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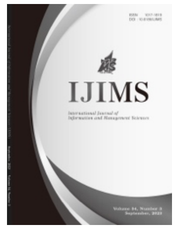

The Causal Model of Supply Chain Management Practice Drivers and Practice Levels in the Context of Sustainable Development

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Keywords

Sustainable Development; Driving Factors; Practical Level; Supply Chain Management; Configuration Research

Abstract

The research aims to explore the driving factors of supply chain management (SCM) practices in the context of sustainable development and their impact on the level of practice. To this end, a multi-level evaluation model is proposed and analyzed using content analysis and questionnaire surveys. The study investigated data from 74 manufacturing companies and used descriptive statistical analysis and Cronbach's alpha reliability test to evaluate the internal consistency of the constructed indicator system. And analyzed the causal relationship between driving factors and practical level. The results show that there is a difference of 11.34 between the intersection points of practical level, with specific values of 56.27 and 44.93. The difference between the upper and lower thresholds is 6.37 and 5.21, respectively. The driving factors continue to show a growth pattern, increasing from an initial value of 0.04 to 0.96. The practical pressure gradually increased from 0.03 to 0.98, and its growth curve was relatively flat. The above results reveal the significant impact of organizational environmental management, external social capital, and other factors on the practical level of supply chain management, and emphasize the importance of flexibility in supply chain management.

1. Introduction

With the increasingly close connection between the global economy and the ecological environment, sustainable development (SD) has become a focal issue in contemporary society (Bag et al., 2022). In the context of SD, supply chain management (SCM) is an essential component of enterprise operations and received widespread attention (Sarkar et al., 2022). The close integration of SCM with SD goals has become particularly crucial in the study of the driving factors and impact of SCM practices (Nkrumah et al., 2021). The driving factors of

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SCM practice involve various internal and external factors, which directly or indirectly drive SCM towards a more sustainable direction (Ali & Aboelmaged, 2022). The driving factors include but are not limited to policies and regulations, consumer expectations, technological progress, and the urgency of environmental protection. The practical level of SCM represents the actual execution effectiveness as well as level of enterprises in SCM, and is a key criterion for evaluating the sustainability of the supply chain (Gazman, 2023). Supply chain management not only achieves economic benefits for enterprises, but also undertakes environmental protection and social responsibility. Studying the driving factors of supply chain management practices and their impact on practical levels is of great significance for guiding enterprises to achieve sustainable supply chain management. This not only helps companies improve the efficiency and responsiveness of their supply chain, but also helps them identify and manage risks related to suppliers, enhancing the resilience of their supply chain. However, existing research still lacks in-depth exploration of the causal relationship between these driving factors and practical levels, especially in the context of SD. Therefore, the research aims to provide clearer and more systematic theoretical frameworks and practical guidance for enterprises, researchers, and policy makers, in order to enable supply chain management to play a more critical role in the global sustainable development process. The study proposes a causal model for the driving factors and practical level of supply chain management practices in the context of sustainable development. The research contribution mainly includes the following two aspects. On the one hand, it proposes a systematic theoretical framework for evaluating and guiding the supply chain management practices of enterprises in the context of sustainable development; On the other hand, it reveals the significant impact of organizational environmental management, external social capital, and other factors on the practical level of supply chain management, emphasizes the importance of flexibility in supply chain management, and provides practical guidance for enterprises to achieve sustainable supply chain management.

1. Related work

Faced with the increasingly severe development situation of environmental issues, many countries consider green development as the core driving force for economic growth. Therefore, the concept of ecological civilization construction has gradually developed, promoting innovation in green SCM, and many scholars have actively studied SCM. Gawusu et al. established green SCM under the renewable energy. This emphasizes the insights needed to significantly improve performance and address obstacles to the development of renewable energy green SCM, and proposes some useful technologies and a new conceptual model. Research has shown that this model considers the connection between enterprises and value creation (Gawusu et al., 2022). Roh et al. examined how internal green activities promote environmental performance in enterprises, and used structural equation modeling techniques. The research results indicated that green management innovation and intellectual property have a direct impact on green SCM (Roh, et al., 2022). Novitasari et al. evaluated green innovation as a mediating variable in the influence of green SCM on corporate performance, using purposive sampling method and testing the data using stata16. The results indicated that green SCM possessed a positive influence on green innovation, which possessed a positive influence on enterprise performance. The green SCM had no influence on enterprise performance (Novitasari & Agustia, 2021). Green innovation possessed a mediating influence between green SCM and enterprise performance. Pal et al. studied various pricing decisions, green innovation levels, and promotional efforts of participants under centralized Nash policies, manufacturer Stackelberg policies, and vertical Nash policies, and analyzed the relationships between various parameters. The research results indicate that green innovation is very effective in improving the profit margin of enterprises, and for green products, dual channel supply chains are more efficient than single channel supply chains (Pal et al., 2023).

