# Green and Platform Supply Chain Management

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Expanding green consumption market and precise data promotion advantages make the platform economy have a significant effect on influencing manufacturers to carry out green R&D and production activities, and government subsidies have a positive incentive effect. A manufacturer invests in green technologies to produce products and sell them through a smart platform supply chain by an agency selling or reselling strategy, in which the platform provides data-driven marketing technology to promote green products.

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government subsidy

## 1. Introduction

The green R&D and production have gained more and more enterprise attention. Green behavior can meet consumers green preferences and government policies in the dilemma that the rapid development of the economy creates environmental problems and the deterioration of the global climate has become an important issue of concern to the international community. In practice, Haier Bio has been actively undertaking the corporate responsibility of green development, and the concept of green and green development runs through the whole process and chain of production and operation, constantly promoting the green transformation and upgrading of the enterprise. In the design process, carbon neutral design is adopted from the beginning of design to realize the energy-saving upgrade of products. In response to the national goal of carbon neutralization in 2045, "rapidly reduce green emissions, actively carry out carbon reduction work in the field of R&D", China Great Wall focuses on the three key areas of "energy saving green technology, green material application, energy reconstruction", and develops green vehicles to help China's environmental protection cause. At the same time, major political and legislative initiatives have been proposed to better incentivize enterprises' green activities. For example, The Paris climate Conference in 2016 resulted in a major intergovernmental agreement obliging signatory governments and government agencies to provide incentives in terms of financial or legislative assistance to support and scale up green products and technologies in different industries. Chinese President Xi Jinping announced at the Climate Ambition Summit sponsored by the United Nations and relevant countries that China will adopt more effective policies and measures, including subsidy for manufacturers based on the number of green and low-carbon products they produce and sell. Through subsidy, the government can stimulate manufacturers to increase investment in green technology and improve the greenness of products. For the above reasons, the areas about supply chain operation and government subsidy strategy for green R&D always are the research hotspots in theory and practice.

With the rapid development of the Internet and the digital economy, platform economy based on networking, digitalization, and smart technology is conducive to promoting the optimization and upgrading of industrial structure, improving user experience, flourishing various markets, improving the efficiency of resource allocation in the whole society, and injecting new vitality into the traditional economy. Enterprises gradually realize that platform is the core of supply chain system construction and development. It can give full play to its data advantages to reduce and eliminate carbon emissions in the operation process of the industrial chain. Therefore, it is important to study how the government guides manufacturers to participate in the operation of smart platform supply chain, and to invest in green technologies to improve ecological benefits while taking into account economic benefits. Platforms can provide two cooperative modes for manufacturers to sale products, agency selling, and reselling. For example, JD.COM works with brands such as Huawei, Coach and Burberry under the reselling model, in which the brands sell their products to JD.COM at wholesale prices, which JD.COM sells to consumers at a markup. However, when JD.COM cooperates with Topsports, Sephora and other brands, it adopts the agent selling mode. By this way, the manufacture can sell products to consumers directly through the platform of JD.COM, and JD.COM charges a certain service commission fee (JD.COM public welfare, 2020). Amazon started with a reselling mode, as the mode developed, Amazon broke the reselling model which is similar to the entity retail model, and adopted an agency selling mode to help enterprises sell products directly to the terminal consumer. In addition, due to the platform's natural data collection advantages, the platform supply chain is based on data-driven analysis to describe, predict, analyze, and guide consumer behavior, providing better marketing activities for green products, that is data-driven marketing (DDM). For example, in September 2018, Taobao created a series of data-based and content-based targeted marketing programs for Shiseido, and established Shiseido's specific data center bank to provide data for marketing. In 2018, JD.COM adopted data-driven marketing to cooperate with many well-known brands in the industry, such as mobile phone brand Huawei, food brand Lang Jiu, and home appliance brand Bear. At the same time, data-driven marketing generates new types of costs, such as data collection costs and data analysis costs. Research on the promotion effect of smart marketing level on green products can provide effective quidance and help for green R&D activities in reality. Operating platform supply chain can help enterprises to improve the efficiency of green technology investment activities and realize the overall development of economic and ecological benefits.

In this background, three questions must be answered: (1) How does the potential market demand of green products, the sensitivities of consumers to green product attributes and data analysis technology affect the levels of the manufacturer's green technology and the platform's data-driven marketing, as well as all member's profits in a platform supply chain system? (2) Which is the best strategy (the agency selling or reselling strategy) that can make higher levels of green technology and data-driven marketing, gaining more profit for all members, and how does the service commission rate affect the manufacturer's selling strategy choice? (3) Are government subsidies related to green technology conducive to the manufacturer to improve the level of green technology, and is it conducive to all members to obtain more profit, and how does the government subsidy affects the system members' choice about agency selling or reselling strategy?

