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Impact of green innovation on the sustainable performance of Thai food industry

Monika Tantayanubutr, Vinai Panjakajornsak

Faculty of Administrative and Management, King Mongkut's Institutes of Technology Lad Krabang, Thailand

corresponding e-mail: monika(dot)cgd[at]hotmail(dot)com
address: 99/11 Moo 4, Soi Lampho 9, Lampho road, Tambon Lampho,
Amphor Bangbuathong, Nonthaburi, Thailand

Abstract: This research examines the impact of green innovation on the sustainable performance of Thai food industry implementing green industry initiatives in compliance with the national Green Industry Project. The correlation analysis was conducted on green supply chain integration (GSCI) and corporate social responsibility (CSR) as key influencing variables, while the green innovation was a moderator. A total of 441 samples were received from the total population of 8,520 accredited Green Industry Mark enterprises (GIM) (2016). Structural equation modeling (SEM) was employed to test the empirical data derived from surveys, which were collected from entrepreneurs and chief executive officers involved in the Thai food industry. The model indicated the absolute fit indices, confirming the validity and reliability of the SEM analysis. The findings confirmed the positive relationship of the selected key factors and their effect on the sustainable performance.

JEL Classifications: L25, Q56, Q58

Keywords: Microinsurance, financial inclusion, insurance quiz, demographic variables

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1. Introduction

The Thai food industry is an important contributor to the economic values of Thailand, as it is one of the seven highest-ranking countries in the food and agricultural product processing industries. The predominant challenges facing the Thai food industry are rapidly increasing in terms of the high competition in world food markets, the depletion of natural resources, the impacts of climate change, complicated labor issues, and tariffs and non-tariff trade barriers. As a result, the Thai food industry requires progressive development to pursue modern food processing technology to enhance competitive advantages and address environmental and social concerns for sustainable performance (NFI, 2017). The awareness of green innovation (GI) and sustainable industrial development in Thai industries is prominent given the recent increase in GI operations. However, Thai industries are behind the set target in terms of engaging in the national Green Industry Project. The major concern is that the additional investment in greening the products and processes will lead to extra costs for the industries and stakeholders (Ministry of Industry Thailand, 2013).

To address this issue, the researchers aimed to develop an analytical tool to validate key influencing factors and their significant effects on business performance with a view to sharing a structural model for the Thai food industry, as well as other industries, to determine the impact of key factors in green operations and to explore opportunities in engaging in green industry initiatives. Most previous studies related to GI were conducted on the entire production process (Doran, 2012) of high-technology industries (Zailani, 2015). The present study emphasizes the food industry, which is seen as a low-technology

industry according to the United Nations Industrial Development Organization (UNIDO) classification (UNIDO, 2016) but that plays an important role in the economic system of agricultural countries in terms of producing considerable economic value through production and employment (GSB Research Center, 2017).

This research was conducted to verify the impact of GI on the sustainable performance of the Thai food industry by implementing GI initiatives in compliance with the national Green Industry Project under the Thai Ministry of Industry. The study focused on (1) the positive correlation between green supply chain integration (GSCI) and corporate social responsibility (CSR), for which GI acted a moderator, and (2) the effects of these variables on business sustainability.

The impact of green innovation on the sustainable performance was found from two recent studies. (1) Zailani, et al. (2015) proposed the integration of key influencing factors through green innovation activities that provided the positive effect on the sustainable performance in terms of the increase of competitive advantages and productivity; the reduction of production costs (Eiadat et al., 2008) and waste from production process (Zailani et al., 2015) through the environmental regulations (Eiadat et al., 2008); the market needs (Chiou et al., 2011); as well as the coporate policies and practices on the green innovation initiatives (Eiadat et al., 2008). (2) Weng, et al. (2015) studied the impact of green innovation on the corporate and environmental performance in view of relevant stakeholders, including customers, suppliers, employees, officials, and competitors (Freeman, 2010), in order to determine decisive policies on green innovation that affected the efficiency of production and management, which led to environmental and social performance (Renning, 2000).

Following the contexts of green industry activities, this study focused on three key variables: (1) GSCI, which is the relational dimension of industries and alliances in sharing information and practices, aiming at reducing negative environmental impacts throughout a supply chain (Flynn et al., 2010; Wong et al., 2011; Wu, 2013); (2) CSR, which defines the corporate responsiveness and commitment to stakeholders, who play key roles in the demand for GI (Demirel & Kesidou, 2011; Kesidou & Demirel, 2012; Weng et al., 2015); and (3) GI, which integrates technology considering economic, environmental and social concerns (Chen et al., 2006; Lee, 2008; Chiou et al., 2011; Doran, 2012) into all products and processes in response to the eco-efficiency trends and secures resources for long-term production (Zailani, et al., 2015). The positive correlation among these variables was determined by analyzing the quantitative data collected from questionnaires using structural equation modeling (SEM). The significant effects of influencing variables were verified by referring to the qualitative data from in-depth interviews with the management of Thai food industry. The resulting data were analyzed from three perspectives: (1) GSCI and CSR to GI; (2) GSCI, CSR, and GI in green industry; and (3) GSCI, CSR and GI related to sustainable performance.