The practical issues in green SCM have attracted widespread attention from the academic and business communities. The research on green SCM in developed Western countries is relatively mature, and scholars conduct in-depth analysis from their respective research perspectives, including research on practical levels and driving factors. Mehmood et al. used a systematic literature review method to critically analyze existing literature. The research results found that environment, policy, economy, and economic benefits are the three driving factors, while institutional risk, financial risk, and technical risk are the three major obstacles to implementing SCM practices (Mehmood et al., 2021). Raj et al. proposed a conceptual framework to analyze challenges and their related mitigation strategies, and used grey decision testing and evaluation laboratory methods to analyze the relationships between various supply chain challenges. The results indicate that supply inconsistency is the challenge most related to other factors, and provide guidance and strategies for practitioners and scholars to better respond to supply chain challenges (Raj et al., 2022). Shen et al. studied the influence of the epidemic on supply chain elasticity as well as summarized the challenges faced by China's retail supply chain. Through the joint efforts of multiple enterprises, governments, and the entire Chinese society, the entire market situation in China has been markedly controlled. The research results indicate that it is recommended that enterprises pay attention to operational flexibility and collaboration outside the supply chain for coping with large-scale supply chain disruptions (Shen & Sun, 2023).

In summary, in the face of increasingly severe environmental issues, the concept of green development and ecological civilization construction is gradually occupying a central position globally. However, existing methods only mention multiple factors that affect GSCM, without delving into the causal relationship between factors and practical levels, and emphasizing single factors, such as only focusing on internal management practices. In addition, existing technologies focus on static descriptions and cannot systematically analyze the dynamic changes in practice. To address the above issues, a multi-level evaluation model has been developed, incorporating external environmental factors such as economy, politics, and socio-cultural factors into the evaluation system. The causal relationship between the driving factors of supply chain management practices and the level of practice has been thoroughly analyzed to fill the existing research gap.

2. Research on the Driving Factors and Practical Level of SCM on the Ground of SD

This chapter proposes the construction of a supply chain management practice index system based on content analysis, and explores the core content of supply chain management from both theoretical and practical perspectives.

2.1 Construction of SCM Practice Indicator System on the Ground of Content Analysis Method

Faced with today's environmental pressure and SD requirements, SCM is no longer just a means for enhancing enterprise efficiency, but also a key to achieving environmental protection and economic win-win situation. Transparent and accurately monitored indicators for evaluating the practical level of SCM can guide the implementation of greener and more sustainable SCM (Fasan et al., 2021). The construction principles of the SCM practice indicator system are shown in Fig.1.

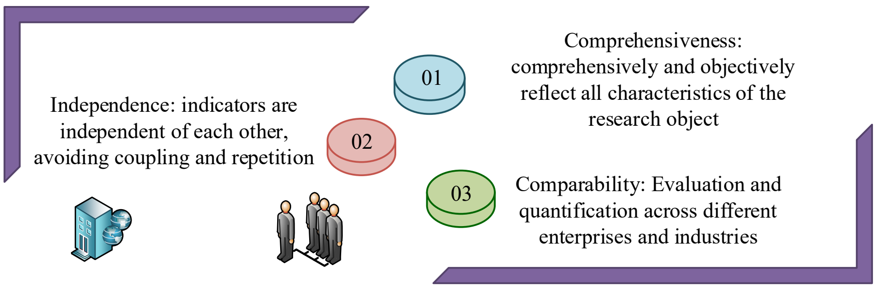


Fig. 1 *SCM Practice Index System Construction Principle*

Fig. 1 illustrates the basic principles of constructing a supply chain management practice indicator system, including independence, comparability, and comprehensiveness. It lays the theoretical foundation for the entire study and guides the construction of subsequent indicator systems and the development of evaluation models. Each indicator should have its own measurement goals and evaluation criteria to avoid misleading data analysis due to the mixing of indicators (Bhatia & Gangwani, 2021). The SCM practice indicator system needs to be applied to SCM practices of different scales, industries, and regions. The construction steps of the supply chain management practice indicator system are as follows, including establishing initial indicators, revising the indicator system, and further revising based on test results. Among them, there is a positive correlation between the ecological design of the enterprise and the level of effort. When enterprises do not carry out ecological design, assuming that the demand for products is elastic and the natural random factors that affect product description within a production cycle are non negative and continuous random variables, the formula for calculating the profit function between enterprises and customers is shown in equation (1) (Ohara et al., 2021).

$$\pi_{NB} = (p_N - w_N - c_b)(Q - \alpha p_N) \tag{1}$$

In equation (1), π_{NB} represents the revenue of enterprise customers under the NB ecosystem scenario. α represents the user's sensitivity to unit product prices. Q represents the demand capacity of the product in the market. w_N represents the purchase price of raw materials in the ecological design scenario. c_b represents the cost required for enterprise customers to produce a unit of product. p_N represents the retail price of the product. The NB ecological situation corresponds to the improvement of environmental information through ecological design, while the NB ecological situation tests the direct economic benefits brought by ecological design, including price premiums and possible tax incentives. When constructing a SCM indicator system for enterprises, the mathematical expression of the profit function between enterprises and customers is shown in equation (2).

$$\pi_{YB} = (p_Y - w_Y - c_b + \delta\tau_Y)(Q - \alpha p_Y) \tag{2}$$

In equation (2), π_{YB} represents the revenue of enterprise customers under the YB ecosystem scenario. p_Y represents the retail price of the enterprise's products when adopting the ecological design scenario. δ represents the coefficient of return per unit product obtained by enterprise customers due to the ecological design of the enterprise. When making centralized decisions, companies and customers should determine the optimal product production volume and market retail price from the perspective of maximizing the expected revenue of the entire supply chain. From this, it can be concluded that for any given agricultural production volume and random uncertainty factors, there exists a uniquely determined optimal retail price. The following inference can be drawn: the optimal retail price of a product is negatively correlated with actual production volume. The corresponding income function can be obtained, and its calculation formula is shown in equation (3) (Huan et al., 2023).

