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Role of green innovation, green internal, and external supply chain management practices: a gateway to environmental sustainability

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ABSTRACT

Amid rising environmental woes, this study investigates the influence of green innovation, green supply chain management (GSCM), and total quality management (TQM) on ecological sustainability. It also inspects the moderating effect of internal environmental management using primary data collected from 358 respondents from China's manufacturing industry. The findings exhibit that GSCM (cooperation with the customers and green procurement) significantly and positively influences ecological performance. Besides, green innovations reassure environmental practices, while TQM illustrates an insignificant impact on environmental performance. The outcomes strongly support that internal environmental management significantly moderates the connection between customer cooperation and environmental performance. It offers a valuable suggestion for firms and policymakers.

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1. Introduction

In the 21st century, the environmental issue is accepted as a significant challenge for which academicians, researchers, governmental organisations, and environmental activists try to create a trade-off between economic progress and ecological consequences (Balasubramanian et al., 2020; Shan et al., 2021). The World Environmental Conference (WEC) has been held since 2008, which mandates the global community to turn their development models into green and ecological dimensions while addressing environmental degradation. With the increasing awareness among different groups and societies, business organisations face growing pressure to deal with their environmental mismanagement practices in the form of toxic and wasteful materials during production. Since the 90s, it has been mandatory for business enterprises to modify their production models to meet the needs for environmental protection (Angell & Klassen, 1999; Chien et al., 2022). Because of increasing

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environmental pressure, business organisations seek to adopt and implement new measures to reduce the adverse environmental impacts generated through production and other operations (Khuntia et al., 2018). Hence, green supply chain management (GSCM) is critical to achieving environmental sustainability. GSCM considers all the resources and activities entitled to product development, purchasing and outsourcing, distribution, and reverse logistics (Sundarakani et al., 2010). Earlier studies have widely supported the role of GSCM in dealing with various concerns like environmental regulations, market demands, environmental degradation, green performance, and competitiveness (Benzidia et al., 2021; Y. J. Chen & Sheu, 2009; Rahmani & Yavari, 2019; Yu et al., 2021).

China is regarded as 'the world's factory' while dealing with rapid industrial and manufacturing growth in recent decades. However, the activities of the chemical and textile industries have also created severe environmental threats. Over the past two decades, the loss of total gross domestic product (GDP) caused by environmental damages has been between 7 and 20% (Li et al., 2020). Moreover, the enterprise production-related output is mainly responsible for environmental pollution among various activities. The Chinese government has increased the pressure on the business enterprise to reduce the adverse environmental outcomes of such an increasing threat to nature. In this regard, China has accepted many obligations to the GSCM both in the local and internal markets, where the internal market constantly focuses on similar practices as followed by the Chinese economy (Li et al., 2020). However, relevant discussion in the existing literature considering the role of GSMC in dealing with the environmental performance of manufacturing firms in China is insufficient.

In the recent literature, various authors have focussed on green innovation (GIN) based on the internal and external environment of the enterprises (Hazarika & Zhang, 2019). At the same time, GIN firms are believed to achieve environmental protection and energy saving (Saunila et al., 2018). In most earlier studies, GIN is replaced with ecological innovation, eco-innovations, and environmental innovations. Meanwhile, GIN is a good strategy for business organisations to achieve a competitive edge over rivals as it helps in environmentally sustainable products, management tools, and processes. However, the practical implications of GIN within the organisation significantly depend upon both the internal and external environment (X.-x. Huang et al., 2016).

The significance of ecological innovations in creating a sustainable environment for the business and community is also under consideration in the current literature (Waqas et al., 2021); however, from the context of the manufacturing industry in China, such a nexus is still in the emerging phase. At the same time, the role of total quality management (TQM) in justifying organisational performance has also achieved some good attention from researchers (Abbas & Kumari, 2021). Considering the TQM as a management system for consistent improvement, the long-term agenda of such practices is to achieve maximum customer satisfaction by utilising available resources (Qasrawi et al., 2017). Moreover, with their quality management and green performance strategies, those firms have outstanding potential to respond to changing customers' preferences and the green environment.

Therefore, considering TQM for checking the trends in environmental performance is quite evident.

Based on the above discussion, the current study will contribute to the existing body of literature by analysing the role of GSCM via cooperation with the customers and green procurement, green innovations, and TQM, specifically taking samples from selected Chinese manufacturing firms. Moreover, it also contributes by examining the moderating effect of internal environmental management on the relationship between the above-stated variables.

The rest of the paper is organised in the following manner: Sec. 2 covers the literature review. Sections 3 and 4 determine the research methods and study findings with the discussion. The last section concludes the study with policy implications and limitations for future directions.

