supply chain, and the "linear" development has led to the green supply chain of the engineering industry showing a heavy reliance on the energy sector and short-term benefits, which has resulted in the crowding out of resources in the green supply chain, and the crowding out of resources in the green supply chain, and the crowding out of resources in the green supply chain. As a result, the resources of green supply chain are squeezed and the support for green and sustainable development of the industry is weak [11].

Overconfidence theory

A large number of psychological researchers have proved that people are affected by overconfidence in the decision-making process, and will overestimate their own abilities, thus affecting the quality of decision-making. Among the studies on overconfidence, the classifications of overestimation, overpositioning and overprecision are generally recognized by scholars. Scholars have constructed different mathematical models to study the impact of overconfidence on supply chain decision making. Among them, Zherui Liu (2012) assumed that

retailers are overconfident and used $a_0 = (1+\lambda)a$ to denote the impact of overconfident retailers' overestimation of their marketing capabilities on market demand. Jiang Shiying (2020) constructed a mathematical model of overconfidence, in which the random variable of market demand when retailers are completely rational is $\theta + \mu$ and the random variable of market when retailers are overconfident is (1-λ)$\theta + \lambda\mu$, $\lambda \in [0,1]$. The larger λ is, the higher the degree of retailer overconfidence is [12]. Jinling Cai (2019) depicted over-accurate estimation of demand uncertainty as X_i obeying $[\mu - \Delta_i, \mu + \Delta_i]$, $0 \leq \Delta_i \leq 1$. In this study, we will refer to Liu Zherui's study on overconfident retailers [13].

This study will refer to Liu Zherui's mathematical model of overconfident retailers' overestimation of their own marketing capabilities to analyze the impact of manufacturers' overconfident behaviors on green supply chain decision-making.

Assuming that the manufacturer is blindly confident and is not aware of its overconfident behavior, the retailer is completely rational and can detect the manufacturer's overconfidence and is aware of the manufacturer's overconfidence level. Overconfident manufacturers make decisions based on their beliefs about the market demand for green products, while retailers are fully rational and make decisions based on the real market demand for green products. The expected profit of the overconfident manufacturer and the expected profit of the retailer are as follows:

$$\pi_{om} = (w-c)(a - bp + (a+k)g + \mu) - \frac{1}{2}Ig^2 \tag{1}$$

$$\pi_r = (p-w)(a - bp + kg + \mu) \tag{2}$$

Decentralized Decision Making - Retailer Dominated Model (MRS)

This subsection focuses on the retailer-dominated green supply chain, taking into account the overconfident behavior of the manufacturer, in which the retailer enjoys the dominance of the supply chain over the manufacturer. In this case, the retailer enjoys the dominant power in the supply chain and prioritizes decision-making over the manufacturer. In order to facilitate the calculation, the retailer's retail profit per unit of green product t, t= p – w, is introduced, based on the existing supply chain research methods as follows:

$$\underset{w,g}{\text{Max}}\, \pi_{Om}^{MRS} = (w-c)[a - b(w+t) + (\alpha+k)g + \mu] - \frac{1}{2}Ig^2 \tag{3}$$

$$\underset{t}{\text{Max}}\, \pi_{r}^{MS} = t[a - b(w+t) + kg + \mu] \tag{4}$$

At this point the overconfident manufacturer's true profit is as follow:

$$\underset{w,g}{\text{Max}}\, \pi_{m}^{MRS} = (w-c)[a - b(w+t) + kg + \mu] - \frac{1}{2}Ig^2 \tag{5}$$

The solution process uses the backward derivation method to solve for the manufacturer's decision variable and then the the decision variable of the retailer. The derivation of equation leads to the Hessian matrix of π_{Om}^{MRS} as follows:

$$H^{\pi_{Om}^{MRS}} = \begin{bmatrix} \frac{\partial^2 \pi_{Om}^{MRS}}{\partial w^2} & \frac{\partial^2 \pi_{Om}^{MRS}}{\partial w \partial g} \\ \frac{\partial^2 \pi_{Om}^{MRS}}{\partial w \partial g} & \frac{\partial^2 \pi_{Om}^{MRS}}{\partial g^2} \end{bmatrix} = \begin{bmatrix} -2b & \alpha + k \\ \alpha + k & -I \end{bmatrix} \quad (6)$$

The association of $\frac{\partial \pi_{Om}^{MRS}}{\partial w} = 0, \frac{\partial \pi_{Om}^{MRS}}{\partial g} = 0$ gives:

$$w_{O}^{MRS} = \frac{I(a+\mu+bc-bt)-c(\alpha+k)^2}{2Ib-(\alpha+k)^2} \quad (7)$$

$$g_{O}^{MRS} = \frac{(\alpha+k)(a+\mu-bc-bt)}{2Ib-(\alpha+k)^2} \quad (8)$$

The optimal retail margint^{MRS*} is:

$$t^{MRS*} = \frac{(a+\mu-bc)}{2b} \quad (9)$$

Green Supply Chain Management Strategy

3.1 Promotion of environmental legislation

Government regulations and legislation are the main drivers for green supply chain management. Relevant laws and policies formulated by the state, as a typical mandatory external pressure, have a crucial impact on the operation of enterprises from all perspectives. In recent years, the increasing prominence of environmental and resource problems has received more and more attention, and countries have formulated stricter environmental management standards and laws and regulations to restrain the polluting behaviours of enterprises, such as the ISO 14000 series of environmental standards issued by the International Organization for Standardization and the Cleaner Production Promotion Law issued by China. Cleaner Production Promotion Law issued by China, etc. External regulation and legislation are strong driving forces for the implementation of green supply chain management, especially in the area of regulatory compliance. External regulation and legislation are powerful drivers for the implementation of green supply chain management, especially proactive and innovative approaches to regulatory compliance [13]. Nowadays, the pressure on the survival and development of manufacturing enterprises is increasing with the revision of environmental management standards, laws and regulations at home and abroad, and compliance with these laws and regulations and the implementation of green supply chain management strategies have become a major trend in the environmental behaviour of manufacturing enterprises [14].