1.1 Thailand Green Industry Project

In 2011, the Thai Ministry of Industry launched the "Green Industry Project" as a national strategic mechanism for improving the green economy and development. The green industry initiatives are intended to promote and build the capacity of Thai industrial sectors, particularly small and medium-sized enterprises (SMEs), to conduct environmentally friendly operations following eco-efficiency trends. The initiatives aimed at enhancing business growth and competitive advantages in international trade, thus targeting an increase in green gross domestic product (GDP) and the sustainability of the green economy of the country. The realization of the Green Industry Project was established on 2 pillars - (i) continuous improvement and (ii) sustainable development; it incorporated 2 managerial aspects - (i) total quality management (TQM) and (ii) triple bottom line (TBL) with the integration of economic, environmental, and social considerations (Ministry of Industry Thailand, 2013). Currently, the number of

participants in the Green Industry Project is behind the set target, which aims at having 70,000 manufacturers accredited by the Green Industry Mark (GIM) by 2018. One of the challenges is the reconciliation of economic, environmental and social responsibility and the sustainability of the business, particularly the rising costs of compliance without positive financial returns.

Considering the competitive advantages in international markets, where corporate responsibility toward the environment and society must be explicitly incorporated into business operations, a major challenge for Thai industries is to ensure that all products and processes soundly address environmental and social concerns while maintaining profits. To encourage the decision making of entrepreneurs and management to engage in the Green Industry Project, the relevant influencing factors must be clearly identified so that Thai industries can be responsive to challenges and secure opportunities for business sustainability.

1.2 Food industry in Thailand

Called the "Kitchen of the World" as one of the world's top food producers and distributors, the Thai food industry accounted for 20.1 percent of the nominal GDP in 2016, providing the greatest portion of economic value of all the domestic manufacturing sectors, and is projected to continue growing. Thailand provides an abundance of natural resources. Most raw materials for the food processing industry are locally available, with some partially imported (NESDB ECONOMIC REPORT, 2017). However, the withdrawal of the European Union's Generalized Scheme of Preferences (GSP) from over 6,200 Thai products since 1 January 2015 caused Thailand to lose some of its competitive advantages in food exports to its competitors that obtained GSP benefits in global markets.

Opportunities to expand food processing products are being explored, considering consumer trends, particularly in terms of the growing demand for health and wellness products and ready-to-eat food products (GSB Research Center, 2017; OIE, 2017). Optional distribution channels allow consumers to easily search for goods, while innovative products and services attract purchasing decisions. Due to the high dependency on natural and human resources, the Thai food industry faces specific challenges regarding environmental and social conditions along its supply chain. Given that the food industry has a unique and multifaceted structure (Hartmann, 2011), GI is the key to integrating technology and sound environmental management throughout the product life cycle (GSB Research Center, 2017).

According to the cumulative records of 53,254 registered food manufacturers of the Thai Ministry of Industry, as of 2016, in the Thai food industry, mainly composed of SMEs, approximately 8,520 enterprises obtained the GIM accreditation, an award scheme structured to encourage Thai industries to commit to continuous improvement towards green operations under the national Green Industry Project. Given the early stage of development, the Thai food industry has encountered challenges and opportunities in realizing its commitment to business operations and eco/social-efficiency activities, providing a way forward for multiple stakeholders to develop strategic policies, planning and practices in raising awareness and enhancing engagement in green industry initiatives and GI, thus helping to offset the slight shortfall in competitive disadvantages from the GSP.

2. Literature review

Upon review of the relevant theories and research, the following sections describe the characteristics of the key variables selected for the proposed research model.

2.1 Green innovation

Green innovation (GI) was initially addressed in the late 1990s, proposing change from existing production technologies to the invention of innovative products and processes under environmental regulations and sound economic, environmental and social considerations with the aim of long-term production and sustainable industrial development (Cleff & Rennings, 1999; OECD, 2009). Following a literature review, the subsequent terms were considered to refer to common concepts, namely, green innovation, eco/ecological innovation, sustainable innovation, and environmental innovation, with slightly different definitions in terms of environmental, social, technological, or micro/macroeconomic aspects (Schiederig et al., 2011). The aforementioned terms interchangeably referred to the innovative products and processes that reduced environmental impacts (Cleff & Rennings, 1999; Chen et al., 2006). Nevertheless, most studies focused on the development and performance of green innovation management (Chiou et al., 2011).

The GI concept was developed in combination with environmental economics theory, which emphasizes the institutional and environmental regulations, and innovation economics theory, which focuses on innovative technology and entrepreneurship at the start-up, while marketing factors affecting business growth and expansion are also considered (Cleff & Rennings, 1999).

GI enables manufacturers to obtain incentives from efficiently using natural resources and assets, reducing waste, energy consumption and pollution, enhancing productivity (Cheng et al., 2014), as well as promoting corporate image, thus enhancing competitive advantages and long-term profitability (Porter & Van der Linde, 1995; OECD, 2009). GI is therefore regarded as a crucial driver for decoupling natural resource depletion and addressing economic, environmental and social challenges in every stage of the product life cycle.

