Asian Administration and Management Review

Original Research Article

Received: 4 March 2024 **Revised:** 23 April 2024 **Accepted:** 26 April 2024

IMPACT OF GREEN ENTREPRENEURIAL ORIENTATION ON SUSTAINABLE PERFORMANCE: THE MEDIATING ROLE OF GREEN INTELLECTUAL CAPITAL AND GREEN SUPPLY CHAIN MANAGEMENT

Wenli HU[1] and Teetut TRESIRICHOD[1]

1 Rajamangala University of Technology Thanyaburi, Thailand;
wenli_h@mail.rmutt.ac.th (W. H.); teetut_t@rmutt.ac.th (T. T.)

Handling Editor:
Professor Dr.Wing-Keung WONG Asia University, Taiwan
(This article belongs to the Theme 1: Business Performance, Competitiveness, and Sustainability)

Reviewers:
1) Assistant Professor Dr.Chattrarat HOTRAWAISAYA SSRU, Thailand
2) Dr.Chanattee POOMPRUK ARU, Thailand
3) Dr.Nutnapha LEKHAWICHIT YRU, Thailand

Abstract

Based on the natural resource perspective and stakeholder theory, this study aims to investigate the mediating roles of green entrepreneurial orientation (GEO) on sustainable performance (SuP) in green intellectual capital (GIC) and green supply chain management (GSCM). This study is based on a survey of 516 Chinese manufacturing executives. As a methodological procedure, partial least squares structural equation modeling is used to test all hypothesized relationships. The results indicate that GEO has a positive impact on sustainable performance in the Chinese manufacturing industry and significantly influences sustainable performance through sustainable supply chain management and green intellectual capital. This study provides new empirical evidence that validates the mediating role of green intellectual capital and green supply chain management between green entrepreneurial orientation and sustainable performance. The implementation of a green entrepreneurial orientation in enterprises encourages environmental awareness and proactive actions within the organization, thereby promoting the development of green intellectual capital and green supply chain management, thus positively impacting sustainable performance. Developing a research model that provides managers insights to formulate strategies and useful perspectives to improve corporate sustainable performance.

Keywords: Green Entrepreneurial Orientation, Green Intellectual Capital, Green Supply Chain Management, Sustainable Performance

Citation Information: Hu, W., & Tresirichod, T. (2024). Impact of Green Entrepreneurial Orientation on Sustainable Performance: The Mediating Role of Green Intellectual Capital and Green Supply Chain Management. *Asian Administration and Management Review, 7*(1), 159-175. https://doi.org/10.14456/aamr.2024.15

Introduction

The manufacturing industry is a strong driver for the economy and supports the country's industrialization and modernization process (Naughton, 2021). However, the manufacturing industry also faces many challenges, with the crude development approach leading to environmental degradation and resource depletion (Yuan & Xiang, 2018). Consequently, greening the manufacturing sector has become a strategic necessity for manufacturing enterprises to improve their competitiveness and performance (Horbach et al., 2012). Moreover, green business orientation has attracted much attention as a strategic decision-making model that reconciles environmental protection and business. Existing studies have mainly focused on the relationship between green entrepreneurial orientation and performance, arguing that green entrepreneurial orientation is related to environmental orientation and growth performance (Golicic & Smith, 2013). The positive impact of green entrepreneurial orientation on corporate financial performance is well documented (Jiang et al., 2018), while its key role in sustainable performance is ignored. Green entrepreneurial orientation is not directly translated into firm performance and there is no significant relationship between the two (Parrish, 2010). In addition, it has been suggested that there may be other factors between green entrepreneurial orientation and firm performance that affect the relationship, with a lack of mediating variables (Alegre & Chiva, 2013). These studies suggest that the mechanisms through which green entrepreneurial orientation affects sustainable performance are unclear.

Natural resource base theory states that the economic activities of enterprises are directly dependent on natural resources and that sustainable business development must emphasize the close relationship between the economy, society, and the environment. Intellectual capital helps to optimize the use of resources and operational efficiency, reduce the negative impact on the environment, and reduce the waste of resources (Inayat et al., 2022). This capital is not only an adaptive use of limited resources, but also a positive response to environmental constraints. Green supply chain management provides a win-win solution to the conflict between environmental management and business performance (Chen & Chang, 2011). Green intellectual capital and green supply chain management are resources and capabilities that can bring sustainable performance to organizations. However, the role of green intellectual capital and green supply chain management in implementing a green entrepreneurial orientation to enhance sustainable performance has received less attention from scholars. As one of the largest manufacturing bases globally, China's manufacturing sector contributes significantly to carbon dioxide emissions, exerting a profound impact on the environment amidst its rapid economic development. China's manufacturing industry confronts numerous challenges, including prevalent issues of environmental pollution and resource overconsumption (Yuan & Xiang, 2018). Moreover, considerable gaps persist in product quality and innovation capacity (Liu & Xie, 2020). Nevertheless, strategic management holds paramount importance for the advancement of Chinese firms, with entrepreneurial orientation emerging as a pivotal driver of firm performance in China (Zhou & Li, 2007). Therefore, starting from the natural resource perspective, this study explores the pathway through which enterprises can develop sustainable performance by implementing a green entrepreneurial orientation, while analyzing in depth the role of green intellectual capital and green supply chain management in the relationship between them.

Literature Reviews

Green Entrepreneurial Orientation and Sustainable Performance

The concept of entrepreneurial orientation (EO) has undergone extensive examination within the realms of business strategy and organizational performance. EO denotes the strategic stance of an organization characterized by innovativeness, proactiveness, and risk-taking. Building upon this framework, green entrepreneurial orientation (GEO) expands these dimensions to

incorporate environmentally sustainable practices. Scholars have underscored the significance of GEO in driving eco-innovation, environmental responsibility, and competitive advantage in the marketplace (Makhloufi et al., 2022). Sustainable performance epitomizes an organization's capacity to concurrently achieve economic, environmental, and social objectives (Asadi et al., 2020). It transcends conventional financial metrics, encompassing environmental stewardship, social responsibility, and long-term viability. Research in this domain has stressed the imperative for businesses to embed sustainability within their core strategies and operations, thereby enhancing competitiveness, mitigating risks, and generating value for stakeholders.