3.2 Green Manufacturing

Green manufacturing considers environmental impacts throughout the entire process of product design, raw material selection, production process and waste disposal, to realize resource conservation and promote sustainable development of the society. Green manufacturing takes into account the environmental impacts of product design, raw material selection, production processes and waste disposal, to realize resource conservation and promote sustainable social development. Lin Zhi-Bing explored manufacturers' manufacturing strategies by considering network externalities and consumer preferences. As shown in Figure 2, the results show that manufacturers prefer green manufacturing strategies when their green technology efficiency or

network externalities are high enough. Considering both green manufacturing and green marketing, Bai and Tang explore the impacts of non-cooperative and cooperative decisions on environmental inputs and profits. The study found that environmental inputs increase profits by increasing demand, and that supply chain systems are more profitable in the case of cooperative decision-making [15].

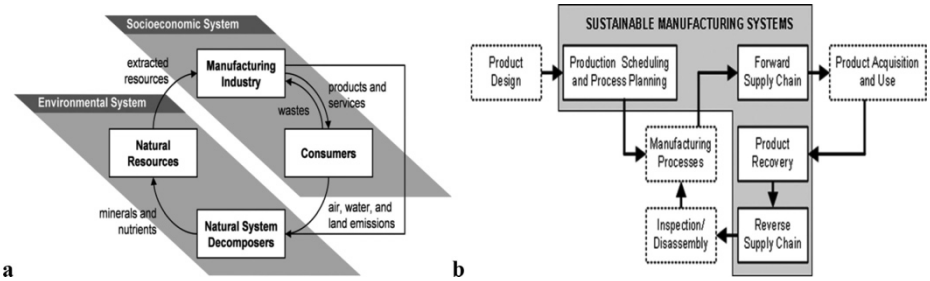

Figure 2. Green sustainable manufacturing syste

3.3 Universal participation of managers to incentivize green supply chain management

Participation and support from managers are key factors in the successful implementation of green supply chain management. Top management's commitment to green supply chain management, such as increasing communication channels for environmental management, setting organizational environmental management goals, establishing an environmental incentive system, and increasing employees' environmental initiatives, can help enterprises establish an environmental management system that suits their business characteristics. Top management's support and commitment to green initiatives are conducive to the smooth implementation of green supply chain management. The support of middle managers for green supply chain management is reflected in their ability to effectively coordinate cross-departmental environmental activities, which in turn enhances the overall awareness of environmental management in the enterprise. Therefore, the commitment from top management and the support from middle management can improve the environmental attitude of enterprises and the shaping of green corporate culture.

3.4 Build a green supply chain-oriented management process

The traditional logistics management model is generally based on a one-way supply chain, combined with the daily development projects of the enterprise, and rationally allocates resources. However, a one-way supply chain cannot adapt to the development of a modern enterprise and needs to be adjusted and modified in management standards and guidance processes. According to the GSCM model in Figure 3, Combined with the social goals of green and sustainable development, reconstruct the logistics management process, adhere to the customer demand-oriented, constantly adjust the management structure and details, and establish the connection between the logistics supply chain and logistics management. At the same time, it is also necessary to expand the overall scope of logistics management, learn to integrate management experience into the process, combine the actual needs and conditions of enterprise development, learn from each other, constantly improve and optimize the logistics management process, and ensure the daily logistics management effect.

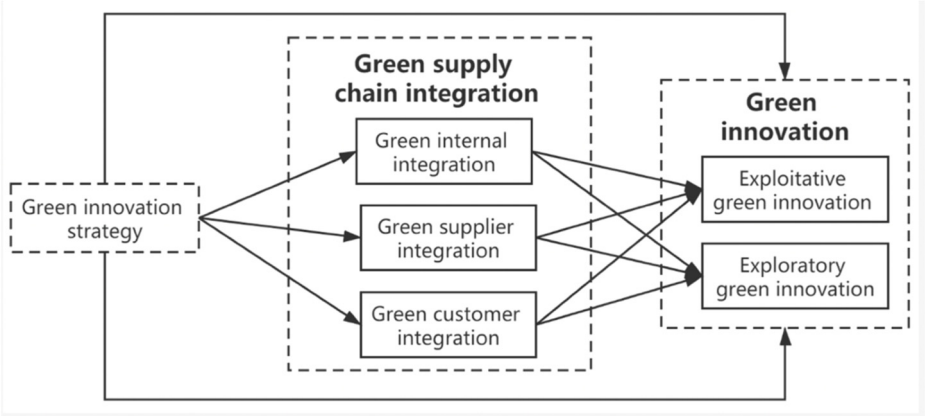

Figure 3. The model for GSCM

4 Conclusion

In the context of the new industrialization strategy, the national government is paving the way for the establishment of a domestic economic system and a resource-conserving society based on minimum resource consumption, minimum environmental pollution, and an efficient economy. Green supply chain management has become an emerging management method for Chinese manufacturers to improve their environmental and economic performance and enhance their overall competitiveness. From the above analysis, the implementation of green supply chain management will bring long-term economic and social benefits. Enterprises need to formulate corporate green management and management standards under the guidance of strategies, release the potential of global operations and resource allocation, strengthen the fine control system of project cost centres, and improve the combined operation mechanism of project management and supply chain management dual-line information systems. Guide all employees to participate in the management and operation of the green circular supply chain, and promote the integration of the green circular supply chain in production and operation management.

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