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The Influence of Green Supply Chain Management on Collaborative Innovation in Manufacturing Enterprises

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Abstract: This study utilizes questionnaire data collected from manufacturing enterprises in various regions through a survey method. It employs a moderated mediation model to empirically analyze the impact of green supply chain management on collaborative innovation and its underlying mechanisms. The results indicate that green supply chain management can promote collaborative innovation levels by fostering green innovation, and corporate social capital positively moderates the mediating effect of green innovation in the latter path. The research findings contribute to the further enhancement of collaborative innovation levels in manufacturing enterprises, expand the research on the antecedents of collaborative innovation, and provide a basis for the sustainable development of manufacturing.

Keywords: Green Supply Chain Management; Collaborative Innovation; Green Innovation; Corporate Social Capital; Moderated Mediation.

1. Introduction

As China enters a new stage of rapid development, the adoption of a low-carbon economy can significantly drive sustainable development in the country [1].Climate change, natural resource scarcity, and increasing air and water pollution are environmental issues that are intensifying, having significant impacts on human survival and societal sustainability. This has garnered immense attention from global governments, non-governmental organizations, business entities, and the public. In particular, the manufacturing industry, known for its high consumption and emissions, faces challenges such as high energy consumption and large carbon emissions, which have become significant constraints on its development.

The rapid development of the economy and society has placed higher demands on enterprise development, with increasing emphasis on the level of collaborative innovation among businesses [2]，Resource scarcity and environmental pollution pose challenges to manufacturing enterprises, necessitating a focus on environmental issues. To achieve efficiency, profitability, brand image, and market share, enterprises are increasingly emphasizing green development and implementing green supply chain management to reduce environmental problems. Green supply chain management has become a future trend in supply chain development, with China issuing relevant requirements and policies for green development and green supply chain management. The "Fourteenth Five-Year Plan" proposes an overall framework for accelerating the green transformation of development methods, and the "dual circulation" strategy requires green development in manufacturing, emphasizing the level of greenization in the supply chain. Public environmental awareness and government regulations prompt organizations to adopt corporate environmental practices, with GI serving as an important means for enterprises to reduce environmental impact. Additionally, the emergence of green supply chain management, coupled with GI, is crucial for enterprises to achieve collaborative innovation. Moreover, an increasing number of companies recognize that maintaining a competitive advantage in the fiercely competitive market relies on accessing necessary resources from the external environment, with leveraging social capital being viewed as the optimal approach to acquire these resources [3].

In today's context of dual constraints from ecological balance and economic development, the expansion of green demand in the market and increasingly stringent environmental regulations have led to an increased risk of interruption or stagnation in traditional supply chain management models for enterprises. This, in turn, affects the business development of enterprises. Therefore, exploring the mechanism of how green supply chain management influences collaborative innovation is of practical significance.

2. Theoretical Basis and Research Hypothesis

2.1. The direct impact of green supply chain management on collaborative innovation

Green Supply Chain Management (GSCM) is a supply chain management approach that integrates environmental protection and sustainable development principles. It emphasizes achieving resource conservation, reducing environmental pollution, and promoting ecological preservation at various stages of the product lifecycle [4].Furthermore, related research has suggested that GSCM is associated with improvements in environmental and cost-based performance [5].

The internal and external measures of GSCM have a positive and significant effect on reducing environmental costs for enterprises [6]，Moreover, by guiding enterprises to develop operational and financing strategies to mitigate potential operational and financing risks, GSCM can effectively aid in enterprise risk management [7].Through the implementation of GSCM, enterprises enhance collaboration between suppliers and customers, facilitating the

identification and mitigation of environmental issues shared across the supply chain. This initiative ensures the monitoring and verification of environmentally friendly materials provided by suppliers, thereby minimizing the adverse environmental impacts during the production process [8].