$$\pi_C = (p_C - c_b + \delta\tau_Y)(q - \alpha p_Y) - \frac{k\tau_C^2}{2} \tag{3}$$

In equation (3), π_C represents the total revenue of the supply chain during centralized decision-making. τ_C represents the level of effort in ecological design under the C ecological scenario. q represents the sales volume of the product under the ecological design scenario. k represents the service cost coefficient, and p_C represents the retail price under the C ecological design scenario. The supply chain coordination mechanism in centralized and decentralized decision-making assumes that the set retail price of the product will affect the production volume of user input, and its mathematical expression is shown in equation (4) (Bendadou et al., 2021).

$$\pi_Y^* = \frac{k(Q - \alpha c_b - \alpha c_s)^2(6k - \alpha\delta^2)}{2\alpha(4k - \alpha\delta^2)^2} \tag{4}$$

In equation (4), c_s represents the cost required by the manufacturer to produce a unit of raw materials, and the mathematical expression for the decision function of the enterprise and its customer benefits is shown in equation (5).

$$\pi_{CB} = \beta(p_C - c_b - c_s + \delta\tau_Y)(Q - \alpha p_Y) - \frac{\gamma k\tau_C^2}{2} \tag{5}$$

In equation (5), β represents the proportion of the manufacturer's share of the overall profit of the supply chain. $\frac{\gamma k\tau_C^2}{2}$ represents the ecological design cost borne by the enterprise customer, and $\gamma \in [0,1]$. The specific process of content analysis is as follows. Firstly, it is necessary to select sample companies, determine the research subjects, and choose globally ranked manufacturing enterprises as samples. At the same time, relevant environmental behavior materials, including official website information, annual reports, etc., should be downloaded.

Secondly, using existing literature to construct a preliminary indicator framework, and randomly selecting samples for pre analysis, combined with the actual situation of leading manufacturing enterprises, the indicators of the supply chain management practice indicator system were deleted and supplemented, and finally the supply chain management practice indicator system of leading manufacturing enterprises was determined (Gao et al., 2023). Then, a coding criterion with Chengdu significance was constructed, and two groups of personnel were arranged to code and score the environmental materials. Finally, the reliability and validity of the scoring results were tested to ensure the accuracy and scientificity of the analysis of the supply chain management practice level. Based on this, the average value was taken as the final record for further statistical analysis. From this, the supply chain management practice indicator system based on content analysis can be obtained as shown in Fig. 2.

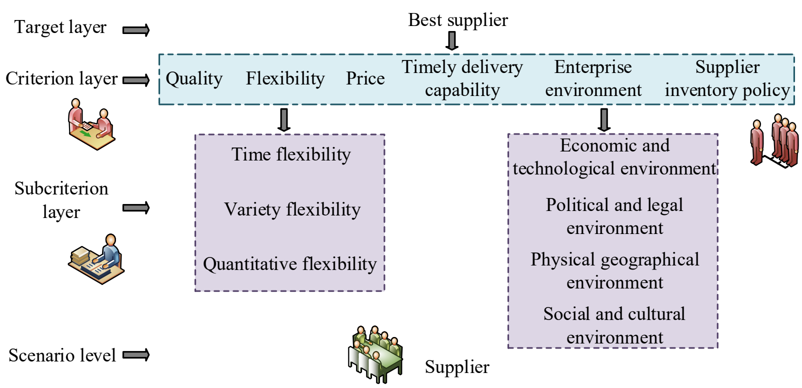


Fig. 2 *Practice Index System of SCM on the Ground of Content Analysis*

Fig. 2 is a direct product of Fig. 1, which concretizes the evaluation indicators of supply chain management practices and provides a foundation for subsequent data analysis. The indicator system constructed in the study integrates operational variables such as the ecological design cost of formulas (1) - (5) and the supply chain coordination mechanism of formula (4), making up for the lack of practical relevance in traditional research. In the construction of the SCM practice indicator system, the content analysis method can extract the best practices and key performance indicators of the supply chain. This can provide enterprises with more accurate and practical evaluation and management tools. The formula for calculating the reliability of encoding interaction discrimination is shown in equation (6).

$$R = \frac{n \cdot K}{1 + (n-1) \cdot K} \tag{6}$$

In equation (6), R represents the discriminant reliability of the interaction between encoders. n represents the number of participants in coding. K represents the average mutual agreement between encoders. Encoding is an important step in content analysis, which involves converting textual data into numerical form that can be statistically analyzed; An encoder is an individual that performs encoding tasks. The relevant calculation is showcased in equation (7).

$$K_{AB} = \frac{2M_{AB}}{N_A + N_B} \tag{7}$$

In equation (7), M_{AB} represents the quantity of identical analysis units encoded by two encoders. N_A represents the number of analysis units encoded by encoder A. N_B represents the number of analysis units encoded by Coder B. When entering the mediation effect test, the mathematical expression of the relationship between its variables is shown in equation (8).

$$Y = C'X + bM + e_3 \tag{8}$$

In equation (8), X serves as the independent variable. Y serves as the dependent variable. Y serves as a mediation variable. C' represents the inspection coefficient. e represents a constant. The content analysis method combines theoretical research and practical application, making the indicator system more scientific and comprehensive.