2. Literature review

2.1. Green supply chain management and environmental sustainability

GSCM aims to eliminate solid waste, toxic chemicals, and pollutants. As a result, GSCM is essential in triggering any organisation's overall environmental impact while helping it improve environmental performance (Yildiz Çankaya & Sezen, 2019). Integrating environmental considerations into the supply chain and its management is the idea behind GSCM (Green et al., 2012). As a result, GSCM plays a significant role in determining how much influence supply chain activities have on an organisation's overall environmental progress. Therefore, GSCM can improve sustainable environmental practices. In recent years, there has been a rise in the research conducted on environmentally responsible management of supply chains in various industries. For instance, Badi and Murtagh (2019) investigate 207 publications while focussing on various industries in different economies. Their study concludes that GSCM comprises different activities, from the product's production to its end delivery to the customers.

Samad et al. (2021) show their significant interest in investigating the trends in GSCM. They claim that the idea behind GSCM is to include environmental considerations. Moreover, the study focuses on environmental, operational, and economic performance, considering the role of GSCM as a key explanatory variable. The results confirm that GSCM practices are positively and significantly linked with the environmental, operational, and economic performance dimensions. Additionally, their study justifies that collaborative capability significantly moderates the relationship between GSCM, environmental, and economic performance outlook. A. Jabbour et al. (2017) investigate whether or not consumers collaborate on the aspect of the internal environmental performance of organisations. Resource Dependence Theory (RDT) and Ecological Modernisation (EM) are utilised to assess the impacts of external GSCM procedures, specifically customer cooperation and green financing, on Environmental Performance (ENP). Based on the empirical estimations, the findings state that Brazilian organisations are more consumer-based than suppliers to enhance EP. Moreover, a matrix is proposed to better understand the roles that stakeholders and customers play to get an improved EP through GSCM. Although both GSCM and

ENP are directly linked; however, a clear connection between the implementation of GSCM practices and the development of ENP has become a hindrance for different industries.

Organisations attempt to overcome this barrier to justify integrating GSCM practices, as expressed by Shoaeinaeini et al. (2021). However, consumer environmental awareness and green subsidies justify the pricing policies for the GSCM. Habib et al. (2022) have comprehensively investigated the association between GSCM and ENP in Bangladesh's garments/textiles industry. Survey methodology obtained responses from 403 garment firms in a similar region for confirmatory factor analysis and structural equation modelling techniques. The empirical findings show that implementing GSCM practices is significantly and positively linked to environmental, economic, and operational performance dynamics. However, one of the critical issues observed in the garment industry is that it cannot integrate its environmental management practices with its stakeholder's long-run. Besides, one of the major contributions of their study is to incorporate the dynamics like green designing, green manufacturing, green purchasing, green transportation, green facilities, and end-of-life management under the title of GSCM. Based on the above arguments, the following hypotheses have been proposed.

H1: Green supply chain management's significant impact on environmental performance is in terms of cooperation with the customers.

H2: There is a significant impact of green supply chain management in terms of green procurement on environmental performance.

2.2. Green innovation and environmental sustainability

According to Skordoulis et al. (2022), a company's strategy for environmental conservation and special measures concentrating on implementing eco-friendly technology can boost its financial outcomes. Wen et al. (2022) investigate the connection between environmental quality and green innovations (GIN) in South Asian countries based on such arguments. The panel data set for five South Asian emerging economies from 1990 to 2014 was collected while applying the Dynamic Ordinary Least-squares (DOLS) and Fully Modified Ordinary Least-squares (FMOLS) to examine the long-term connection between variables. The study results show that GIN significantly raises South Asia's environmental quality. The findings of this study provide policymakers in South Asia with better alternatives for environmental sustainability through green innovation.

In addition, GIN is linked to an established environmental management strategy and encourages environmental performance (Sarpong & Meissner, 2018). Additionally, by reducing waste and costs, green product and process innovation lessens the negative environmental effect and improves its financial and social performance. Moreover, green innovation should not be seen as a company's reactive response to stakeholder demand but as proactive organisational practices that will improve environmental performance and provide a competitive edge (Yuana et al., 2022). Chiou et al. (2011) claim that although the literature support for the nexus between GSCM and environmental performance is reasonably presented, the link

between GIN, ENP, and competitive advantage is yet to be explicitly explored in different regional contexts. Considering the sample from 124 companies working in Taiwan, data was collected through a questionnaire and tested empirically. The results show that green innovation contributes significant benefits in the form of ENP and a competitive advantage over rivals.

Rehman et al. (2021) have also explored the role of GIN, green intellectual capital (GIC), and human resource management on ENP while claiming that the relationship between these variables is complex. Moreover, GIN helps mediate the association between GIC and green HRM practices where the environmental strategies directly promote the ENP. Wang et al. (2022) aim to focus on the association between GIN, ENP, and green financing for the developing economies during 2000 to 2016 through advanced-panel methodology. The results under long-run show that both GIN and ENP are positively associated with each other.

Based on the above discussion, it is inferred that ENP is stimulated by green innovation linked to a strong environmental management strategy. Furthermore, by reducing waste and costs, green product and process innovation improve the firm's financial and social performance and reduce the organisation's negative environmental effects. Therefore H3 is proposed and tested.

H3: Green Innovation significantly determines environmental performance.

