Green R&D Financing Strategy in Platform Supply Chain

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Platform enterprises can improve green R&D efficiency by data-driven marketing (DDM) activities and can also provide financing assistance to manufacturers.

Keywords: green R&D ; financing ; platform supply chain ; data-driven marketing

1. Introduction

The rapid development of the global economy has caused serious environmental pollution. Therefore, many enterprises carry out green R&D, production, and operation management activities in the supply chain [1]. For example, Haier Bio fulfills corporate responsibility via R&D, and carries the concept of green and low-carbon development throughout the whole chain of production and operation [2]. Moreover, Haier has reached agreement with JD.com to promote products through data-driven marketing technology. In April 2021, Honeywell made a solemn commitment to sustainability by achieving carbon neutrality in all of its operations and facilities by 2035, and has repeatedly set and exceeded aggressive sustainable development goals, reducing greenhouse gas emissions from its operations and facilities by more than 90% since 2004 [3]. The “Green 360” program initiated by Wal-Mart states that all the products it sells must be 100% zero-cost manufacturing and energy renewable [4], and Wal-Mart can provide financing loans to these businesses.

However, green R&D needs a huge amount of capital, and it is often far from enough to rely only on manufacturers themselves when they conduct product R&D activities and expand new fields. Thus, how to relieve the shortage of capital in developing green products becomes one of the biggest challenges for many enterprises worldwide. Currently, banking financing is a main financing channel. Many banking institutions have started lending to green SEMs since the International Finance Corporation (IFC) announced the equator Principles in 2003. China has implemented green credit policies and encouraged banks and other financial institutions to provide credit support to cash-strapped, low-carbon enterprises since 2007 [5]. By the end of 2018, the accumulated amount of green credit provided by the industrial and Commercial Bank of China, Agricultural Bank of China, China Construction Bank, Bank of China, Bank of Communications, and Postal Savings Bank of China had exceeded CNY 4.4 trillion [6]. Cornerstone Technologies Holdings Limited announced a green loan financing of about HKD 150 million in 2022. All these measures have played a positive role in supporting green R&D for the manufacturers. However, as capital providers, banks usually decide whether or not to grant loans by assessing the risks of lending enterprises only, albeit without considering supply chain risks, i.e., the risks of upstream and downstream stakeholders of enterprises. This is not conducive to the sustainable development of supply chain members.

With the rapid progress of Internet technology, the platform economy is conducive to improving the allocation efficiency of social resources and giving birth to many new forms of business with the characteristics of networking, digitalization, and intelligence. For example, JD.com collaborates 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, and then JD.com sells them to consumers at a markup. However, when JD.com cooperates with Topsports, Sephora, and other brands, it adopts the agency selling model, and charges certain platform commission fees and sells its products through JD platform. Since 2010, the Amazon platform in the United States has not only sold various enterprises’ products through agency selling mode, but also opened a new selling channel to sell products. In addition, the platform provides enterprises with a new way of financing besides financing by bank, that is, to provide loans to manufacturers or suppliers who sell products on its platform. Thus, the platforms can not only provide online distribution channels but also online financing services for enterprises through supplier selling, credit and other transaction data, so as to facilitate the distribution of enterprises and relieve their capital pressure. For example, Alibaba, the owner of the Taobao platform, provides loans to B2B enterprises operating on its platform [7]. In 2018, JD.com launched “JD Express Bank”, a new online financial service based on big data analysis and

new Internet technologies. Moreover, JD.com has also established the “Jingdong Bao” financing channel to meet the needs of small and median enterprises. Companies selling goods on Amazon platform can obtain loans from the Amazon platform, with the loan amount ranging from USD 1000 to 750,000 up to one year, and the annual interest rate ranging from 6% to 17% [8]. Platform financing channel has become a more convenient and efficient way: on one hand, it is conducive to the production and operation activities of enterprises; on the other hand, it can also make the platform obtain a higher income. Furthermore, the platform has the natural advantage of data collection, which can describe, predict, analyze, and guide consumers’ purchasing behaviors based on the acquired data and provide high-quality and accurate marketing services for all kinds of products, including green products [9]. At the same time, the platform’s data-driven marketing (DDM) activities can promote green products, strengthen green consumption concept of consumers, and improve the market share of green products [10]. Therefore, more and more manufacturers are selling green products on the platform. For example, JD.com uses DDM to cooperate with many well-known brands in the industry, such as mobile phone brand Huawei and food and home appliance brand Haier to sell their green products.

