The Mediating Role of Innovation Performance between the Relationship of Green Supply Chain Management Skills and Environmental Performance

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Abstract---Current study examines the effect of Green Supply Chain Management (GSCM) skills on the environmental performance of manufacturing companies in Thailand. This study also evaluate the mediating role of innovation performance among the relationship of GSCM skills and environmental performance. The sample was limited to the firms that had certification of ISO 14001 EMS in Thailand. Data were collected from the companies mentioned above through a questionnaire. The technique that is used to investigate the association between the understudy variables is PLS-SEM. Multiple regression has been used to test the direct relationship among the variables used in the study while multiple regression with the bootstrapping procedure is used to check the mediating role of innovation performance on the association of GSCM skills and environmental performance. The results revealed a positive association between GSCM skills and environmental performance. In addition, results also elaborated that innovation performance mediates the association between GSCM skills and firm's environmental performance.

Keywords: GSCM skills, environmental performance, innovation performance, green supply chain management

1. Introduction

Growing attentiveness regarding the environment has increased the emergence of GSCM skills regarding the selection of supplier. Various types of sources such as decreasing energy consumption, minimizing the companies' cost and lack of financial sources create the pressure on the companies to develop friendly business environment practices [1]. A comprehensive range of actors, such as non-government organizations (NGOs), legislators and consumers, are forcing the companies to ensure environmental practices for the protection of nature. These environmental practices comprise all the processes and activities that are designed to enhance the performance of the firm [2]. Therefore, environmental pressures have influenced the retail business and "business to business" (B2B) companies. Moreover, companies must be thinking about the expectations of partners and customers regarding the environment. Some of the B2B companies have a larger effect on environment than other types of companies. Thus, different kinds of companies may experience various kinds of challenges and pressures in the protection of the environment.

In the past few years, the sustainability of the environment has become an emerging area of research in the field of OM. Whereas, research on the sustainability of the environment in the sector of logistics is still limited [3]. In addition, it is prominent that logistics operations, specifically

transportation, have a substantial effect on the environment. However, this sector of logistics is greatly competitive, and logistics services providers (LSPs) must be sensitive in respect to their needs of customers [4]. Moreover, Yeung, et al. [5] found in their study that one of the ways to provide additional value to customers is a friendly logistic services environment. Therefore, the focus of LSPs is to develop the GSCM skills for enhancing the performance and offering the differentiated value-added services to their customers. However, the studies on environmental pressures and GSCM skills have been very limited and need to explore this area further. Furthermore, Zhu and Sarkis [6] conducted the study on "supply chain management" (SCM) and found that environmental performance influenced by the practices of GSCM. Moreover, they could not found that whether these SCM skills have better performance in other measures. Green environmental companies are considered as innovative and forward-looking companies [7]. Thus, the focus of this study on the question of whether innovation performs a major role in the association between the GSCM skills and environmental performance or not.

Figure 1.1 given below elaborate the importance and the implementation of GSCM for the firm. To implement the GSCM in the institution, strong governance and management skills are required [8]. Strong leadership, high business capabilities, strong environmental compliances and business partner's collaborations are the factors that are required in the implementing of GSCM in the institution according to Figure 1.1.

GSCM skills means the capability of the institution to implement the green practices to minimize the impact of the environment [9]. Moreover, it is very important for the firm to process the skills of GSCM to adopt environmental practices [10]. Present study enrich the literature about skills of SCM and environmental performance with the help of innovation performance. Thus, research question of current study is: Does innovation performance mediates the association between GSCM skill and environmental performance? This study starts with background that is followed by literature review of past studies and development of hypotheses (Haseeb, Iqbal-Hussain, Ślusarczyk, & Jermsittiparsert, 2019). Then this study continues with the theoretical framework, structural equation modeling (SEM), theoretical and practical implications. In the last section, this study draws conclusions, discuss limitations and also provide the suggestions for further interesting areas.

Figure 1.1 ***Green Supply Chain Management Framework***

2. Theoretical Background

According to resource-based view (RBV), all the firm are not same in terms of competencies, organizational skills and sets of available resources are different in various types of firms [11]. Thus, accumulating the organizational skills are the key to achieve a competitive advantage [12]. Moreover, the competitive advantage attained by an organization through a unique set of capabilities and resources [13]. Additionally, resources are considered as inputs for the organizational processes [14], whereas, capabilities refer to the ability of the firm to combine their resources for better performance [15]. In the previous study, RBV theory explains the organizational performance and skills impact on environmental business practices [16]. It initial evidence that this study used the RBV to evaluate the SCM skills impact on "environmental performance" through innovational performance.