Collaborative Innovation (CI) refers to the joint innovation activities conducted by enterprises and external partners, aiming to achieve resource sharing, risk sharing, and mutual benefits. Participants from various sectors such as government, companies, non-profit organizations, universities, and other social groups collaborate and authorize each other's involvement in innovation activities, thus stimulating more innovative endeavors [9].The CI model serves as a crucial support for enterprise groups to construct comprehensive and synergistic innovation systems [10], This cooperative model aids enterprises in responding quickly to market demands, reducing research and development costs, and enhancing innovation capabilities [11].

GSCM and CI are both crucial strategies for enhancing sustainable development and competitiveness within businesses [12]. GSCM emphasizes the importance of achieving resource conservation, reducing environmental pollution, and protecting ecosystems at every stage of the product lifecycle. Similarly, CI aims to foster resource sharing, risk-sharing, and mutual benefits. These two approaches share some similarities and mutually reinforce each other, driving businesses towards sustainable and innovative directions.

In conclusion, there is a close relationship between GSCM and CI. By enhancing GSCM, businesses can promote strategic collaboration and win-win partnerships with their counterparts. This can lead to advantages such as resource sharing, optimized allocation, technological innovation, and market expansion, further enhancing the competitiveness and sustainability of enterprises.

Based on this, the following hypothesis is proposed for this study:

H1: Green supply chain management has a significant positive impact on the implementation of collaborative innovation.

2.2. The mediating role of green innovation

Green Innovation (GI) refers to innovative activities undertaken by businesses in the realms of technology, products, processes, and management to meet market demands and address environmental issues. Business managers have come to realize that GI is a crucial factor for sustainable development and can offer competitive advantages [13].This type of innovation aims to achieve environmental protection, resource conservation, and sustainable development. Innovation serves as the engine of economic growth, and GI can make this growth sustainable [14].

Existing research indicates a close relationship between GSCM and GI. The growing environmental awareness among the public and the implementation of government regulations compel organizations to adopt environmental practices such as GSCM and GI, which are crucial for achieving professional improvements in environmental performance within these organizations [15].As consumer awareness of environmental protection and sustainable development continues to rise, market demand is gradually shifting towards greener alternatives [16].In order to meet this market demand, businesses need to adopt GSCM strategies and engage in GI with suppliers, customers, and other partners. This type of innovation helps businesses offer products and services that better align with market demand, thus enhancing competitiveness. GSCM optimizes procurement, production, and logistics processes to achieve efficient resource utilization and savings [17].GI further integrates these resources, fostering complementary advantages between businesses and their partners, and accelerating the innovation process. This integration and optimization of resources undoubtedly contribute to enhancing operational efficiency and competitiveness of enterprises [18].

In conclusion, GI plays a significant role in bridging GSCM and CI. Through GI, businesses can better meet market demands, integrate resources, achieve mutual cooperation, and create shared value, thereby further advancing the development of GSCM and CI. This relationship provides crucial theoretical support and practical guidance for enterprises to achieve sustainable development.

Based on this, the following hypothesis is proposed for this study:

H2: GI mediates the relationship between green supply chain management and collaborative innovation.

2.3. The moderating effect of corporate social capital

Corporate Social Capital (CSC) refers to the various social relationships, networks, and alliances established by a company during its operations. These relationships enable the sharing and exchange of resources, information, and knowledge, accumulated through the ongoing development of social connections within a network. Scholars increasingly emphasize the importance of social capital in supply chain management research [19].This theory can be applied in the study of GSCM, as it is essentially an extension of supply chain management that integrates environmental concerns into supply chain practices [20].

CSC provides companies with abundant resources, information, and knowledge. By establishing strong collaborative relationships with suppliers, customers, and even competitors, companies can access more market insights, technological knowledge, and resource support, thereby facilitating GI [21].CI relies on processes of divergence and convergence, embracing diverse ideas and viewpoints through interactive learning, consensus-building, and commitment implementation [22] , This relationship of resource acquisition and sharing helps companies better respond to market challenges and opportunities. This phenomenon aligns well with the impact of GI on CI.

In summary, CSC plays a crucial role in facilitating GI and CI. By fostering strong social relationships, networks, and alliances, companies can better access resources, promote cooperation, and enhance their image, thereby achieving sustainable development and improving competitiveness. This relationship provides important theoretical support and practical guidance for companies to achieve GI and CI.