2. Green Supply Chain Management

Green supply chain, also known as environment-conscious supply chain, is a mode of balancing economic growth and environmental protection and incorporating green environmental behavior into enterprise management [11]. In the 1990s, scholars began to study green supply chain management. In 1994, Moffat et al. [12] proposed the concept of green procurement when they studied the impact of products on the environment and advised that companies choose the right raw materials through environmental guidelines and focus on recycling. In 1996, scholars from Michigan State University proposed the embryonic form of green supply chain management theory. On this basis, Handfield [13] broadens the meaning of environmentally responsible manufacturing for enterprises, providing a reference for enterprises in the supply chain to reduce their impact on the environment in the process of operation.

In recent years, many scholars have put forward many insightful views on the concept of green supply chain and its management. Some scholars analyze green supply chain management from the aspects of green procurement, environmental innovation concept, product manufacturing and recycling, environmental benefits [14][15][16][17][18], and so on. From the perspective of e-commerce and green production, Rahmani and Yavari [19] define green supply chain management as that which considers the necessity of the environment in supply chain management while paying attention to ecological benefits in product design, material supply, processing, transportation, and product recycling and reuse interaction. De et al. [20], taking a Norwegian Salmon Supply Chain Network as evidence, studied the impact of different supply chain arrangements in the food supply chain on the cost of carbon emissions (a kind of green R&D cost) to solve environmental problems, and considered the restrictions related to carbon emissions. Gao et al. [21] consider the issue of green supply chain management with green standards formulated by the government and focused on the study of green products with two different green technologies. The research found that the improvement of green R&D technologies can continuously improve the environmental benefits of development-intensive green products. Ma et al. [22] found that green supply chain management is an environmental management mode to attract consumers to green consumption through manufacturers’ green emission reduction technologies, which thus alleviates the global environmental crisis. Liu et al.’s [23] study from the perspective of agriculture found that green supply chain management is an effective measure to drive economic development, benefit the people, and reduce carbon emission pollution under the constraints of carbon tax. The above scholars define their understanding of green supply chain management from different industries and perspectives. By summarizing their common points, it can be seen that green supply chain management is a modern management mode that comprehensively considers environmental impact and resource efficiency. As an important way for manufacturing enterprises to fulfill policy requirements and environmental responsibilities and achieve sustainable development, green R&D has long attracted extensive attention of scholars. How to enhance the green R&D ability of enterprises in the supply chain is one of the core issues. However, the existing literature ignores the fact that most supply chain members face capital constraints when investing in green technologies; however, in reality, they are more vulnerable to capital constraints in operational decisions. Therefore, the researchers consider whether the establishment of a financing relationship with the platform is more beneficial for manufacturers to produce green products compared to borrowing from banks during supply chain operations.

3. Supply Chain Financing Management

Traditionally, to mitigate the negative impact of capital constraints, many enterprises in the supply chain have turned to external institutions to meet their financing needs [24], among which financing by bank is one of the most common financing strategies. Some of the early literature studied co-financing and inventory decisions by incorporating capital constraints into traditional newsvendor models. Although the traditional bank credit financing may solve the financing