2.2 Research on the Practical Level and Driving Factors of Enterprise SCM

The research on the practical level and driving factors of enterprise SCM has become a focus of business operations and academic research. The practical level of SCM reflects the ability and performance of enterprises in SCM (Sahoo & Vijayvargy, 2021). Understanding and mastering the factors driving SCM practices has a direct or indirect influence about the improvement and enhancement of SCM practices. The analysis of measurement variables for driving factors of enterprise SCM is shown in Fig. 3.

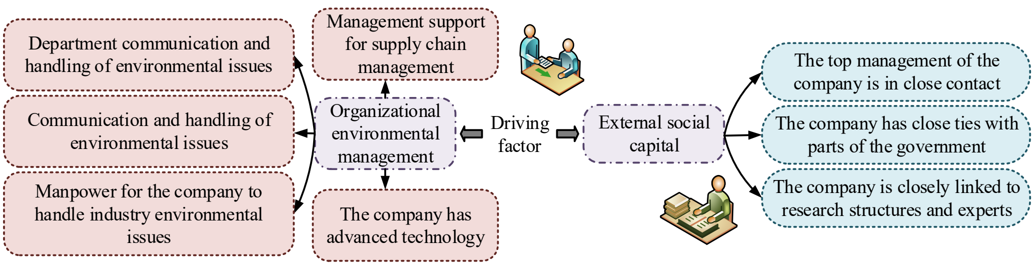


Fig. 3 *Analysis of Measurement Variables of Enterprise SCM Drivers*

Fig. 3 analyzes the driving factors that affect enterprise supply chain management practices, including internal and external factors, and further explores the key driving factors that affect supply chain management practices, providing a perspective for understanding the dynamic changes in supply chain management practices. In the driving factors, ecological design standardizes the dispersion of various indicators and uses equal weight coefficients to calculate environmental management performance. The calculation formula is shown in equation (9).

$$EL_i = \frac{1}{3}SI_i^{'} + \frac{1}{3}RI_i^{'} + \frac{1}{3}WI_i^{'} \tag{9}$$

In equation (9), EL_i represents the level of ecological civilization construction in region i. $SI_i^{'}$ serves as the normalized value of the deviation of the socio-economic construction index for region i. $RI_i^{'}$ serves as the normalized value of the deviation of the resource and environmental pressure index for region i. $WI_i^{'}$ serves as the normalized value of the corporate welfare level index deviation for region i. The calculation formula for socio-economic construction is shown in equation (10).

$$SI_i = \sqrt{1/3\,(PI_i^2 + LI_i^2 + EI_i^2)} \tag{10}$$

In equation (10), SI_i represents the socio-economic construction index. PI_i represents the population aggregation of region i. LI_i represents the intensity of territorial development in region i. EI_i represents the economic agglomeration degree of region i. The selection of measurement variables should be combined with the specific situation of the enterprise and the characteristics of the supply chain, and should be consistent with the enterprise's strategic goals, business needs, and continuous improvement goals. The variables for measuring the level of enterprise supply chain management practices include green procurement, ecological design, and customer cooperation, etc. Together with Fig. 3, they constitute a comprehensive analysis of supply chain management practices.

The measurement variable of enterprise SCM practice level is a quantitative evaluation of the effectiveness of enterprise SCM practice. It transforms key management activities or achievements into measurable indicators to more accurately evaluate the performance and efficiency of the supply chain (Wu et al., 2023). By incorporating ecological design into product design, enterprises can effectively evaluate the effectiveness of ecological design and make wiser decisions on environmental goals and product innovation. The content analysis method is tested for encoding consistency, and after constructing an encoding error matrix, coefficient calculation is carried. The relevant calculation is showcased in equation (11).

$$K = \frac{P_0 - P_e}{1 - P_e} \tag{11}$$

In equation (11), K represents the Kappa coefficient. P_0 represents the prediction accuracy. P_e represents accidental consistency. The calculation formula for accidental consistency is shown in equation (12).

$$P_e = \frac{S_1 S_3 + S_2 S_4}{N^2} \tag{12}$$

In equation (12), N represents the total amount of information collected. S_1 and S_3 represent the total number of uncoded information for researchers 1 and 3. S_2 and S_4 represent the total number of information encoded by researchers 2 and 4. The measurement variable of institutional pressure in SCM is used to analyze and measure the influence of institutional environment on SCM. Reasonable measurement variables can correctly affect SCM and adjust and optimize supply chain strategies accordingly. The measurement variables of institutional pressure in SCM are shown in Fig. 4.

