The impact of green supply chain integration on the innovation of Vietnamese agricultural enterprises

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Abstract

While green supply chain integration (GSCI) is important, its effect on lip innovation remains unclear. Drawing on information processing theory, the author explores how three aspects of GSCI (i.e., green supplier integration, internal integration, and customer integration) affect two types of innovation (product innovation and process innovation). The author tests the hypotheses using two-dimensional survey data from 222 Vietnamese agricultural enterprises and model analysis of structural equations.

1. INTRODUCTION

While green supply chain integration (GSCI) is important, its effect on lip innovation remains unclear. Drawing on information processing theory, the author explores how three aspects of GSCI (i.e., green supplier integration, internal integration, and customer integration) affect two types of innovation (product innovation and process innovation). The author tests the hypotheses using two-dimensional survey data from 222 Vietnamese agricultural enterprises and model analysis of structural equations.

While there is widespread interest in the importance of green supply chain integration (GSCI), there is still limited research on how GSCI can improve companies' green innovation performance. From a natural resource-based perspective and dynamic competency theory, based on the theoretical logic of "resources-capacity-performance", this study aims to explore the relationship between GSCI and the green innovation performance of the enterprise and its intrinsic mechanisms. To test the research model, this study collected survey data from 405 Chinese manufacturing companies and tested them using hierarchical regression and bootstrap analysis. The results show that all three aspects of GSCI, namely green internal integration, green supplier

integration, and green customer integration, have a positive impact on supply chain flexibility. In addition, supply chain flexibility has a significant positive impact on process innovation and green products. This study also found that supply chain flexibility acts as a partial intermediary between all three aspects of GSCI and green product and process innovation; that is, GSCI can further boost companies' green innovation performance by improving supply chain flexibility. The results of this study not only enrich theoretical research on the factors driving green innovation of enterprises, but also provide policy suggestions for manufacturing enterprises and government policymakers related to the implementation and promotion of green innovation activities. This study also found that supply chain flexibility acts as a partial intermediary between all three aspects of GSCI and green product and process innovation; that is, GSCI can further boost companies' green innovation performance by improving supply chain flexibility. The results of this study not only enrich theoretical research on the factors driving green innovation of enterprises, but also provide policy suggestions for manufacturing enterprises and government policymakers related to the implementation and promotion of green innovation activities. This study also found that supply chain flexibility acts as a partial intermediary between all three aspects of GSCI and green product and process innovation; that is, GSCI can further boost companies' green innovation performance by improving supply chain flexibility. The results of this study not only enrich theoretical research on the factors driving green innovation of enterprises, but also provide policy suggestions for manufacturing enterprises and government policymakers related to the implementation and promotion of green innovation activities.

2. Literature review

2.1. Green supply chain integration

Green supply chain integration concept

Green supply chain management concept

According to Lee (2015), green supply chain management (GSCM) is an environmentally oriented supply chain management strategy in which "green" ideas are introduced to improve the performance of environmental protection in SCM activities.

GSCM is an extremely promising strategy when taking into account environmental factors in supply chain management. Broadly, GSCM delivers comprehensive environmental improvements by adopting a lifecycle approach from product design, material selection, final production and sales, and recall.

According to Srivastara (2007) defines GSCM as "integrating environmental thinking into SCM, including product design, selection and sourcing of raw materials, manufacturing processes, delivery of final products to customers, and end-of-life management of products after lifetime". According to Hsu and Hu (2010), GSCM is a proactive approach to improving the environmental performance of processes and products in line with environmental regulatory requirements. Taking a green approach to managing resources in the supply chain has become a trend, which makes GSCM an important topic in many studies.

Zhu et al. (2005) proposed that GSCM is a form of SCM to reduce the negative impact of products and services on the environment, starting from the design and purchase of raw materials to the production and treatment of post-consumption waste. Testa and Iraldo (2010) point out that GSCM has been adopted by many companies to meet customer

requirements for environmentally friendly products and services, produced through green processes and meeting environmental laws.

To summarize, we can draw some general conclusions about "Green Supply Chain Management" as follows:

GSCM is a set of activities that integrate environmental issues into SCM to improve the environmental performance of the entire supply chain as well as contribute to environmental protection.

GSCM with its importance is becoming a popular trend for businesses worldwide in the 21st century.

