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Green Supply Chain Management and Strategic Procurement in Enhancing Enterprise Competitiveness

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Abstract

China's intelligent manufacturing industry is a major pillar of the national economy, driving the country to transform from being known as the "factory of the world" to becoming a global manufacturing power and significantly contributing to sustainable economic growth. In these circumstances, the use of green supply chain management is an inevitable and imperative strategic requirement. The research employed a quantitative methodology, surveying 397 Chinese intelligent manufacturing enterprises to analyze the effects of green supply chain management and strategic procurement on enterprise competitiveness. Filling a known gap in literature, the research formulated an analytical framework to analyze the combined effect of green supply chain practices and strategic procurement. Using SPSS and AMOS as data analysis and structural model test software, this research empirically identified that strategic procurement was a partial mediator between enterprise competitiveness and green supply chain management. The research confirmed that green supply chain management had a positive effect on strategic procurement and enterprise competitiveness, and strategic procurement had a positive effect on enterprise competitiveness. In general, these findings provide practical and theoretical significance, leading smart manufacturing companies to learn how to use green supply chain management to improve their competitiveness and providing useful references for policymakers and industry players who aim to promote sustainable industrial development.

Keywords: Intelligent Manufacturing; Green Supply Chain Management; Strategic Procurement; Enterprise Competitiveness.

1. Introduction

Intelligent manufacturing enterprises are a core part of China's manufacturing industry and a core contributor to the nation's strategic plan to transition from being an enormous scale of production to a world manufacturing giant. They are a primary contributor to driving economic growth in a sustainable manner. However, the accelerated development of the world economy brought about exhausted energy and natural resources and worsened global environmental problems such as climate change and pollution, which are major threats to global sustainability [1] and China's long-term policies. Therefore, green sustainable development has attracted more and more international concerns. With

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deteriorating environmental situations, the conventional model of high input, high consumption, and high pollution has been proved to be non-sustainable, and consequently, the production sector has been forced to seek an urgent shift towards cleaner environment development paths [2].

Green supply chain management has gradually become a key approach to fostering sustainable business development and ensuring long-term competitiveness [3]. Apart from its historical connection with nature conservation and corporate social responsibility, the green supply chain today is a strategic concept as an industrial upgrading force, an incentive for national economic growth, and enterprise core competitiveness [4]. In today's market situation of the present era, business competition is transforming towards supply chain competition, and hence there is a need to adopt green supply chain approaches for competitiveness [5]. On this front, it is of very high importance to frame procurement management and streamline procurement models to decrease operational expenditure and enhance businesses' overall performance [6].

Following the introduction of the "Industry 4.0" strategy by Germany, China also launched its counterpart, "Made in China 2025" [7], in 2015 to speed up the smart transformation of its manufacturing industry. This action has been complemented with policy papers like the "14th Five-Year Plan for the Development of Intelligent Manufacturing" [8] that target acquiring more than 50% stakes of large-scale enterprises' intelligent manufacturing by 2025. Market estimates also target this exponential growth, with the estimate of China's intelligent manufacturing business value reaching some 5.8 trillion yuan by 2026 [8]. These intricate policy rules and immense capital promotion have provided a solid basis for the industry's further growth. Apart from this, due to increasing global labor costs, Chinese enterprises are being forced more and more to achieve efficiency and lower the cost of operation with automation and smart solutions. Against this backdrop, research into factors affecting green supply chain management of smart manufacturing companies is not only important for elevating the competitive edge of enterprises but also for promoting sustainable development in accordance with China's national strategic aspirations.

In August 2024, the State Council of China released the "Opinions on Accelerating the Comprehensive Green Transformation of Economic and Social Development," followed by a September 2024 policy paper by the Ministry of Ecology and Environment, both of which reaffirmed the country's resolve to propel green and low-carbon industries and promote green supply chains [9, 10]. These guidelines strongly promote collective innovation, which aims to decrease pollution and carbon emissions together while placing significant emphasis on support for the advanced, smart, and green industrial transformation process. The execution of these tangible and supportive policies not only defined the strategic map for China's progress in the green supply chain but also gave obvious channels and incentives to the relevant industries to adopt comprehensive green supply chain management practices. All of these efforts significantly contributed to driving the industries toward sound growth as well as industrial growth in coordination with China's overall environmental and economic objectives.

Despite the growing importance of green supply chain management in research and business, literature has richly focused on other aspects but largely neglected its effects on social performance, with a clear gap in the existing literature [11-13]. Of particular interest, strategic procurement as a component of green supply chain management and its effects on business competitiveness remain mostly untapped. Much of the current research addresses green supply chain management and strategic procurement separately as topics, leading to a partial picture of how their integration can be leveraged in order to enhance performance and produce innovation for smart manufacturing companies. To fulfil these research deficiencies and to raise the academic consciousness of green supply chain management, strategic procurement, and enterprise competitiveness, this research follows three general objectives:

- To build an efficient process model for the accomplishment of green supply chain management among enterprises.
- To uncover the mechanisms by which green supply chain management and strategic procurement impact enterprise competitiveness
- To examine the mediating functions of green supply chains and strategic procurement in determining the competitiveness of Chinese intelligent manufacturing enterprises.

By accomplishing these goals, this research hopes to contribute practical suggestions to companies that want to utilize effective green supply chain management strategies and maximize their competitive edge in the increasingly sustainability-conscious industrial environment.

This research significantly contributes to the whole supply chain management system, which motivates researchers and practitioners to pay special attention to the most important issues of enterprise integration, strategic purchasing, and green supply chain management. The structure of the present study is arranged as follows: First, presents the study, outlining the background of research, gaps, and objectives. Second, discusses literature and theory on green supply chains, strategic buying, and enterprise competitiveness, forming research hypotheses. Third, presents the research design, data gathering, sample determination, and data analysis procedure to ensure scientific validity and reliability. Fourth, discusses and clarifies the findings of data analysis, and hypotheses are confirmed. Fifth, concludes with an examination of the implications of the findings, theoretical and practical implications, highlights research limitations, and proposes future research directions.

2. Literature Review

2.1. Literature Research Model

Based on a vast volume of literature on the effects of green supply chain management and strategic procurement on enterprise competitiveness, the present research develops a mechanism model to describe the process of constructing the platform of green supply chain management in Chinese intelligent manufacturing enterprises. Focusing on the logic of "green supply chain–strategic procurement management–enterprise competitiveness," the model captures the dynamic interplay among these elements by analyzing key factors including supplier selection and administration, cost control and risk aversion, formulation and execution of purchase strategy, and market analysis and forecasting. It further accounts for contextual factors, such as environmental policy and production and operations management, to distinguish enterprise competitiveness across dimensions like market share, customer satisfaction, brand impact, financial power, and innovation capability. The integrative framework tries to fill important gaps in current literature and offer an encompassing framework for leading enterprises towards superior competitive performance (see Figure 1).