2.1. Literature Review

It presents the literature of past studies on the variable understudy such as skills of GSCM and their links with innovation performance and environmental performance [17]. Moreover, Faruk, et al. [16] argued that very limited studies had been conducted on GSCM. The study by Zhu and Sarkis [6] investigated the association of GSCM with environmental performance. They found that GSCM skills could be an effective tool to increase the environmental performance of the firm. Similarly, Zhu, et al. [18] also investigated the manufacturing firms of China and concluded the positive link between the practices of GSCM and operational as well as environmental performance. Likewise, Zhu, et al. [19] conducted the study on automobile manufacturing firm of China and found that adoption of GSCM practices could be the effective measure for enhancing the environmental performance of the firm.

Moreover, the study by Zhu, et al. [20] explored the diverse factor such as marketing, regulations, cost pressure, suppliers and relevant practices of industry level with a focus on relationships among the adoption of GSCM practices. The results of their study revealed that learning of organization can increase the effectiveness of GSCM practices. Thus, that learning programs are the valuable activities for practices of GSCM, and their study also highlighted the importance of regulators, customers, and suppliers in association with GSCM practices [21]. However, the study by Azevedo, et al. [22] examined the relationships among the practices of GSCM and performance of the supply chain of Portuguese automotive industry (Umrani, Mahmood & Ahmed, 2016). The results of their study indicated the positive impact of some green practices on customer satisfaction, quality, and efficiency, whereas negative impact has been observed of some other green practices on other performance measures of the supply chain. Moreover, another study conducted on issues regarding the GSCM practices in the UK [23]. The results revealed that engagement and practices of GSCM are limited between firms in B2B markets [24]. In addition, the results of their study also indicated that trust development with partners of the supply chain is a very relevant factor of engagement to GSCM between firms in sector of B2B [24]. Furthermore, Chan, et al. [25] conducted the study on practices of SCM and examined a significant relationship among green pressures and GSCM practices.

The regulations of a government drive the suppliers and designers to collaborate with respect to minimize the burdens of the environment [26]. The results of one study that are conducted to check the link between GSCM practices and drivers and found that practices of GSCM are positively affected by the drivers of GSCM. They also suggested that several factors have mediating effects on these relationships such as regulatory pressure, innovation and competitive pressure [27]. In addition, Yang, et al. [28] conducted the study on container shipping industry of Taiwan by examining the association between green performance and competitiveness of the firm. The result of their study showed that external as well as internal GSCM practices have a positive association with the performance of the environment. Similarly, Hajmohammad, et al. [29] examined the manufacturing firm of Canada to investigate the roles of "supply and lean management" practices in improving the environmental performance of the entity. The result

of their study revealed that supply and lean management activities are the agents through which resources are employed in environmental practices, and these formal practices are not associated with the performance of the environment. Moreover, the finding of their study suggested that practices of GSCM are a significant indicator of environmental performance.

The effective skills of SCM are necessary for the sustainability and innovation that leads the institutions towards enhanced environmental performance [30]. Likewise, the study of Liao and Kuo [31] examined the link between innovations, supply chain value and the results of their study showed that SCM is an effective tool that enhanced the firm performance while sustainability and innovation are leading the institutions towards enhanced firm performance. Moreover commitment and collaboration are also associated with companies that have enhanced environmental performance (Ali & Haseeb, 2019). Likewise, Luzzini, et al. [32] investigated the linkage among commitment, sustainability, capabilities of collaboration and firm's cost and environmental performance. The data were collected from procurement managers of ten countries of North America and Europe. The results of their study revealed the significant and positive relationship among commitment sustainability and capabilities of the collaboration of the firms but did not support the association between performance and collaboration. The past literature indicated that companies face pressure frequently to implement the GSCM practices, but sustainable practices of GSCM have a positive link with the environmental performance of the firm. Sustainability and innovation are always associated with each other, and companies must be innovative with respect to develop sustainable models of business and lead the institutions towards enhanced environmental performance [33]. This study also assess the links among the GSCM practices and environmental performance with the help of innovation performance.