Based on this, the following hypothesis is proposed in this study:

H3: Corporate social capital moderates the relationship between GI and collaborative innovation.

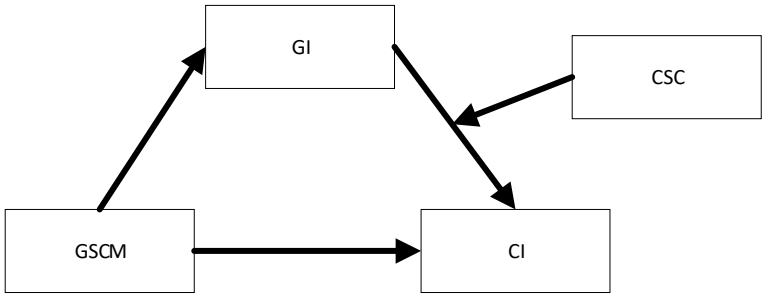

Figure 1. Hypothesis model

3. Research Design

3.1. Research Objectives

This study referenced previous literature [23] and conducted a questionnaire survey among representative manufacturing companies in various regions. The survey was designed, distributed, and collected using Questionnaire Star, with a total of 561 responses received. After excluding responses that were deemed unreasonable, such as those where the work experience exceeded the actual age, those with obvious errors, and those with completion times that were too short, 518 valid questionnaires were obtained, resulting in an effective response rate of 92.34%. The overall distribution of the obtained sample is presented below:

Table 1. The distribution of the sample population's overall structure

Variable and classification		Frequency	
Variable	Classification	Number	Percentage/%
Position	Basic level	269	51.93
	Middle level	186	35.91
	Senior level	63	12.16
Years of working	Less than 3 years	200	38.61
	3-5 years	165	31.85
	More than 5 years	153	29.54
Degree of education	College and below	153	34.36
	Undergraduate	106	41.89
	Master degree or above	42	23.75
Nature of enterprise management	State-owned business	92	17.76
	Private enterprise	133	25.68
	Overseas-funded enterprise	103	19.88
	Sino-foreign joint venture	91	17.57
	Others	99	19.11
Firm size	Less than 300 people	101	19.5
	300-1000 people	102	19.69
	More than 1000 people	315	60.81
Enterprise industry type	Auto industry	78	15.06
	Electrical machinery and equipment industry	97	18.73
	Computer communications and other electronic equipment industries	110	21.24
	Petrochemical industry	72	13.90
	Textile industry	97	18.73
	Others	64	12.36

3.2. Research scale

3.2.1. Green supply chain management

This study drew upon the mature scales developed by Zhu et al [24] and Li Lin [25] to construct a research scale focusing on GSCM, tailored to the purpose of this study. The scale mainly comprises five dimensions: internal environmental management, ecological design, collaboration with customers, return on investment, and green procurement. Each dimension consists of four items, totalling twenty measurement items.

3.2.2. Green innovation

This study drew upon the mature scales developed by Chen [26] and Chiou et al. [27] to construct a research scale focusing on GI, tailored to the purpose of this study. The scale mainly comprises three dimensions: green product innovation, green process innovation, and green management innovation. Each dimension consists of four items, totalling twelve measurement items.

3.2.3. Corporate social capital

This study referenced the mature scales developed by Wei Ying [28] and Tsai and Ghoshal 1 [29] to create a research scale focusing on CSC, tailored to the purpose of this study. The scale comprises three dimensions: structural capital, relational capital, and cognitive capital. Each dimension consists of four questions, totalling twelve items.

3.2.4. Collaborative innovation

This study drew upon the established scales developed by Liu Xueqin [30] Zhang Jingwen [31], and Jiang Yunfeng [32] to construct a research scale focusing on CI, tailored to the purpose of this study. The scale comprises three dimensions: collaborative knowledge innovation, collaborative technological innovation, and collaborative managerial innovation. The dimension of collaborative knowledge innovation consists of five items, while the remaining two dimensions each have four items, totalling thirteen items.