GSCM implementation promotes environmental performance , helps businesses raise awareness in environmental protection.

Overall, with increasing pressure on environmental issues, GSCM is a much-needed strategy. The success of GSCM depends on environmental, social and economic outputs to ensure operational performance and sustainable development of the business. Therefore, researching and applying green supply chain management is one of the top goals in maintaining the sustainability of businesses

Supply Chain Integration

According to Flynn et al. (2010), supply chain integration (SCI) is a process where all parties involved in perfecting products are integrated into a single system. This requires significant coordination and alignment to ensure parts of the business are always working effectively towards the same goal.

The concept of SCI emerged decades ago and has been adopted by companies across the globe to dramatically improve their systems. While there are many different ways to implement this mechanism, all must ensure there is an element of "information sharing". Therefore, Yu et al. (2019) made the point: SCI can be thought of as a mechanism of 'supply chain information processing and general interpretation' to minimize ambiguity by increasing the ability of supply chain partners to interpret information.

The fact that the parts and information needed for a product are displayed where needed, when needed, not only helps prevent delays in the production process but also eliminates a lot of wasted time, storage space. When done properly, SCI will move the parties towards a unified destination.

In short, SCI is the construction of communication systems of all stakeholders in order to improve the performance of information exchange based on plans, implementation and completion of transport and logistics activities throughout the life of the product.

Green Supply Chain Integration

According to Sarkis et al. (2011), GSCI can be defined as the degree to which a manufacturer builds strategic relationships with partners in its supply chain and integrates environmental concerns into internal and inter-organizational processes. This definition once again emphasizes the application of the philosophy of supply chain integration into GSCM to form the concept of GSCI. Because the idea of green supply chain integration originates from the combination of green supply chain management and supply chain integration. GSCI is a much more focused and specific concept than GSCM.

According to Mao, Zhang and Li (2017) as well as Du et al. (2018), GSCI is the degree to which a manufacturer integrates with its supply chain partners and collaboratively manages internal

and inter-organizational processes to reduce its impact on the environment. Accordingly, GSCI emphasizes the importance of green cooperation to achieve mutually beneficial sustainability goals.

According to Flynn et al. (2010) and Shi et al. (2012), GSCI can be defined as a collaboration between an enterprise and supply chain partners to direct environmental performance internally and inter-organizationally. Up to now, although there is no official definition of GSCI, some general conclusions can be generalized as follows:

GSCI refers to the extent to which a manufacturer cooperates strategically with parties in the supply chain to meet environmental requirements.

As a structure, GSCI helps businesses allocate, coordinate and implement key resources needed for environmental strategy.

Green supply chain integration classification

As of now, not many studies have come up with the model used to divide GSCI. According to Flynn et al. (2010), most studies on GSCI division often use the same model, relying on SCI division to divide GSCI into 3 categories: green internal integration, green supplier integration, and green customer integration.

Green Internal Integration

Flynn et al. (2010) and colleagues definegreen internal integration (GII) as the degree to which an enterprise conducts environmental management activities when managing internal processes. Typical activities include cross-functional cooperation to improve the environment, focusing on strengthening cooperation between departments, creating favorable conditions for employees to participate in environmental initiatives, accumulating and sharing knowledge on environmental protection.

GII uses hierarchy, information sharing, interfunctional integration system as a mechanism to integrate business strategy with management system, and cross-functional cooperation to solve environmental problems. Such mechanisms integrate environmental and business management objectives and responsibilities. An integrated environmental management system leverages various functions to integrate environmental criteria into employee codes of conduct, commercial decisions, and resource management decisions. Integrated information systems are based on a product lifecycle approach, supporting cross-functional collaboration, joint planning, and implementation of environmental management activities. Hierarchical coordination, integrated strategy, and management systems are the foundation of integrated information processing and exchange capabilities.

Green Supplier Integration

According to Flynn et al. (2010),the Green Supplier Partnership (GSI) uses mechanisms such as information sharing, collaboration, and closed-loop process linkages with suppliers, emphasizing collaboration with suppliers in addressing environmental issues. As a buyer, you often use a combined governance structure that includes environmental cooperation and monitoring to verify that suppliers are implementing environmental management activities. Typically, GSI activities include setting common environmental objectives with suppliers, informing suppliers of environmental requirements such as cleaner production specifications or technologies, performing environmental audits of suppliers. Require suppliers to perform environmental management or to obtain third-party

certification of their environmental management and to select suppliers on the basis of environmental criteria.