### 2. Green and Platform Supply Chain Management

#### 2.1. ESG and Green Supply Chain Management

Sustainable and green activities can help improve enterprises' environmental, social and governance (ESG) performance, which has been proved by some scholars from an empirical perspective. For example, Husted et al. <sup>[1]</sup> use ESG data of 459 enterprises from nine countries to analyze and find that sustainable governance can improve ESG performance. Wang et al. <sup>[2]</sup> conduct an annual observation sample study of 1980 enterprises from the top 500 green companies in the United States from 2009 to 2013 and point out that green activities of enterprises had significant effects on their social responsibility fulfillment and financial performance improvement. Yang et al. <sup>[3]</sup> confirmed that clean energy, green finance, and economic development are important and positive signs for sustainable practices based on G7 sustainable economies from 2010 to 2018. Tan et al. <sup>[4]</sup> investigated the impact of ESG rating on enterprise green innovation based on data related to Chinese A-share listed companies from 2010 to 2018, and showed that ESG rating can significantly promote the quantity and quality of enterprise green innovation.

Based on the ESG concepts and measures proposed by the above achievements, green production and operation activities from the perspective of supply chain can well achieve the goal of balancing economic growth and environmental protection. In 1996, scholars from Michigan State University proposed the embryonic form of green supply chain management theory. Subsequently, some scholars put forward the idea that green supply chain management is sustainable and ecological management <sup>[5][6][7]</sup>. Nagel <sup>[8]</sup> showed that green procurement is an extremely important driving factor in green supply chain management, and environmental awareness should penetrate every link of the supply chain. Hall et al. <sup>[9]</sup> believed that green supply chain management is an effective way for enterprises to bear environmental pressure and put environmental innovation concept through the whole supply chain process, to realize environmental protection. Zsidisin et al. <sup>[10]</sup> researched how green supply chain management integrates green environmental awareness into the whole process of product manufacturing and recycling to carry out environmental management. Tachizawa et al. [11] explored how green supply chain management can improve environmental benefits and maximize resource utilization as the goal. Rahmani et al. [12] defined green supply chain management as considering the necessity of environment and paying attention to ecological benefits in product design, material supply, processing, transportation, and product recycling and reuse interaction. Nekmahmud et al. [13] systematically combed the literatures about green supply chain management and identify the obstacles and key factors of implementing green supply chain management. Hariharasudan et al. [14] assessed how green supply chain management is still the focus of scholars' attention and plays an important role in changing environmental issues. Astawa et al. [15] discovered that the practice of green supply chain management has positive impact on the performance and competitive advantage of five-star hotels by conducting analysis of 145 respondents. Kot et al. [16] investigated the supply chain management practices of 613 small and medium-sized enterprises around the world, and found that environmental and social sustainability are the shutdown factors that can affect supply chain management performance. The above scholars published their research on green supply chain management from different industries and perspectives, and some scholars discuss the operation management of green supply chain from the perspective of manufacturers' green R&D activities and consumers' participation. For example, Liu et al.  $\begin{bmatrix} 17 \\ 2 \end{bmatrix}$  studied whether suppliers invest in carbon emission reduction and establish a decision-making model for green agricultural supply chain. The results showed

that cooperation between manufacturers and retailers can achieve the goal of protecting environment and members' profits. Ma et al. <sup>[18]</sup> believed that green supply chain management is an environmental management mode to attract consumers to carry out green consumption through manufacturers' green emission reduction technologies, thus alleviating the global environmental crisis. Zhu et al. <sup>[19]</sup> studied the design and development of green products in competitive environment and found that price competition can make the greenness of products increase and promote green R&D activities. Hong et al. <sup>[20]</sup> discussed the design and development of green products in a two-echelon supply chain by taking consumer reference behavior as a reference point, and the results showed that consumers' green awareness play a positive role on green R&D.

In order to encourage enterprises to improve green technology investment level and promote sustainable economic development, the government can provide green subsidy and standard for enterprises' technology investment <sup>[21]</sup> <sup>[22]</sup>, which can motivate members and consumers in the supply chain to obtain more benefits and improve their enthusiasm to fulfill social responsibilities <sup>[23]</sup>. Yang et al. <sup>[24]</sup> analyzed the impact of government subsidy on technological innovation of competitive enterprises and found that government subsidy can alleviate the prisoner's dilemma between the two competitive enterprises and improve their profits. Gao et al. [25] assessed the improvement of green R&D technology and how it can continuously improve the environmental benefits of development-intensive green products considering government sets green standards. Xue et al. <sup>[26]</sup> analyzed the decision making of the green supply chain with energy-saving products, and they found that the government subsidy is positively correlated with the energy-saving level, product price and market demand, which could significantly improve social welfare and promote the improvement of energy-saving products. Li et al. [27] investigated the impact of government subsidy on the innovation level of secondary supply chain, and the results showed that consumer subsidy is more effective than producer subsidy in promoting innovation investment. Ma et al. [18] considered that under government intervention, manufacturers invest in green emission reduction technology to reduce carbon emissions, and retailers invest in information technology to deliver green quality of products to consumers. Ma et al. show that higher emission reduction subsidy encourages investment in green emission reduction technology and makes all members' profits increase. Chen et al. [28] researched the impact of government subsidy policies on collaborative innovation in a two-layer supply chain, and found that government subsidy helps improve innovation efficiency. In addition, other scholars discussed the limited government budget and sufficient government budget <sup>[29][30]</sup>, the government's subsidy scheme for green technology in competitive manufacturing [31], the different channel structure with government subsidy [32], the government's subsidy to supply chain members through linear subsidy and fixed subsidy <sup>[33]</sup>, how the government allocates special subsidies between consumers and manufacturers [34][35], etc., to subsidize members in supply chain and carry out green R&D and production management.