2.3. Total quality management and environmental sustainability

The literature discussion on the nexus between TQM and environmental stance also has the researchers' attention. Abbas (2020a) investigates the relationship between TQM and corporate green performance (CGP). He analyzes how TQM influences CGP in light of the environmental deterioration primarily caused by industrial sectors. More specifically, based on the American 'Malcolm Baldrige National Quality Awad' CGP dimensions entitled green management techniques, operations, and effectiveness of green goods were considered by the author. Conversely, CSR encompasses social, employee, and consumer aspects. The study gathers datasets from the management of Pakistani medium- and large-sized companies. According to the structural equational analyses, TQM substantially affects CGP. It shows that TQM improves the organisational capacity to meet green performance goals. Moreover, it has been discovered that CSR partially mediates between CGP and TQM. Green et al. (2018) objectively evaluate the synergistic effects of TQM and environmentally friendly supply chain policies on ENP. The PLS-SEM approach evaluates the data from a sample of 225 US marketing managers. It is inferred that TQM and environmentally friendly techniques are closely associated.

Jimoh et al. (2019) examine the relationship between TQM practices and corporate green performance. Additionally, their study investigates how organisational culture (OC) influences the TQM procedures and CGP based on the resource-based and environmental theory. The structural analysis results demonstrated the positive effect of TQM on CGP. This shows that TQM methods significantly increase organisational capabilities to meet green performance goals. Yubing Yu et al. (2019) build a model to analyse the connections between environmental performance, GSCM, and supply

chain quality integration (SCQI), considering customer and supplier interactions. The model has been empirically evaluated using information gathered from 308 Chinese manufacturing firms. The study discovers that integrating client and supplier quality favours environmentally friendly procurement and consumer collaboration, which enhances ENP. The given study contributes to the literature on quality management and green management techniques by illuminating how SCQI affects ENP, hence debating environmental sustainability. Abbas (2020a) aims to investigate the trends in green organisational performance through TQM practices. The results confirm that TQM significantly enhances the organisational capabilities to achieve higher green performance. Based on the above discussion, H4 is developed.

H4: Total quality management has significant impacts on environmental performance.

2.4. Internal environmental management and environmental sustainability

An Environmental Management System (EMS), a set of processes and methodologies, is considered one way for an organisation to increase the efficiency of its operations while simultaneously reducing the negative impacts on the environment (EPA, 2022). In the contemporary business environment, the majority of industrial organisations are familiar with the ideas of accounting for environmental management. Internal environmental management (IEM) is based on the intra-firm practices developed through internal organisational resources while considering the strategic environmental objectives (Green et al., 2012). For addressing such objectives, regular training of the employees also generates some real understanding for the human resource to actively play their role in dealing with environmental responsibilities while complying with environmental regulations (Sharpe, 2017). However, the strength of implementing green practices within the organisation significantly depends upon department cooperation. At the same time, auditing the environmental practices would help the firms to track non-compliance with environmental regulations while ensuring ecological targets (Zhu & Sarkis, 2004). As the title of IEM is directly connected with environmental sustainability, Afum et al. (2021) investigate the combined effect of GHRM and IEM on ENP, financial performance, and corporate reputation. Data was collected through 164 firms working in Ghana and further analysed through PLS-SEM. The study findings show that the combined effect of GHRM and IEM is significantly and positively linked with ENP and financial performance. Therefore, it is suggested that firms that need to enjoy better reputations and higher ENP should focus on integrating GHRM and IEM. Jabbour et al. (2014) focus on environmental management maturity, quality management, and GSCM to justify the trends in green performance, for which data was collected from 95 Brazilian firms. The results confirm that for the improvement in green organisational performance, an attention should be paid to environmental management, green innovation and GSCM, respectively. Although the direct influence of IEM on environmental sustainability and performance dynamics have been investigated in the existing literature; however none of the current literature is able to investigate its moderating effect on the association between GSCM, GIN, TQM,

and ENP, respectively. Therefore, this study has contributed to the literature while testing the following hypotheses.

H5: Internal environmental management has a significant impact on environmental performance.

H6: Internal environmental management significantly moderates the relationship between CEC and ENP.

H7: Internal environmental management significantly moderates the relationship between GPR and ENP.

H8: Internal environmental management significantly moderates the relationship between GIN and ENP.

H9: Internal environmental management significantly moderates the relationship between CEC and ENP.

3. Research methods

The current research investigates the GSCM, GIN, and TQM as critical explanatory variables for ENP in Chinese firms while adding the moderating effect of IEM. Initially, a questionnaire was developed for data collection from the targeted firms in China. For measuring the GSCM, two latent constructs entitled cooperation with the customers (CEC) and green procurement (GPR) with selected from existing literature. More specifically, CEC is measured through four items as extracted from the research contribution of Zhu et al. (2008), where the sample items consist of 'Your company cooperates with customers to promote environmentally friendly design' and 'Your company cooperates with customers to promote green packaging', respectively. Similarly, GPR is measured through six items based on the sample statements like 'Your company puts an ecolabel on the supplied products' and 'Your company evaluates the environmental protection practices of sub-tier suppliers', as selected from the study of Zhu et al. (2008), accordingly. In addition, GIN is measured through five items based on the theoretical suggestion of Y.-S. Chen et al. (2006). Sample items consist of 'The company chooses the materials of the product that produce the least amount of pollution', and 'The company uses the smallest amount of materials to create the product'. Moreover, ENP and IEM measurements consist of five items each, as extracted from the research study by Green et al. (2012) and Zhu et al. (2008). Besides, TQM has been measured through five items (Abbas, 2020b).