Green Customer Integration

According to Flynn et al. (2010), Green Customer Integration (GCI) also relies on integration mechanisms between organizations such as information exchange and collaboration to facilitate strategic information sharing, collaboration, and closed process linkages with customers. As suppliers of products to customers, entrepreneurs often use environmental collaboration rather than monitoring to integrate with their customers. Common GCI methodologies include: joint planning with customers to achieve environmental goals, joint selection of ecological strategies to reduce environmental pollution, or cooperation on cleaner production and greener packaging.

Green Supply Chain Integration Scale

As shown, GSCI is represented through three aspects including GII, GSI and GCI. According to Kong et al. (2020), these three aspects of integration are jointly measured according to the following criteria: Achieving common environmental goals; Develop a mutual understanding of responsibilities related to environmental performance; Working together to reduce the environmental impact of our operations; Conduct general planning to anticipate and solve environment-related problems. Make general decisions about ways to reduce the environmental impact of your products.

2.2. Enterprise innovation

The research papers produced recognize two types of green innovation. Green product innovation uses cleaner materials and product technology to (re)product design and packaging (Huang and Li 2017). Green process innovation using green sourcing, manufacturing, and logistics technologies without changing product design (Christmann 2000; Li et al. 2016). Early evidence suggests that both green products and process innovation can drive competitive advantage (Chen, Lai and Wen 2006; Chuang and Huang 2015), but a more recent study shows the inefficiencies of green process innovation (Chang 2011). Therefore, the performance of green products and process innovation may be different. Both green and process product innovation has been shown to be positively associated with the environment and solid performance (Huang and Li 2017; Liu et al. 2018), but green product design has failed to improve environmental performance in China (Zhu, Sarkis and Lai 2007). Green process innovation (i.e., green manufacturing) is proven to benefit both financial and non-financial performance (Peng and Lin 2008), but no cost advantage is achieved if a company simply adopts known best practices (Christmann 2000; Liu et al. 2018).

Green Process Innovation

Green process innovation (GPCI) is defined as "modifications made to production processes and systems in an effort to ensure energy savings, pollution prevention, and waste recycling" (Li et al. 2016, 1092). The term "production process and system" here can be narrowly considered production. Accordingly, GPCI focuses on reducing waste and energy consumption in sourcing, manufacturing, and logistics operations without product redesign (Christmann 2000). By investing in GPCI, companies can claim environmental benefits in their manufacturing and logistics operations. Christmann (2000) argues that the new GPCI reduces the production costs of the enterprise. GPCI can save regulatory and resource costs by

reducing environmental damage and energy use in manufacturing and logistics operations. GPCI involves adopting a life cycle approach and appropriate technologies to reduce input costs of raw materials and waste disposal, while avoiding the purchase of end-of-process pollution control devices.

Theo Kong, Feng, Huang and Cai (20), green process innovation is measured based on the following indicators:

The production process of the enterprise effectively reduces the emission of hazardous substances or waste

The production process of the enterprise recycles waste and exhaust gases allowing them to be processed and reused

The production process of the enterprise helps to reduce the consumption of water, electricity, coal or oil

The production process of the enterprise minimizes the use of raw materials

Green Product Innovation

Green product innovation (GPDI) occurs when green concepts are integrated into product (re)product design and packaging (Huang and Li 2017) to improve product quality and product differentiation (Chen, Lai, and Wen 2006). GPDI often involves significant changes to technology, materials, and product design. GPDI can reduce the environmental impact of the manufacturing process, as well as when customers use green products or packaging – for example, washing machines that require less water and energy consumption or packaging that can be easily reused or recycled. GPDI is associated with a product differentiation strategy that is likely to generate brand loyalty and a positive reputation rather than being used to improve economic performance. Price compensation can be created by first-mover competitors through the creation of new standards (for core processes) or early access (through sourcing processes) to critical resources and customers. This differentiation strategy will almost always add costs and may take time to reach actual returns.