problems of many enterprises, it is often difficult for enterprises to obtain loans directly from banks and other financial institutions, due to the lack of certain tangible internal resources, high transaction costs, high operational risks, serious information asymmetry, and high bank loan costs [25]. In addition to a bank, manufacturers can also finance through suppliers, retailers, etc. Kouvelis and Zhao [26] studied the situation where both retailers and suppliers are constrained by capital and need short-term financing, concluding that, if an optimally structured trade credit contract is provided, retailers always prefer supplier financing rather than bank financing. Wu et al. [27] studied the situation where manufacturers take measures to reduce carbon emissions, while retailers are funded by banks or manufacturers due to limited funds, and explained how financing and the capital of retailers affect order quantity and carbon emission reduction. Jin et al. [8] study three financing strategies of bilateral supply chains in which both suppliers and retailers are subject to financial constraints. The three financing strategies are, respectively, non-cooperative bank sole financing strategy, cooperative bank trade credit financing strategy, and bank supplier guarantee financing strategy. Yang et al. [28] studied financing and pricing decisions in a supply chain, and the results show that supply chain provides decision-making options for new entrants and manufacturers must choose financing by retailer or bank according to the conditions. Huang et al. [29] studied the case of financing by bank, and the government can subsidize banks by providing financing as well as manufacturers and retailers. Fang and Xu [30] studied the green supply chain financing system composed of a capital-constrained manufacturer, a retailer, and a bank, and analyzed the financing behavior of manufacturers. Tang et al. [31] studied two innovative financing schemes emerging in recent years. The first is purchase order financing, which allows financial institutions to provide loans to suppliers by considering the value of purchase orders issued by creditworthy buyers. The second is buyer's direct financing, that is, manufacturers issue purchase contracts and loans directly to suppliers. Both of these financing methods enable suppliers to obtain production financing.

With the development of the online marketplace, the platform provides loan services for members of the functional supply chain. Platform is an emerging Internet financial business model, which has just entered the development period, but the effect of financing by platform cannot be underestimated. As a product of the Internet era, platform plays an increasingly prominent role in the financial field due to its advantages of low financing threshold and convenient financing methods, which helps to solve the financing problems of cash-strapped enterprises. Therefore, financing by platform has become a new direction of financing development. Gao et al. [32] studied how the service commission rates for the platform affect manufacturer's wholesale price decisions and retailer's order quantity decision when the retailer or manufacturer borrows money from the online P2P lending platform under the condition that both suppliers and retailers are faced with capital constraints. Yan et al. [33] studied the form of online finance and encouraged SME manufacturers, especially those with capital constraints, to consider online channel options and implement dual-channel strategies. Yan et al. [34] discussed a two-channel supply chain structure, in which retailers and e-commerce platforms can free ride on each other's selling efforts, while e-commerce platforms can provide online financial services to capital-constraint suppliers.

The issue how the manufacturer selects its financing channel has been studied by many scholars. Firstly, Dong et al. [35] showed that the financial providers under online and offline environments are different. For online supply chain finance, e-commerce platform is the financial service provider, while offline supply chain finance is provided by commercial banks or other financial institutions. Secondly, Gong et al. [36] shows that e-commerce platforms play a role in product distribution and financial provision, which will influence the decisions of more supply chain members. He believes that e-commerce platforms play an important role in the platform economy, providing distribution channels for SME manufacturers, helping them promote the distribution and production, and alleviating capital strains through online financing projects. Zhen et al. [37] established a model in which a capital-constrained manufacturer sells products through retailers and third-party platforms and can obtain financing from third-party platforms, retailers, or banks. For the manufacturer, financing from a third-party platform strategy is always better than financing from bank strategy. In conclusion, it is an open question how the dual roles of third-party platform lending and participation in direct channels affect dual-channel management of manufacturers. Third-party platforms must balance interest income with revenue-sharing payments from manufacturers when setting interest rates. Higher interest rates may increase loan revenues but reduce the number of products sold on the platform.

4. Platform Supply Chain Management

The Internet can provide a new way of communication for enterprises and consumers and can provide new distribution channels for manufacturers and retailers. Terry et al. [38] proposed that the platform model of online shopping could provide manufacturers with an opportunity to expand the market. Mantin et al. [39] proposed that retailers are increasingly adopting the dual distribution channel model, that is, these retailers not only act as traditional merchants (buying and reselling goods), but also provide an online platform for third-party sellers to compete for the same customers. Li et al. [40]

pointed out that retailers can gain more profits through the online and offline selling of product classification. The above research shows that manufacturers and retailers can gain benefits by choosing appropriate platform selling strategies.