3.3. Data processing

The study employed Harman's single factor test to conduct a factor analysis on the measurement items of the four variables: GSCM, GI, CSC, and CI. Three factors with eigenvalues greater than one were extracted. The results indicated that the largest factor contribution rate was only 35.83%, which is below the critical threshold of 40%, thereby excluding the issue of common method bias.

3.4. Common method bias

The present study employed the Harman single factor test to conduct factor analysis on the measurement items of four variables: GSCM, GI, CSC, and CI. Three factors with eigenvalues greater than one were extracted. The results revealed that the maximum contribution rate of the factors was only 35.83%, which is below the critical threshold of 40%, thus mitigating the issue of common method bias.

4. Empirical Analysis

4.1. Measurement of reliability and validity

Following exploratory factor analysis to validate the variables' validity, confirmatory factor analysis was conducted to establish the convergent and discriminant validity of the measured constructs.

Table 2 demonstrates that all item factor loadings were greater than 0.645 ($p < 0.001$), and their corresponding composite reliabilities (CR) exceeded the recommended threshold of 0.7, indicating the reliability of the scale used. Additionally, the extracted average variance explained (AVE) values were all greater than 0.5, confirming convergent validity. Furthermore, the Cronbach's alpha coefficients for each construct exceeded 0.7, indicating satisfactory scale reliability. Moreover, since all correlation values were less than the square root of their respective AVEs, the constructs demonstrated acceptable discriminant validity.

Table 2. Confirmatory Factor Analysis

Variable	Item	Factor loading	Cronbach'α coefficient value	AVE	CR
	IEM	0.773			
	ED	0.678			
GSCM	CWC	0.696	0.760	0.515	0.841
	IR	0.727			
	GP	0.709			
	PD	0.722			
GI	PI	0.743	0.690	0.524	0.769
	MI	0.707			
	SC	0.773			
CSC	RC	0.782	0.665	0.557	0.790
	CC	0.680			
	CKI	0.714			
CI	CTI	0.746	0.678	0.512	0.759
	CMI	0.685			

4.2. Descriptive statistics and correlation analysis

Table 3. Means, standard deviations, and correlation matrix for each variable.

Variable	M±SD	GSCM	GI	CSC	CI
GSCM	3.10±0.66	1			
GI	3.81±0.69	.464**	1		
CSC	3.85±0.70	.404**	.770**	1	
CI	3.60±0.62	.666**	.764**	.640**	1

Note: *P < 0.05, **P < 0.01, ***P < 0.001, two-tailed significance, the same below.

As shown in Table 1, the statistical analysis results revealed significant positive correlations ($p < 0.01$) among GSCM, GI, CSC, and CI.

4.3. Testing the mediating effect of green innovation

Regression analysis results presented in Table 2

demonstrate that GSCM significantly and positively predicts CI in manufacturing enterprises, supporting Hypothesis 1. The mediation effect between GI and CI in the relationship between GSCM and CI was tested using SPSS Process V4 with model 4. With 5000 bootstrap resamples and a 95% confidence interval, the mediation effect of GI in the relationship between GSCM and CI was examined. The results revealed that GI positively predicts CI, and GSCM also positively predicts CI. Bootstrap mediation analysis results, as shown in Table 3, indicate that the total effect, direct effect, and the mediation effect of GI between GSCM and CI were all significant at the 95% confidence interval, with a mediation effect value of 0.0704, accounting for 22.45% of the total effect, thus supporting Hypothesis 2.