All the items were measured on five points Likert Scale, ranging from strongly disagree to strongly agree. Both online and face-to-face techniques for the data collection were considered for which various manufacturing firms in China were considered. A sample of 467 responses were initially collected through online and offline techniques. However, several offline questionnaires were missing the proper feedback from the respondents; therefore, they dropped from the sample of 467. Consequently, a final valid sample of 358 responses was analysed through Smart PLS 3.0 while applying both the measurement and structural models.

Figure 1 shows the research framework of the study covering the direct and indirect association between the variables.

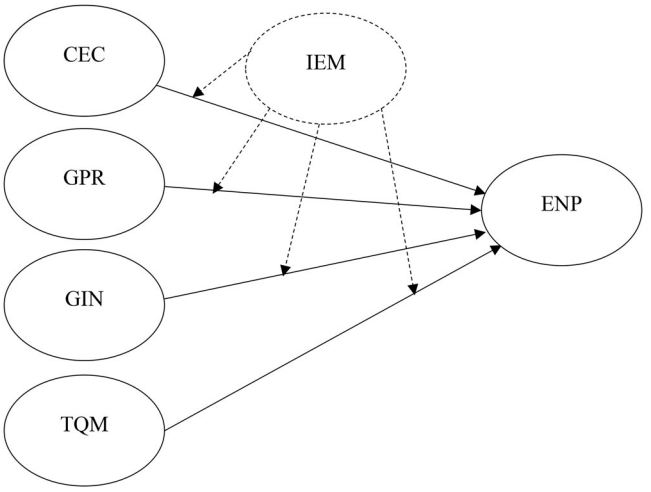

Figure 1. Framework of the study. Note: CEC: Cooperation with customers, ENP: environmental performance, GIN: green innovation, GPR: green procurement, IEM: internal environmental management, TQM: total quality management. Source: Author's own.

Table 1. Reliability and validity.

Variables	Cronbach's alpha	rho_A	Composite reliability	(AVE)
CEC	0.788	0.803	0.861	0.609
ENP	0.801	0.799	0.883	0.717
GIN	0.746	0.724	0.842	0.535
GPR	0.850	0.951	0.893	0.678
IEM	0.859	0.869	0.899	0.641
TQM	0.889	0.906	0.923	0.750

Note: CEC: Cooperation with customers, ENP: environmental performance, GIN: green innovation, GPR: green procurement, IEM: internal environmental management, TQM: total quality management.
Source: Author's own.

4. Results and discussion

4.1. Measurement model assessment

Initially, this study assesses the measurement model for which findings are covered in Table 1. To check the constructs' reliability and validity, overall Cronbach's alpha for the study variables entitled cooperation with the customers, environmental performance, green innovation, green procurement, internal environmental management, and total quality management has been calculated using Smart PLS. As per the threshold level of Cronbach's Alpha, all the study constructs have reported their relative score of above 0.70, confirming the existence of reliability of the constructs. Similarly, the findings in Table 1 also report the rho_A for all the variables above 0.70, confirming the consistency in the reliability of the latent variables. Moreover, the internal consistency of the scaled items and accepted as similar to Cronbach's alpha score (Netemeyer et al., 2003). As per the suggestion of Netemeyer et al. (2003), the threshold level for the study constructs in composite reliability should be at least 0.80. As per the findings, all the variables show a relative score of composite reliability of

Table 2. Fornell-Larcker criterion.

	CEC	ENP	GIN	GPR	IEM	TQM
CEC	0.780					
ENP	0.289	0.847				
GIN	0.153	0.149	0.731			
GPR	−0.165	−0.084	−0.719	0.823		
IEM	0.447	0.349	0.292	−0.137	0.801	
TQM	0.480	0.269	0.306	−0.172	0.608	0.866

Note: CEC: Cooperation with customers, ENP: environmental performance, GIN: green innovation, GPR: green procurement, IEM: internal environmental management, TQM: total quality management.
Source: Author's own.

above 0.80. Besides, Table 1 covers the AVE scores, which show that all the variables show acceptable values above 0.50 (Hair et al., 1998).

Fornell and Bookstein (1982) criteria have been utilised to investigate the discriminant validity of the latent constructs, for which findings are presented in Table 2. As per the given criteria of Fornell-Larcker, the values shown in the diagonal (Table 2) must be greater than the rest of the values in the off-diagonal. The results confirm that the diagonal values for the study constructs are greater than the rest of the values in the parallel row and column, through which the discriminant validity of the model would be justified. This approach is significantly justified in the existing body of literature (Cepeda-Carrión et al., 2022). More specifically, the Fornell-Larcker reflects the square root of AVE of the latent construct, which is greater than its correlation with the other constructs in a similar model (Errassafi et al., 2019).