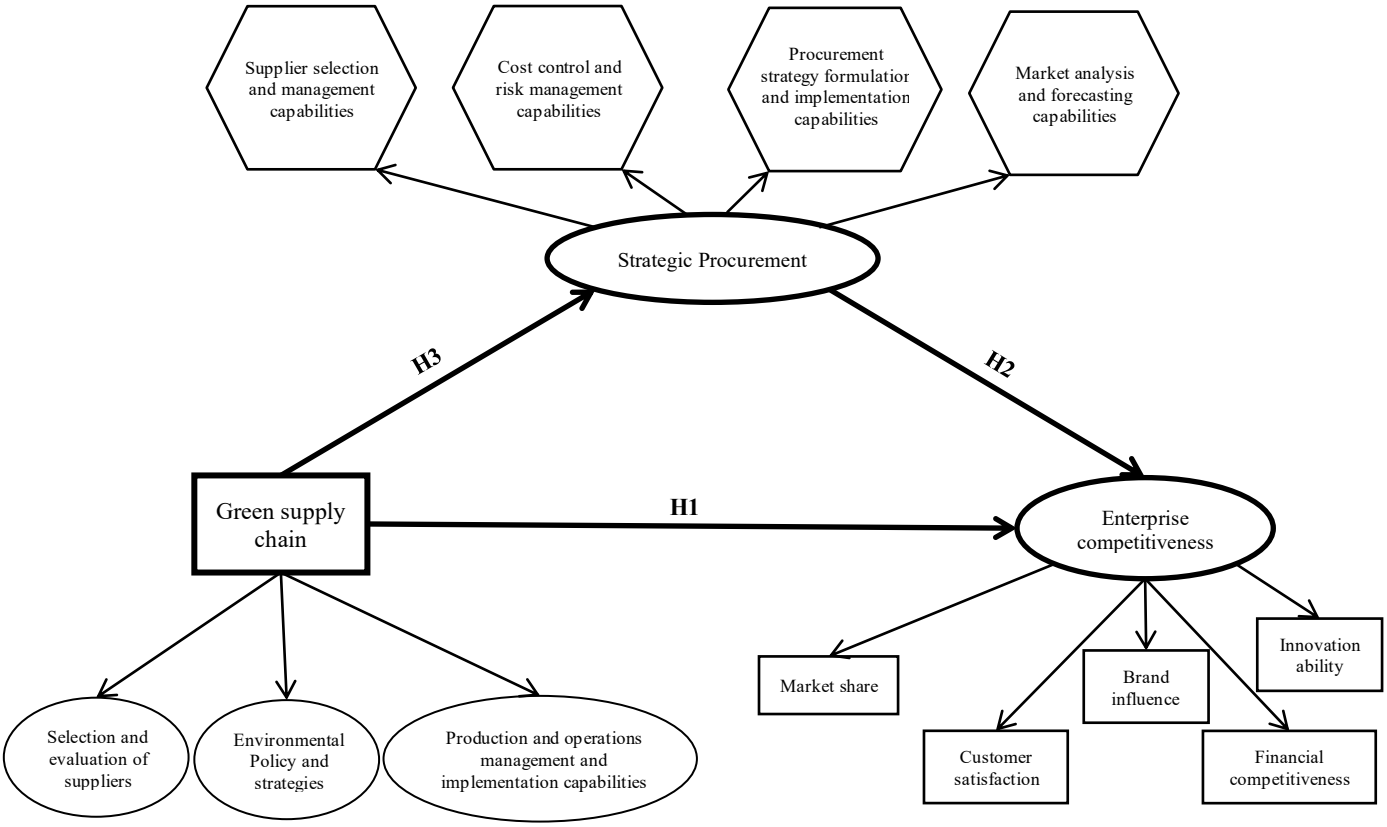

Figure 1. Literature Research Model

2.2. Research Theory

The primary theoretical foundation guiding this study is sustainable development theory, originally articulated by the World Commission on Environment and Development. This theory conceptualizes sustainable development as meeting the needs of the present without compromising the ability of future generations to meet their own needs, grounded in the core principles of fairness, sustainability, and commonality. As enterprises increasingly prioritize sustainability, green supply chain management has become integral to promoting long-term development and

competitive advantage. Sustainable development theory thus offers a robust and relevant framework for analyzing how green supply chain management influences enterprise performance, underscoring its essential role in advancing both environmental and organizational objectives [14].

2.3. Relationship Between Theory and Model

Sustainability, strategic management, and risk management theories together provide a robust conceptual framework for examining the relationship between green supply chain management and enterprise competitiveness. Within this framework, sustainable development theory elucidates how green supply chain initiatives can enhance corporate performance and serve as a key pathway for enterprises to embody sustainable development principles in practice [15]. Strategic procurement, as a crucial element of strategic management, plays a pivotal role in facilitating green supply chain management by enabling enterprises to fulfill their social responsibilities, mitigate environmental impacts, and achieve stable, long-term growth alongside economic gains—all of which align with the fundamental tenets of sustainable development theory [16]. Accordingly, both green supply chain management and strategic procurement can be regarded as practical extensions of sustainable development theory, jointly providing a strong theoretical basis for analyzing their influence on corporate performance and competitiveness [17].

2.4. Green Supply Chain Management on Enterprise Competitiveness

Green supply chain management (GSCM) is integral to bolstering the competitiveness of manufacturing enterprises by mitigating environmental damage, enhancing resource efficiency, and lowering carbon emissions and waste. By incorporating sustainable practices across all supply chain activities, GSCM enables companies to achieve long-term development goals while simultaneously improving their market position. Recent research offers a diversified and in-depth exploration of how these green initiatives contribute to enterprise competitiveness. In this vein, traditional supply chain management, which can be considered an advanced form of GSCM, emphasizes the coordinated actions of various stakeholders in promoting environmentally responsible practices within manufacturing processes [18].

Existing studies have demonstrated that green supply chain management (GSCM) technologies support manufacturing enterprises in achieving a balance between economic growth and environmental protection, with their influence on business performance increasingly recognized [19, 20]. Empirical analyses have further shown that implementing GSCM across both upstream and downstream segments of the supply chain significantly enhances environmental innovation and strengthens enterprise competitiveness. Specifically, increased investment in environmental performance within these supply chain links contributes to improved competitive advantage [21]. Moreover, GSCM practices have been found to exert a significant positive effect on overall enterprise performance, particularly in terms of market and financial outcomes. Building upon these findings, this study proposes the following research hypothesis:

H1: Green supply chain management has a positive impact on enterprise competitiveness, which means that enterprises with a higher level of green supply chain management have an advantage in improving competitiveness.

2.5. Strategic Procurement Management on Enterprise Competitiveness

Drawing on both the findings of previous scholars [20] and survey interview results, this study conceptualizes strategic procurement capabilities across four key dimensions: supplier selection and management, cost control and risk management, procurement strategy formulation and implementation, and market analysis and forecasting. Strategic procurement management emerges as a critical driver of enterprise competitiveness by enhancing organizational performance and strengthening relationships with suppliers. A growing body of empirical evidence demonstrates that higher levels of strategic procurement are positively correlated with improved corporate outcomes, as enterprises adept at strategic procurement not only communicate more effectively with suppliers but also achieve cost reductions and foster innovation. The level of strategic procurement reflects an enterprise's capacity to secure competitive advantages through supplier collaboration and process optimization, leading to cost savings, improved product quality, and greater innovation—all of which bolster market position [22]. For instance, empirical research has shown that strategic procurement management significantly contributes to corporate performance by reducing costs, improving supply chain coordination, and increasing overall competitiveness [23]. These findings indicate that strategic procurement transcends simple cost control, encompassing broader objectives such as supply chain efficiency and risk mitigation. By systematically refining procurement processes and supplier strategies, firms can enhance quality, productivity, and long-term competitive advantage. On this basis, the present study formulates the following research hypothesis:

H2: Strategic procurement management has a positive effect on enterprise competitiveness, which means that enterprises adopting strategic procurement management practices have an advantage in improving competitiveness.

2.6. Green Supply Chain Management on Strategic Procurement

Despite limited academic exploration, recent studies offer meaningful insights into the impact of green supply chain management (GSCM) on strategic procurement. For instance, Nagel (2002) investigated the integration of environmental quality within OEM supply chains and demonstrated a positive correlation between green purchasing and sustainable supply practices [24]. Relatedly, Yang Zhen (2022) examined green procurement in power grid enterprises, illustrating how group procurement strategies can drive a green transformation within supply chain processes [25]. All these findings indicate that GSCM influences strategic procurement in multiple dimensions: it enhances environmental performance and corporate social responsibility, refines procurement strategies, strengthens brand image, reduces environmental risks, and improves operational efficiency. In essence, enterprises that invest in comprehensive GSCM practices are better positioned to make informed strategic procurement decisions that ultimately bolster their competitive advantage. Thus, the hypothesis below is proposed:

H3: Green supply chain management has a positive effect on strategic procurement, which means that enterprises with higher levels of green supply chain management have advantages in strategic procurement choices.

2.7. Mediating Role of Strategic Procurement Management

To fully understand the impact of green supply chain management (GSCM) on enterprise competitiveness, it is essential to examine the mediating role of strategic procurement management, which helps uncover the underlying mechanisms linking GSCM practices to competitive outcomes. As a core organizational capability, strategic procurement enhances a firm's ability to leverage external resources during the implementation of green supply chain initiatives, thereby contributing to sustained improvements in competitiveness [26]. Importantly, strategic procurement is not solely an internal enterprise function but a collaborative effort between firms and suppliers throughout the supply chain, reinforcing its influence on enterprise performance. By making informed and strategic procurement decisions, firms can effectively bridge the relationship between GSCM and competitiveness, leading to optimized performance outcomes [27]. Existing studies have consistently highlighted the significant mediating role of strategic procurement in strengthening the positive effect of GSCM on enterprise competitiveness.