GPDI can help consumers reduce waste and energy consumption when using products, but the need for a radical product redesign means that green product innovation can be more difficult to save manufacturers and achieve differentiation. These arguments explain why GPDI can lead to both positive and negative cost impacts while reducing the environmental impact of Chinese manufacturing companies (Zhu and Sarkis 2004).

According to Kong, Feng, Huang and Cai (2020),green product innovation is measured based on the following indicators:

Enterprises select the materials of the product that generate the least amount of pollution to conduct product development or design

The enterprise selects the materials of the product that consumes the least energy and resources to conduct product development or design

Enterprises use the fewest materials to form products to conduct product development or design

You will carefully consider whether the product is easy to recycle, reuse and compostable to proceed with product development or design

3. Research methodology

3.1. Research hypotheses and models

The H1, H2, and H3 hypotheses, respectively, suggest that three aspects of GSCI (GII, GSI and GCI) are important premise of green product/process innovation. We base these hypotheses on OIPT, because any innovation project requires internal and external knowledge (Cohen and Levinthal 1990) and an effort to minimize uncertainty (Rogers 2003). According to OPIT, companies deal with uncertainty by reducing the need for information processing and/or increasing their ability to process information (Daft and Lengel 1986; Galbraith, 1973). The uncertainty faced by green innovation is reflected by difficulties in deciding which environmental practices or technologies to adopt and figuring out how to justify and achieve their cost benefits. The use of integrated mechanisms such as hierarchy, information exchange, and cooperation helps to alleviate such uncertainties (Galbraith 1973; Wong, Boon-itt and Wong 2011). GII can promote green innovation through integrated mechanisms such as hierarchy, information exchange, integrated management systems, and goal adjustment. By clarifying strategic choices, GII aligns business and environmental management strategies to invest in green innovation. Knowledge of environmental technologies is created by exchanging information. Mechanisms that integrate hierarchies (Ettlie and Reza 1992) and integrated management systems (Margerum and Born 2000) aligned with environmental objectives can drive efforts to allocate resources to achieve green innovation in design, sourcing, operations, etc packaging and logistics operations (Shrivastava 1995). Such integration mechanisms increase internal information processing capabilities so that product design activity can be adapted to create products that enable superior pricing, cost-effectiveness, and eco-performance; sourcing and operations can achieve cost reductions through cost and waste reduction initiatives (Mentzer et al. 2001); and packaging design and logistics activities can be redesigned to allow recycling and reduce carbon emissions. So thehypothesis proposes:

Hypothesis H1: Green internal integration (GII) is positively related to (a) green process innovation and (b) green product innovation.

Integration with suppliers (GSI) and customers (GCI) can reduce strategic uncertainty by improving information processing capacity. Supply chain integration can be thought of as a 'supply chain information processing and general interpretation' mechanism to reduce uncertainty, because it increases supply chain partners' ability to interpret information (Yu et al. 2019, 789). GSI involves the use of several information processing mechanisms. New information is obtained through the exchange of information on objectives, responsibilities, strategies, benefits, best practices and performance standards with suppliers (Lai and Wong 2012; Rao 2002). Coordinated information exchange, standardization and integration of closed loop processes and related environmental planning and performance management with suppliers (Bowen et al. 2001; Kleindorfer, Singhal, and Wassenhove 2005; Montabon, Sroufe and Narasimhan 2007) to reuse end-of-life products or components. Vendor Support provides support and knowledge to vendors (Hu and Hsu 2010; Rao 2002; Wong et al. 2012) and help suppliers become more cost-effective through energy and resource savings (Grant, Trautrims and Wong 2017). Upstream cooperation mechanisms promote common goal setting and problem solving (Vachon and Klassen 2008). Cooperation, especially with small suppliers

(Srivastava and Gnyawali 2011), helps them acquire technological capabilities from different parties (Lee and Klassen 2008). As suppliers' information-processing capacities improve, they, in turn, can provide more forage materials and new knowledge to greenen their green product design sourcing, operations, and logistics activities.