At present, the two basic selling modes widely used by large e-commerce platforms are the traditional reselling mode and the new agency selling mode [41]. Many scholars have studied how manufacturers and platforms choose and innovate selling modes. Abhishek et al. [42] studied the balance of two e-retailers under different selling mode configurations when a manufacturer sells through two e-retailers, and used a stylized theoretical model to answer when e-retailers should use the agent mode and when they should use the reselling mode. Geng et al. [43] discussed the interaction between the pricing of additional products by upstream manufacturers and the selection of a selling mode for a downstream online platform, and found that the choice of selling mode affects the manufacturer's choice between additional pricing and bundling. Under the condition that the commission rate of the platform is not too low and the market potential of additional products is not too great, the platform is more inclined to the agency selling mode. Tan and Carrillo [44] explored the selling strategy choice between agency selling and wholesale (reselling) mode when digital goods are sold on an online platform and showed that agency selling mode is beneficial to the sales of digital products for the behavior of revenue-sharing and the direct control of price by an upstream publisher. Hao and Fan [45] paid attention to the pricing of e-books and e-book readers under wholesale (reselling) or agency selling mode, and they pointed out that the price of e-books in reselling mode is low because of the complementary relationship between e-books and e-book readers in the market. Liu et al. [10] investigated a platform's preference between agency selling and reselling, taking into account the influence of DDM, and established and compared four modes: NO-DDM + agency selling, NO-DDM + reselling, DDM + agency selling and DDM + reselling. The results showed that, with the improvement of DDM efficiency, the platform is more willing to adopt the reselling model. Ha et al. [46] studied selling strategy choice in a platform supply chain in which the third-party platform can provide an agency selling channel, reselling channel, or both selling channels and derive the equilibrium selling strategy choice.

In the context of high-quality economic and social development, platform economy helps enterprises achieve green transformation development. Du et al. [47] took the emerging issue of platform-oriented green advertising in practice as the research object, and discussed the role of platform economy in the development of green economy, concluding that the platform can gain more profits by using the best promotion strategy than the performance-based promotion strategy. The research on platform with DDM technology has become a hot topic for researchers recently. Traditional green modular design has the risk of losing the use of product platform planning strategy. Liu et al. [48] constructed a theoretical model of the information adoption behavior of green agricultural products in an e-commerce platform, and the results show that a safe environment and the information technology of the platform have a positive impact on consumers' willingness to receive green agricultural product information on the commercial platform. Li [49] studied how the corresponding technology cost invested by the smart platform reduces the channel cost in the smart platform supply chain, and the research shows that the platform could also invest in the smart platform technology without bearing any channel cost. However, channel structure and green R&D are not addressed in the above literature.

References

1. Zhao, R.; Neighbour, G.; Han, J. Using game theory to describe strategy selection for environmental risk and carbon emissions reduction in the green supply chain. J. Loss Prev. Process Ind. 2012, 25, 927–936.
2. Haier Bio Practices Green Transformation and Creates a Model of Low-Carbon Enterprise. Available online: https://baijiahao.baidu.com/s?id=1727626469671112962&wfr=spider&for=pc (accessed on 18 March 2022).
3. Honeywell to Become Carbon Neutral by 2035, Boosting China's "Dual Carbon" Transition. Available online: https://baijiahao.baidu.com/s?id=1733048298543059756&wfr=spider&for=pc (accessed on 17 May 2022).
4. Wal-Mart's "Environmental 360" Moves the Chinese Market. Available online: http://www.linkshop.com/news/200886356.shtml (accessed on 6 February 2008).
5. Wesseh, P.K.; Lin, B. Optimal carbon taxes for China and implications for power generation, welfare, and the environment. Energy Policy 2018, 118, 1–8.
6. Cong, J.; Pang, T.; Peng, H. Optimal strategies for capital constrained low-carbon supply chains under yield uncertainty. J. Clean. Prod. 2020, 256, 120339.
7. Interfax. Alibaba Establishes Small Loans Lender in Chongqing; China IT Newswire: Beijing, China, 2011; p. 1.
8. Jin, W.; Zhang, Q.; Luo, J. Non-collaborative and collaborative financing in a bilateral supply chain with capital constraints. Omega 2019, 88, 210–222.