Green business orientation emphasizes the balance between economic, social, and environmental aspects (Fang, 2022) and thus contributes to sustainable performance. For instance, (Jabbour & de Sousa Jabbour, 2016) conducted a study examining the influence of GEO on firm performance in the context of the green economy. The findings indicated that organizations with a stronger GEO exhibited higher levels of eco-innovation and environmental performance, leading to enhanced financial performance and competitive advantage. Delmas & Blass (2010) believe that incorporating a green business orientation in organizations improves sustainable performance by curbing resource waste and increasing energy efficiency. In a comprehensive study involving 264 Chinese companies, Jiang et al. (2018) found a positive impact of green entrepreneurial orientation on both environmental orientation and financial performance. Therefore, the following hypotheses are put forward in this study.

H1: Green entrepreneurial orientation has a positive impact on sustainable performance.

Green Entrepreneurial Orientation and Green Intellectual Capital

Intellectual capital (IC) refers to the intangible assets, knowledge, and capabilities within an organization that contribute to its competitive advantage and value creation. Green intellectual capital encompasses the comprehensive stock of intangible assets, knowledge, experience, expertise, and innovation capabilities that an organization or company possesses in the area of environmental sustainability and environmental friendliness (Chen, 2008). The Natural Resource Base View assumes that future business competition will be determined by ecosystems and that smart companies will link business development with environmental considerations to promote business growth (Hart, 1995). A green entrepreneurial orientation improves the utilization of corporate resources by exploring green technologies and reducing resource consumption in the manufacture of products (Triguero et al., 2013). At the same time, it raises organizational members' awareness of environmental issues and promotes knowledge, experience, and skills in environmental protection (Chen, 2008), thus contributing to the formation of green intellectual capital. A green entrepreneurial orientation motivates organizations to innovate at both technological and managerial levels, culminating in the establishment of a smarter green production and operation system (Wang, 2019). This smart system improves the company's adaptability to environmental changes, reduces resource waste and promotes capital accumulation. Therefore, the following hypothesis is put forward.

H2: Green entrepreneurial orientation has a positive effect on green intellectual capital.

Green Intellectual Capital and Sustainable Performance

Huang & Kung (2011) believe that a deep understanding of environmental issues alone does not guarantee sustainable development for an organization. They argue that successful environmental management requires the integration of different aspects of knowledge. Organizational management of intangible assets, such as knowledge, combined with a commitment to environmental stewardship can lead to greater competitive advantage and improved resource management capabilities, promoting sustainable performance (Zhang et al., 2020). Intellectual and intangible resources play a critical role in business operations. Companies that prioritize green intellectual capital can become key players in achieving

sustainable growth, which can lead to a distinctive competitive advantage (Malik et al., 2020). Therefore, the following hypothesis is put forward in this study.

H4: Green intellectual capital has a positive impact on sustainable performance.

Green Entrepreneurial Orientation, Green Intellectual Capital and Sustainable Performance

From the perspective of resource-based theory, adopting a green entrepreneurial orientation empowers companies to develop and nurture environmentally oriented knowledge and skills, thereby promoting the integration of green intellectual capital. By cultivating and appropriating this specific resource, companies are better able to make adaptive strategic adjustments in the face of environmental uncertainty, thereby gaining a competitive advantage in terms of sustainable performance. By building external partnerships and diffusing green intellectual capital via a green entrepreneurial orientation, firms are also better equipped to meet societal expectations and strengthen their sense of corporate social responsibility, thereby enhancing the social impact of sustainable performance (Li et al., 2021). The resource-based perspective emphasizes the importance of human capital for companies to secure a competitive advantage (Yong et al., 2019). As an important intangible asset, green human capital not only increases employee satisfaction but also has a positive impact on organizational performance (Zaid et al., 2018). Therefore, the following hypothesis is put forward.

H6: Green intellectual capital mediates the relationship between green entrepreneurial orientation and sustainable performance.

Green Entrepreneurial Orientation and Green Supply Chain Management

Green supply chain management (GSCM) involves integrating environmental considerations into all aspects of the supply chain, from raw material sourcing to product delivery and disposal. According to the RBV, as McGahan (2021) argues, companies cannot achieve sustainable development without integrating into their supply chains. GSCM involves the integration of sustainable development concepts and practices into the operational aspects of a company's supply chain (Walker et al., 2008). Companies that embrace GEO are often more inclined to select environmentally conscious suppliers and source environmentally friendly materials, thereby mitigating environmental risks and reducing the environmental impact of their supply chains. Building such green supply chains not only improves the efficiency of resource utilization but also promotes the creation of green supply chain benefits (Yildiz Çankaya & Sezen, 2019). Therefore, the following hypothesis is put forward.

H3: Green entrepreneurial orientation has a positive effect on green supply chain management.

Green Supply Chain Management and Sustainable Performance

GSCM can bring many benefits to business operations (Chin et al., 2015). Research in this area has shown that organizations can achieve environmental and economic benefits by adopting GSCM practices, including reduced carbon emissions, resource conservation, cost savings, and improved operational efficiency (Chienwattanasook & Onputtha,2022). For example, Seuring & Müller (2008) conducted a meta-analysis of studies examining the relationship between GSCM practices and firm performance. Their research found a positive correlation between the adoption of GSCM practices and various performance indicators. GSCM emphasizes the reduction of environmental impacts in supply chain management (Pagell & Wu, 2009). Companies can achieve effective resource utilization and waste reduction through advanced environmental technology and experience, and by adopting measures such as green production. In terms of economic benefits, this can reduce supply chain costs, improve business productivity, and reduce inventory levels.

H5: Green supply chain management has a positive impact on sustainable performance.

Green Entrepreneurial Orientation, Green Supply Chain Management, Sustainable Performance

In the context of implementing green strategies, the active development of a green supply chain is proving to be helpful in promoting cooperation networks, improving access to resources and strengthening innovative capacity. Research shows a correlation between green supply chain management and the green entrepreneurial orientation of companies, which in turn facilitates the sustainable development of these companies (Ermawati et al., 2024). This orientation increases the innovative capacity of companies, improves their competitive advantage, and promotes economic efficiency (Cortes et al., 2021). Building a green supply chain enables companies to spread environmentally conscious practices throughout the supply chain network, pool environmental resources and improve access to environmental technologies. This not only helps to improve firms' innovation capabilities (Seman et al., 2019), but also provides strong support for the realization of sustainable performance. The following hypothesis is proposed.

H7: Green supply chain management mediates the relationship between green entrepreneurship orientation and sustainable performance.

From the literature review, the conceptual framework can be drawn as shown in Figure 1.