The concepts and definitions of GI stipulate the importance of innovation in response to environmental concerns. From an academic perspective, GI components comprised the following:

(1) Green product innovation: the corporate commitment to create innovative products that reduced environmental effects throughout the supply chain (Cleff & Rennings, 1999; Chen et al., 2006).

(2) Green process innovation: corporate responsiveness to improve the production processes towards eco-efficiency trends and the application of innovative technologies involved in energy saving, pollution prevention, waste recycling, green product designs, or corporate environmental management (Cleff & Rennings, 1999; Chen et al., 2006).

(3) Green management innovation: the corporate effectiveness in managing the green supply chain and manipulating the budget, resources and operations (Chiou et al., 2011)

2.2 Green supply chain integration

Green supply chain integration (GSCI) is defined as the collaboration of internal and external stakeholders (Wu, 2013; Al-Zu'bi et al., 2015) in environmental management with the aim of reducing negative environmental impacts throughout the supply chain and achieving business growth and sustainability (Hart, 1995; Chin et al., 2015).

The GSCI concept was developed from the natural resource-based view of the firm (NRBV), which revealed the dependency of business competitive advantages on natural resources and the environment. In this connection, the firms played key roles in determining strategies to manipulate resource requirements and prevent pollution (Hart, 1995; Wu, 2013). Accordingly, green supply chain management (GSCM) was proposed to integrate environmental concerns into supply chain management (e.g., product design,

product life cycle analysis (Wu, 2013), workflow analysis, procurement, production, and logistics). Moreover, effective communication and good relationships between industries and their stakeholders were key factors for trust-based networking and commitment to mutual collaboration (Flynn, 2010; Chin et al., 2015).

The concepts and definitions of GSCI elaborated the collaboration of stakeholders in compliance with eco-friendly activities. From an academic perspective, GSCI components consist of the following:

(1) Internal integration: the participation of corporate members in engaging in green activities and developing an integrated environmental management system across multiple functions and locations (Wu, 2013).

(2) Supplier integration: collaboration with suppliers in the supply chain to increase productivity and reduce risks by managing supplier information across the product lifecycle, applying responsible sourcing and procurement processes, and involving suppliers in product development (Chen et al., 2006; Wu, 2013).

(3) Customer integration: the management of customer information and relationships, including adopting advanced technologies for customer transactions, performing information exchange, and increasing customer involvement in product innovation (Wu, 2013).

2.3 Corporate social responsibility

Corporate social responsibility (CSR) refers to the corporate self-regulatory mechanism that integrates social consideration into business operations. This approach evolved from multiple concepts, including agency theory (Friedman, 1970), corporate social performance (Bowen, 1953; Carroll, 1979), stakeholder theory (Clarkson, 1995; Freeman, 2010), social issues theory (Lee, 2008), public policies, and business ethics (Freeman, 2010). The CSR concept was then extended to cover all stakeholders (e.g., employees, consumers, suppliers, and communities) and included comprehensive aspects of operations (e.g., environmental issues, consumer health concerns, and occupational safety) (Jones, 1980). CSR eventually became global in scope (Carroll, 2014) and played a role in all corporate activities and changes.

Having once been unpopular among business and shareholders in view of its costs (Friedman, 1970; Lee, 2008), CSR is currently accepted because of the importance of social trust in corporate ethical standards (Carroll, 2014) and accountability beyond the interests of business by integrating environmental and social considerations (Carroll & Shabana, 2010) into strategic management, corporate policies and ethics (Freeman, 2010). CSR in the food industry is regarded as a way for the business to safeguard against risks from its interactions throughout the food supply chain and networks (Hartmann, 2011).

The concepts and definitions of CSR align with the corporate commitment to integrate social and environmental considerations into business operations and interactions while addressing the expectations of shareholders and stakeholders. From an academic point of view (Carroll, 1979; Mahmoud & Hinson, 2012; Al-Shuaibi, 2016), CSR components include the following:

(1) Economic responsibilities: the efforts to ensure the profitability and create long-term value for stakeholders while contributing to sustainable economic performance.

(2) Legal responsibilities: the responsibility to conform with laws and business obligations to ensure fully legal compliance regarding licenses, permits, registration, taxes, liability, human resources, product safety, and security regulations.

(3) Ethical responsibilities: the accountability of the business to make ethical and moral decisions in terms of recognizing and responding to the multiple principles and values of internal and external stakeholders.

(4) Discretionary responsibilities: the highest expectation of society for an organization at a given point of time after economic, legal, ethical responsibilities are fulfilled, including the contribution of financial resources and philanthropic activities for communities.

2.4 Sustainable performance

Sustainable performance integrates social responsibility, environmental impact, and economic viability (Barney, 1991) into corporate strategies and operations for long-term productivity and profitability (Porter & Kramer, 2006). In addition to environmental and economic motivations (Székely & Knirsch, 2005), innovative products and services fulfill social requirements and stakeholder expectations (Govindan et al., 2013), particularly in the food industry, where production without causing harm to the environment and consumer health is a primary concern (Hartmann, 2011). The determination of sustainable performance consists of the following three perspectives.