3. Research Methodology

3.1. Research Design

This research adopts a cross-sectional research design and uses a questionnaire to survey intelligent manufacturing enterprises, adopts a quantitative approach, which is particularly well-suited for studies aiming to test relationships between variables using statistical techniques. The overarching goal is to provide evidence-based insights that can help enterprises develop and optimize green supply chains, thereby improving their overall competitiveness [28, 29].

3.2. Questionnaire

This study employed a questionnaire survey grounded in the proposed conceptual framework and utilized convenience sampling as the primary data collection method [30]. Convenience sampling, a form of non-probability sampling, involves selecting participants based on their accessibility and availability to the researcher. The East China region was specifically chosen for respondent recruitment due to its advanced intelligent manufacturing sector, comprehensive industrial chain, and strong capabilities in manufacturing and innovation. These regional characteristics offer unique advantages for promoting green and low-carbon supply chain practices. Accordingly, intelligent manufacturing enterprises in East China were identified as the focal research subjects, enabling the study to capture relevant insights from a context particularly well-suited to examining green supply chain management and strategic procurement.

3.3. Required Data and Sources

This study used a structured questionnaire to collect data from respondents in China, providing an empirical foundation for examining green supply chain management practices within the region's intelligent manufacturing sector. A benchmark of 47,793 Chinese intelligent manufacturing enterprises—based on 2024 published figures—served as a reference point for our analysis. The research focused on identifying the shortcomings in current green supply chain management practices among enterprises operating, with a particular emphasis on how the integration of strategic procurement management can enhance enterprise competitiveness. By directly engaging with industry practitioners, the study aims to supply robust theoretical support and actionable insights to guide the implementation of more effective green supply chain strategies.

3.4. Sampling Techniques

According to the sample size estimation, a total of around 397 smart manufacturing companies were a representative sample from the population of companies in China as a whole. Such a sample provides a credible

and efficient analysis of the interrelationship between green supply chain management, strategic purchasing, and enterprise competitiveness. In this research, 500 questionnaires were sent and received back by 442. Following data screening, 397 valid questionnaires were left where response rate and validity were 88.40% and 89.82%, respectively (see Figure 2).

$$n = \frac{N}{1+N(e)^2}; \quad \text{Get } n \approx 397 \tag{1}$$

where: n: Sample Size; N: Population Size (Number of Intelligent Manufacturing Enterprises in China 47793); e = Significance Level (0.05).

3.5. Methods of Data Analysis

This research conducted structural equation modeling and regression analysis to verify the structural model in SPSS and AMOS and to examine the mediating role of strategic procurement between green supply chain management and enterprise competitiveness. For the testing of convergent validity and composite reliability, average variance extracted (AVE) and composite reliability (CR) were obtained for each dimension. Based on designated criteria, a minimum of CR 0.7 and AVE 0.5 are required to provide evidence of sufficient convergent validity and composite reliability.

Below is the calculation formula:

$$\text{AVE} = \Sigma(\text{factor loadings}^2) / ((\Sigma \text{ factor loadings})^2 + (\Sigma \text{ measurement error of each measurement variable})) \tag{2}$$

$$\text{CR} = (\Sigma \text{ standardized factor loadings})^2 / ((\Sigma \text{ standardized factor loadings})^2 + (\Sigma \text{ measurement error for each measured variable})) \tag{3}$$

3.6. Data Analysis

Demographic analysis indicates relatively equal gender distribution, and respondents are predominantly of middle age or younger—the most typical age among employees from Chinese intelligent manufacturing companies. Most respondents have a bachelor's degree or below, and a significant number hold a master's degree, which can facilitate their understanding of the survey questions. In addition, the average monthly income is mostly between 5000 and 10,000 RMB. The design of the questionnaire was informed by research expertise of the right sort, thereby ensuring a well-informed perception of the then industry situation. Additionally, managerial-level respondents gave comments on company competitiveness and strategy that also help ensure the validity and reliability of the data.

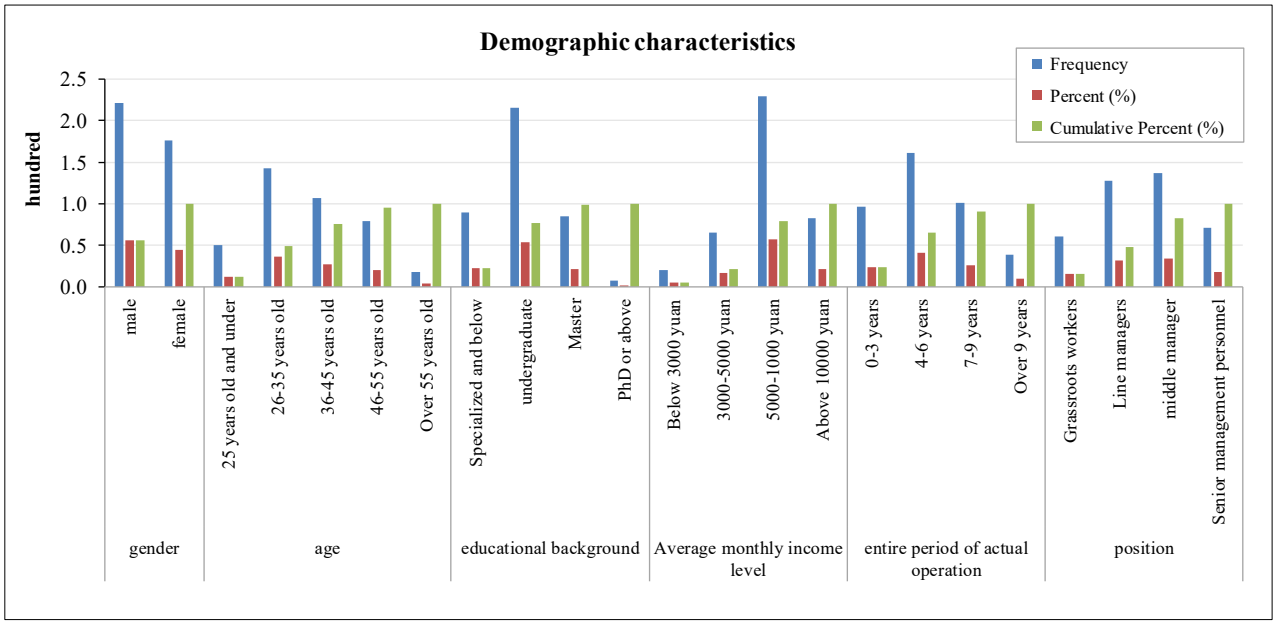

Figure 2. Descriptive Statistical Analysis of Population Characteristics (N = 397)

The data shows that there is a mixed profile among the enterprises covered in the survey. They are approximately 25.44% government-owned and 34.01% privately owned. Based on longevity, 20.91% of the firms have been in operation for 16–20 years, 19.40% for 11–15 years, and 20.15% for 6–10 years, showing a wide spectrum of organizational maturity. Medium-sized firms dominate the sample. Moreover, they have a diversified business network of their business partners—customers, banks and financial institutions, suppliers, and agents/distributors—significant to their operational as well as manufacturing process.