Table 4. Analysis of the mediating effect of the intermediary variable of GI

Predictive variable	Model 1: CI		Model 2: GI		Model 3: CI	
	β	t	β	t	β	t
GSCM	0.3328	8.0159***	0.2317	5.4113***	0.2581	6.4068***
GI					0.3211	7.9952***
R2	0.1107		0.0537		0.2089	
F	64.2553***		29.2816***		29.2816***	

Table 5. Bootstrap mediation analysis for GI

GSCM→CI	Effect size	Boot SE	Boot CI 95%	Effect ratio (%)
Total effect	0.314	0.0392	[0.2370, 0.3909]	100
Direct effect	0.2435	0.038	[0.1689, 0.3182]	77.55
Intermediary effect of GI	0.0704	0.0217	[0.0326, 0.1157]	22.45

4.4. Moderation effect analysis of CSC

Furthermore, the study utilized Process macro model 14 to examine the moderated mediation model. The moderation effect of CSC is presented in Table 4: CSC significantly and positively predicts CI (β = 0.2538, t = 9.8621, P < 0.001). The interaction term between CSC and GI significantly influences CI in manufacturing enterprises (β = 0.3155, t = 9.0052, P < 0.001). These findings indicate that CSC moderates the relationship between GSCM and CI, supporting Hypothesis 3. The study primarily focuses on the moderating effect of CSC in the relationship between GI and CI. Thus, by conducting simple slope tests, the analysis examined how CSC at different levels influences the effect of GI on CI in manufacturing enterprises, as depicted in Figure 2.

Table 6. Results of moderated mediation analysis

Predictor variables	Model 1: CI		Model 14: GI		Model 14: CI	
	β	t	β	t	β	t
GSCM	0.33	8.02***	0.23	5.41***	0.16	4.49***
GI					0.32	10.51***
CSC					0.25	9.86***
GI*CSC					0.32	9.01***
R2	0.11		0.05		0.34	
F	64.26***		29.28***		65.55***	

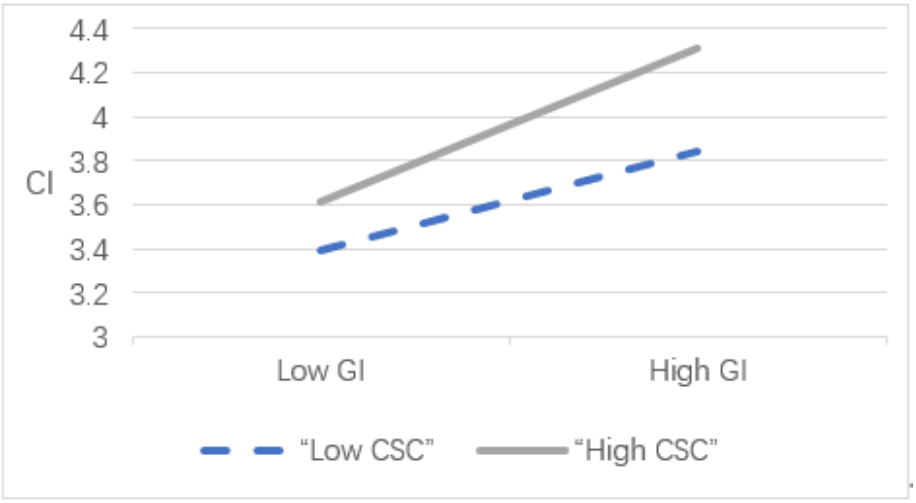

Figure 2. The moderating effect of CSC on the relationship between GSCM and CI

The simple slope test reveals that when CSC is low, CI shows a significant upward trend with increasing GI (β=0.22, t=5.87, P<0.001), indicating that a one-standard deviation increases in GI leads to a 0.22-standard deviation increase in CI. Similarly, when CSC is high, CI still demonstrates a significant upward trend with increasing GI (β=0.35, t=9.67, P<0.001), with a one-standard deviation increase in GI resulting in a 0.35-standard deviation increase in CI, showing a higher magnitude of increase compared to when CSC is low. The difference in the effect of GI on CI between high and low levels of CSC is significant (difference=0.14, P<0.001), indicating that the impact of GI on CI strengthens with the improvement of CSC.

4.5. Robustness testing

To ensure the reliability of the study conclusions and better elucidate the causal relationship between GSCM and CI, robustness tests were conducted. Approximately 60% (311 samples) and 80% (415 samples) of the valid analysis samples were randomly selected using software to retest the "GSCM-CI," "GSCM-GI-CI," "GSCM-GI," "GI-CI," and the moderation effects of CSC.