Additionally, the discriminant validity of the latent construct is also investigated through the HTMT ratio, for which findings have been presented in Table 3. More specifically, the HTMT ratio of correlation reflects the discriminant if the value is less than 0.90 (Henseler et al., 2015). As per the findings below, the HTMT ratio of correlation between the latent constructs of the study shows that the maximum value is 0.693 between internal environmental management and total quality management. Therefore, it is inferred that discriminant validity exists between the study variables.

Besides, the measurement model of the current study is also investigated in terms of multicollinearity between the selected variables, for which Table 4 shows the variance inflation factor (VIF). As per the given threshold level of 5 in the existing literature (O'Brien, 2007), the result confirms that VIF for all the study variables is less than five, which means that there is no problem with the higher interdependency between cooperation with the customers, environmental performance, green innovation, green procurement, internal environmental management, and total quality management, respectively. Figure 2 reports the output for the measurement model of the study covering the factor loadings of comparable items for latent constructs. It is observed that the relative items have reported their factor loadings of above 0.50.

4.2. Structural model Assessment

4.2.1. Direction relationship between the variables

The findings in Table 5 cover the direct association between the selected variables. The results show that CEC is significantly and positively linked with environmental

Table 3. Heterotrait-monotrait ratio (HTMT).

	CEC	ENP	GIN	GPR	IEM	TQM
CEC	–					
ENP	0.348					
GIN	0.204	0.176				
GPR	0.219	0.093	0.316			
IEM	0.526	0.412	0.359	0.195		
TQM	0.568	0.309	0.376	0.206	0.693	–

Note: CEC: Cooperation with customers, ENP: environmental performance, GIN: green innovation, GPR: green procurement, IEM: internal environmental management, TQM: total quality management.
Source: Author's own.

Table 4. Inner VIF values.

Variables	ENP
CEC	1.400
ENP	–
GIN	2.319
GPR	2.143
IEM	1.726
TQM	1.791

Note: CEC: Cooperation with customers, ENP: environmental performance, GIN: green innovation, GPR: green procurement, IEM: internal environmental management, TQM: total quality management.
Source: Author's own.

performance (i.e., beta = 0.160, standard deviation = 0.055, T-statistics = 2.909, p-value = 0.0004). It shows that green supply chain management in cooperation with the customers helps increase the environmental performance among the selected companies in China. More specifically, this would indicate that promoting the GSCM in the form of CEC is a good indication for achieving positive trends in environmental practices. The findings confirm that stakeholders like customers are essential in green supply chain management practices.

The pressure from the market, customers, and other stakeholders would create an overall compression for the betterment of the environment (Y.-C. Huang et al., 2021). At the same time, cooperating with the customers would help the company focus on its green SCM practices, which in turn causes a significant upward shift in environmental performance and vice versa. For this purpose, it is highly recommended that companies look into their green business practices specifically while taking care of their customers in the relative market (Y.-C. Huang et al., 2021). As the association between CEC and ENP is significantly positive; therefore, it is inferred that H1 is accepted.

The results show that green procurement positively impacts ENP, for which the coefficient is highly significant at 5%. More specifically, it shows that a 1% upward shift in GPR is causing an overall change of 0.260% in ENP in China. The stated coefficient reflects a t-score of 3.209, confirming the significant association between green procurement and environmental performance. In this regard, Esty and Winston (2006) state that a green supply chain comprises green procurement, which focuses on the suppliers to develop the products' environmental sustainability (Zhu et al., 2008). Moreover, earlier studies have also investigated the role of green procurement among the supply chain indicators to reflect the trends in green organisational