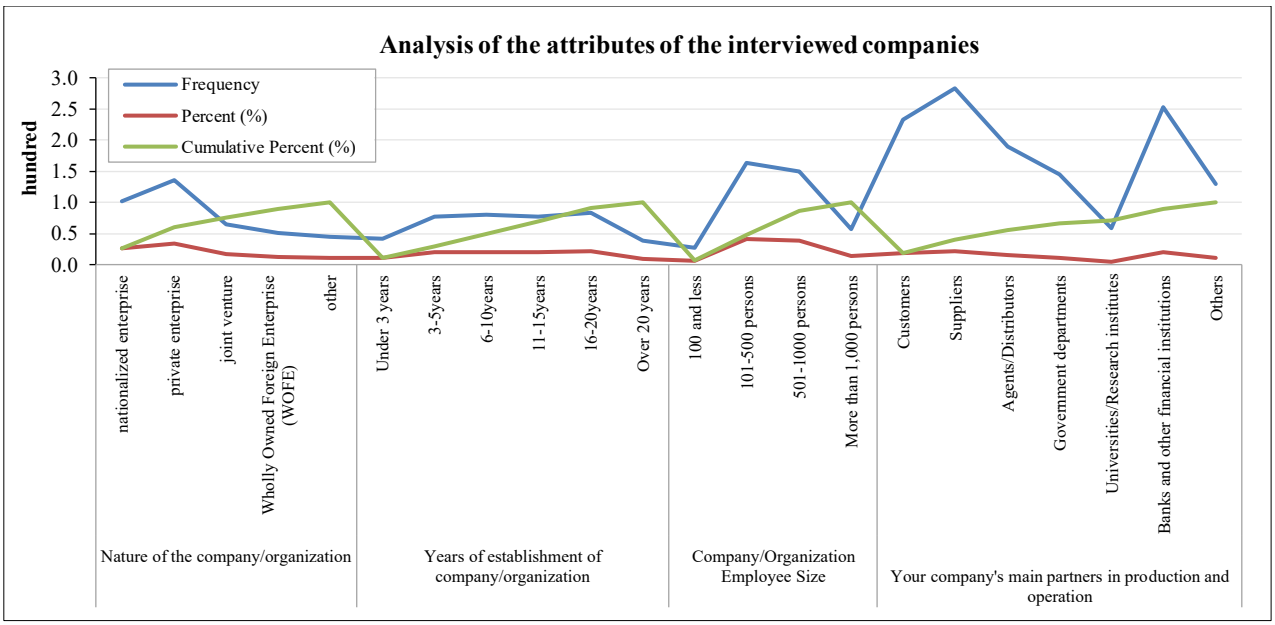

Figure 3. Descriptive statistical analysis of company nature (N = 397)

3.7. Scale Design

Drawing on prior studies [31, 32], this paper structures the green supply chain management scale into three dimensions—supplier selection and evaluation, environmental policy and strategy, and production and operation management and implementation capability—comprising nine items (Figure 3). In addition, informed by earlier research [33] and interview outcomes, strategic procurement capability is segmented into four dimensions: supplier selection and management capability, cost control and risk management capability, purchasing strategy development and implementation capability, and market analysis and forecasting capability, which are measured by 13 items. Furthermore, the enterprise competitiveness scale is formed on five dimensions—market share, customer satisfaction, brand influence, financial competitiveness, and innovation ability—with 10 items assessing these constructs [34-38].

Table 1 demonstrates that the internal consistency of the subscales measuring green supply chain management, strategic procurement, and enterprise competitiveness is robust, with most reliability scores exceeding 0.7. Each questionnaire item shows a total correlation coefficient (CITC) above the 0.3 threshold, further affirming the instrument's coherence. The overall Cronbach's alpha of 0.957, coupled with a KMO value of 0.916, indicates the strong reliability and stability of the survey. In terms of convergent validity, all standardized loading coefficients are above 0.5, each variable's composite reliability (CR) exceeds 0.7, and the average variance extracted (AVE) is above 0.5. These results collectively indicate that the measurement model meets established standards for reliability and convergent validity. Details are as follows:

- The reliability analysis for green supply chain management, as presented in the following table, demonstrates strong internal consistency across all measured dimensions: the Cronbach's α coefficient for supplier selection and evaluation is 0.844, for environmental policy and strategy is 0.861, and for production and operation management and implementation capability is 0.856. Since all three coefficients exceed the accepted threshold of 0.7, the results indicate that the questionnaire demonstrates a high level of reliability, confirming that the measurement of green supply chain management constructs in this study is both robust and consistent.
- The reliability analysis for strategic procurement, as detailed in the following table, indicates strong internal consistency across all measured dimensions: the Cronbach's α coefficient for supplier selection and management ability is 0.878, for cost control and risk management ability is 0.857, for procurement strategy formulation and implementation ability is 0.869, and for market analysis and forecasting ability is 0.901. Since all four Cronbach's α coefficients exceed the widely accepted threshold of 0.7, the results confirm that the strategic procurement constructs in this study are measured with a high degree of reliability, thereby validating the robustness and consistency of the questionnaire.
- The reliability analysis of enterprise competitiveness, as presented in the following table, demonstrates strong internal consistency across all measured dimensions: the Cronbach's α coefficient for market share is 0.839, customer satisfaction is 0.890, brand influence is 0.900, financial competitiveness is 0.900, and innovation capability is 0.815. Since all five Cronbach's α coefficients exceed the commonly accepted threshold of 0.7, the results indicate a high level of reliability for the questionnaire, confirming that the measurement of enterprise competitiveness in this study is both consistent and robust.

Table 1. Scale item description and reliability test

Classify	Dimension of measurement	Subject	CITC	Standardized Factor loadings	Cronbach's a	AVE	CR
Green supply chain	Selection and evaluation of suppliers	Your company considers the environmental performance of suppliers as an important criterion for selecting suppliers	0.657	0.726	0.844	0.663	0.854
		Your company conducts regular environmental performance evaluations of suppliers and adjusts supplier relationships accordingly	0.784	0.906			
		Your company encourages and supports suppliers to implement environmental improvements	0.702	0.8			
	Environmental Policy and strategies	Your company has a clear green supply chain policy or strategy in place	0.674	0.723	0.861	0.681	0.864
		Relevant policies or strategies developed by your company include objectives to reduce environmental impacts, improve resource efficiency and promote sustainable development	0.784	0.882			
		Your company's green supply chain policy or strategy is supported and driven by senior leadership	0.755	0.861			
	Production and operations management and implementation capabilities	Your company employs environmentally friendly technologies and processes in the manufacturing process to reduce energy consumption and emissions	0.713	0.778	0.856	0.664	0.855
		Your company has an effective waste management and resource recovery system in place	0.737	0.846			
		Your company regularly assesses and manages environmental risks in production and operations	0.735	0.819			
Strategic procurement	Supplier selection and management capabilities	Your company is able to establish long-term and stable relationships with suppliers	0.696	0.766	0.878	0.646	0.879
		Your company is able to accurately assess the quality, price and delivery time of suppliers	0.707	0.761			
		Your company is able to leverage supplier resources to achieve cost optimization and efficiency gains	0.770	0.847			
		Your company is able to effectively handle communication and coordination with suppliers	0.775	0.837			
	Cost control and risk management capabilities	Your company can develop effective cost control strategies to reduce procurement costs	0.630	0.722	0.857	0.604	0.820
		Your company is able to identify and assess potential risks in the procurement process and develop responses to them	0.675	0.785			
		Your company can regularly review procurement contracts and supplier performance to ensure cost control and risk management effectiveness	0.706	0.821			
	Procurement strategy formulation and implementation capabilities	Your company can develop procurement strategies and plans based on corporate strategic goals	0.779	0.877	0.869	0.691	0.870
		Your company is able to coordinate internal resources to ensure the smooth implementation of procurement strategies	0.740	0.808			
		Your company can monitor the implementation of procurement strategies and adjust and optimize strategies in a timely manner	0.731	0.807			
	Market analysis and forecasting capabilities	Your company can accurately grasp market dynamics and trends, providing strong support for purchasing decisions	0.796	0.85	0.901	0.752	0.901
		I can use data analysis tools to predict market demand and price fluctuations	0.832	0.916			
		I can analyze competitors' purchasing strategies and adjust my own purchasing plans	0.783	0.834			
Enterprise competitiveness	Market share	Your company's products or services have a high market share	0.697	0.791	0.839	0.636	0.840
		Your company's products or services continue to grow in market share within the industry	0.689	0.766			
		Your company's products or services are highly competitive in the market	0.724	0.834			
	Customer satisfaction	Your company is able to respond to and address customer issues and needs in a timely manner	0.778	0.826	0.890	0.729	0.890
		The company's customers are highly satisfied with your company's products or services	0.798	0.877			
		The company's customers are more loyal to your company's products or services	0.778	0.858			
	Brand influence	Your company's brand has a high degree of popularity and reputation in the market	0.842	0.921	0.900	0.755	0.902
		Your company's brand image can attract many new customers	0.805	0.871			
		Your company's brand image can retain many old customers	0.763	0.812			
	Financial competitiveness	Cost control and efficiency improvements at your company help improve profitability	0.828	0.911	0.900	0.751	0.900
		Your company can effectively manage and control financial risks to ensure financial stability	0.803	0.86			
		Your company can rationally plan and use funds to reduce financial risks	0.777	0.827			
	Innovation ability	Your company has a reasonable organizational structure and high decision-making and execution efficiency	0.698	0.82	0.815	0.596	0.815
		Your company frequently develops or improves new products or services	0.648	0.725			
		Your company can flexibly respond to market changes and adjust strategies and plans in a timely manner	0.653	0.768			