Economic performance

Economic performance (EP): the financial implications of profitability, revenue growth, and operating cost (Porter & Van der Linde, 1995), including expenses incurred from environmental and social activities (Zhu & Sarkis, 2004), and the nonfinancial parameters of business performance that meet the operational goals of enterprises and shareholders in terms of the growth of market share and expansion into new markets for the stability of the industries and products in marketplace (Chin et al., 2015; Geng et al., 2017). The concepts and definitions of EP reveal the impact of significant indicators for sustainable performance. The EP components, in response to shareholders, cover three observed variables:

- Market performance: the achievement of marketing value, including the enhancement of market share (Giovanni, 2010; Yang, 2013).
- Financial performance: the achievement of profitability (Giovanni, 2010; Yang, 2013).
- Operational performance: the efficiency in production and distribution (Wong et al., 2011; Yang, 2013).

Environmental performance

Environmental performance (NP): the corporate operation in response to environmental challenges, covering all impacts from production, products and services (Zhu & Sarkis, 2004). This study measured the environmental management system (EMS) to determine the overall systematic structure that addressed concerns pertaining to the production of innovative products (Giovanni, 2010), including pollution control, resource efficiency and environment management (Zhu & Sarkis, 2004; Chiou et al., 2011; Zhu et al., 2013).

The concepts and definitions of NP incorporate the effects from the operation of environmental management. The NP components comprise the following:

- Pollution management: production with statistically identifiable significance in reducing polluting emissions.
- Resource efficiency: the use of natural resources sustainably while minimizing the impact on the environment.
- Environment control: the improvement of the physical workplace to enhance work and business effectiveness (Giovanni, 2010; Laosirihongthong et al., 2013; Yang, 2013; Zhu et al., 2013).

Social performance

Social performance (SP): the enterprise's commitment to incorporate social benefits into business strategies and operations, focusing on stakeholder satisfaction and social responsiveness (Clarkson, 1995), and involving internal factors (e.g., employment practices) and external factors (e.g., community relations and social impact) (Székely & Knirsch, 2005; Carroll & Shabana, 2010).

The concepts and definitions of SP referred to the social expectation and recognition on the outcomes of business performance. The SP components consist of the following:

- Employee practices: the improvement of employee engagement and the corporate practices relating to decent work, remunerations and benefits and human rights (Giovanni, 2010; Yang, 2013).
- Community relations: corporate interactions with stakeholders and communities to create mutual understanding, trust, and support (Giovanni, 2010; Yang, 2013).
- Social impact: corporate consideration of the effects of business operations on society and communities (Carroll, 1979; Yang, 2013).

2.5 Research hypotheses

Development of hypotheses

The achievement of sustainable performance is unable to be obviously reflected in the short term due to additional investments in activities following GSCI, CSR, and GI. In this context, this study attempted to validate those variables and their positive correlation and to understand the impact of key factors that influence business performance and its sustainability.

Multiple empirical research findings confirmed the positive correlation among GSCI, CSR and GI. GSCI incorporates strategic policies and actions into day-to-day functions while responding to environmental challenges that occur in particular steps of the product life cycle (Wu, 2013) and building a seamless supply chain for long-term productivity (Flynn et al., 2010; Lee & Kim, 2011; Al-Zu'bi, 2015). CSR was a key demand factor that induced GI (Demirel & Kesidou, 2011). Stakeholder management theory was applied to investigate the particular influencing elements of stakeholders to determine approaches to GI (Weng, 2015). GI provides enterprises with the benefits of reduced cost and time in production processes (Chen et al., 2006, Chiou et al., 2011) and increasing competitive advantages (Porter & Van der Linde, 1995; Doran & Ryan, 2012).

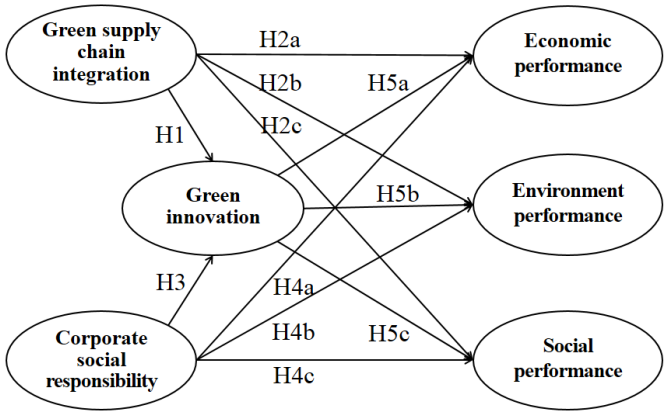
Given those influencing implications, GSCI, CSR and GI influenced the ultimate outcomes with respect to economic (Chen et al., 2006; Afonso et al., 2012; Cheng and Shiu, 2012; Weng et al., 2015), environmental (Chiou et al., 2011; Weng et al., 2015), and social performance, thus leading to sustainable performance (Barney, 1991; Manmoud & Hinson, 2012; Carroll & Buchholtz 2014; Zailani et al., 2015; Al-Shuaibi, 2016).

However, the analysis of sustainability matrices found a large discrepancy in the results due to the different methods and tools of measurement (Govindan et al., 2013). Therefore, the present research aimed to establish an analytical model for the effective measurement of corporate progress towards sustainable performance. The positive correlation between GSCI, CSR, and GI and sustainable performance is proposed in the research framework (Figure 1).