3. Hypotheses Development

The following are the hypotheses that are developed based on all above-mentioned literature of previous studies:

3.1. GSCM Skills and Environmental Performance

Most of the past studies including Zhu and Sarkis [6], Hajmohammad, et al. [29] and Wu, et al. [27] found significant relationship among of GSCM skills and environmental performance. Based on all above-mentioned literature this study also develops the hypothesis as follow:

H1: GSCM skills have a significant and positive impact on the environmental performance of the firm.

3.2. GSCM Skills and Innovation Performance

Most of the past studies such as Hajmohammad, et al. [29] and Wu, et al. [27] found a significant relationship between GSCM skills and innovation performance. Based on all literature mentioned above this study also develops the hypothesis as follow:

H2: GSCM skills have a significant and positive impact on the innovation performance of the firm.

3.3. Innovation Performance and Environmental Performance

Most of the previous studies including Zhu and Sarkis [6] and Wu, et al. [27] indicated that "innovation performance" are necessary for the improvement in environmental performance. Based on all literature as mentioned above this study also develops the hypothesis as follow:

H3: "Innovation performance has a significant and positive impact on the environmental performance of the firm".

3.4. Mediating Role of Innovation Performance among the Relationship of GSCM Skills and Environmental Performance

Innovation is the indicator of the performance in terms of new services, products and new ways of thinking and doing [34]. Innovation is the key factor that plays an energetic role in minimizing environmental pressure with the help of GSCM skills [35]. Since past studies have observed a positive association between GSCM skills and environmental performance, while innovation performance has also positively associated with GSCM skills and environmental performance. Thus, environmental performance can be achieved through innovation and innovation are derived from GSCM skills. Therefore, this study is developed the second hypothesis based on previous studies is as follow:

H4: Innovation performance mediates the association between GSCM skills and environmental performance of the firms.

4. Research Method

To check the role of GSCM skills in improving the innovational and environmental performance, the sample was limited to the firms that had certification of "ISO 14001 EMS" in Thailand. The list of all the ISO certified companies was found from "Thai Industrial Standard Institute (TISI)". According to the previous studies, the lead players of ISO 140001 EMS associated are more proactive in implementing the initiatives of the green supply chain [36]. Data were collected from the mentioned-above companies through a questionnaire. This survey instrument sent to the EMS project management department particularly to the "environmental management representatives" (EMR). The survey instruments were sent to the 502 companies that are listed in the TISI database and 190 responses were returned that are valid for the study with response rate 37.85 percent.

4.1. Measures

This study is used GSCM skills as a predictor that have 23 items and 5 points Likert scale was used to answer the questions [19]. While environmental performance is used as a dependent variable in the study that has six items with 5 points Likert scale. In addition, innovation performance used as a mediator in the study that has 12 items and 5 points Likert scale is used to answer the questions [37].

4.2. Data Collection Procedure

This study selected the firms that have "ISO 14001 EMS" certification for data collection. Than 502 companies that were selected on the basis of their willingness to participate in the study. For getting willingness, sent the mail to the manager of the human resource of every organization. After getting willingness from the HR managers, the questionnaire was sent to them by post, and after three weeks 217 responses were received out of them only 190 responses were valid for the study.

4.3. Research Framework

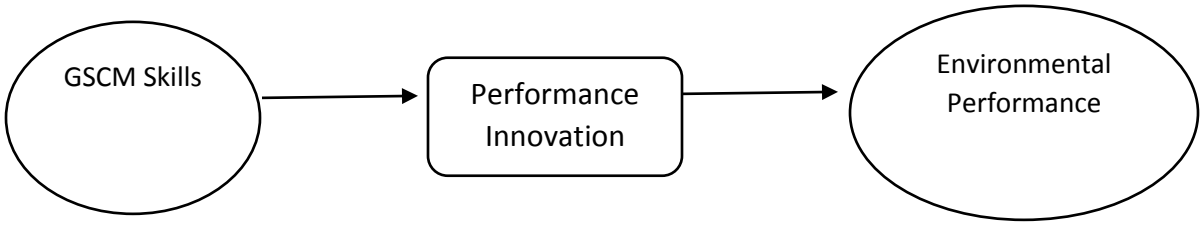

Figure 4.1 Theoretical Framework

5. Results

PLS-SEM approach is used to check the association between the variables of the study. The measurement model deals with relationships of indicators and constructs that can be checked through convergent validity and discriminant validity. The convergent validity is checked through "Average Variance Extracted (AVE), Cronbach's Alpha and composite reliability" while discriminant validity is verified through Heterotrait and Monotrait Ratio (HTMT). Table 5.1 given below shows the convergent validity of the data that contains outer loadings, AVE, Cronbach's Alpha and composite reliability.