4.5.1. Robustness testing of correlation analysis and the mediation effect

The results of the analysis conducted with 60% and 80% of the samples are consistent with the results of the full sample model, including the mediation effects, demonstrating strong robustness. Therefore, the hypothesis testing is validated.

Table 7. Descriptive statistics and Pearson correlation analysis for the samples of 60% and 80%

Variable	Sample size	M±SD	1	2	3	4
1.GSCM	60%	3.11±0.61	1			
	80%	3.09±0.68	1			
2.GI	60%	3.85±0.65	.433**	1		
	80%	3.79±0.70	.468**	1		
3.CSC	60%	3.87±0.66	.427**	.787**	1	
	80%	3.84±0.69	.431**	.743**	1	
4.CI	60%	3.62±0.58	.681**	.780**	.580**	1
	80%	3.59±0.60	.642**	.739**	.634**	1

Table 8. Mediation analysis of the intermediate variable for GI in the samples of 60% and 80%

Predictive variable	Sample size	Mode l1: CI		Model 2: GI		Model 3: CI	
		β	t	β	t	β	t
GSCM	60%	0.326	7.468***	0.229	5.345***	0.223	6.298***
	80%	0.357	8.011***	0.236	5.891***	0.255	6.579***
GI	60%					0.342	7.128***
	80%					0.315	7.298***
R2	60%	0.1312		0.0567		0.1956	
	80%	0.1485		0.0539		0.2041	
F	60%	64.255***		29.282***		29.282***	
	80%	68.781***		28.458***		28.458***	

Table 9. Bootstrap mediation effects of GI for 60% and 80% sample sizes

GSCM →CI	Sample size	Effect size	Boot SE	Boot CI 95%	Effect ratio (%)
Total effect	60%	0.319	0.0347	[0.1952,0.3541]	100
	80%	0.321	0.0384	[0.2195,0.3842]	100
Direct effect	60%	0.247	0.0359	[0.1681, 0.2841]	77.43
	80%	0.232	0.0345	[0.1557, 0.2998]	72.27
Intermediary effect of GI	60%	0.072	0.0217	[0.0435,0.1358]	22.57
	80%	0.089	0.0208	[0.0384，0.1067]	27.73

4.5.2. Robustness test for moderated mediation analysis

When examining the moderating effect of CSC, the research findings aligned with the original study results, demonstrating strong robustness, thereby validating the research hypotheses.

Table 10. Results of moderated mediation analysis with 60% and 80% sample sizes

Predictive variable	Sample size	Model 1: CI		Model 14: GI		Model 14: CI	
		β	t	β	t	β	t
GSCM	60%	0.34	8.69***	0.21	6.34***	0.16	5.12**
	80%	0.31	8.57***	0.23	5.17***	0.15	4.58***
GI	60%					0.34	12.56**
	80%					0.33	11.25***
CSC	60%					0.22	8.14***
	80%					0.23	8.96***
GI*CSC	60%					0.28	8.57***
	80%					0.30	8.26***
R2	60%	0.11		0.07		0.30	
	80%	0.09		0.06		0.29	
F	60%	69.28***		31.52***		64.77***	
	80%	71.52***		28.97***		64.86***	

5. Discussion

CI entails guiding and orchestrating mechanisms to harness the capabilities and strengths of enterprises, integrating complementary resources, facilitating mutual complementarity, and accelerating the dissemination and industrialization of technology by collaboratively engaging in industrial technology innovation and the industrialization of scientific and technological achievements. However, in the current era, the challenge remains on how to enhance the path of CI for manufacturing enterprises and construct a new paradigm for the green transformation of manufacturing enterprises. This study is grounded in the new goals, tasks, and requirements of the development of socialism with Chinese characteristics in the new era, conducting empirical research based on theoretical analysis and providing corresponding recommendations for enhancing the level of CI in manufacturing enterprises.