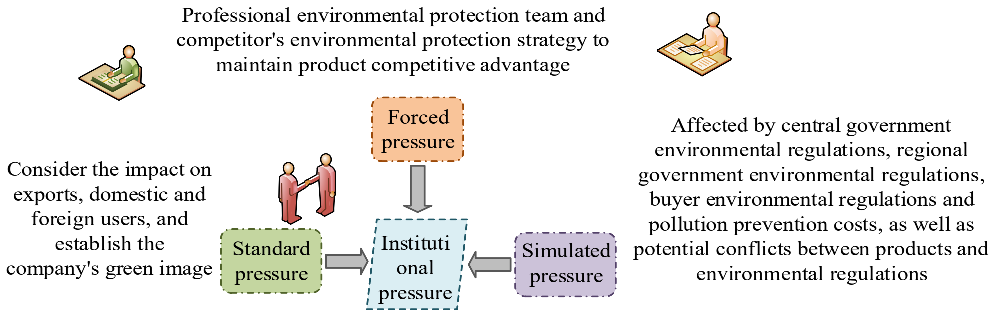


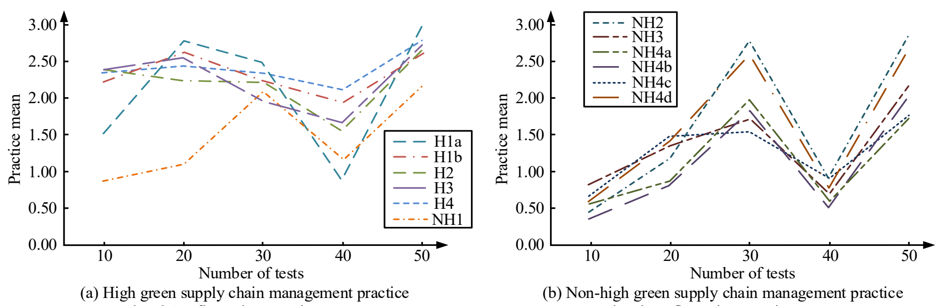
Fig. 4 *Measurement Variables of Institutional Pressure in SCM*

Fig. 4 explores the impact of institutional environment on supply chain management, including mandatory pressure, standard pressure, and simulated pressure, which extends the analysis of external factors in Fig. 3 and particularly emphasizes. The specific impact of institutional environment on supply chain management practices provides deeper insights into the external driving factors of supply chain management practices. Compulsory pressure is a type of institutional pressure that mainly comes from government regulations, policies, and regulatory requirements, reflecting the compliance risks of enterprises in terms of regulations and the effectiveness of their response strategies. Standard pressure refers to the examination of the number of industry standards that a company meets, the degree of deviation from best practices, and the resulting changes in market share or customer satisfaction in the face of industry standards. Simulated stress refers to successful practices in peer competition, customer expectations, or other businesses. Measuring these pressures can help companies better respond to changes in the external environment, optimize supply chain strategies, and ensure efficient and robust operations under various pressures.

3. Testing and Analysis of the Driving Factors and Practical Levels of SCM on the Ground of SD

To verify the impact of the content analysis method used in this experiment on the driving factors and practical level of SCM practice, experimental analysis and exploration are conducted. In this study, sample data from 74 companies are used. On the ground of statistical information from the United Nations Conference on Trade and Development (UNCTAD), it is possible to obtain the GDP and population data of the countries where these enterprises are headquartered in 2021, as well as the per capita GDP in 2021. In addition, the report released by Yale University every two years, especially the 2021 National Environmental Performance Index (EPI), is cited. Using information from the official website of the United Nations, relevant research collected SDG12 data from countries or regions corresponding to the share of various enterprises in different consumer markets in 2021. Due to the relatively small changes in data between consecutive years by leading manufacturing companies, in the absence of some data, this study uses data from 2020 as a substitute. Among them, the list of some surveyed companies is as follows. The surveyed enterprises, primarily concentrated in the manufacturing sector, include Dongfeng Liuzhou Automobile Co., LTD, focusing on automotive and new energy vehicle R&D and production; Guangxi Automobile Group Co., LTD, engaged in automobile, auto parts, engine, bus, and modified car manufacturing; Liuzhou Wuling Automobile Co., LTD, specializing in micro auto parts, engines, and special vehicles production and sales; Guilin Bus Industry Group Co., LTD, involved in complete bus, chassis, and auto parts production; Guangxi Yuchai Machinery Group Co., LTD, dedicated to engine and new energy vehicle development and production; and Liuzhou Yizhou Automobile Air Conditioning Co., LTD, concentrating on R&D, manufacturing, and sales of scroll-type automotive air conditioning compressors and systems.

H represents the configuration of high green SCM practice level. NH represents the configuration of non high green SCM practice level. H1a configuration is a consumer oriented enterprise driven by national economic and environmental policies, HIb configuration is a consumer oriented enterprise driven by competitors, sustainable markets, and resource capabilities, H2 configuration is a consumer oriented enterprise driven by national economic, environmental policies, and sustainable consumption markets, H3 configuration is a consumer oriented or industrial oriented enterprise driven by national economic, environmental policies, competitors, and resource capabilities, and H4 configuration is an industrial oriented enterprise driven by national economic, environmental policies, and resource capabilities. NHI configuration is a consumer oriented enterprise lacking national economic and environmental policy drivers, NH2 configuration is an industrial oriented enterprise lacking sustainable consumption market and resource capability drivers, NH3 configuration is an industrial oriented enterprise lacking competition and resource capability drivers, NH4a configuration is an industrial oriented enterprise lacking national economic, environmental policy and competitor drivers, NH4b configuration is an industrial oriented enterprise lacking national economic and resource capability drivers, NH4c configuration is an industrial oriented enterprise lacking national economic and competitor drivers, and NH4d configuration is an industrial oriented enterprise lacking national economic drivers. The practice mean curves of its high-level and non high-level green SCM practice driven models are shown in Fig. 5.