4. Research Findings

4.1. Common Method Bias

Cross-sectional data was collected, with the questionnaire survey serving as the sole data source. To ensure the internal validity of the research findings, the widely used Harman single-factor method was employed to test for common method bias. The results, presented in Table 2, indicate that there were Thirteen factors with eigenvalues exceeding 1. The initial variance explained by the largest factor was 72.342%, below the critical threshold of 50%. Consequently, the results suggest that the study was not significantly affected by common method bias [39].

Table 2. Harman's Single-Factor Test

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	16.685	30.898	30.898	16.685	30.898	30.898
2	4.115	7.621	38.519	4.115	7.621	38.519
3	2.719	5.035	43.554	2.719	5.035	43.554
4	2.575	4.768	48.322	2.575	4.768	48.322
5	1.971	3.650	51.972	1.971	3.650	51.972
6	1.681	3.113	55.086	1.681	3.113	55.086
7	1.633	3.025	58.111	1.633	3.025	58.111
8	1.458	2.701	60.812	1.458	2.701	60.812
9	1.382	2.560	63.372	1.382	2.560	63.372
10	1.343	2.486	65.858	1.343	2.486	65.858
11	1.225	2.269	68.127	1.225	2.269	68.127
12	1.160	2.147	70.275	1.160	2.147	70.275
13	1.116	2.067	72.342	1.116	2.067	72.342

4.2. Basic Model Analysis

According to the theoretical model developed in this study, green supply chain management, strategic procurement, and enterprise competitiveness were incorporated into a single structural equation model to empirically test the proposed hypotheses. The model's fit indices indicate a strong overall fit: the absolute indices—χ^2/df at 1.705, RMSEA at 0.042, GFI at 0.877, and AGFI at 0.859—along with incremental indices—IFI at 0.953, TLI at 0.949, and CFI at 0.953—and parsimonious indices—PGFI at 0.766, PNFI at 0.823, and PCFI at 0.878—all meet or exceed the accepted academic standards (Table 3). This strong set of fit measures confirms the validity of the model and supports the hypothesized relationships among the variables.

Table 3. Analysis of Fit Index of Structural Equation Modeling Model

Fitting indicators		Evaluation criteria	Test result
Absolute fitting index	χ2	-	1046.687
	df	-	614
	χ2/df	＜5	1.705
	RMSEA	＜0.01	0.042
	GFI	＞0.80	0.877
	AGFI	＞0.80	0.859
Value added fitting index	IFI	＞0.90	0.953
	TLI	＞0.90	0.949
	CFI	＞0.90	0.953
Parsimony fit index	PGFI	＞0.50	0.766
	PNFI	＞0.50	0.823
	PCFI	＞0.50	0.878

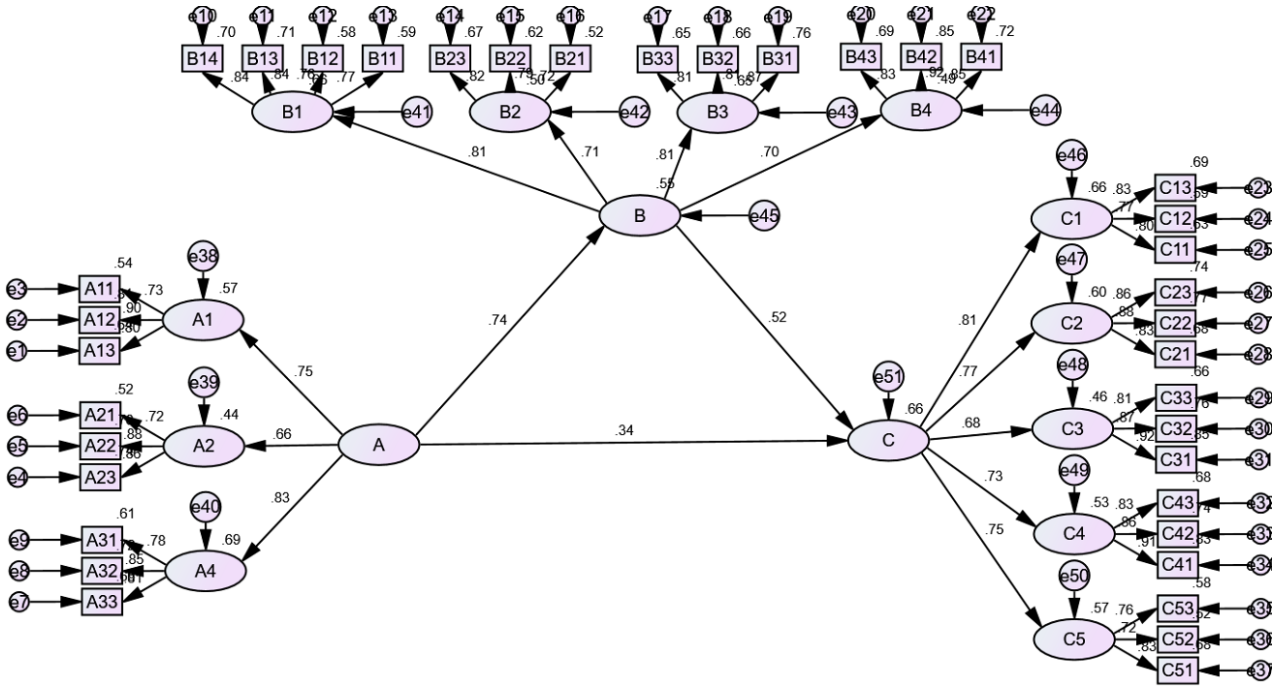

Figure 4. Plot of structural equation modeling test results

By setting green supply chain management (supplier selection and evaluation, environmental policy and strategy, production and operation management, and implementation capacity); Strategic Procurement (supplier selection and management capacity, cost control and risk management capacity, procurement strategy development and implementation capacity, and market analysis and forecasting capacity); and Enterprise Competitiveness (market share, customer satisfaction, brand impact, financial competitiveness, and innovation ability), the basic model not only verifies the intrinsic relationship between the variables (Figure 4) but also paves the way for verifying the mediating role of Strategic Procurement below.

4.3. Test of Hypothesis

Analyzing Table 4 reveals that the R^2 value for Strategic Procurement was 0.552, indicating that green supply chain management explained 55.2% of the variance in Strategic Procurement. The R2 value for Enterprise Competitiveness was 0.656, indicating that green supply chain management and Strategic Procurement explained 65.6% of the variance in Enterprise Competitiveness.

First, Table 4 illustrates the relationship between green supply chain management and Enterprise Competitiveness. The path coefficient value (β=0.361) and t-value (t=3.914) indicate a statistically significant positive impact of green supply chain management on Enterprise Competitiveness (p=0.000<0.001). These results provide robust empirical support for hypothesis H1, leading to its acceptance. The research results, Firms that excel in green supply chain practices are better equipped to meet consumer demand for environmentally friendly products, attracting a broader base of green consumers and enhancing participation in value creation. This, in turn, drives the expansion of market share and bolsters overall competitiveness. Consequently, the conclusion that green supply chain management exerts a significant positive influence on enterprise competitiveness is both theoretically and empirically substantiated [23].