9. Cohen, M.C. Big data and service opetations. Prod. Oper. Manag. 2018, 27, 1709–1723.
10. Liu, W.; Yan, X.; Li, X.; Wei, W. The impacts of market size and data-driven marketing on the sales mode selection in an Internet platform based supply chain. Transp. Res. Part E 2020, 136, 101914.
11. Chiou, T.-Y.; Chan, H.K.; Lettice, F.; Chung, S.H. The influence of greening the suppliers and green innovation on environmental performance and competitive advantage in Taiwan. Transp. Res. Part E Logist. Transp. Rev. 2011, 47, 822–836.
12. Moffat, G.; Williams, R.A.; Webb, C. Selective separations in environmental and industrial processes using magnetic carrier technology. Miner. Eng. 1994, 7, 1039–1056.
13. Handfield, R.B. Green supply chain: Best practices from the furniture industry. J. Oper. Manag. 1997, 15, 293–315.
14. Hall, J. Environmental supply chain dynamics. J. Clean. Prod. 2000, 8, 455–471.
15. Zsidisin, G.A.; Siferd, S.P. Environmental purchasing: A framework for theory development. J. Purch. Supply Manag. 2001, 7, 61–73.
16. Tachizawa, E.M.; Gimenez, C.; Sierra, V. Green supply chain management approaches: Drivers and performance implications. Int. J. Oper. Prod. Manag. 2015, 35, 1546–1566.
17. Ray, A.; De, A.; Mondal, S.; Wang, J. Selection of best buyback strategy for original equipment manufacturer and independent remanufacturer—Game theoretic approach. Int. J. Prod. Res. 2021, 59, 5495–5524.
18. Zhuang, X.Y.; Li, W.H.; Xu, Y.S. Port planning and sustainable development based on prediction modelling of port throughput: A case study of the deep-water Dongjiakou Port. Sustainability 2022, 14, 4276.
19. Rahmani, K.; Yavari, M. Pricing policies for a dual-channel green supply chain under demand disruptions. Comput. Ind. Eng. 2018, 127, 493–510.
20. De, A.; Gorton, M.; Hubbard, C.; Aditjandrad, P. Optimization model for sustainable food supply chains: An application to Norwegian salmon. Transp. Res. Part E Logist. Transp. Rev. 2022, 161, 102723.
21. Gao, J.; Xiao, Z.; Wei, H.; Zhou, G. Dual-channel green supply chain management with eco-label policy: A perspective of two types of green products. Comput. Ind. Eng. 2020, 146, 106613.
22. Ma, S.; He, Y.; Gu, R.; Li, S. Sustainable supply chain management considering technology investments and government intervention. Transp. Res. Part E Logist. Transp. Rev. 2021, 149, 102290.
23. Liu, Z.; Lang, L.; Hu, B.; Shi, L.; Zhao, Y. Emission reduction decision of agricultural supply chain considering carbon tax and investment cooperation. J. Clean. Prod. 2021, 294, 126305.
24. Yang, R.; Tang, W.S. Technology improvement strategy for green products under competition: The role of government subsidy. Eur. J. Oper. Res. 2021, 289, 553–568.
25. Wang, C.; Leng, M.; Liang, L. Choosing an online retail channel for a manufacturer: Direct selling or consignment? Int. J. Prod. Econ. 2018, 195, 338–358.
26. Kouvelis, P.; Zhao, W. Financing the Newsvendor: Supplier vs. Bank, and the Structure of Optimal Trade Credit Contracts. Oper. Res. 2012, 60, 566–580.
27. Wu, D.D.; Yang, L.; Olson, D.L. Green supply chain management under capital constraint. Int. J. Prod. Econ. 2019, 215, 3–10.
28. Yang, H.; Sun, F.; Chen, J.; Chen, B. Financing decisions in a supply chain with a capital-constrained manufacturer as new entrant. Int. J. Prod. Econ. 2019, 216, 321–332.
29. Huang, S.; Fan, Z.P.; Wang, N.N. Green subsidy modes and pricing strategy in a capital-constrained supply chain. Transp. Res. Part E 2020, 136, 101885.
30. Fang, L.; Xu, S. Financing equilibrium in a green supply chain with capital constraint. Comput. Ind. Eng. 2020, 143, 106390.
31. Tang, C.S.; Yang, S.A.; Wu, J. Sourcing from Suppliers with Financial Constraints and Performance Risk. Manuf. Serv. Oper. Manag. 2017, 20, 70–84.
32. Gao, G.X.; Fan, Z.P.; Fang, X. Optimal stackelberg strategies for financing a supply chain through online peer-to-peer lending. Eur. J. Oper. Res. 2018, 267, 585–597.
33. Yan, N.; Liu, Y.; Xu, X. Strategic dual-channel pricing games with e-retailer finance. Eur. J. Oper. Res. 2020, 283, 138–151.
34. Yan, N.N.; Zhang, Y.P.; Xun, X. Online finance with dual channels and bidirectional free-riding effect. Int. J. Prod. Econ. 2021, 231, 107834.