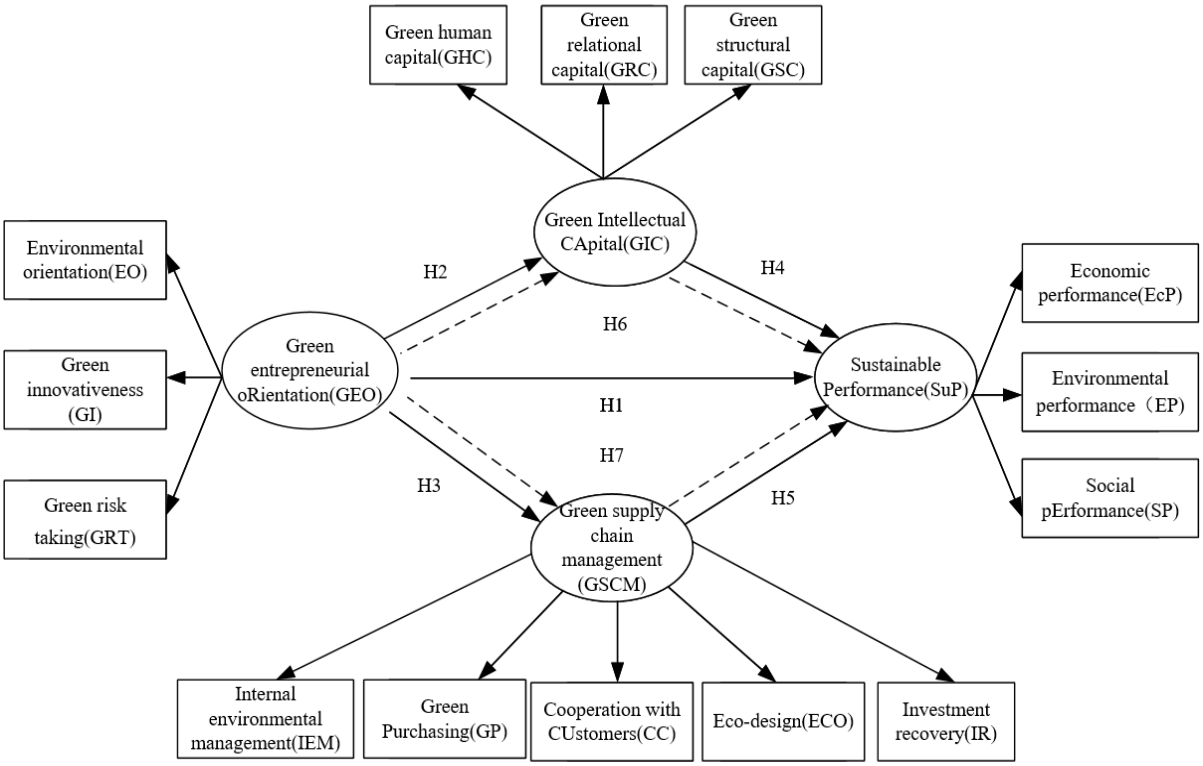

Figure 1 Conceptual Framework

Research Methodology

Sample and Procedure

The authors designed a five-part online survey with demographic information, GEO, GIC, GSCM, and the dependent variable SuP. Manufacturing occupies a central position in economic development, and China's manufacturing sector is an important pillar of the global manufacturing industry. For this reason, the study conducted an in-depth survey of medium- and large-sized manufacturing industries in China with more than 300 employees, distributing questionnaires according to industry categories and the number of enterprises. To solve the problem of questionnaire recovery, the authors hired a professional research company to assist with data recovery in the Chinese manufacturing industry. The company contacted the top

management of the Chinese manufacturing industry and collected data mainly through online questionnaires. Calculations were made to ensure that the number of responses was at least five times the number of individual questions. In total, the study included 52 questions requiring a minimum of 260 responses. In this study, before starting the data collection, five experts such as management professors and top managers of companies were invited to conduct Index of Item Objective Coherence (IOC) to determine the validity of the questionnaire's Item Objective Coherence. We distributed 70 questionnaires for pre-study and 56 questionnaires were returned with Cronbach's alpha of O.967, greater than 0.7.A total of 1,200 questionnaires were distributed and 516 were successfully returned, a response rate of 43%. This exceeded the minimum requirement and represented an adequate and reliable sample for the study (Joong-Kun Cho et al., 2008). Of the 516 returned questionnaires, 346 (67.05%) were male and 170 (32.95%) were female. The participants were mainly in middle and senior management positions, totaling 435 (84.30%), while the remaining participants were general managers. In terms of industry categories Light textile industry 110 (21.32%), Resource processing industry 244 (47.29%), Machinery and electronic manufacturing 162 (31.40%). (31.40%).

SPSS version 21 was used for data collection, screening, demographic analysis, and descriptive analysis. Partial Least Squares Structural Equation Modeling (PLS-SEM) can serve as a valuable tool for regression analysis, particularly when the data deviate from a normal distribution. Additionally, as the theoretical model developed in this study remains subject to refinement, and related theoretical studies require further enrichment, the utilization of SmartPLS 4.0 was deemed appropriate for both measurement model and structural model analyses.

Measures

This study aims to determine the relationship between GEO, GIC, GSCM and SuP. There are several aspects of GEO that can describe the performance of a company. This study combines the definition of Entrepreneurial Orientation and the studies of scholars Golsefid-Alavi et al. (2021), of environmental orientation, green innovation capability, and green risk taking into 3 first-order constructs to analyze GEO (10 items). Green intellectual capital consists of 3 first-order constructs (12 items) based on Yusoff et al. (2019), including green human capital (GHC), green relational capital (GRC) and green structural capital (GSC). Green supply chain management (17 items) mainly consists of internal environmental management (IEM), green purchasing (GP), collaboration with customers, eco-design (ECO), investment recovery (IR). 5 first-order constructs were measured, referring to Yusoff et al. (2019). Sustainable performance (13 items) consists of 3 first-order constructs, including economic performance (EcP), environmental performance (EP) and social performance (SP), following Habib et al. (2020).

Research Results

In this study, we created a higher-order model with a reflective-reflective structure. Subsequently, a second-order model was developed using the repeated indicators method for the measurement model and structural model test, as shown in Figure 1.