Research framework

The research framework to study the impact of GI on the sustainable performance of the Thai food industry was constructed from the influence and intercorrelation of GSCI and CSR on GI and measurable through their outcomes on economic, environmental and social performance. The primary internal influencing factors were obtained by reviewing multiple aspects of CSR activities responding to stakeholders and social concerns, while the major external influencing factors were investigated through GSCI on corporate networking and collaboration of multi-stakeholders throughout supply chain. The proposed model for the research framework is displayed in Figure 1.

FIGURE 1. PROPOSED RESEARCH FRAMEWORK



3. Research methodology

3.1 Research design

Several research methods were applied to collect, analyze and validate the quantitative data from questionnaires. Qualitative data from in-depth interviews were applied to verify the interpretation of the data analysis. Maximum likelihood estimation (MLE) was used to estimate the parameters to categorize sets of data derived from the surveys and to identify missing values. A measurement model (MM) was deployed to observe latent variables. The validity and reliability of data were evaluated by using confirmatory factor analysis (CFA). SEM in AMOS21 software was formulated to analyze the data, verify the proposed hypotheses, and evaluate the significance of the theories and the positive correlation of variables (Hair, 2010; Schumacker & Lomzx, 2010).

3.2 Data collection

The sampling frame was selected from entrepreneurs and chief executive officers involved in the food industry, which included 8,520 enterprises accredited with the GIM from the Thai Ministry of Industry. The representatives of the given population were sampled by using stratified cluster sampling. Out of 1,046 questionnaires distributed to the population

proportionated by region, 441 of the returned questionnaires were considered valid and completed, a response rate of 42.16%. Additionally, purposive sampling identified eight experts in the Thai food industry, with positions as entrepreneurs, CEOs and professional personnel.

3.3 Questionnaire development

The questionnaires consisted of two sections: (1) general information regarding the enterprises and respondents and (2) the rating of 76 questions, employing 7-point Likert-type scales from "strongly disagree (= 1)" to "strongly agree (= 7)" as the anchor points (Diener, 1985). The items for the rating scales were adapted from reviewing the relevant variables of existing theories and empirical research findings (Table 1).

3.4 Pre-test analysis

The validation of the questionnaires was conducted to enhance the quality of the data collection in two steps: (1) The content validity was reviewed by five researchers to determine the relevancy and validity of the questions, including latent variables. The Index of Item-Objective Congruence (IOC) (Rovinelli, 1977) showed IOC values ranging from 0.60-1.00 for questions, with a result of 0.98 for the overall content, concurring with the objectives of the evaluation. (2) The reliability was estimated using Cronbach's alpha, resulting in values ranging from 0.7 or greater (Conbach, 1951) for particular variables and from 0.759-0.907 for the 6 latent variables, confirming the reliability of the questionnaires.

TABLE 1. QUESTIONNAIRE CONSTRUCTS AND VARIABLES

Constructs	Items	Observed Variables	Based on
Green supply chain integration	5	Green internal integration	Flynn et al., 2010; Wong et al., 2011; Lee & Kim, 2011; Wu, 2013
	5	Green supplier Integration	
	5	Green customer integration	
Corporate social responsibility	5	Economic responsibility	Lee, 2008; Manhmoud & Hinson, 2012; Al-Shuaibi, 2016
	4	Legal responsibility	
	4	Ethical responsibility	
	5	Discretionary responsibility	
Green innovation	4	Green product innovation	Chen et al., 2006; Chiou et al., 2011; Wu, 2013; Cheng et al., 2014
	5	Green process innovation	
	4	Green managerial innovation	Chiou et al., 2011
Economic performance	4	Marketing performance	Flynn et al., 2010; Giovanni, 2010; Yang, 2013; Wong et al., 2011; Zhu et al., 2013; Green et al., 2012
	4	Financial performance	
	4	Operational performance	
Environment performance	3	Pollution management	Giovanni, 2010; Green et al., 2012; Laosirihongthong et al., 2013; Yang, 2013; Zhu et al., 2013
	3	Resource efficiency	
	3	Environment control	
Social performance	3	Employment practice	Giovanni, 2010; Yang, 2013
	3	Community relations	
	3	Social impact	

4. Results

4.1 Descriptive analysis

The profiles of the 441 valid respondents revealed that most respondents are currently entrepreneurs (53.06%) in food industrial firms with approximately 21-30 years of working experience (42.40%). The highest response rates were obtained from the grains and products sector (43.54%), along with the enterprises operating for over 10 years in the food industry (40.36%), owning assets between THB 50 to 200 million (50.11%), and hiring 50 to 200 employees (49.66%). Those profiles ensured the quality and validity of the sample with high-ranking personnel with solid experience in the food industry, mostly SMEs, given that the entrepreneurs and CEOs are the key decision-makers on business policies, planning, and practices.

4.2 Reliability and validity measurement

The reliability and validity of the indicators were verified by calculating Cronbach's alpha for each construct and item. The highest values showed the best consistency according to the suggested values for Cronbach's alpha (α) ≥0.70 (ranging between 0.751 and 0.881) (Nunnally & Bernstein, 1994), the corrected item-total correlation (CITC) ≥0.40 (ranging between 0.504 and 0.720), and the skewedness (SK) and kurtosis (KU) between -3.0 to 3.0 (ranging between -0.388 and 0.336 and -0.762 and 0.574, respectively) (Glass & Stanley, 1970).