Secondly, Table 4 illustrates the relationship between Strategic Procurement and Enterprise Competitiveness. The path coefficient value (β=0.508) and t-value (t=5.240) indicate a statistically significant positive impact of Strategic Procurement on Enterprise Competitiveness (p=0.000<0.001). These results provide robust empirical support for hypothesis H2, leading to its acceptance. The research results, by fostering stable, long-term partnerships with multiple suppliers, strategic procurement enhances a firm's capacity to manage and respond to supply chain risks and unforeseen disruptions. This increased supply chain resilience and flexibility enables enterprises to maintain a competitive advantage, even in the face of complex and volatile market environments.

Finally, Table 4 illustrates the relationship between green supply chain management and Strategic Procurement. The path coefficient value (β=0.741) and t-value (t=8.773) indicate a statistically significant positive impact of green supply chain management on Strategic Procurement (p=0.000<0.001). These results provide robust empirical support for hypothesis H3, leading to its acceptance. The results presented indicate a significant positive relationship between green supply chain management and strategic procurement. This finding highlights the pivotal role of green supply chain management in providing a solid foundation for the effective implementation of strategic procurement within enterprises [40].

Table 4. Results of Direct Effect Test

Assume	Non-standardized influence coefficient	S.E.	C.R.	P	Standardization influence coefficient	R^2	Assumption results
H1	0.319	0.082	3.914	***	0.361	0.656	establish
H2	0.43	0.082	5.24	***	0.508		establish
H3	0.774	0.088	8.773	***	0.741	0.552	establish

Notes: N=397. * p <0.05, **p <0.01, ***p <0.001

4.4. Analysis of the Mediation Model

In examining the mediating effect within the pathway from green supply chain management to Enterprise Competitiveness via strategic procurement, the results reveal an indirect effect of 0.388. The 95% confidence intervals obtained through both the bias-corrected percentile method [0.231, 0.611] and the percentile method [0.221, 0.590] do not include zero, indicating that the mediating effect is statistically significant. The direct effect of green supply chain management on Enterprise Competitiveness, after accounting for strategic procurement, is 0.342, with corresponding 95% confidence intervals ([0.079, 0.585] for the bias-corrected percentile method and [0.087, 0.593] for the percentile method) also excluding zero (Table 5). These results confirm that strategic procurement serves as a significant partial mediator between green supply chain management and Enterprise Competitiveness. Consequently, that strategic procurement management plays a mediating role between green supply chain management and Enterprise Competitiveness—is supported. all these processes underscore the partial mediating role of strategic procurement in translating green supply chain management practices into enhanced Enterprise Competitiveness [41].

Table 5. Mediating Effect Test

Effect	Estimate	S.E.	P	Bias-corrected percentile Method 95% CI		Percentile method 95% CI		Effect size
				Lower	Upper	Lower	Upper	
Indirect effect	0.388	0.093	0.000***	0.231	0.611	0.221	0.590	53.15%
Direct effect	0.342	0.129	0.016*	0.079	0.585	0.087	0.593	46.85%
Total effect	0.730	0.065	0.001**	0.591	0.850	0.598	0.854	-

Notes: N=397. * p <0.05, **p <0.01, ***p <0.001

In short, the path coefficients and P values show that the direct and indirect relationships within the theoretical model of sustainable development from green supply chain management to corporate competition are significant at $p < 0.05$ for both types of relationships. Green supply chain management significantly influences enterprise competition both directly and indirectly.

5. Conclusions

The research presents the overall results to depict the major findings of this research. The following are the research business recommendations and the way forward for future research through adoption of this research framework.

5.1. Research Conclusion

This study yields four main conclusions regarding the interconnections among green supply chain management, strategic procurement, and enterprise competitiveness.

First, green supply chain management significantly enhances enterprise competitiveness, particularly as the global shift toward a low-carbon economy accelerates. Strengthening green supply chain practices has become essential not only for sustainable development but also for the ongoing advancement of firms' competitive positions [42]. The strategic value of green supply chains now extends far beyond traditional environmental protection and corporate social responsibility, serving as a catalyst for transforming national economies, reshaping the global industrial landscape, and driving core competitive advantages [43]. Current academic research further corroborates that the implementation of green supply chain management practices promotes enterprise competitiveness, with this relationship well recognized in both theory and practice

Second, strategic procurement management is shown to significantly improve enterprise competitiveness by enabling organizations to better navigate complex market environments through the integration of internal capabilities and external resources, thereby supporting long-term, stable, and sustainable growth [44]. By fostering long-term supplier partnerships, optimizing procurement processes, and reducing costs, strategic procurement not only stabilizes the supply chain but also drives innovation and competitive improvement [45].

Third, green supply chain management exerts a positive influence on strategic procurement by encouraging firms to prioritize environmental considerations in supplier collaborations and innovation efforts. This focus enables the adoption of greener materials and processes, reducing raw material use and capital expenditures while enhancing operational efficiency and overall competitiveness [46].

Finally, strategic procurement management functions as a mediating variable between green supply chain management and enterprise competitiveness, enabling enterprises to achieve optimal resource allocation, reduce costs, improve product quality, and strengthen the stability and sustainability of the supply chain. Consequently, green supply chain management can indirectly bolster enterprise competitiveness by way of strategic procurement, further demonstrating the complex and multifaceted nature of these interrelationships [47, 48].

5.2. Theoretical Contribution

This research produces several key theoretical contributions to sustainable development theory. Synergic development of economic, environmental, and social objectives is central to the accomplishment of recycling and reuse of resources under the sustainable development scenario. The conclusion reiterates that green supply chain management practices can internalize the costs of the environment, minimize the ecological footprint, and stimulate economic development through precise green supply chain management practices and thus provide a feasible path towards sustainable development in the manufacturing industry. The study also gives significant inputs for China's green supply chain management system upgrading and the efficiency of the overall supply chain. The research continues to define strategic procurement as the linchpin of green development across the value chain, attributing to it a role as the focal catalyst to sustainability goals. Strategic buying decisions have been found to influence the environmental performance of the entire supply chain, whereas green supplier partnership stands as a requisite impetus in enabling sustainable supply chain development and enhancing the approaches used to measure sustainability in times of industrial transformation [49, 50].

5.3. Management Recommendations

To effectively implement and advance green supply chain management, this study presents several management recommendations for both enterprises and policymakers. First, enterprises should establish clear and comprehensive green supply chain management policies, integrating these into their broader strategic planning to ensure sustained competitiveness and long-term sustainability. Intelligent manufacturing enterprises, in particular, are encouraged to increase investment and allocate greater resources toward green supply chain initiatives to foster innovation and enhance operational efficiency. Regular environmental assessments of suppliers are also essential to ensure all supply chain partners adhere to environmental and sustainability standards, thereby maintaining the integrity and stability of the green supply chain.

Furthermore, enhancing the awareness and commitment of senior management is crucial, as leadership support for green supply chain strategies can strengthen a company’s green brand image, improve stakeholder perceptions, and underscore the competitive advantages of environmentally responsible practices. Improving the quality and expertise of procurement personnel is another key recommendation; enterprises should invest in developing the skills and capabilities of procurement teams to enhance strategic procurement effectiveness. From a policy perspective, governments should play an active role in encouraging enterprises to adopt green supply chain practices by guiding and incentivizing core enterprises to participate, strengthening relevant laws, policies, and standards, and promoting corporate social responsibility. Additionally, robust legal frameworks and supervisory mechanisms should be established and refined to ensure compliance with environmental regulations, monitor corporate supply chain activities, and promote the consistent and effective implementation of green supply chain management.

5.4. Research Limitations

This study’s cross-sectional design provides only a snapshot of green supply chain management practices, capturing data within a fixed time frame and thereby limiting the ability to reflect the dynamic and evolving nature of these practices. Given that green supply chain management is inherently a dynamic process, the short-term effects captured by this research may not fully represent the long-term impacts of implementation. Although steps were taken to address common method bias in data analysis, such bias cannot be completely eliminated in cross-sectional studies. Therefore, future research should employ longitudinal designs spanning multiple years to more effectively examine the direction and magnitude of relationships among key indicators over time. Such longitudinal approaches would not only provide a more profound understanding of how green supply chain practices evolve but also allow for a more nuanced exploration of the long-term benefits—such as increased environmental efficiency and reduced energy consumption—that may arise from sustained implementation.