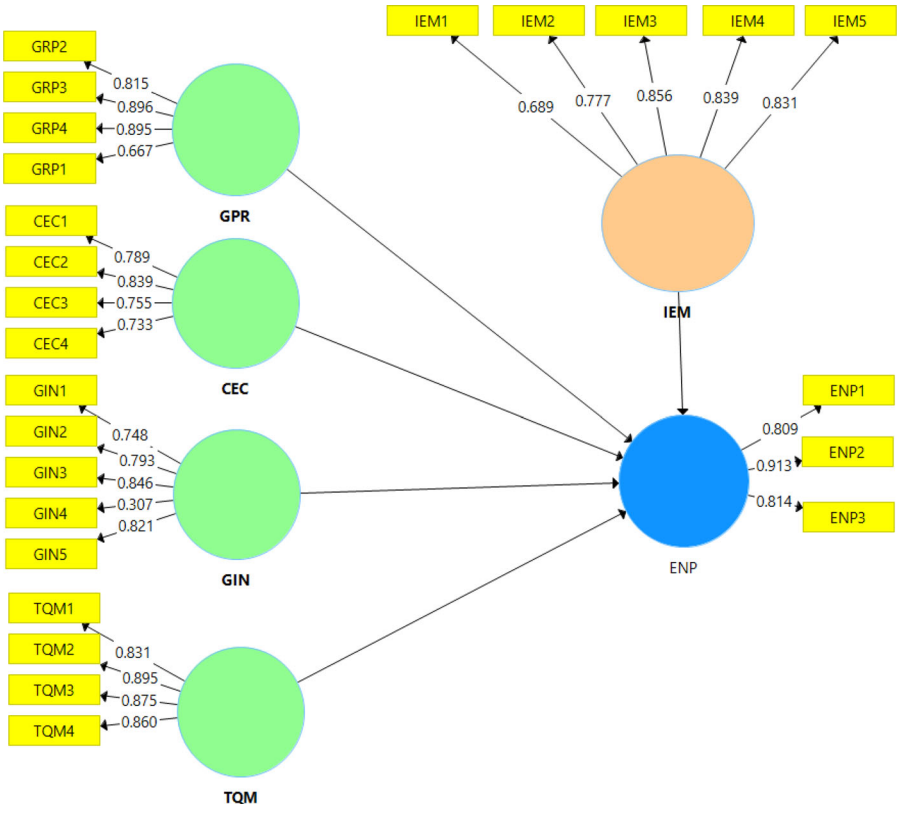

Figure 2. Measurement model output. Note: CEC: Cooperation with customers, ENP: environmental performance, GIN: green innovation, GPR: green procurement, IEM: internal environmental management, TQM: total quality management, Items entitled GPR5, GPR6, TQM5, ENP4, and ENP5 were deleted because of lower factor loadings. Source: Author's own.

Table 5. Direction relationships.

Hypotheses	Directions	Original sample	Standard deviation	T statistics	P-values
H1	CEC -> ENP	0.160	0.055	2.909	0.004
H2	GPR -> ENP	0.260	0.081	3.209	0.000
H3	GIN -> ENP	0.631	0.078	8.089	0.000
H4	TQM -> ENP	0.028	0.055	0.510	0.610
H5	IEM -> ENP	0.245	0.057	4.307	0.000

Note: CEC: Cooperation with customers, ENP: environmental performance, GIN: green innovation, GPR: green procurement, IEM: internal environmental management, TQM: total quality management.
Source: Author's own.

performance. For instance, Jermsittiparsert et al. (2019) claim that green procurement must be environmentally friendly. In this regard, firms must focus on their purchasing habits while considering the supplier's attitude towards environmental regulations so that products must be produced and supplied environmentally friendly. The results accept H2.

Table 5 reports that the coefficient for the relationship between GIN and ENP is 0.631, with a standard deviation of 0.078. This show that a 1% increase in green innovation tends to increase ENP by 0.631% in Chinese companies. Additionally, the

t-statistics for the nexus between GIN-ENP is 8.089 with a p-value of 0.000. It shows that higher green innovation practices would significantly promote environmental performance. In the existing literature, a vast body of literature has confirmed the positive impact of GIN on ENP. For example, Chiou et al. (2011) investigated the influence of green innovation on environmental performance across 124 companies working across eight Taiwan industries. The findings through the structural equation modelling approach confirm that GIN significantly and positively impacts ENP among the selected industries, further enhancing the competitive advantage. Singh et al. (2020) also focus on the relationship between GIN and ENP for small and medium enterprises while collecting the data through a survey questionnaire. The results support the direct impact of GIN on ENP. Besides, Rehman et al. (2021) also observe the trends in environmental outlook through green innovation and intellectual capital, where it is confirmed that green innovation strategies lead to higher ENP; therefore, H3 is supported.

Moreover, such procurement should not have violated environmental regulations (Kronborg Jensen, 2012). Contrarily the relationship between TQM and ENP is found to be positively insignificant, which means that there is no impact of TQM on the environmental performance of selected firms in China. However, IEM has reflected a significant and positive impact on environmental performance with a coefficient of 0.245 and a t-value of 4.307. It means that managing the internal environment in the organisational would generate an overall fruitful impact on environmental outcomes. Additionally, IEM helps the organisation realise environmental goals while considering its internal resources and capabilities. In this regard, existing literature urges the firms to implement an environmental management system (EMS) while achieving ISO14001 certification (Balasubramanian & Shukla, 2017). Additionally, regular environmental training for the employees would help achieve better IEM, promoting the organisation's environmental practices. Therefore, it is inferred that more promotion of IEM is a good indication of achieving an upward trend in ENP; hence H5 is supported. For better understanding, Figure 3 shows the output for the direct association between the study variables, where the inner model covers the p-values of the latent constructs.