The first criteria for convergent validity are the outer loading should be greater than 0.50, and Table 5.1 shows that the outer loading of all items is more than 0.50. These figures show that there is no problem with the convergent validity of the data. In addition, the second criteria to check the convergent validity is the Cronbach's Alpha that should be greater than 0.70, and the results show that it is greater than 0.70. The Cronbach's Alpha of environmental performance is 0.766 while GSCM skills is 0.866 and innovational performance is 0.716. Moreover, the third criteria of convergent validity is composite reliability that should also be more than 0.70, and the results show that it is greater than the above criteria. The composite reliability of environmental performance is 0.837 while GSCM skills is 0.886 and innovational performance is 0.791. Additionally, the last criteria for convergent validity is Average Variance Extracted (AVE) that should be more than 0.50 and Table 5.1 shows it is greater than above criteria for all the constructs. The AVE for environmental performance is 0.561 whereas GSCM skills is 0.562 and innovational performance is 0.691. The results show that there is no issue with the convergent validity of the data in this study.

Table 5.1 ***Convergent Validity***

Constructs	Items	Loadings	Cronbach's Alpha	Composite Reliability	"Average Variance Extracted" (AVE)
Environmental Performance	EP1	0.71	0.766	0.837	0.561
	EP2	0.729			
	EP3	0.675			
	EP4	0.675			
	EP5	0.638			
	EP6	0.642			
"Green Supply Chain Management Skills"	GSCM1	0.605	0.866	0.886	0.562
	GSCM10	0.327			
	GSCM11	0.527			
	GSCM12	0.65			
	GSCM13	0.58			
	GSCM14	0.61			
	GSCM15	0.518			
	GSCM16	0.571			
	GSCM17	0.472			
	GSCM18	0.574			
	GSCM19	0.418			

	GSCM2	0.543			
	GSCM20	0.479			
	GSCM21	0.488			
	GSCM22	0.639			
	GSCM23	0.529			
	GSCM3	0.547			
	GSCM4	0.439			
	GSCM5	0.227			
	GSCM6	0.357			
	GSCM7	0.321			
	GSCM8	0.591			
	GSCM9	0.502			
Innovation Performance	IP1	0.706	0.716	0.791	0.697
	IP10	0.555			
	IP11	0.201			
	IP12	0.402			

Table 5.1 (Continue)

Constructs	**Items**	**Loadings**	**Cronbach's Alpha**	**Composite Reliability**	**"Average Variance Extracted" (AVE)**
	IP13	0.509			
	IP2	0.695			
	IP3	0.627			
	IP4	0.26			
	IP5	0.475			
	IP6	0.564			
	IP7	0.656			
	IP8	0.621			
	IP9	0.536			

The discriminant validity means that the constructs of the study are different from each other, that means constructs are not highly correlated with each other. Discriminant validity can be check through Fornell and Larcker criteria or Heterotrait-Monotrait Ratio (HTMT). Fornell and Larcker that is the square root of AVE is the old criteria of checking discriminant validity, and most the researchers discourage to use this criterion. Thus, HTMT ratio that is introduced by the Henseler, et al. [38] to check the discriminant validity of the constructs. This study is also used the HTMT ratio to check the discriminant validity of the constructs used in current study. Table 5.2 given below shows the HTMT ratio of the constructs.

The thumb rule of HTMT ratio is less than 0.90, but when the ratio of HTMT is greater than the figure mentioned above, the discriminant validity is not up to the mark [39]. Table 5.2 shows the HTMT ratio is

less than 0.90 that means there is no problem with discriminant validity of the constructs.