While this study conceptualizes green supply chain management, strategic procurement, and enterprise competitiveness as multidimensional constructs—encompassing dimensions such as supplier selection, environmental policy, operational capabilities, cost control, and market influence primarily focuses on the overarching logical relationships among these three core variables. As a result, the complex mechanisms and interactions between their respective sub-dimensions remain underexplored. Future research should therefore seek to deepen the analysis by

examining how specific dimensions of green supply chain management and strategic procurement interact to influence distinct facets of enterprise competitiveness. Such an approach would offer richer theoretical insights and more targeted practical recommendations by illuminating the pathways through which these multidimensional constructs drive sustainable competitive advantage.

5.5. Recommendation for future research

For future research, the following directions are suggested for further research. Firstly, follow-up studies need to expand their focus to multiple industries and areas so that they can compare the relationships between green supply chain management, strategic procurement, and enterprise competitiveness in various industrial and regional contexts. This approach would serve to illuminate the degree to which such experiences in smart manufacturing firms in East China are generalizable or otherwise translatable to other industries and locations. Future research should also delve deeper into the processes through which there are interrelationships between green supply chain management, strategic procurement, and firm competitiveness to further enrich and elaborate the theoretical foundations of this research stream. Finally, researchers are invited to work extremely closely with industry practitioners to innovate and pilot actionable, feasible tools and techniques for strategic purchasing management and green supply chains in an attempt to assess their relevance and usefulness to actual enterprise problems and demands.

6. Declarations

6.1. Author Contributions

Conceptualization, J.L. and S.P.; methodology, J.L. and S.P.; software, J.L.; validation, J.L. and S.P.; formal analysis, J.L. and S.P.; investigation, J.L. and S.P.; resources, J.L.; data curation, J.L.; writing—original draft preparation, J.L. and S.P.; writing—review and editing, J.L., S.Z., and S.P.; visualization, J.L. and S.P.; supervision, S.P.; project administration, S.P.; funding acquisition, J.L. All authors have read and agreed to the published version of the manuscript.

6.2. Data Availability Statement

The data presented in this study are available in the article.

6.3. Funding and Acknowledgments

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6.4. Institutional Review Board Statement

Not applicable.

6.5. Informed Consent Statement

Not applicable.

6.6. Declaration of Competing Interest

The authors declare that there are no conflicts of interest concerning the publication of this manuscript. Furthermore, all ethical considerations, including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, and redundancies have been completely observed by the authors.

7. References

[1] Liu, J., Feng, Y., & Zhu, Q. (2021). Involving second-tier suppliers in Green supply chain management: drivers and heterogenous understandings by firms along supply chains. International Journal of Production Research, 61(14), 4765–4785. doi:10.1080/00207543.2021.2002966.

[2] Zhang B. (2023). Research on green supply chain integration of manufacturing enterprises and its impact on green innovation performance. China National Knowledge Infrastructure. Available online: https://chn.oversea.cnki.net/KCMS/detail/detail.aspx?dbcode=CDFD&dbname=CDFDLAST2024&filename=1023929292.nh&uniplatform=OVERSEA&v=fmVch1m8rbngOopa5W_wPWF_U-wxMqp9nohG6qrgrqROg0QAVpQzb1pMMfgA5qm0 (accessed on November 2025).

[3] Gawusu, S., Zhang, X., Jamatutu, S. A., Ahmed, A., Amadu, A. A., & Djam Miensah, E. (2022). The dynamics of green supply chain management within the framework of renewable energy. International Journal of Energy Research, 46(2), 684–711. doi:10.1002/er.7278.

[4] Lyw (2024). Research on strategic thinking and development paths of China's green supply chain. Available online: https://nefi.develpress.com/?p=16293 (accessed on November 2025).

[5] Li Xin. (2024). Green Supply Chain Management and Green Innovation Performance of Automobile Companies: The Moderating Effect of Environmental Regulation. E-Commerce Letters, 13(02), 2623–2632. doi:10.12677/ecl.2024.132321

[6] Labaran, M. J., & Masood, T. (2023). Industry 4.0 Driven Green Supply Chain Management in Renewable Energy Sector: A Critical Systematic Literature Review. Energies, 16(19), 6977. doi:10.3390/en16196977.

[7] Juan, M. (2015). Notice of the State Council on the issuance of "Made in China 2025"_Machinery Manufacturing and Heavy Industry_China Government Network. Available online: https://www.gov.cn/zhengce/content/2015-05/19/content_9784.htm (accessed on November 2025).

[8] He, Y. (2021). Notice of eight departments on issuing the "14th Five-Year Plan for Intelligent Manufacturing Development"_State Council Department Documents_China Government Network. Available online: https://www.gov.cn/zhengce/zhengceku/2021-12/28/content_5664996.htm (accessed on November 2025).

[9] Yu, Z. (2024). Opinions of the Central Committee of the Communist Party of China and the State Council on Accelerating Economic and Social Development and Promoting a Comprehensive Green Transformation_Central Government Documents_China Government Online. Available online: https://www.gov.cn/zhengce/202408/content_6967663.htm (accessed on November 2025).

[10] Wei, R. (2024). Ministry of Ecology and Environment: Support enterprises in developing green and low-carbon industries and green supply chains, and carry out collaborative innovation in pollution reduction and carbon reduction. PMEC China World Pharmaceutical Machinery, Packaging Equipment and Materials China Exhibition. Available online: https://www.pmecchina.com/archives/55737 (accessed on November 2025).

[11] Albrakat, N. S. A., Al-Hawary, S. I. S., & Muflih, S. M. (2023). The effect of green supply chain on the export performance of the Jordanian pharmaceutical industry. Uncertain Supply Chain Management, 11(2), 613–624. doi:10.5267/j.uscm.2023.2.003.

[12] Ketchen, D. J., Crook, T. R., & Craighead, C. W. (2014). From supply chains to supply ecosystems: Implications for strategic sourcing research and practice. Journal of Business Logistics, 35(3), 165–171. doi:10.1111/jbl.12057.

[13] Li, S., & Zhao, F. (2024). Research on technology innovation path of Intelligent Manufacturing enterprises—Based on qualitative comparative analysis of fuzzy sets under TOE framework. PLoS ONE, 19(10), 309784. doi:10.1371/journal.pone.0309784.

[14] Sarkar, A. (2022). Minimalonomics: A novel economic model to address environmental sustainability and earth's carrying capacity. Journal of Cleaner Production, 371, 133663. doi:10.1016/j.jclepro.2022.133663.

[15] Dzwigol, H. (2020). Methodological and Empirical platform of triangulation in strategic management. Academy of Strategic Management Journal/Academy of Strategic Management Journal, 19(4), 1–8.

[16] Javanmardi, E., Liu, S., & Xie, N. (2023). Exploring the Challenges to Sustainable Development from the Perspective of Grey Systems Theory. Systems, 11(2), 70. doi:10.3390/systems11020070.

[17] Le, T. T., Vo, X. V., & Venkatesh, V. G. (2022). Role of green innovation and supply chain management in driving sustainable corporate performance. Journal of Cleaner Production, 374, 133875. doi:10.1016/j.jclepro.2022.133875.

[18] Habib, M. A., Bao, Y., & Ilmudeen, A. (2020). The impact of green entrepreneurial orientation, market orientation and green supply chain management practices on sustainable firm performance. Cogent Business and Management, 7(1), 1743616. doi:10.1080/23311975.2020.1743616.

[19] Kumar, A., Zavadskas, E. K., Mangla, S. K., Agrawal, V., Sharma, K., & Gupta, D. (2018). When risks need attention: adoption of green supply chain initiatives in the pharmaceutical industry. International Journal of Production Research, 57(11), 3554–3576. doi:10.1080/00207543.2018.1543969.

[20] Bányai, Á. (2024). The Influence of Procurement Logistics Strategy on Organizational Hierarchies: Strategic, Tactical, and Operational Perspectives. Advanced Logistic Systems - Theory and Practice, 18(4), 73–88. doi:10.32971/als.2024.039.