4.2.3. Analyzing the moderating effect

After investigating the direct relationships between the variables, Table 6 explores the moderating role of IEM. The results show that the interactive term of CEC and IEM is positively and significantly linked with the ENP, confirming that combined cooperation with the customers and internal environmental management generates fruitful results in better environmental performance. More specifically, the t-statistics of 6.60 helps achieve the p-value of 0.000, which means that there is a significant and positive moderating effect of IEM on the relationship between CEC and ENP in the Chinese economy. This is because more focus on IEM and green supply chain activities like CEC would help in green environmental practices. At the same time, such integration between IEM and CEC also provides more capabilities to the firms to reduce the environmental impacts of their operational activities. At the same time,

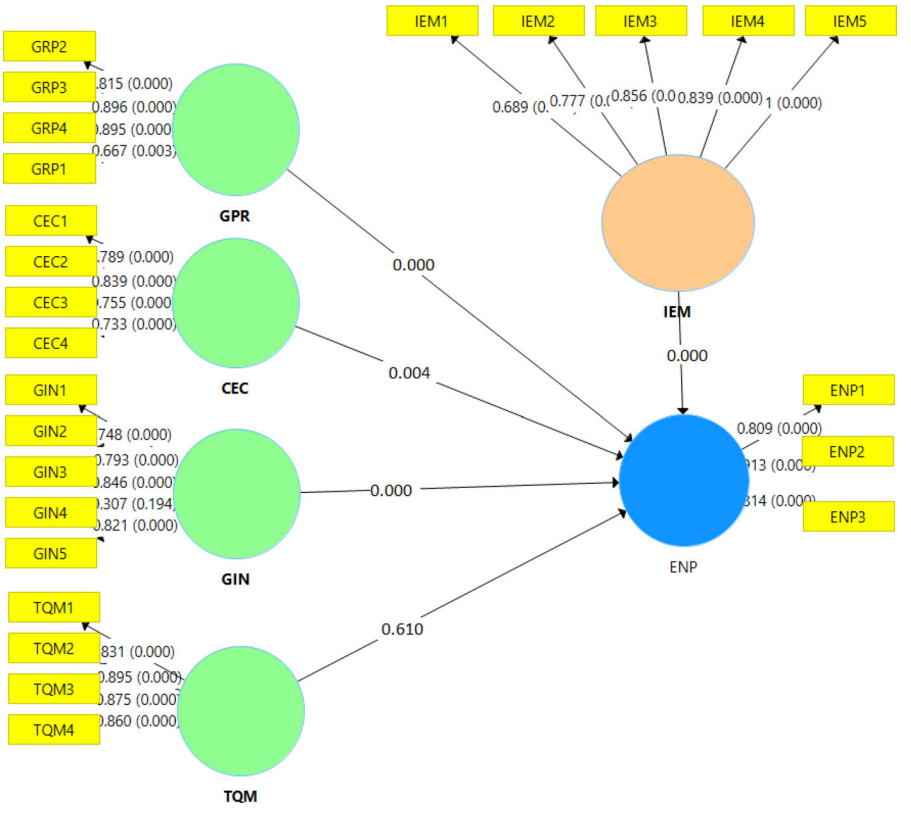

Figure 3. Direction relationships between the variables. Note: CEC: Cooperation with customers, ENP: environmental performance, GIN: green innovation, GPR: green procurement, IEM: internal environmental management, TQM: total quality management. Source: Author's own.

Table 6. Moderating effect of IEM.

Hypotheses	Relationship	Original sample	SD	T statistics	P values
H6	CEC*IEM -> ENP	0.330	0.05	6.6	0.000
H7	GPR*IEM -> ENP	−0.038	0.064	0.59	0.555
H8	GIN*IEM -> ENP	0.007	0.065	0.107	0.915
H9	TQM*IEM -> ENP	0.22	0.063	3.492063	0.000

Note: CEC: Cooperation with customers, ENP: environmental performance, GIN: green innovation, GPR: green procurement, IEM: internal environmental management, TQM: total quality management.
Source: Author's own.

coordination and well-developed intra-firm cooperation also generate more strength for the business organisations for which IEM is crucial.

IEM also promotes synergy and efficiency within the organisation (De Giovanni & Vinzi, 2012). Therefore, integrating IEM with GSCM practices like CEC is quite evident, through which more sustainable environmental results would be achieved. Therefore, H6 is supported. However, the moderating effect of IEM between green innovation and ENP and between GPR and ENP is found to be positively (negatively) insignificant. This shows that IEM has no interactive role in promoting the association between green innovation and environmental performance and between green