(a) High green supply chain management practice level Configuration practice mean
(b) Non-high green supply chain management practice level configuration practice mean

Fig. 5 *Practice Mean Curve of High and Non-High Level Green SCM Practice Driven Model*

Fig. 5 shows the stability advantages of high green SCM practices, which exhibit stronger steady-state characteristics compared to non high green SCM practices. In Fig. 5 (a), the volatility of the H1a and NH1 curves is relatively higher, with the difference between the maximum and minimum means being 1.52 and 1.61. In Fig. 5 (b), the maximum mean of practical level reached its peak at 30 and 50 tests, showing relatively significant differences. Compared to the lowest term in the practical average, the difference is as high as 2.05. This deonstrates that a marked disparity in stability between high green SCM and non high green SCM. The above results indicate that the research method quantifies the dynamic impact of driving factors on practical level through multivariate modeling and configuration analysis, revealing the relationship between GSCM driving factors and time level. The numerical function distribution of the EPI and the cumulative distribution curve of SCM practice pressure experience are shown in Fig. 6.

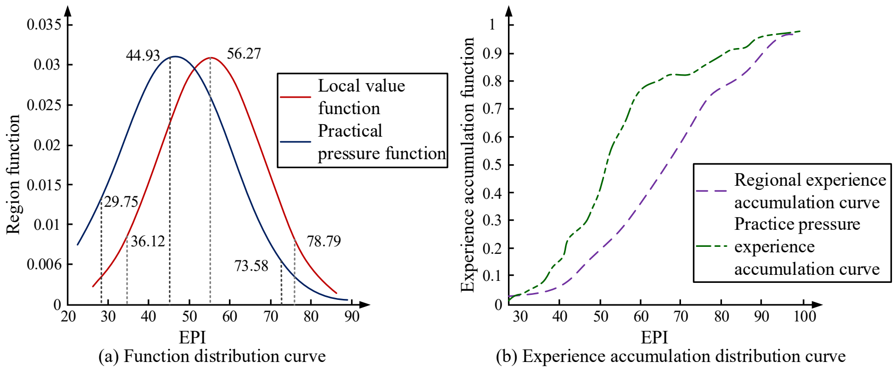


Fig. 6 *EPI Numerical Function Distribution and SCM Practice Pressure Experience Accumulation Distribution Curve*

Fig. 6 shows that the distribution of EPI numerical functions is basically balanced, and there is a significant difference between the two. The cumulative distribution of practical pressure shows greater differences, and the accumulation of practical pressure is not the same. In Fig. 6 (a), there is a significant difference between the two intersections, with values of 56.27 and 44.93 respectively, resulting in a difference of 11.34. And the disparity in the upper and lower thresholds is 6.37 and 5.21, respectively. In Fig. 6 (b), the continuous variables of the driving factors show a growth trend throughout the entire process, and the growth of the regional experience accumulation curve basically shows a linear increase, with an initial value of 0.04, while the final value increases to 0.96. The initial value of practical pressure is 0.03, while the final value is 0.98, and the growth of the experience accumulation curve is more stable and slow. The functional distribution and experience accumulation distribution curve of sustainable consumption market and enterprise resource capacity is shown in Fig. 7.

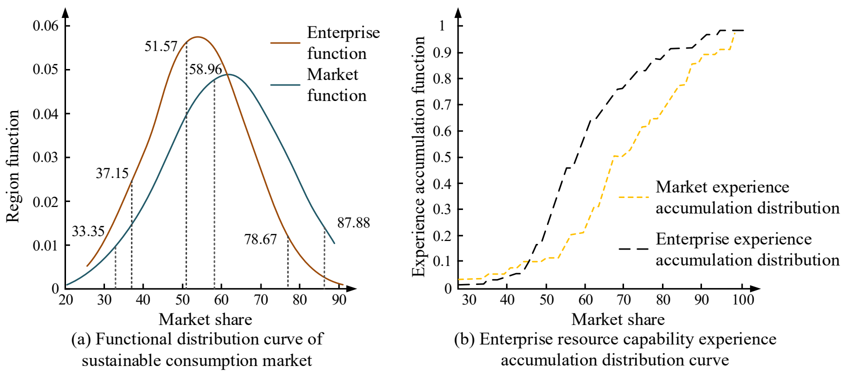


Fig. 7 *Function Distribution and Experience Accumulation Distribution Curve of Sustainable Consumption Market and Enterprise Resource Capacity*

Fig. 7 shows that the global sustainable consumption market share function distribution and the cumulative distribution of enterprise resource capacity experience appear uniform overall, but the specific differences are quite significant. In Fig. 7 (a), the global sustainable consumer market is unevenly distributed in different scenarios. In Fig. 7 (b), the experience accumulation curve of global consumer market share shows an upward trend. This indicates the complex and dynamic interaction between the global sustainable consumption market and corporate resource capabilities. This can provide precise intervention for policy makers, such as providing ecological design subsidies to small and medium-sized enterprises. The reliability test outcomes of the three variables are showcased in Table 1.