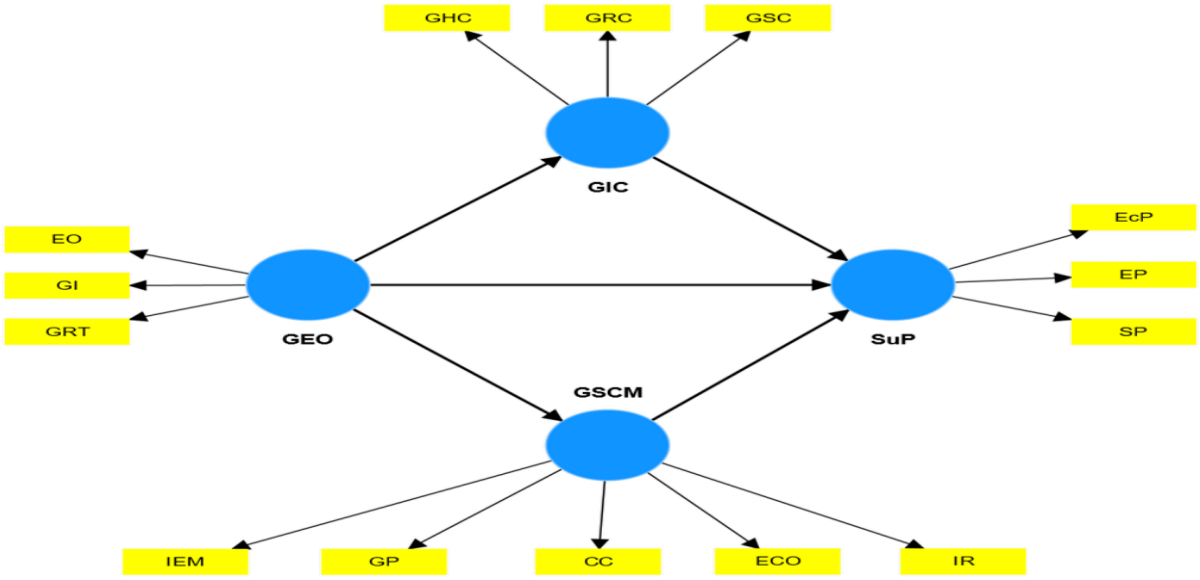

Figure 2 Reduced Form Model

Assessment of the Measurement Model

1) Indicator loadings and internal consistency reliability: In this study, PLS-SEM was used to analyze the indicators. Table 1 shows the details of the loadings. According to Hair et al. (2011), the loadings of the indicators should ideally be higher than 0.7. The factor loadings in this study ranged from .788 to .861 and were all greater than 0.7. Internal consistency reliability should be indicated by Cronbach's alpha (α) and composite reliability (CR). Hair et al. (2010) suggest that the Cronbach's alpha coefficient must be greater than 0.7 for a variable to have good reliability. The values of Cronbach's a in this study are between 0.784 and 0.861 and the values of CR are between 0.789 and 0.863, which are both greater than 0.7. As shown in Table 1.

Table 1 Validity and reliability of measurement model

	Item	Loadings	VIF	Cronbach's Alpha	CR	AVE
GEO	EO	0.857	1.834	0.784	0.789	0.699
	GI	0.861	1.772			
	GRT	0.788	1.457			
GIC	GHC	0.838	1.661	0.794	0.794	0.708
	GRC	0.843	1.671			
	GSC	0.843	1.710			
GSCM	IEM	0.806	1.859	0.861	0.863	0.643
	GP	0.798	1.858			
	CC	0.788	1.821			
	ECO	0.788	1.812			
	IR	0.828	2.015			
SuP	EcP	0.831	1.617	0.793	0.793	0.707
	EP	0.847	1.740			
	SP	0.846	1.687			

2) Convergent validity: The average variance extracted (AVE) reflects the extent to which the latent factors explain the variance of the observed variables and is an important indicator of convergent validity. The AVE should be greater than 0.5 (Hair et al., 2012; Hulland, 1999).

According to the result of PLS, the AVE values in this study range from 0.643 to 0.708, which are all greater than 0.5 (Table 1).

3) Discriminant validity: In this study, the Fornell-Larcker criterion, the factor loading values and the heterotrait-monotrait correlation ratio (HTMT) were used to perform the test of differential validity. The Fornell-Larcker criterion states that the square root of the AVE of each construct should be greater than its correlation with other constructs (Hair et al., 2012; Vinzi et al., 2010). The results of the study showed that the AVE values for each construct were lower than their squared differences (Table 2).

Table 2 Fornell-Larcker Criterion

	GEO	**GIC**	**GSCM**	**SuP**
GEO	0.836			
GIC	0.564	0.841		
GSCM	0.624	0.457	0.802	
SuP	0.568	0.516	0.616	0.841

The cross-loading approach means that the factor loadings of an indicator on the construct to which it belongs should be greater than the loadings between the indicator and other constructs in the model (Chin, 1998). The externally loaded indicator values of each construct (shown in bold) were significantly higher than all their cross-loadings on the other constructs, demonstrating the validity of discriminant validity (Table 3).

Table 3 Cross-Loading Analysis

	GEO	**GIC**	**GSCM**	**SuP**
EO	0.857	0.464	0.529	0.447
GI	0.861	0.534	0.536	0.515
GRT	0.788	0.410	0.501	0.459
GHC	0.474	0.838	0.403	0.433
GRC	0.495	0.843	0.355	0.429
GSC	0.456	0.843	0.396	0.440
IEM	0.509	0.327	0.806	0.534
GP	0.475	0.374	0.798	0.484
CC	0.485	0.319	0.788	0.457
ECO	0.496	0.36	0.788	0.455
IR	0.536	0.447	0.828	0.531
EcP	0.457	0.429	0.524	0.831
EP	0.471	0.428	0.508	0.847
SP	0.505	0.444	0.522	0.846

Henseler et al. (2015) proposed the HTMT to assess discriminant validity, where HTMT values must be less than 0.90 to have discriminant validity. As can be seen in Table 4, the HTMT values in this study were between 0.551 and 0.759, less than 0.90, indicating that discriminant validity was established between the two constructs of reflection measurement.

Table 4 Heterotrait-Monotrait Ratio (HTMT)

	GEO	**GIC**	**GSCM**	**SuP**
GEO				
GIC	0.712			
GSCM	0.759	0.551		
SuP	0.719	0.650	0.743	

Structural Modelling Evaluation

1) Collinearity Issue: During model validation, covariance must first be eliminated. Multicollinearity is usually tested with the variance inflation factor VIF. A tolerance value greater than or equal to 0.2 and a VIF value less than or equal to 5 means that there is no covariance problem between the indicators (Hair et al., 2011). Table 1 shows that the VIF values in this study range from 1.457 to 2.015, which are all greater than 0.2 and less than 5. Therefore, the covariance problem has no negative impact on the path coefficients of the structural model in this study.