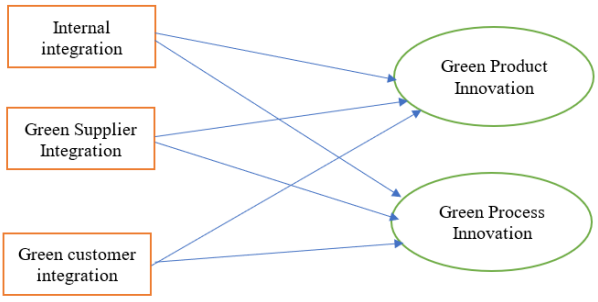
Hypothesis H2: Green supplier integration (GSI) is positively related to (a) green process innovation and (b) green product innovation.

Similar integration mechanisms are used by GCI to increase its ability to process information to understand downstream markets. GCI involves exchanging information with customers regarding environmental goals, practices and strategies, cleaner manufacturing technologies, and product lifecycle impacts (Darnall, Jolley and Handfield 2008; Vachon and Klassen 2008; Wang, Chen and Song 2018; Zhu et al. 2008). Customers are more aware of the problems and support the efforts of such proactive suppliers, leading to better and longer-lasting relationships with customers (Dyer and Singh 1998). GCI coordinates communication and collaboration with customers. Partnering with customers creates shared environmental responsibility and achieves common environmental goals (Lee, Kim and Choi 2012; Vachon and Klassen 2008; Zhu et al. 2008). Through GCI, market-based integration mechanisms are used to provide more environmentally friendly products to customers (Ettlie and Reza 1992). Cooperation promotes the sharing of environmental impact information and environment-related issues, and makes joint decisions related to reducing environmental impacts (Vachon and Klassen 2008; Wong, Wong and Boon-itt 2015). Collaboration and information sharing help coordinate closed-loop processes and logistics planning activities. Increased information capacity helps identify and influence customer needs, and this new knowledge can better inform innovative activities in green product design, packaging and logistics activities.

Hypothesis H3: Green customer integration (GCI) is positively related to (a) green process innovation and (b) green product innovation.

The research model is as follows:

Figure 1. Research Model



Where the variables in the research model are derived and the scale is as follows:

Table 1. Table of scale origins

Get lost	2nd Order Factor	Items	Scale (Items)	Origin	Encode
Green Supplier Integration	Green Supply Chain Integration	1. Achieving environmental goals collectively. 2. Developing a mutual understanding of	1. Achieve common environmental goals. 2. Develop a mutual understanding of	Kong, T., Feng, T., Huang, Y., &	GSI

		responsibilities regarding environmental Performance. 3. Working together to reduce environmental impact of our activities. 4. Conducting joint planning to anticipate and resolve environmental-related problems. 5. Making joint decisions about ways to reduce the environmental impact of our products.	responsibilities related to environmental performance. 3. Work together to reduce the environmental impact of our operations. 4. Conduct general planning to anticipate and solve environment-related problems. 5. Make general decisions about ways to reduce the environmental impact of our products	Cai, J. (2020)	
Green Internal Integration	Green Supply Chain Integration	1. Achieving environmental goals collectively. 2. Developing a mutual understanding of responsibilities regarding environmental Performance. 3. Working together to reduce environmental impact of our activities. 4. Conducting joint planning to anticipate and resolve environmental-related problems. 5. Making joint decisions about ways to reduce the environmental impact of our products.	1. Achieve common environmental goals. 2. Develop a mutual understanding of responsibilities related to environmental performance. 3. Work together to reduce the environmental impact of our operations. 4. Conduct general planning to anticipate and solve environment-related problems. 5. Make general decisions about ways to reduce the environmental impact of our products.	Kong, T., Feng, T., Huang, Y., & Cai, J. (2020)	GII
Green Customer Integration	Green Supply	1. Achieving environmental goals collectively.	1. Achieve common environmental goals.	Kong, T., Feng, T., Huang, Y., &	GCI