Table.1 *Reliability Test Results of Three Variables*

Variable	Item quantity	Cronbach's α coefficient
Driving factor		
Organizational environmental management	5	0.956
External social capital	3	0.806
Practical level		
Green procurement	5	0.983
Ecological design	4	0.961
Customer cooperation	3	0.861
Institutional pressure		
Forced pressure	5	0.945
Standard pressure	4	0.949
Simulated pressure	3	0.855

Table 1 shows that the α coefficient of external social capital is relatively low, but an α coefficient exceeding 0.7 is acceptable. Therefore, both have good consistency and reliability. Among green procurement, ecological design and customer cooperation, the Cronbach's α coefficient of green procurement is the highest, reaching 0.983. Among institutional pressures, the Cronbach's α coefficient of standard pressure is the highest, so the measurement results of standard pressure are the most reliable. In addition, according to formula (11), the indicator system passed the coding consistency test and the Kappa coefficient was greater than 0.8. This indicates that the measurement results of these variables are consistent and reliable, providing a solid basis for subsequent data analysis and interpretation. In addition, the study also used more advanced sampling appropriateness measures (KMO) and Bartlett's sphericity test for analysis. The results are shown in Table 2.

Table.2 *KMO and Bartlett Sphericity Test Results*

Inspection items		Driving factor	Practical level	Institutional pressure
KMO		0.836	0.853	0.824
Bartlett sphericity test	Approximate chi square allocation	168.863	441.126	285.462
	Freedom	27	87	75
	Significance	0.000	0.000	0.000

Table 2 shows that the KMO values of each factor exceed 0.8, indicating the presence of common factors among variables. The Bartlett sphericity test results are significant, indicating that the corresponding items in the indicator system can be used and analyzed.

4. Conclusion

SD brings new challenges and opportunities to SCM, and it is urgent to study the driving factors of SCM practice and the causal patterns between practice levels. However, there is still ambiguity and inadequacy in the quantitative description of the interaction between driving factors and practical level. In response to this research dilemma, this study proposes a study on the driving factors and causal models of SCM practice under the SD. The experimental results indicate that compared with the single factor dominant method (Mehmood et al., 2021), this study reveals the combination effect of factors and avoids isolated analysis bias. The volatility of the H1a and NH1 curves is relatively higher, with a difference of 1.52 and 1.61 between the maximum and minimum means. The maximum mean of practical level reached its peak at 30 and 50 tests, with a mean range of 1.63 to 2.71 and relatively large differences. The Cronbach's α coefficients for organizational environmental management and external social capital are 0.956 and 0.806. The Cronbach's α coefficients for green procurement, ecological design, and customer cooperation are 0.983, 0.961, and 0.861, respectively. In institutional pressure, the Cronbach's α coefficients for forced pressure, standard pressure, and simulated pressure are 0.945, 0.949, and 0.855, respectively. In summary, the research method integrates multiple dimensions such as quality, flexibility, price, timely delivery capability, and enterprise environment, providing a more comprehensive evaluation framework for the theory of supply chain management; At the same time, it provides a practical tool for enterprises to select and evaluate suppliers in complex supply chain environments, thereby improving the efficiency and responsiveness of the supply chain. There are still research limitations in this study, which only selects manufacturing enterprises as the sample library and does not cover other service industries. Therefore, it is necessary to further expand the research scope and comprehensively evaluate the SCM practice level of each enterprise in future research.

Survey questionnaire list

Organizational environmental management:

Is there a clear environmental management policy?

2. Have you participated in external certifications or standards related to environmental management?
3. Are environmental performance indicators regularly monitored and reported?
4. Is environmental management training provided to employees?
5. Is the effectiveness of its environmental management policies regularly evaluated?

External social capital:

Do you have good cooperative relationships with suppliers, distributors, and other partners?

2. Do you participate in industry organizations or associations to promote environmental sustainability?
3. Have you collaborated with government agencies to improve environmental management practices?

Green procurement:

Do you consider the environmental performance of suppliers when selecting them?

2. Should we prioritize the procurement of environmentally friendly materials or products?
3. Are suppliers required to provide an environmental impact assessment report?

Ecological Design:

1. Have environmental impacts been considered during the product design phase?
2. Is life cycle assessment (LCA) used to optimize product design?
3. Have ecological design principles been implemented in the product development process?

Customer cooperation:

1. Do you collaborate with customers to improve the environmental performance of the supply chain?
2. Have their environmental management strategies been adjusted according to customer needs?
3. Is environmental performance information shared with customers?

Institutional pressure:

Mandatory pressure: 1. Have environmental management practices been improved due to legal and regulatory requirements? 2. Are you facing environmental compliance pressure from the government?

Standard pressure: 1. Does it comply with industry environmental standards? 2. Has environmental performance been improved due to customer or partner requirements?

Simulated stress: 1. Has the environmental management of competitors been improved due to their environmental performance? 2. Has it been affected by the environmental performance of other companies in the same industry?

Conflict of Interests

The author declares that there's no conflict of interests.