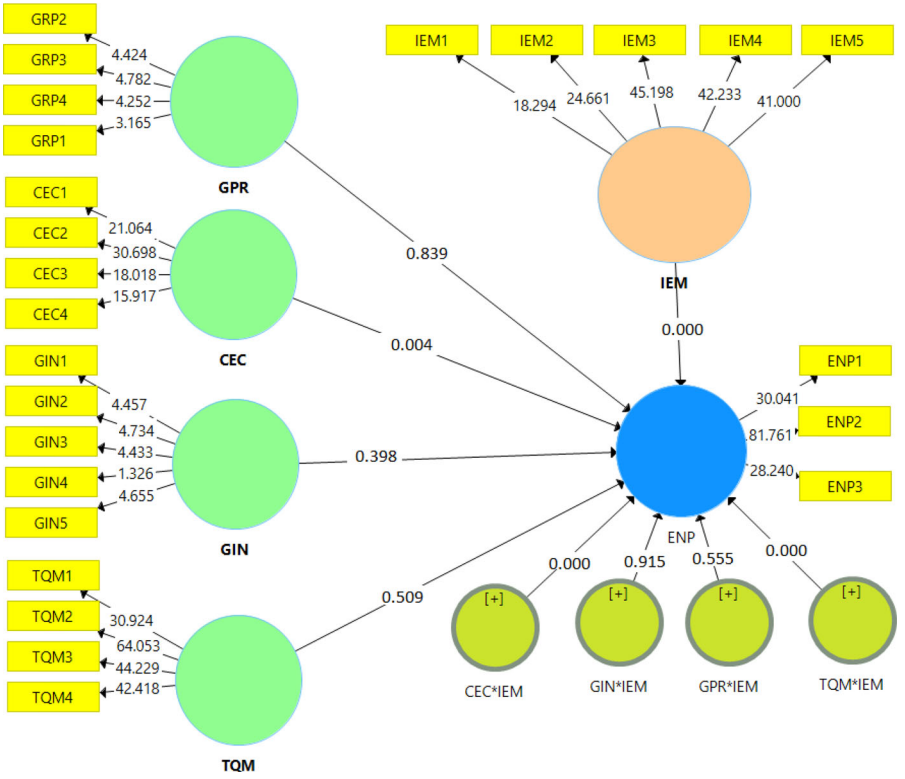

Figure 4. Structural model output. Note: CEC: Cooperation with customers, ENP: environmental performance, GIN: green innovation, GPR: green procurement, IEM: internal environmental management, TQM: total quality management. Source: Author's own.

procurement and environmental performance. However, the direct impact of green innovation and GPR on ENP is highly significant, which means that both of these indicators are quite important in achieving higher environmental performance for which IEM has no influence as a moderator. Finally, our findings show that IEM significantly and positively moderates the relationship between total quality management and ENP (beta = 0.220, SD = 0.063, T-statistics, 3.49, p-value = 0.000). It shows that with the presence of IEM, the selected firms in China may create a strong and positive association between quality management practices and environmental outcomes. Such results support H9. Figure 4 indicates the output for the structural model covering the moderating effect of IEM between exogenous constructs and ENP.

5. Conclusion and implications

This study investigates the role of green supply chain management practices as measured through cooperation with the customers and green procurement, green innovation, and total quality management in determining the environmental performance of Chinese firms. Both the measurement model and structural model were applied through Smart PLS 3.0. The results indicate that green supply chain management and innovations significantly determine China's positive environmental performance

trends. Moreover, the study results also investigate whether the internal environmental management practices significantly mediate the association between green procurement, customer cooperation, green innovation, total quality management, and environmental performance. The findings confirm that better IEM practices would help strengthen the positive relationship of GSCM in the form of CEC and TQM with environmental performance in the Chinese economy. Based on these empirical findings, the followings are the theoretical and practical implications:

This study reveals that focussing on external stakeholders like customers may generate better environmental outcomes. Such cooperation would help promote the environmentally-friendly design for cleaner production, green packing, and less energy consumption during transportation. In this regard, it is highly suggested that manufacturing firms in China constantly focus on regular customer interaction to achieve better GSCM practices and sustainable environmental outcomes. At the same time, interaction with the supplier is another strategy to promote GSCM practices, specifically during procurement. Moreover, monitoring the environmental-protection practices of the suppliers would be another suggestion for manufacturing firms to significantly achieve green outcomes under the shadow of the supply chain management process. The above suggestions mainly consider that management at manufacturing firms must focus on its key stakeholders linked with the GSM practices.

In addition, green innovation reflects a significantly positive linkage with the environmental performance of manufacturing firms in China. This would suggest that promoting such innovation, while supported by manufacturing firms' research and development expenditure, may also generate some consistent environmental outcomes in low degradation. At the same time, management at these organisations needs to replace their existing energy sources with innovative and clean so that the environmental burden can be reduced accordingly. Finally, IEM provides significant evidence to moderate the relationship between CEC-ENP and TQM-ENP. In this regard, integrating stakeholder management practices with internal environmental practices is highly suggested as it further promotes green environmental results in China's manufacturing industry. Meanwhile, management should focus on enhancing cross-functional cooperation among different departments and a proper environmental management system.

Besides, this research is also linked with several limitations that highlight future directions. For example, this study only focuses on China's manufacturing industry while ignoring the other sectors and sub-sectors. Additionally, it only considers cooperation with the customers and green procurement to reflect the green supply chain management practices. Moreover, only primary data collection techniques like questionnaires were considered. Future studies are suggested to expand the GCSM focus in the form of green design, purchasing, manufacturing, transportation, and facilities. At the same time, the implication of mixed-method research may also generate some outstanding results in generalisation and policy implications.

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