The reliability of each construct was examined through CFA by using the composite reliability (CR) to measure the internal consistency of a single construct, marking all CR values exceeding 0.7 (ranging between 0.889 to 0.954), and stipulating the reliability of the measurement (Fornell, 1981). Accordingly, the validity of the measuring model fit was tested by using the average variance extracted (AVE), resulting in >0.5 (ranging between 0.576 and 0.747) (O'Rourke & Hatche, 2013).

4.3 Confirmatory factor analysis

The construct validity and factor structure of the hypothesized model were analyzed by using CFA. Convergence validity was adopted to measure the factor loadings of the observed variables and latent variables. All factor loadings showed significant values over 0.5, indicating the consistency of the evaluating questions with respect to the suggested values (p-value >0.5) (Fornell & Larcker, 1981). Correspondingly, the item reliability (R2) was over >0.5, indicating convergent validity (Hair, et al., 2010). The overall results therefore proved the reliability and validity of the questionnaires (Table 2).

TABLE 2. CONSTRUCT RELIABILITY AND VALIDITY DETAILS AND CONFIRMATORY FACTOR ANALYSIS SUMMARY

Constructs	α	CR	AVE (%)	Observed variables	Loadings	R^2
Green supply chain integration	0.906	0.898	0.747	Green internal integration	0.875	0.766
				Green supplier integration	0.871	0.759
				Green customer integration	0.846	0.716
Corporate social responsibility	0.918	0.882	0.652	Economic responsibility	0.821	0.674
				Legal responsibility	0.765	0.586
				Ethical responsibility	0.803	0.646
				Discretionary responsibility	0.838	0.703

TABLE 2. CONSTRUCT RELIABILITY AND VALIDITY DETAILS AND CONFIRMATORY FACTOR ANALYSIS SUMMARY

Constructs	α	CR	AVE (%)	Observed variables	Loadings	R^2
Green innovation	0.809	0.845	0.576	Green product innovation	0.762	0.581
				Green process innovation	0.780	0.609
				Green managerial innovation	0.753	0.567
Economic performance	0.887	0.842	0.640	Marketing performance	0.812	0.659
				Financial performance	0.820	0.672
				Operational performance	0.767	0.588
Environmental performance	0.881	0.857	0.667	Pollution management	0.821	0.749
				Resource efficiency	0.825	0.825
				Environment control	0.804	0.663
Social performance	0.832	0.786	0.553	Employment practice	0.827	0.684
				Community relations	0.720	0.519
				Social impact	0.675	0.456

4.4 Structural equation modeling summary

The analytical results of the structural equation modeling showed multiple values for the goodness-of-fit indices, indicating the accuracy of the model fit (Table 3).

TABLE 3. MODEL FIT TESTING

	λ2	df	λ2/df	p	GFI	AGFI	CFI	RMSEA
Recommended values	N/A	N/A	<3.00[1]	>0.05[2]	>0.90[1]	>0.90[2]	>0.95[1]	<0.05[1]
Final structural model	214.062	113	1.894	0.000	0.952	0.919	0.986	0.045

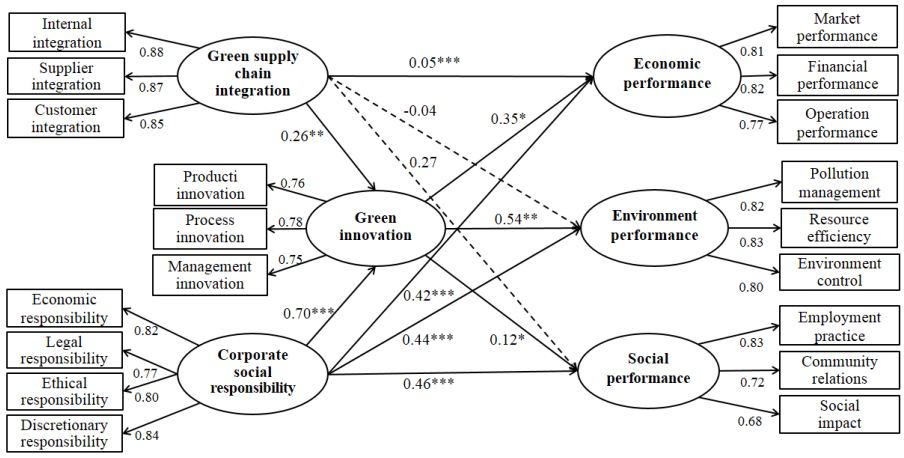
Note: (1) (Hair, et al., 2010), and (2) (Byrne, 2016).

The SEM results of the hypothesis tests revealed nine significant correlations, including H1, H2a, H3, H4a-H4c and H5a-H5c. However, non-significant relationships were found in H2b (GSCI and EP) and H2c (GSCI and SP) (Table 4 and Figure 2).