Reference

Ali, I., & Aboelmaged, M. G. S. (2022). Implementation of supply chain 4.0 in the food and beverage industry: perceived drivers and barriers. *International Journal of Productivity and Performance Management, 71*(4), 1426-1443. https://doi.org/10.1108/IJPPM-07-2020-0393

Bag, S., Dhamija, P., Bryde, D. J., & Singh, R. K. (2022). Effect of eco-innovation on green supply chain management, circular economy capability, and performance of small and medium enterprises. *Journal of Business Research, 141*(5), 60-72. https://doi.org/10.1016/j.jbusres.2021.12.011

Bendadou, A., Kalai, R., Jemai, Z., & Rekik Y. (2021). Impact of merging activities in a supply chain under the Guaranteed Service Model: Centralized and decentralized cases. *Applied Mathematical Modelling, 93*(2), 509-524. https://doi.org/10.1016/j.apm.2020.12.024

Bhatia, M. S., & Gangwani, K. K. (2021). Green supply chain management: Scientometric review and analysis of empirical research. *Journal of Cleaner Production, 284*(2), 124-722. https://doi.org/10.1016/j.jclepro.2020.124722

Fasan, M., Soerger Zaro, E., Soerger Zaro, C., Soerger Zaro, C., Porco, B., & Tiscini, R. (2021). An empirical analysis: Did green supply chain management alleviate the effects of COVID-19. *Business Strategy and the Environment, 30*(5), 2702-2712. https://doi.org/10.1002/bse.2772

Gao, T., Dang, X., Xu, D., Zhao,, Z., Liu, T., & Zhang, Y. (2023). The impact of green supply chain management on sustainability performance in Chinese manufacturing companies. *International journal of computational systems engineering, 7*(2/3/4), 199-210. https://doi.org/10.1007/s10489-022-04196-7

Gawusu, S., Zhang, X., AJamatutu, S., Ahmed, A., Amadu, A. A., & Miensah, E. D. (2022). The dynamics of green supply chain management within the framework of renewable energy. *International Journal of Energy Research, 46*(2), 684-711. https://doi.org/10.1002/er.7278

Gazman, V. D. (2023). A new criterion for the ESG model. *Green and Low-Carbon Economy, 1*(1), 22–27. https://doi.org/10.47852/bonviewGLCE3202511

Huan, Z., Qingxin, L., & Jianli, J. (2023). Effect and formulation of ecolabel policy: A perspective of green supply chain decision and coordination. *Environmental Science and Pollution Research, 30*(34), 82406-82420. https://doi.org/10.1007/s11356-023-28125-4

Mehmood, A., Ahmed, S., Viza, E., Bogush, A., & Ayyub, R. M. (2021). Drivers and barriers towards circular economy in agri-food supply chain: a review. *Business Strategy & Development, 4*(4), 465-481. https://doi.org/10.1002/bsd2.171

Nkrumah, S. K., Asamoah, D., Annan, J., & Agyei-Owusu, B. (2021). Examining green capabilities as drivers of green supply chain management adoption. *Management Research Review, 44*(1), 94-111. https://doi.org/10.1108/MRR-01-2020-0015

Novitasari, M., & Agustia, D. (2021). Green supply chain management and firm performance: The mediating effect of green innovation. *Journal of Industrial Engineering and Management, 14*(2), 391-403. https://doi.org/10.3926/JIEM.3384

Ohara, S., Yoo, J. K., & Shiraishi, H. (2021). Study on a Decision Support Model for Implementing a Closed-Loop Manufacturing System Considering Operating Costs. *Journal of Japan Industrial Management Association, 72*(1), 55-64. https://doi.org/10.11221/jima.72.55

Pal, B., Sarkar, A., & Sarkar, B. (2023). Optimal decisions in a dual-channel competitive green supply chain management under promotional effort. *Expert Systems with Applications, 211*(1), 118-315. https://doi.org/10.1016/j.eswa.2022.118315

Raj, A., Mukherjee, A. A., Sousa Jabbour, A. B. L., & Srivastava, S. K. (2022). Supply chain management during and post-COVID-19 pandemic: Mitigation strategies and practical lessons learned. *Journal of Business Research, 142*(5), 1125-1139. https://doi.org/10.1016/j.jbusres.2022.01.037

Roh, T., Noh, J., Oh, Y., & Park, K. S. (2022). Structural relationships of a firm's green strategies for environmental performance: The roles of green supply chain management and green marketing innovation. *Journal of Cleaner Production, 356*(5), 131-877. https://doi.org/10.1016/j.jclepro.2022.131877

Sahoo, S., & Vijayvargy, L. (2021). Green supply chain management practices and its impact on organizational performance: evidence from Indian manufacturers. *Journal of Manufacturing Technology Management, 32*(4), 862-886. https://doi.org/10.1108/JMTM-04-2020-0173

Sarkar, B., Ganguly, B., Pareek, S., & Caedenas-Barron, L. E. (2022). A three-echelon green supply chain management for biodegradable products with three transportation modes. *Computers & Industrial Engineering, 174*(2), 108-727. https://doi.org/10.1016/j.cie.2022.108727

Shen, Z. M., & Sun, Y. (2023). Strengthening supply chain resilience during COVID-19: A case study of JD.com. *Journal of Operations Management, 69*(3), 359-383. https://doi.org/10.1002/joom.1161

Wu, Z., Zhao, Y., & Zhang, N. (2023). A literature survey of green and low-carbon economics using natural experiment approaches in top field journal. *Green and Low-Carbon Economy, 1*(1), 2-14. https://doi.org/10.47852/bonviewGLCE3202827

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