5.1. The impact of green supply chain management on collaborative innovation

In recent years, researchers have gradually deepened their understanding of the importance of GSCM for manufacturing enterprises, also realizing the significantly positive significance of GSCM for CI. However, research on the relationship and influencing mechanisms between GSCM and CI in the context of Chinese culture remains immature. The empirical survey results of this study demonstrate that GSCM significantly positively predicts CI in manufacturing enterprises, consistent with existing research findings abroad.[34].Given the relationship between GSCM and CI, managers need to formulate strategies to enhance enterprise CI.

5.2. Green innovation mediates the relationship between green supply chain management and collaborative innovation.

The research results indicate that GI plays a significant mediating role between supply chain management and CI. GSCM not only directly influences CI in manufacturing enterprises but also further affects CI through the mediating role of GI. This indicates that GSCM has become a new requirement for supply chain management in the new era, comprehensively addressing environmental issues at various stages of the supply chain, emphasizing environmental protection, and promoting the coordinated development of economy and environment. This empirical result helps to fill the gap in traditional supply chain management's neglect of environmental factors and enhances the sustainability of the supply chain [35].

Manufacturing enterprises should actively unleash the potential of GI as a crucial means to enhance CI levels. By organically integrating GSCM with innovation, the effectiveness and cooperation between the two can be enhanced, thereby driving the comprehensive development of enterprises. Implementing GI activities, such as internal environmental management, ecological design, collaboration with customers, investment recovery, and green procurement, has a positive impact on CI in enterprises. In response to severe environmental pressures, these GI initiatives not only enhance the green image of enterprises but also strengthen core competitiveness, thereby promoting a more significant impact of GSCM on CI [36].

5.3. CSC moderates the relationship between green supply chain management and collaborative innovation.

This study also examined the moderating effect of corporate social capital on the process of "GSCM - GI - CI," revealing that corporate social capital moderates the relationship between GSCM and CI. Corporate social capital can enhance the proactive nature of GI in manufacturing enterprises and play a crucial role in enhancing their expertise in professional fields, as well as their understanding and comprehension levels in various domains [37]. The understanding and social capital levels in these different domains can better promote innovation among them.

Specifically, strengthening cooperation is an effective way to enhance corporate social capital. By maintaining good communication and connections with cooperative enterprises and partners, shaping common values and visions, and exchanging information frequently, enterprises can accumulate more social capital. Relying on externally acquired social capital, especially by strengthening cooperation with partners [38] , is a key method for implementing GSCM, effectively enhancing the level of CI and competitive advantage of manufacturing enterprises [39].

6. The Significance, Limitations, And Future Prospects of The Research

In the current context, manufacturing enterprises are thriving, and whether they are large or small, they should adopt a forward-thinking mindset to adapt to future policy environments. This not only reflects their core competitiveness but also serves as the source of driving economic stability and growth for enterprises. In summary, this study not only expands the research content on the relationship between GSCM and CI but also confirms the moderating effect of corporate social capital on the relationship between GI and CI in manufacturing enterprises. The research findings suggest that manufacturing enterprises should implement GSCM on a larger scale and with greater emphasis on developing their levels of GI and corporate social capital. The research results lay a theoretical foundation for enhancing the level of CI in manufacturing enterprises and provide references for the industry to build a new paradigm of CI.

However, there are some limitations. Firstly, this study only selected a portion of manufacturing enterprises in the Sichuan-Chongqing region and coastal areas as research subjects. In the future, expanding the sample scope and size could further validate the research model. Secondly, the study variables are limited, and the research on the involved variables in this paper is relatively broad, focusing on corporate social capital and GI as a whole. Exploring the sub-dimensions of these variables in detail in this study would increase the complexity of the model. Therefore, future research could focus on specific dimensions of enterprise GI to examine their mediating role in GSCM and CI, as well as on specific dimensions of corporate social capital to investigate their moderating effect between GI and CI. Lastly, the data collection is limited. GSCM activities are dynamic processes, and this study only collected data over a certain period. Therefore, future studies could involve multiple rounds of data collection to further explore the long-term impact mechanisms of implementing GSCM on CI.

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