TABLE 4. RESULTS OF HYPOTHESES TESTS

HYPOTHESES		EFFECT	SUPPORTED
H1	Green supply chain integration → Green innovation	+	Yes
H2a	Green supply chain integration → Economic performance	+	Yes
H2b	Green supply chain integration → Environmental performance	-	No
H2c	Green supply chain integration → Social performance	+	No
H3	Corporate social responsibility → Green innovation	+	Yes
H4a	Corporate social responsibility → Economic performance	+	Yes
H4b	Corporate social responsibility → Environmental performance	+	Yes
H4c	Corporate social responsibility → Social performance	+	Yes
H5a	Green innovation → Economic performance	+	Yes
H5b	Green innovation → Environmental performance	+	Yes
H5c	Green innovation → Social performance	+	Yes

FIGURE 2. FINAL MODEL



Additionally, the analysis of the direct, indirect and total effects of the variables (GI, EP, NP and SP) on sustainable performance was conducted (Table 5).

TABLE 5. THE ANALYSIS OF DIRECT, INDIRECT AND TOTAL EFFECTS

Variables	R^2	Effect	Antecedent		
			GSCI	*CSR*	*GINNO*
Green innovation	0.955	Direct	0.261	0.699	
		Indirect	0.000	0.000	
		Total	0.261	0.699	
Economic performance	0.802	Direct	0.045	0.419	0.348
		Indirect	0.091	0.243	0.000
		Total	0.136	0.662	0.348
Environmental performance	0.917	Direct	0.000	0.443	0.541
		Indirect	0.141	0.378	0.000
		Total	0.141	0.821	0.541
Social performance	0.737	Direct	0.000	0.463	0.115
		Indirect	0.032	0.080	0.000
		Total	0.032	0.543	0.115

5. Findings and discussion

Multiple theories and methodologies were applied to analyze the data collected from the selected Thai food industrial firms engaged in green innovation initiatives under the Green Industry Project of the Thai Ministry of Industry. The analytical results supported 9 research hypotheses out of the 11 initially defined. The statistical values of the empirical data derived from the surveys and in-depth interviews also demonstrated the positive correlation among the selected variables GSCI, CSR and GI, highlighting the significant implications of those key influencing variables for sustainable performance.

The following analytical results describe the findings of the positive correlations of influencing variables from three perspectives: (1) GSCI and CSR to GI; (2) GSCI, CSR and GI on green industry; and (3) GSCI, CSR and GI on sustainable performance.

5.1 The influence of GSCI and CSR on GI.

The analytical SEM results revealed a positive correlation between GSCI and GI given the statistical significance of $p<0.01$ (H1) and the direct effect of GSCI on GI, concurring with previous studies on the influence of GSCI and GI under the environmental uncertainty of the IT industry in Taiwan (Wu, 2013), and on the environmental performance and competitive advantage of companies in Taiwan (Chiou et al., 2011).

The results also revealed a correlation between CSR and GI, with a statistical significance of $p<0.001$ (H3), and the direct effect of CSR on GI, corresponding to previous research on the effect of CSR and GI from stakeholder perspectives in Taiwan (Weng et al., 2015), and supporting the finding of innovation and productivity as mediating factors in Saudi Arabian companies (Al-Shuaibi, 2016). Previous results also revealed that there was no effect of CSR on GI due to different stakeholders and the environmental strategies of Irish companies (Demirel & Kesidou, 2011).

Moreover, the study determined that CSR had a higher impact on GI compared to the effect of GSCI. Given that GSCI implementation in Thai industries is in the early stages, the recommendation is that the networking of stakeholders throughout the supply chain should be further developed.

5.2 The influence of GSCI, CSR and GI on green industry.

The positive correlation among GSCI, CSR and GI and their impact on green industry was not found from reviewing previous research conducted in the food industry in Thailand and other countries with similar contexts. The findings were drawn from interesting survey responses. The in-depth interviews found the relatively low capacity of Thai food industrial firms in managing information and interaction through GSCI, reflecting that the food industry in agricultural countries may lack policies and strategies for environmental control and management. As most Thai food manufacturers are currently in the initial stage of green industry operation, the Green Industry Project may seek to promote GSCI networks to strengthen the overall supply chain and aid stakeholders in pursuing green industry initiatives. This study also signified that, to enhance the green industry operation, the management in the Thai food industry are encouraged to include environmental considerations in business strategic planning and operations, share knowledge across functional areas, and establish networks with customers and suppliers throughout the supply chain.

The interview responses also showed that CSR activities in the Thai food industry, which involved high volumes of employees in nature, played key roles in terms of engaging internal and external stakeholders and providing direct and indirect effects on the green

industry and green innovation. Furthermore, the main concerns of the Thai food industry emphasized the customer requirements, especially for food safety. To assure customers of the quality of food products and accountability of the production processes, CRS is therefore the key influencing factor of the business in response to stakeholder concerns and requirements.

According to the Green Industry Project, CSR initiatives are a main focus. Given the empirical research findings that CSR positively stimulates GI, the Thai food industry may promote CSR activities to enhance GI creation associated with rapid changes in market requirements corresponding to environmental and social concerns. The key challenge is that a GI operation requires high investment and continuous improvement to achieve the results. Most importantly, GI is considered confidential commercial and intellectual property; therefore, the responses derived from the surveys may not entirely represent the actual GI operations in the selected food industrial firms.