[21] Zhang Jinsong, Zhang Xiaoqian & Wang Qinyun. (2019). Research on the relationship between institutional pressure, green supply chain management practices and enterprise performance. Journal of Wuhan Textile University (05), 24-30. Available online: https://wenku.baidu.com/view/1d61d271b72acfc789eb172ded630b1c58ee9b49?fr=xueshu_top&_wkts_=1732965174292&needWelcomeRecommand=1 (accessed on November 2025).

[22] Zhiming, S. (2019). Research on the impact of procurement strategy level on procurement practice and performance (Master's thesis, Xi'an University of Technology). Master's degree.

[23] Novitasari, M., Wijaya, A. L., Agustin, N. M., Gunardi, A., & Dana, L. P. (2023). Corporate social responsibility and firm performance: Green supply chain management as a mediating variable. Corporate Social Responsibility and Environmental Management, 30(1), 267–276. doi:10.1002/csr.2353.

[24] Nagel, M. H. (2000). Environmental supply-chain management versus green procurement in the scope of a business and leadership perspective. IEEE International Symposium on Electronics and the Environment. doi:10.1109/isee.2000.857652.

[25] Zhen, Y. (2022). Research on Green Procurement Strategy of Power Grid Enterprises under the Target Background of "Carbon Peak and Carbon Neutrality." Modern Management, 12(03), 211–217. doi:10.12677/mm.2022.123028.

[26] Tengyue, J. (2023). Research on the application of Strategic procurement in supply chain management. Bohai Economic Outlook (11), 29-32. Available online: https://www.zhangqiaokeyan.com/academic-journal-cn_wen-yuan-secondary-edition_thesis/02012154095614.html (accessed on November 2025).

[27] Li, Z., Chen, J., Li, Z., & Zhang, Y. (2024). Strengthen or weaken? How industrial internet platform affects the core competitiveness of manufacturing companies. Operations Management Research, 17(1), 220–232. doi:10.1007/s12063-023-00426-4.

[28] Hunziker, S., & Blankenagel, M. (2024). Cross-Sectional Research Design. In Research Design in Business and Management (pp. 187–199). doi:10.1007/978-3-658-42739-9_10.

[29] McQueen, R. A., & Knussen, C. (2002). Research methods for social science: A practical introduction. Pearson Education.

[30] Etikan, İ., Musa, S. A., & Alkassim, R. S. (2016). Comparison of Convenience Sampling and Purposive Sampling. American Journal of Theoretical and Applied Statistics, 5(1), 1. doi:10.11648/j.ajtas.20160501.11.

[31] Govindan, K., Rajendran, S., Sarkis, J., & Murugesan, P. (2015). Multi criteria decision making approaches for green supplier evaluation and selection: a literature review. Journal of Cleaner Production, 98, 66–83. doi:10.1016/j.jclepro.2013.06.046.

[32] Fuertes, G., Alfaro, M., Vargas, M., Gutierrez, S., Ternero, R., & Sabattin, J. (2020). Conceptual Framework for the Strategic Management: A Literature Review - Descriptive. Journal of Engineering (United Kingdom), 2020, 1–21. doi:10.1155/2020/6253013.

[33] Jones, A. E., Walters, J. E., Stickley, Z., Scoresby, K. J., & Brown, A. R. (2024). Confirmatory Factor Analysis of the Social Worker Satisfaction Scale. Research on Social Work Practice, 34(8), 944–953. doi:10.1177/10497315231214326.

[34] Liu, Z., & Wang, C. (2023). Impact of logistics agglomeration on environmental quality in China: aggravating pollution effect or emission reduction effect? Environmental Science and Pollution Research, 30(41), 93629–93651. doi:10.1007/s11356-023-28914-x.

[35] Yun, Y. (2023) Research on the impact of China's environmental policies on corporate performance: Mechanism and empirical analysis from the perspective of heterogeneous enterprises - Baidu Academic. Available online: https://xueshu.baidu.com/usercenter/paper/show?paperid=1v5d0t80g71s0xr0ey300vm0vm652122&site=xueshu_se (accessed on November 2025).

[36] Feng, D. (2023). Research on the measurement and optimization of competitiveness of power battery enterprises from the perspective of value chain (Master's thesis, Changzhou University). Available online: https://xueshu.baidu.com/usercenter/paper/show?paperid=1s1406w02b3408d03k0s0td0g1397443&site=xueshu_se (accessed on November 2025).

[37] Yihe, T. (2023). Research on fuzzy optimization of empty container transportation considering customer satisfaction under low-carbon background (Master's thesis, Dalian Maritime University). Available online: https://xueshu.baidu.com/usercenter/paper/show?paperid=123n0cy08c6b0ve0mp2u0c100c713801&site=xueshu_se&hitarticle=1 (accessed on November 2025).

[38] Tan, H., Yan, Y., & Wu, Z. Z. (2024). Determinants of the transition towards circular economy in SMEs: a sustainable supply chain management perspective. Environmental Science and Pollution Research, 31(11), 16865–16883. doi:10.1007/s11356-024-31855-8.

[39] Min, H., Park, J., & Kim, H. J. (2016). Common method bias in hospitality research: A critical review of literature and an empirical study. International Journal of Hospitality Management, 56, 126–135. doi:10.1016/j.ijhm.2016.04.010.

[40] Wei, B., Wang, N., Jiang, Q., & He, Z. (2022). Green Procurement and Outsourcing. In Enterprises' Green Growth Model and Value Chain Reconstruction: Theory and Method, 205–223. doi:10.1007/978-981-19-3991-4_9.

[41] Liu, J., Hu, H., Tong, X., & Zhu, Q. (2020). Behavioral and technical perspectives of green supply chain management practices: Empirical evidence from an emerging market. Transportation Research Part E: Logistics and Transportation Review, 140. doi:10.1016/j.tre.2020.102013.

[42] Cucchiella, F., & D'Adamo, I. (2013). Issue on supply chain of renewable energy. Energy Conversion and Management, 76, 774–780. doi:10.1016/j.enconman.2013.07.081.

[43] Santos, A. de M., & Sant'Anna, Â. M. O. (2024). Industry 4.0 technologies for sustainability within small and medium enterprises: A systematic literature review and future directions. Journal of Cleaner Production, 467, 143023. doi:10.1016/j.jclepro.2024.143023.

[44] Ngoc, H. D., Thi, V. A. P., Dao, T. N., & Khanh, L. C. (2025). The relationship between management accounting implementation and business performance of Vietnamese small and medium enterprises. International Journal of Management and Sustainability, 14(1), 205–215. doi:10.18488/11.v14i1.4104.

[45] Tammi, T., Saastamoinen, J., & Reijonen, H. (2025). Buyer's market-oriented culture, strategic procurement capability, and customer performance in the public procurement of innovations. Science and Public Policy, 52(2), 181–192. doi:10.1093/scipol/scae072

[46] Shen, R., Zhou, F., Ye, X., Zhong, L., & Feng, S. (2024). Research on the application of artificial intelligence technology in supply chain management. E3S Web of Conferences, 565. doi:10.1051/e3sconf/202456503017.

[47] Lee, H. (2023). Drivers of green supply chain integration and green product innovation: a motivation-opportunity-ability framework and a dynamic capabilities perspective. Journal of Manufacturing Technology Management, 34(3), 476–495. doi:10.1108/JMTM-09-2022-0311.

[48] Hwihanus, Wijaya, O. Y. A., & Nartasari, D. R. (2022). The role of supply chain management on Indonesian small and medium enterprise competitiveness and performance. Uncertain Supply Chain Management, 10(1), 109–116. doi:10.5267/j.uscm.2021.10.005.

[49] Dzikriansyah, M. A., Masudin, I., Zulfikarijah, F., Jihadi, M., & Jatmiko, R. D. (2023). The role of green supply chain management practices on environmental performance: A case of Indonesian small and medium enterprises. Cleaner Logistics and Supply Chain, 6, 100100. doi:10.1016/j.clscn.2023.100100.

[50] Rane, S. B., Thakker, S. V., & Kant, R. (2021). Stakeholders' involvement in green supply chain: a perspective of blockchain IoT-integrated architecture. Management of Environmental Quality: An International Journal, 32(6), 1166–1191. doi:10.1108/MEQ-11-2019-0248.