	Chain Integration	2. Developing a mutual understanding of responsibilities regarding environmental Performance. 3. Working together to reduce environmental impact of our activities. 4. Conducting joint planning to anticipate and resolve environmental-related problems. 5. Making joint decisions about ways to reduce the environmental impact of our products.	2. Develop a mutual understanding of responsibilities related to environmental performance. 3. Work together to reduce the environmental impact of our operations. 4. Conduct general planning to anticipate and solve environment-related problems. 5. Make general decisions about ways to reduce the environmental impact of our products.	Cai, J. (2020)	
Green Process Innovation		1. The manufacturing process of our firm effectively reduces the emission of hazardous substances or waste. 2. The manufacturing process of our firm recycles waste and emission that allow them to be treated and reused . 3. The manufacturing process of our firm reduces the consumption of water, electricity, coal, or oil. 4. The manufacturing process of our firm reduces the consumption of water, electricity, coal, or oil.	1. Our company's production process effectively reduces the emission of hazardous substances or waste. 2. Our company's production process recycles waste and exhaust gases allowing them to be processed and reused. 3. Our company's production process helps to reduce the consumption of water, electricity, coal or oil. 4. Our company's production process minimizes the use of raw materials.	Kong, T., Feng, T., Huang, Y., & Cai, J. (2020)	GPCI

Green Product Innovation		1. Our firm chooses the materials of the product that produce the least amount of pollution for conducting the product development or design. 2. Our firm chooses the materials of the product that consume the least amount of energy and resources for conducting the product development or design. 3. Our firm uses the fewest amount of materials to comprise the product for conducting the product development or design. 4. Our firm would circumspectly deliberate whether the product is easy to recycle, reuse, and decompose for conducting the product development or design.	1. Our company selects the materials of the product that generate the least pollution to proceed with product development or design. 2. Our company selects the materials of products that consume the least energy and resources to conduct product development or design. 3. Our company uses the least materials to form products to conduct product development or design. 4. Our company will carefully consider whether the product is easy to recycle, reuse and compostable to conduct product development or design.	Kong, T., Feng, T., Huang, Y., & Cai, J. (2020)	GPDI

Research Form

The success of quantitative research depends largely on the selection of research samples. In the study, the research team also chose the random sampling method to select the study sample because it is commonly used and brings more objective results when each element has the same probability of being selected.

Respondents to the survey: Leaders of grassroots, middle and senior levels from Vietnamese agricultural enterprises

Study sample size:

To ensure the representativeness of the study, the authors select a sample of enterprise-size stratification (as shown in the survey). The target sample size is 50 0 Vietnamese agricultural production enterprises by region,

type and scale. After three months of data collection, the authors obtained 312 questionnaires, after screening removed the unreliable ones, the remaining 222 questionnaires satisfied to test the research hypotheses.

Research results

Research results extracted from SPSS 20 software on reliability with Cronbach Alpha coefficient and total variable correlation coefficient are presented as follows:

First: Factor reliability GSCI_SUP

Reliability Statistics

Cronbach's Alpha	N of Items
.769	5

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
GSCI_SUP1	12.98	10.174	.205	.820
GSCI_SUP2	12.80	7.553	.629	.695
GSCI_SUP3	12.79	7.410	.639	.691
GSCI_SUP4	12.83	7.665	.600	.706
GSCI_SUP5	12.82	7.478	.635	.692

Source: Compilation of the study

The test results showed that the GSCI_SUP1 variable had Cronbach's Alpha index if Item Deleted = 0.820 > Cronbach's Alpha of the group. The correlation index is 0.205 < 0.4; Therefore, it is necessary to remove GSCI_SUP1 factor from the model to ensure variable reliability.

Reliability of the GSCI_SUP factor after removing an inappropriate scale

Reliability Statistics

Cronbach's Alpha	N of Items
.820	4

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
GSCI_SUP2	9.72	6.034	.661	.766
GSCI_SUP3	9.72	5.981	.651	.770
GSCI_SUP4	9.76	6.213	.610	.789
GSCI_SUP5	9.74	6.034	.649	.771

Source: Compilation of the study

Second: Factor reliability GSCI_INT

Reliability Statistics

Cronbach's Alpha	N of Items
.822	5

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
GSCI_INT1	12.36	7.072	.770	.737
GSCI_INT2	12.23	7.371	.801	.733
GSCI_INT3	12.25	7.244	.807	.729
GSCI_INT4	12.26	7.898	.542	.810
GSCI_INT5	12.98	9.926	.222	.885

Source: Compilation of the study

The test results showed that the variable GSCI_INT5 Cronbach's Alpha if Item Deleted = 0.885 > Cronbach's Alpha of the group. The correlation index is 0.222 < 0.4; Therefore, it is necessary to remove the GSCI_INT5 factor from the model to ensure the reliability of the variable.