5.3 The influence of GSCI, CSR and GI on sustainable performance.

The analytical results revealed a positive correlation between GSCI and sustainable performance, with statistical significance of $p<.001$ (H2a). Without a direct effect, the analysis showed that GSCI provided an indirect effect through GI on sustainable performance. The GSCI direct effect appeared on economic performance but was otherwise found to have relatively few direct effects on environmental and social performance, despite the direct effect of those variables prevailing in previous studies of Thai manufacturers (Suansawat, 2013), the IT industry in Taiwan (Wu, 2013), food companies in Jordan (Al-Zu'bi et al., 2015), and tea processing firms in Kenya (Muma et al., 2014).

According to the in-depth interviews, the supply chain of the Thai food industry is made up of multiple stakeholders (e.g., farmers, suppliers, food processing workers, dealers, logistic service providers, wholesalers, and retailers), who are mostly SMEs operated by minor business owners without the capacity to establish environmentally friendly networks. Due to those constraints, GSCI does not have a significant impact on the environmental and social performance of the Thai food industry at this stage.

The results also indicated the correlation of CSR to sustainable performance (i.e., economic, environmental and social performance), with the statistical significance of EP $p<.001$ (H4a), NP $p<.001$ (H4b), and SP $p<.001$ (H4c) and the direct and indirect effects of CSR on sustainable performance. The results agreed with previous research on the positive effect of CSR on social and economic performance, which promoted sales and services along with satisfying shareholders (Afonso et al., 2012) and increased profitability and market shares, for which GI acted as strategic factor in capitalizing CSR (Weng et al., 2015).

Furthermore, the findings showed that CSR had a higher impact on sustainable performance compared to the effects of GSCI and GI. The responses from the in-depth interviews also suggested that CSR provided concrete outcomes and generated social awareness among stakeholders. Regardless of the differences in contexts or industries, CSR is present. Following the interviews, the entrepreneurs tended to increase their commitments and incorporate CSR activities into the day-to-day operations in response to the requirements of stakeholders, thus ensuring enhanced corporate performance.

The analysis also showed the correlation between GI and sustainable performance (i.e., economic, environmental and social performance), with the statistical significance of EP $p<.05$ (H5a), NP $p<.05$ (H5b), SP $p<.05$ (H5c), and the direct effect of GI on sustainable performance. The results confirmed the findings in previous studies on GI in automotive supply chain companies in Malaysia (Zailani, 2015) and the role of GI in firm regulations, perception and performance in Ireland (Doran & Ryan, 2012).

Based on the findings from the in-depth interviews and the existing studies from other industries, GI is the key factor influencing sustainable performance. Despite its considerable economic value in Thailand, notably the great sources of agricultural materials, the Thai food industry, for which the raw materials are derived from the agriculture sectors, faces challenges in managing food waste and pollution. The food products also have similarities in nature and many food waste products can be readily recycled in the agricultural industry. Consequently, GI provides solutions for differentiating innovative products and securing natural resources for long-term production.

6. Conclusions

The modality of this research provides structural tools for the Thai food industry to aid in identifying relevant challenges and determining operational progress in green business operations. Furthermore, corporate environmental and social responsibility have promoted stakeholder satisfaction, established business accountability, and reduced business and legal risks while ensuring competitive advantages and profitability.

According to the considerable implications from the analysis of the influencing factors associated with sustainable performance, the Thai food industry is encouraged to consider facilitating GSCI, pursuing CSR activities, and applying GI, in compliance with the Green Industry Project. GI distinctively acts as the mediating variable for the relevant factors that consequently influence sustainable performance.

6.1 Theoretical implications

This academic study developed a research framework to identify the significant implications of sustainable business performance by investigating three key factors: GSCI, CSR and GI. Based on previous research and theories, this study (1) identified the significant roles of GSCI and CSR in GI; (2) focused on GSCI, CSR and GI regarding their specific impact on the green industry, with a summary of literature relating to managerial aspects for business sustainability; and (3) verified the positive correlations between GSCI, CSR and GI and sustainable performance, covering economic, environment and social performance.

6.2 Managerial implications

This research provides new insights for entrepreneurs and management in the Thai food industry with a view to sharing a practical approach and effective modality for identifying influencing factors, analyzing relevant variables to determine their significant implications, and developing solid GI approaches that incorporate economic, environmental, and social considerations through CSR activities, throughout GSCI, in response to diverse challenges and requirements. The analytical results agreed with previous empirical research findings that GI plays a key role in the Thai food industry in terms of enhancing competitive advantages, particularly in the context of agricultural countries, ensuring profitability, thus further leading to industrial growth and sustainability.

7. Limitations and further research

The research results were based on cross-sectional surveys in the Thai food industry, of which indicators to measure the impact of GI may vary in different contexts. Other

industries applying GI should account for this modality to identify relevant internal and external factors in addressing their specific challenges and exploring opportunities for green business. Further studies are also encouraged in terms of the analysis of variables in other industries, cultures and timeframes so that the challenges and lessons learned from implementing GI are systematically analyzed and applied to support decision making and future strategic planning for sustainable business performance.

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