2) Structural Model Relationship: In this study, the bootstrap algorithm in PLS was used to calculate the path coefficient (β) and the t-statistic to test the correlation between independent and dependent variables. Here, 5000 bootstrap samples were used to determine the significance of the path coefficients. From the results in Table 5, GEO on SuP ($t = 4.350$, $\beta = 0.197$, $p < 0.001$), GIC ($t = 19.396$, $\beta = 0.564$, $p < 0.001$), GSCM ($t = 24.181$, $\beta = 0.624$, $p < 0.001$) have a direct positive correlation. Therefore, H1, H2 and H3 are supported, i.e. manufacturing firms with higher GEO, GIC and GSCM are significantly associated with SuP. It is also found that GIC ($t = 5.437$, $\beta = 0.227$, $p < 0.001$), and GSCM ($t = 9.322$, $\beta = 0.389$, $p < 0.001$) have a positive influence on SuP. Therefore, H4 and H5 are supported.

To measure successful mediation effects, the following steps have been established: 1) the direct effect without mediation is significant and 2) the indirect effect of mediation is significant if the previous conditions are met (Hair et al., 2013). As shown in Table 5, the results indicate that GEO has a significant indirect effect on SuP through the mediation of GIC ($t = 5.177$, $\beta = .128$, and $p < 0.001$) and GSCM ($t = 8.469$, $\beta = .243$, and $p < 0.001$). This finding supports H6 and H7. Further, the variance accounted for (V.A.F.) has been estimated to determine the mediating effects' size. where $VAF > 0.8$ indicates fully mediated, $0.2 \leq VAF \geq 0.8$ indicates partially mediated, and $VAF < 0.2$ assumes no mediation. Thus, the results indicate that GIC ($VAF = .394 < 0.8$) and GSCM ($VAF = .394 < .552$) partially mediate the relation between GEO and SuP (Table 6).

Table 5 Bootstrapping results for structural model evaluation and Effect size (f^2)

Hypothesis	Relationship	β	t-value	p-value	f^2	Decision
H1	GEO→SuP	0.197	4.350	0.000	0.037	Supported
H2	GEO→GIC	0.564	19.396	0.000	0.468	Supported
H3	GEO→GSCM	0.624	24.181	0.000	0.639	Supported
H4	GIC→SuP	0.227	5.437	0.000	0.064	Supported
H5	GSCM→SuP	0.389	9.322	0.000	0.169	Supported
H6	GEO→GIC→SuP	0.128	5.177	0.000	-	Supported
H7	GEO→GSCM→SuP	0.243	8.469	0.000	-	Supported

Table 6 Mediation effect test

Hypothesis	Independent variable	Mediating variable	Dependent variable	Direct effect	Indirect effect	Total effect	VAF	Decision
H6	GEO	GIC	SuP	0.197	0.128	0.325	0.394	Partial
H7		GSCM		0.197	0.243	0.440	0.552	Partial

Notes: bootstrapping (n = 5000).

3) Coefficient of determination (R^2): Research by Hair et al. (2010) and others has shown that the presence of R^2 has three critical values of 0.25, 0.5 and 0.75, reflecting the strength of the explanation and representing weak, medium, and strong respectively. SuP($R2 = 0.469$), GIC($R2 = 0.319$), and CSCM($R2 = 0.390$), All are representing weak (Table 7).

Table 7 Coefficient determination (R^2) and Predictive relevance (Q^2)

	R-square	**R-square adjusted**	**Q^2**
GIC	0.319	0.317	0.222
GSCM	0.390	0.389	0.249
SuP	0.469	0.466	0.328

4) Effect size (f^2): The effect size (f^2) is a statistical measure of the extent to which the path effect explains the variance of the dependent variable in structural equation modeling, providing a relative measure of the explanatory strength of the model. According to the f2 value evaluation principle (Cohen, 1988), when $0.02 < f^2 \leq 0.15$, it is a small effect, when $0.15 < f^2 \leq 0.35$, it is a medium effect, and when $f^2 > 0.35$, it is a large effect. GEO has a large effect on GIC ($f^2 = 0.468$) and GSCM ($f^2 = 0.639$). GSCM ($f^2 = 0.169$). A medium effect on SuP. In addition, GEO ($f^2 = 0.037$) and GIC ($f^2 = 0.064$) had a small effect on SuP (Table 5).
5) Predictive relevance (Q^2): The Stone-Geisser test (Q^2) is a test that measures the extent to which the model and its parameters produce observations that must be greater than 0 (Stone, 1974). The steps to generate the q2 values were performed in PLS-SEM using a blindfolding procedure. The blindfolding result shows that can SuP ($Q^2 = .328$), GIC ($Q^2 = .222$) and GSCM ($Q^2 = .249$) are all greater than 0 (Table 7).
6) Model Fit: The SRMR of this model is 0.057 (<0.08) (Hu & Bentler, 1998) , d_ULS is 0.346 (<0.95), and d_G is 0.160 (<0.95) (Dijkstra & Henseler, 2015) indicating that the model has a good fit to the set of sample data.

Conclusion & Discussion

Discussion

In this study, a hypothetical model was created to evaluate the relationship between GEO, GIC, GS CM and SuP based on natural basis theory. The results showed significant support for the relationship between GEO and SuP, which is consistent with the findings of scholars (Jiang et al., 2018). Fatoki (2019) demonstrated a model of green entrepreneurial orientation on sustainable performance. Fatoki (2019) argued that the model was tested on the data of companies in the hotel industry, and the causal relationship green entrepreneurial orientation has a positive impact on the sustainable performance of companies. We argued that green entrepreneurial orientation promotes sustainable performance.
The results support the positive effect of GEO on GIC, a finding that differs from previous studies in which (Wu & Yu, 2023) argued using a sample of hospitals that there is a strong positive correlation between GIC and entrepreneurial orientation and that relational and structural capital has a positive effect on entrepreneurial orientation. However, unlike manufacturing firms, hospitals are exposed to very different competition and consumer demand. Al-Jinini et al. (2019) concluded that intellectual capital has a positive effect on entrepreneurial orientation using Jordanian SMEs as the study population. Considering the relatively limited and competitive resources of SMEs, these companies need to reach a certain level before they can focus more on green development. In conjunction with the natural resource base theory, it is emphasized that sustainable business development depends on effective management and utilization of natural resources.
Moreover, there is a direct positive correlation between GEO and GSCM, which is consistent with the study done by Habib et al. (2020). The study by Linton et al. (2007) stated that companies with a green business orientation more inclined to share information and experience on environmental protection with their supply chain partners in order to create synergies. This study shows the positive impact of green entrepreneurial orientation on green supply chain management.