The above research demonstrates the benefits to enterprises who carry out green supply chain operation activities on improving economic and ecological benefits and also indicates that consumers' green awareness and government green subsidy are important. However, all of these papers research traditional supply chain, there are fewer studies research green supply chain management with platform selling.

#### 2.2. Platform Supply Chain Management

The Internet platform provides a new way of communication for enterprises and consumers and provides a new marketing channel for manufacturers. The introduction of e-commerce platforms can lead to an increase in product market demands with lower selling price and help both the manufacturer and the platform gain more income <sup>[36][37]</sup> <sup>[38]</sup>. The platform supply chain management has become the focus of scholars' research. Platform has clear effects on improving the operation efficiency of supply chain through data analysis technology. For example, the platform can give full play to the advantages of data intelligence, reduce the procurement cost of supply chain <sup>[39]</sup>, and help members in the supply chain to obtain more benefits based on the increase in product demand with mining consumer preferences and data-driven marketing (DDM) technology <sup>[38][39][40]</sup>, improve the coordination and cooperation level among supply chain members <sup>[41]</sup> and innovation level <sup>[42][43]</sup>. The above platform supply chain analysis technology, such as data-driven marketing (DDM).

Because platforms can generally provide agency selling or reselling strategies for manufacturers and retailers, many scholars have conducted studies about the problem of members selling strategy choice. For example, Xiao et al. <sup>[44]</sup> investigated the motivation of retailers to accept digital empowerment of the platform and join the platform, and proposed that the platform with the operation data of each retail store can effectively help retailers select suitable products, thus improving their operation efficiency. Hao et al. [45] assessed the publishing industry, considered the complementary relationship between products and devices, studied the pricing of e-books and ebook readers under wholesale and agency pricing modes, and summarized that due to the existence of the complementary market (i.e., e-book readers), the price of e-books in the pure reselling mode is low. Hagiu et al. [46] assumed information asymmetry among supply chain members and analyzed the problem of marketing activity level on the selection of supplier's selling mode. The agency selling mode and reseller mode depends on more useful information to optimize customized marketing activities for each specific product. Young [47] studied the influence of online review information of third-party consumers on equilibrium selling strategies in a platform supply chain. Abhishek et al. [48] constructed a supply chain model with one manufacturer and two platforms and analyzed the positive or negative cross-channel effect and competitive intensity and other factors on agency selling or reselling modes choice. Tan et al. [49] proved that the mechanism of online market (i.e., agency selling) can benefit both upstream suppliers and retailers in the digital publishing industry by comparing the profits of manufacturers, platforms, and consumer welfare of agency selling and reselling models in the sale of digital products. Tan et al. [50] showed that the agency model is beneficial to the sales of digital products due to the revenue-sharing structure and the direct control of price by upstream publishers by studying the choice between agency model and wholesale model when digital goods are sold on online platforms. Tian et al. <sup>[51]</sup> considered a platform supply chain composed of a retailer and a platform (such as Amazon platform) and analyzed when Amazon allows retailers to sell products on its platform. Zhang et al. [52] considered whether manufacturers add the number of offline stores when selling products through online retailers. Chen et al. <sup>[53]</sup> found that the reselling mode is no longer a win-win strategy in competitive conditions, and a mixture of reselling and agency selling modes can realize the pareto improvement. Tan [54] analyzed the agency mode of digital products based on the digital product industry. Geng [55] discussed the additional product pricing of the upstream manufacturers and downstream online platform of the interaction between selling mode selection, and found that when the platform of the service commission rate is not too low and

additional product under the condition of market potential is not too big, platforms will choose the agency selling mode. Wei et al. <sup>[56]</sup> considered the comprehensive effects of manufacturers' leader-follower relationship and platform retailers' recommendation fees to help the manufacturers choose agency selling or reselling mode to sell products in e-commerce platforms. It can see that manufactures and the platforms may chose different selling strategies for conditional differences.

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