35. Dong, L.; Ren, L.; Zhang, D. Financing Small and Medium-Size Enterprises via Retail Platforms. 2018. Available online: https://ssrn.com/abstract=3257899 (accessed on 1 May 2019).
36. Gong, D.Q.; Liu, S.F.; Liu, J. Who benefits from online financing? A sharing economy e-tailing platform perspective. Int. J. Prod. Econ. 2020, 222, 107490.
37. Zhen, X.; Shi, D.; Li, Y.; Zhang, C. Manufacturer's financing strategy in a dual-channel supply chain: Third-party platform, bank, and retailer credit financing. Transp. Res. Part E Logist. Transp. Rev. 2020, 133, 101820.
38. Terry, C.; Childers, C.; Joann, P.; Stephen, C. Hedonic and utilitarian motivations for online retail shopping behavior. J. Retail. 2001, 77, 511–535.
39. Mantin, B.; Krishnan, H.; Dhar, T. The strategic role of third-party marketplaces in retailing. Prod. Oper. Manag. 2014, 23, 1937–1949.
40. Li, Q.; Wang, Q.; Song, P. Third-party sellers' product entry strategy and its sales impact on a hybrid retail platform. Electron. Commer. Res. Appl. 2021, 47, 101049.
41. Hagiu, A.; Wright, J. Marketplace or reseller? Manag. Sci. 2015, 61, 184–203.
42. Abhishek, V.; Jerath, K.; Zhang, Z.J. Agency Selling or Reselling? Channel Structures in Electronic Retailing. Manag. Sci. 2016, 62, 2259–2280.
43. Geng, X.; Tan, Y.L.; Wei, L. How Add-on Pricing Interacts with Distribution Contracts. Prod. Oper. Manag. 2018, 27, 605–623.
44. Tan, Y.L.; Carrillo, J.E. Strategic analysis of the agency model for digital goods. Prod. Oper. Manag. 2017, 26, 724–741.
45. Hao, L.; Fan, M. An analysis of pricing models in the electronic book market. MIS Q. 2014, 38, 1017–1032.
46. Ha, A.Y.; Tong, S.L.; Wang, Y.J. Channel Structures of Online Retail Platforms. Manuf. Serv. Oper. Manag. 2021, 24, 1547–1561.
47. Du, S.F.; Wang, L.; Hu, L.; Zhu, Y. Platform-led green advertising: Promote the best or promote by performance. Transp. Res. Part E 2019, 128, 115–131.
48. Liu, C.M.; Hao, Q.S.; Zhou, Y. Consumer information acceptance behavior and influencing factors of green agricultural products in e-commerce platform—In the perspective of information ecology. Inf. Sci. 2019, 37, 151–157.
49. Li, X. Reducing channel costs by investing in smart supply chain technologies. Transp. Res. Part E Logist. Transp. Rev. 2020, 137, 101927.