Furthermore, a direct positive relationship between GIC and SuP, which is consistent with Yusliza et al. (2020) whose data for the measurement model is Malaysian manufacturing companies, and green intellectual capital is key to the firm's intangible resources in terms of achieving sustainable performance and competitive advantage for future researchers. This model can be used by manufacturing industries in developing or developed countries as a strategic tool to improve their production capacity. In line with this study, many previous studies have found a direct positive contribution of green intellectual capital to the sustainable performance of firms (Martínez-Falcó et al., 2023; Wang & Juo, 2021).

Additionally, this study hypothesizes that GSCM has a significant impact on SuP. Many previous studies have found that the positive impact of green supply chain management on the sustainable performance of companies is reflected in the dimensions of economic efficiency, environmental sustainability, and social responsibility, which provides strong support for companies to move towards sustainability in the long term (Chin et al., 2015; Yildiz Çankaya & Sezen, 2019). The results of our study confirm this hypothesis.

Moreover, other research has examined the partially mediating role of GIC in the relationship between green entrepreneurial orientation and sustainable performance. Previous studies have focused on the direct effect of green entrepreneurship and sustainable performance and have not examined the mediating mechanism in depth. Green entrepreneurial orientation as a positive environmental strategy contributes to the sustainable development of firms by promoting the adoption of green technologies and sustainable business practices. Chen (2008) argues that a deep understanding of the green industry is crucial for enterprises to succeed in the green market. The implementation of Green Entrepreneurial Orientation by the companies leads to a deeper understanding and accumulation of green industry insights and knowledge by the market management team, as well as the accumulation of environment-related knowledge, experience, and skills, which contributes to sustainable performance. In addition, in-depth analyzes were conducted in conjunction with the knowledge perspective, which emphasizes the important role of intellectual capital in firm performance (Xu & Li, 2022). Ramírez et al. (2021) pointed out that through internal knowledge transformation and application, companies are better able to deal with environmental challenges, which in turn improves sustainable performance. Green intellectual capital as a knowledge resource partially mediates the relationship between green entrepreneurial orientation and sustainable performance by improving firms' knowledge accumulation related to environmental innovation and sustainable operations.

Finally, the study proves the partially mediating role of GSCM in the relationship between green entrepreneurial orientation and sustainable performance. This result is consistent with the conclusion of Habib et al. (2020), whose data for the measurement model is from 246 Bangladeshi textile companies, and the causal model proves the existence of a positive effect of GEO on GSCM, which ultimately affects the sustainable performance of economic performance, environmental performance, and social performance. Moreover, Alsadi & Aloulou (2021) show that supply chain integration fully mediates the effect of technological orientation on firm performance, while it partially mediates the effect of market orientation on firm performance. Our hypothesis significantly supports the mediating relationship of GSCM between green entrepreneurial orientation and sustainable performance.

Managerial Implication

The findings of this study bring the following practical implications. Firstly, the long-term business development and sustainability are intricately linked to the strategies executed by entrepreneurs, and GEO's emphasis on green innovation, risk-taking and green development orientation has resulted in green capital accumulation, such as green intellectual capital. In addition, it also strengthens the level of green supply chain management, which in turn achieves the goal of sustainable corporate development. Nowadays, the contradiction between economic

development and environmental pollution is becoming more and more prominent, and countries are proposing dual-carbon emission reduction policies, and consumers' demand for green products is increasing. Therefore, environmentally sensitive enterprises can promote the goodwill of stakeholders and attract more resources from investors. Enterprises need to disseminate green knowledge among management and employees, and efficiently flow from raw material procurement to products to gain green competitive advantages and maintain sustainable development.

Secondly, the findings offer crucial policy recommendations for governments. Leveraging these insights, governments can design policies that incentivize and support green entrepreneurship, encouraging firms to adopt more environmentally friendly and sustainable business models. This strategic approach will contribute to promoting sustainable regional economic growth, reducing resource wastage, and enhancing environmental quality.

Thirdly, for entrepreneurs and managers endeavoring to enhance economic, environmental, and social performance, this study provides essential managerial guidance. It outlines strategies for seizing a competitive advantage and transforming into an environmentally friendly, sustainable, and simultaneously profitable company. Manufacturing practitioners can enhance the social image of their firms by comprehensively understanding the interplay between strategic and environmental factors and by mitigating their environmental impacts through the implementation of enhanced Green Innovation GIC and GSCM.

Conclusion

GEO, as a guiding strategic policy for steering corporate green transformation and achieving sustainable development, plays a crucial role in addressing the conflicts between economic growth and environmental concerns. By implementing GEO, it can further propel companies to actively fulfill social responsibilities while achieving a win-win situation for sustainable development.

First, the results of the study show that GEO has a positive impact on GIC, GSCM, and SuP. Second, GIC and GSCM have been shown to have a positive direct impact on sustainable performance (SuP). This indicates that companies, by strengthening innovation capabilities and optimizing supply chain management, can directly elevate their levels of sustainable performance. Third, this study shows the partially mediating role of GIC and GSCM between GEO and SuP. This underscores the significance of green intellectual capital and a green supply chain as crucial organizational resources in establishing key connections between innovation orientation and sustainable performance.

In conclusion, this research makes a unique contribution in the field of GEO. It provides new insights for companies to gain a distinctive competitive advantage and serves as inspiration for manufacturing professionals to achieve Sustainable Performance through GIC and GSCM, thereby fostering sustainable development in companies.

Limitation and Further Research

The study may have relied on cross-sectional data, limiting the ability to establish causality between variables. Longitudinal studies could provide a more robust understanding of the dynamics between green entrepreneurial orientation, green intellectual capital, green supply chain management, and sustainable performance over time. The study's sample may have been limited in terms of size or diversity, potentially affecting the generalizability of the findings. Future research could employ larger and more diverse samples across different industries and geographical regions to enhance external validity. Despite efforts to develop reliable measurement instruments, measurement errors may still exist, potentially impacting the validity of the study's findings. Future research could refine measurement items and validate constructs using alternative methods to improve accuracy. Future research could explore potential moderating factors that influence the relationships examined in the model. For example, organizational size, industry type, and regulatory context could moderate the effects

of green entrepreneurial orientation on sustainable performance and its mediation through green intellectual capital and green supply chain management. Investigating the long-term effects of green entrepreneurial orientation on sustainable performance could provide insights into the sustainability of green initiatives over extended time horizons. Longitudinal studies tracking organizational performance over several years could shed light on the durability of sustainability practices and their outcomes. Further research could explore how contextual factors, such as market competitiveness, institutional pressures, and stakeholder expectations, shape the relationships between green entrepreneurial orientation, green intellectual capital, green supply chain management, and sustainable performance. Understanding these contextual influences could inform strategic decision-making for sustainable business practices.