Factor reliability GSCI_INT after removing an inappropriate scale:

Reliability Statistics

Cronbach's Alpha	N of Items
.885	4

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
GSCI_INT1	9.82	5.513	.797	.833
GSCI_INT2	9.69	5.798	.825	.825
GSCI_INT3	9.71	5.657	.840	.818
GSCI_INT4	9.72	6.222	.565	.925

Source: Compilation of the study

Third: Factor reliability GSCI_CUS

Reliability Statistics

Cronbach's Alpha	N of Items
.746	5

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
GSCI_CUS1	12.87	9.881	.271	.801
GSCI_CUS2	12.42	9.166	.552	.686

GSCI_CUS3	12.39	8.801	.605	.666
GSCI_CUS4	12.42	9.001	.555	.685
GSCI_CUS5	12.35	8.755	.637	.656

Source: Compilation of the study

The test results showed that GSCI_CUS1 variable had Cronbach's Alpha index if Item Deleted = 0.801 > Cronbach's Alpha of the group. The correlation index is 0.271 < 0.4; Therefore, it is necessary to remove GSCI_CUS1 factor from the model to ensure variable reliability.

Verify the reliability of the GSCI_CUS factor after removing the inappropriate scale:

Reliability Statistics

Cronbach's Alpha	N of Items
.801	4

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
GSCI_CUS2	9.67	6.036	.600	.758
GSCI_CUS3	9.65	5.883	.617	.750
GSCI_CUS4	9.68	6.005	.574	.771
GSCI_CUS5	9.60	5.782	.668	.725

Source: Compilation of the study

Fourth: GPCI Factor Reliability

Reliability Statistics

Cronbach's Alpha	N of Items
.803	4

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
GPCI1	11.03	4.599	.631	.747
GPCI2	11.02	4.550	.694	.718
GPCI3	10.68	4.750	.559	.783
GPCI4	11.07	4.706	.591	.766

Source: Compilation of the study

Fifth: GPDI factor reliability

Reliability Statistics

Cronbach's Alpha	N of Items
.849	4

stamp-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
GPDI1	10.59	8.870	.699	.804
GPDI2	10.57	9.065	.702	.803
GPDI3	10.50	9.406	.629	.833
GPDI4	10.54	8.896	.722	.794

Source: Compilation of the study

Next, the author reviews the measurement model and the structural model. The aggregate reliability of the study variables is as follows:

Table 2. Synthetic reliability

	Cronbach's Alpha	rho_A	Composite Reliability	Average Variance Extracted (AVE)
Green Customer Integration	**0.802**	**0.806**	**0.870**	**0.626**
Green Internal Integration	**0.889**	**0.919**	**0.924**	**0.756**

Green Process Innovation	**0.804**	**0.818**	**0.872**	**0.630**
Green Product Innovation	**0.849**	**0.854**	**0.898**	**0.688**
Green Supplier Integration	**0.820**	**0.823**	**0.881**	**0.650**

The table above shows that all study variables are satisfied.