References

Al-Jinini, D., Dahiyat, S., & Bontis, N. (2019). Intellectual capital, entrepreneurial orientation, and technical innovation in small and medium-sized enterprises. *Knowledge and Process Management, 26*(2), 69-85.

Alegre, J., & Chiva, R. (2013). Linking entrepreneurial orientation and firm performance: The role of organizational learning capability and innovation performance. *Journal of Small Business Management, 51*(4), 491-507.

Alsadi, A., & Aloulou, W. (2021). Impacts of strategic orientations on Saudi firm performance: is supply chain integration a missing link?. *The International Journal of Logistics Management, 32*(4), 1264-1289.

Asadi, S., Pourhashemi, S., Nilashi, M., Abdullah, R., Samad, S., Yadegaridehkordi, E., Aljojo, N., & Razali, N. (2020). Investigating influence of green innovation on sustainability performance: A case on Malaysian hotel industry. *Journal of Cleaner Production, 258*, 120860.

Chen, Y. (2008). The positive effect of green intellectual capital on competitive advantages of firms. *Journal of business ethics, 77*, 271-286.

Chen, Y., & Chang, C. (2011). Enhance environmental commitments and green intangible assets toward green competitive advantages: an analysis of structural equation modeling (SEM). *Quality & Quantity, 47*(1), 529-543.

Chienwattanasook, K., & Onputtha, S. (2022). The Impact of Inspirational Leadership on Green Supply Chain Management and Organizational Performance of Food and Beverage Companies. *Asian Administration and Management Review, 5*(1), 29-40.

Chin, T., Tat, H., & Sulaiman, Z. (2015). Green supply chain management, environmental collaboration and sustainability performance. *Procedia Cirp, 26*, 695-699.

Chin, W. (1998). The partial least squares approach to structural equation modeling. *Modern methods for business research, 295*(2), 295-336.

Cohen, J. (1988). Set correlation and contingency tables. *Applied psychological measurement, 12*(4), 425-434.

Cortes, A., Lee, Y., Cortes, J., & Liñan, I. (2021). Entrepreneurial orientation in supply chain management: a systematic review. *International Journal of Entrepreneurial Knowledge, 9*(1), 127-143.

Delmas, M., & Blass, V. (2010). Measuring corporate environmental performance: the trade-offs of sustainability ratings. *Business Strategy and the Environment, 19*(4), 245-260.

Dijkstra, T., & Henseler, J. (2015). Consistent and asymptotically normal PLS estimators for linear structural equations. *Computational statistics & data analysis, 81*, 10-23.

Ermawati, E., Budiyanto, B., & Suwitho, S. (2024). The effects of internal driver, external pressure and green entrepreneurial orientation (GEO) on green supply chain management (GSCM) performance through GSCM practice in wood processing companies in Lumajang district. *Uncertain Supply Chain Management, 12*(2), 633-648.

Fang, Y. (2022). Green entrepreneurial orientation, boundary-spanning search and enterprise sustainable performance: The moderating role of environmental dynamism. *Frontiers in Psychology, 13*, 978274.

Fatoki, O. (2019). Green entrepreneurial orientation and firm performance in South Africa. *VsI Entrepreneurship and Sustainability Center, 7*(1), 247-262.

Golicic, S., & Smith, C. (2013). A meta-analysis of environmentally sustainable supply chain management practices and firm performance. *Journal of supply chain management, 49*(2), 78-95.

Golsefid-Alavi, M., Sakhdari, K., & Alirezaei, A. (2021). A review of the literature on entrepreneurship and the environment: opportunities for researching on the green entrepreneurial orientation. *Environmental Engineering and Management Journal, 20*(5), 819-839.

Habib, M., 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 & Management, 7*(1), 1743616.

Hair, J., Ringle, C., & Sarstedt, M. (2011). PLS-SEM: Indeed a silver bullet. *Journal of Marketing theory and Practice, 19*(2), 139-152.

Hair, J., Ringle, C., & Sarstedt, M. (2013). Partial Least Squares Structural Equation Modeling: Rigorous Applications, Better Results and Higher Acceptance. *Long Range Planning, 46*, 1-12.

Hair, J., Sarstedt, M., Ringle, C., & Mena, J. (2012). An assessment of the use of partial least squares structural equation modeling in marketing research. *Journal of the academy of marketing science, 40*, 414-433.

Hair, J., Anderson, R., Babin, B., & Black, W. (2010). *Multivariate Data Analysis: A Global Perspective*. 7th ed. New Jersey: Pearson.

Hart, S. (1995). A natural-resource-based view of the firm. *Academy of management Review, 20*(4), 986-1014.

Henseler, J., Ringle, C., & Sarstedt, M. (2015). A new criterion for assessing discriminant validity in variance-based structural equation modeling. *Journal of the academy of marketing science, 43*, 115-135.

Horbach, J., Rammer, C., & Rennings, K. (2012). Determinants of eco-innovations by type of environmental impact—The role of regulatory push/pull, technology push and market pull. *Ecological economics, 78*, 112-122.

Hu, L., & Bentler, P. (1998). Fit indices in covariance structure modeling: Sensitivity to underparameterized model misspecification. *Psychological Methods, 3*(4), 424-453.

Huang, C., & Kung, F. (2011). Environmental consciousness and intellectual capital management: Evidence from Taiwan's manufacturing industry. *Management Decision, 49*(9), 1405-1425.

Hulland, J. (1999). Use of partial least squares (PLS) in strategic management research: A review of four recent studies. *Strategic management journal, 20*(2), 195-204.

Inayat, A., Afridi, S., & Javed, A. (2022). Green intellectual capital, green absorptive capacity, green dynamic capabilities, and sustainable performance: Green intellectual capital and sustainable performance. *City University Research Journal, 12*(2), 152-170.

Jabbour, C., & de Sousa Jabbour, A. (2016). Green human resource management and green supply chain management: Linking two emerging agendas. *Journal of Cleaner Production, 112*, 1824-1833.