Table 2. Degree of differentiating value

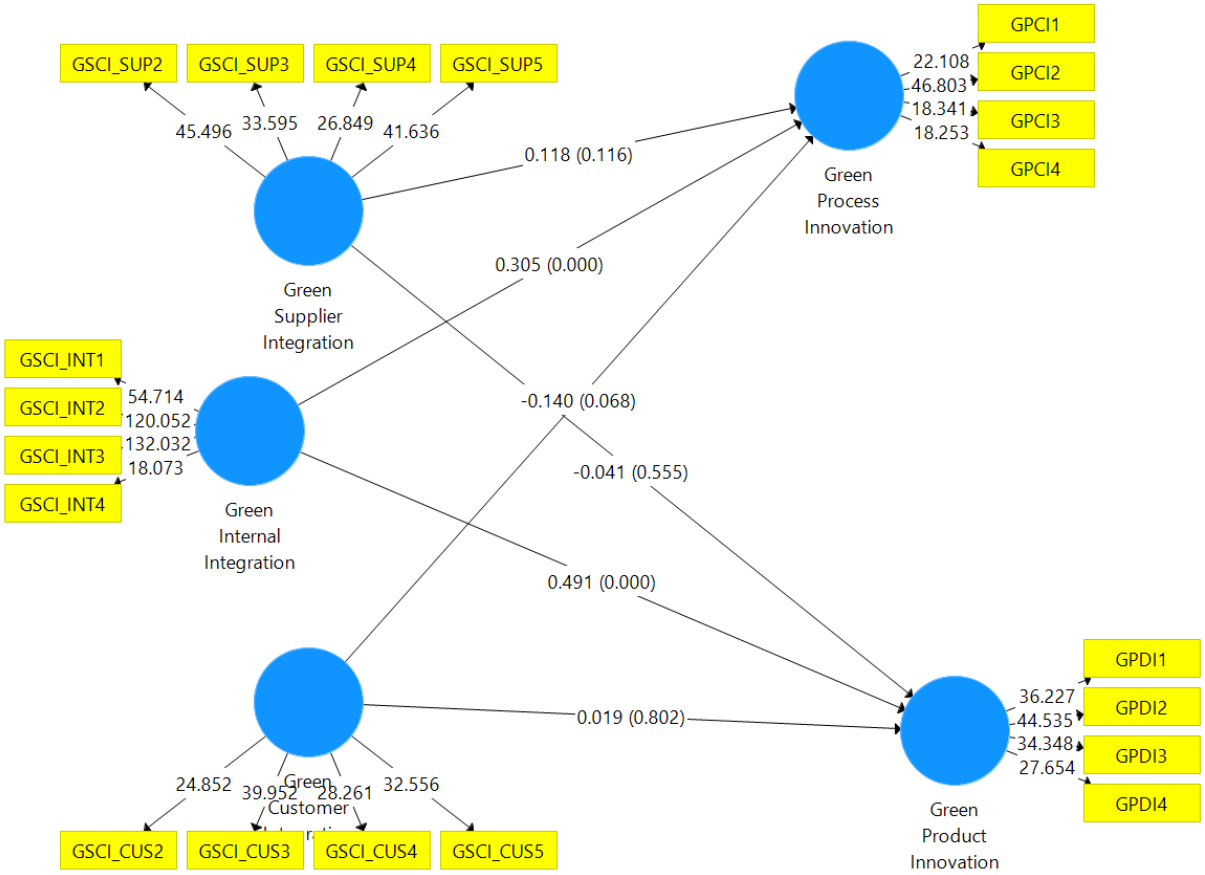
	Green Customer Integration	**Green Internal Integration**	**Green Process Innovation**	**Green Product Innovation**	**Green Supplier Integration**
Green Customer Integration	0.791				
Green Internal Integration	0.809	0.869			
Green Process Innovation	0.207	0.284	0.794		
Green Product Innovation	0.381	0.474	0.195	0.829	
Green Supplier Integration	0.846	0.781	0.238	0.358	0.806

Table 3. Model fit

	Saturated Model	**Estimated Model**
SRMR	0.054	0.055
d_ULS	0.617	0.644
d_G	0.306	0.307
Chi-Square	1018.601	1021.316
NFI	0.862	0.861

All values are satisfied, therefore, the author tests the research hypotheses as follows:

Figure 2. Research results



Preliminary test results showed that only the H2 hypothesis was statistically significant with an impact magnitude of 0.305 and 0.491 at 1% significance (P_value = 0.000), respectively. This means that for agricultural enterprises in this preliminary survey, only green internal integration will create business innovation in both green product innovation and green process innovation. On the other hand, two green integrations with suppliers and customers are not enough grounds to claim to have an impact on business innovation.

Conclusion

Green product innovation (GPDI) occurs when green concepts are integrated into product (re)product design and packaging (Huang and Li 2017) to improve product quality and product differentiation (Chen, Lai, and Wen 2006). GPDI can help consumers reduce waste and energy consumption when using products, but the need for a radical product redesign means that green product innovation can be more difficult to save manufacturers and achieve differentiation. These arguments explain why GPDI can lead to both positive and negative cost impacts while reducing the environmental impact of Chinese manufacturing companies (Zhu and Sarkis 2004)

From this, it can be concluded that GSCI plays an important role in the competitive advantage of companies in the agricultural sector in Vietnam, therefore, in the face of continuous innovation in domestic and foreign markets,

GSCI's development strategy is increasingly valued in companies.

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