Jiang, W., Chai, H., Shao, J., & Feng, T. (2018). Green entrepreneurial orientation for enhancing firm performance: A dynamic capability perspective. *Journal of Cleaner Production, 198*, 1311-1323.

Joong-Kun Cho, J., Ozment, J., & Sink, H. (2008). Logistics capability, logistics outsourcing and firm performance in an e-commerce market. *International Journal of Physical Distribution & Logistics Management, 38*(5), 336-359.

Li, X., Yang, J., Liu, H., & Zhuang, X. (2021). Entrepreneurial orientation and green management in an emerging economy: The moderating effects of social legitimacy and ownership type. *Journal of Cleaner Production, 316*, 128293.

Linton, J., Klassen, R., & Jayaraman, V. (2007). Sustainable supply chains: An introduction. *Journal of operations management, 25*(6), 1075-1082.

Liu, J., & Xie, J. (2020). Environmental regulation, technological innovation, and export competitiveness: An empirical study based on China's manufacturing industry. *International journal of environmental research and public health, 17*(4), 1427.

Makhloufi, L., Laghouag, A., Meirun, T., & Belaid, F. (2022). Impact of green entrepreneurship orientation on environmental performance: The natural resource-based view and environmental policy perspective. *Business Strategy and the Environment, 31*(1), 425-444.

Malik, S., Cao, Y., Mughal, Y., Kundi, G., Mughal, M., & Ramayah, T. (2020). Pathways towards sustainability in organizations: Empirical evidence on the role of green human resource management practices and green intellectual capital. *Sustainability, 12*(8), 3228.

Martínez-Falcó, J., Sánchez-García, E., Millan-Tudela, L., & Marco-Lajara, B. (2023). The role of green agriculture and green supply chain management in the green intellectual capital-Sustainable performance relationship: A structural equation modeling analysis applied to the Spanish wine industry. *Agriculture, 13*(2), 425.

McGahan, A. (2021). Integrating insights from the resource-based view of the firm into the new stakeholder theory. *Journal of Management, 47*(7), 1734-1756.

Naughton, B. (2021). *The rise of China's industrial policy, 1978 to 2020*. México: Facultad de Economía México.

Pagell, M., & Wu, Z. (2009). Building a more complete theory of sustainable supply chain management using case studies of 10 exemplars. *Journal of supply chain management, 45*(2), 37-56.

Parrish, B. (2010). Sustainability-driven entrepreneurship: Principles of organization design. *Journal of business Venturing, 25*(5), 510-523.

Ramírez, Y., Dieguez-Soto, J., & Manzaneque, M. (2021). How does intellectual capital efficiency affect firm performance? The moderating role of family management. *International Journal of Productivity and Performance Management, 70*(2), 297-324.

Seman, N., Govindan, K., Mardani, A., Zakuan, N., Saman, M., Hooker, R., & Ozkul, S. (2019). The mediating effect of green innovation on the relationship between green supply chain management and environmental performance. *Journal of Cleaner Production, 229*, 115-127.

Seuring, S., & Müller, M. (2008) From a Literature Review to a Conceptual Framework for Sustainable Supply Chain Management. *Journal of Cleaner Production, 16*, 1699-1710.

Stone, M. (1974). Cross-validatory choice and assessment of statistical predictions. *Journal of the royal statistical society: Series B (Methodological), 36*(2), 111-133.

Triguero, A., Moreno-Mondéjar, L., & Davia, M. (2013). Drivers of different types of eco-innovation in European SMEs. *Ecological economics, 92*, 25-33.

Vinzi, V., Chin, W., Henseler, J., & Wang, H. (2010). *Handbook of partial least squares: Concepts, Methods and Applications*. Heidelberg: Springer Berlin.

Walker, H., Di Sisto, L., & McBain, D. (2008). Drivers and barriers to environmental supply chain management practices: Lessons from the public and private sectors. *Journal of Purchasing and Supply Management, 14*(1), 69-85.

Wang, C. (2019). How organizational green culture influences green performance and competitive advantage: The mediating role of green innovation. *Journal of Manufacturing Technology Management, 30*(4), 666-683.

Wang, C., & Juo, W. (2021). An environmental policy of green intellectual capital: Green innovation strategy for performance sustainability. *Business Strategy and the Environment, 30*(7), 3241-3254.

Wu, W., & Yu, L. (2023). How Does Environmental Corporate Social Responsibility Affect Technological Innovation? The Role of Green Entrepreneurial Orientation and Green Intellectual Capital. *Journal of the Knowledge Economy,* https://doi.org/10.1007/s13132-023-01132-z.

Xu, J., & Li, J. (2022). The interrelationship between intellectual capital and firm performance: evidence from China's manufacturing sector. *Journal of Intellectual Capital, 23*(2), 313-341.

Yildiz Çankaya, S., & Sezen, B. (2019). Effects of green supply chain management practices on sustainability performance. *Journal of Manufacturing Technology Management, 30*(1), 98-121.

Yong, J., Yusliza, M., Ramayah, T., & Fawehinmi, O. (2019). Nexus between green intellectual capital and green human resource management. *Journal of Cleaner Production, 215,* 364-374.

Yuan, B., & Xiang, Q. (2018). Environmental regulation, industrial innovation and green development of Chinese manufacturing: Based on an extended CDM model. *Journal of Cleaner Production, 176,* 895-908.

Yusliza, M., Yong, J., Tanveer, M., Ramayah, T., Faezah, J., & Muhammad, Z. (2020). A structural model of the impact of green intellectual capital on sustainable performance. *Journal of Cleaner Production, 249,* 119334.

Yusoff, Y., Omar, M., Zaman, M., & Samad, S. (2019). Do all elements of green intellectual capital contribute toward business sustainability? Evidence from the Malaysian context using the Partial Least Squares method. *Journal of Cleaner Production, 234,* 626-637.

Zaid, A., Jaaron, A., & Bon, A. (2018). The impact of green human resource management and green supply chain management practices on sustainable performance: An empirical study. *Journal of Cleaner Production, 204,* 965-979.

Zhang, J., Liang, G., Feng, T., Yuan, C., & Jiang, W. (2020). Green innovation to respond to environmental regulation: How external knowledge adoption and green absorptive capacity matter?. *Business Strategy and the Environment, 29*(1), 39-53.

Zhou, K., & Li, C. (2007). How does strategic orientation matter in Chinese firms?. *Asia Pacific Journal of Management, 24*, 447-466.

Data Availability Statement: The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Conflicts of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's Note: All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the

editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.