The second approach of PLS-SEM is to assess the structural model. This approach elaborates the relationship between the variables used in the study such as GSCM skills, environmental performance, and innovation performance. Table 5.3 given below shows the direct relationship between the variables used in the study. The findings of the study indicated has positively and significantly related to environmental performance (β = 0.348; t = 4.13; LL = 0.210, UL = 0.481), and has supported the hypothesis (H3).

that GSCM skills have positively and significantly associated with environmental performance (β = 0.482; t = 6.12; LL = 0.365, UL = 0.616), and has supported the hypothesis (H1). Moreover, GSCM skills has also positively and significantly associated with innovation performance (β = 0.765; t = 27.141; LL = 0.726, UL = 0.819), and has supported the hypothesis (H2). In addition, innovation performance

Table 5.2 ***Heterotrait-Monotrait Ratio (HTMT)***

	EP	GSCM	IP
EP			
GSCM	0.889		
IP	0.863	0.868	

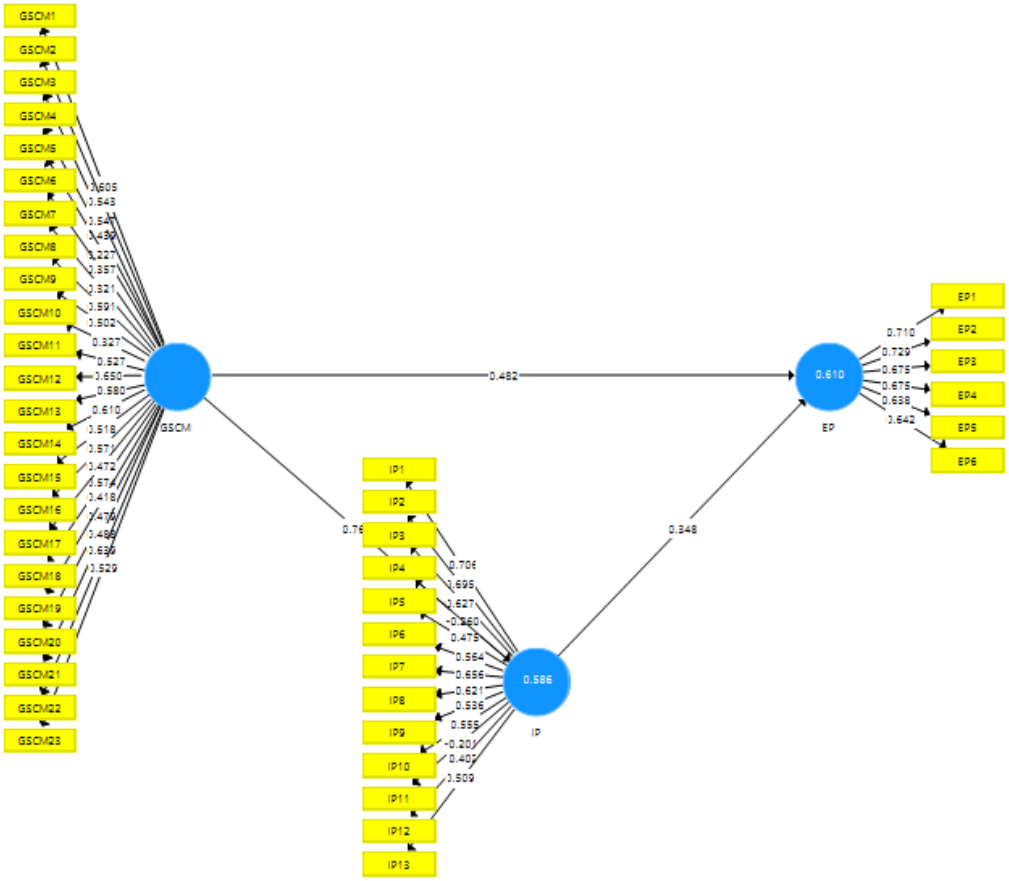

Figure 5.1 Measurement Model Assessment

Table 5.3 ***Path Analysis***

Hypotheses	Relationships	Std. Beta	Std. Error	t-Value	P-Values	L.L	U.L	Decision
H1	GSCM -> EP	0.482	0.079	6.12	0.000	0.365	0.616	Supported
H2	GSCM -> IP	0.765	0.028	27.141	0.000	0.726	0.819	Supported
H3	IP -> EP	0.348	0.084	4.13	0.000	0.210	0.481	Supported

Table 5.4 ***Indirect Effect***

Hypotheses	Relationships	Std. Beta	Std. Error	t-Value	P-Values	L.L	U.L	Decision
H4	GSCM->IP->EP	0.266	0.067	4.040	0.000	0.161	0.375	Supported

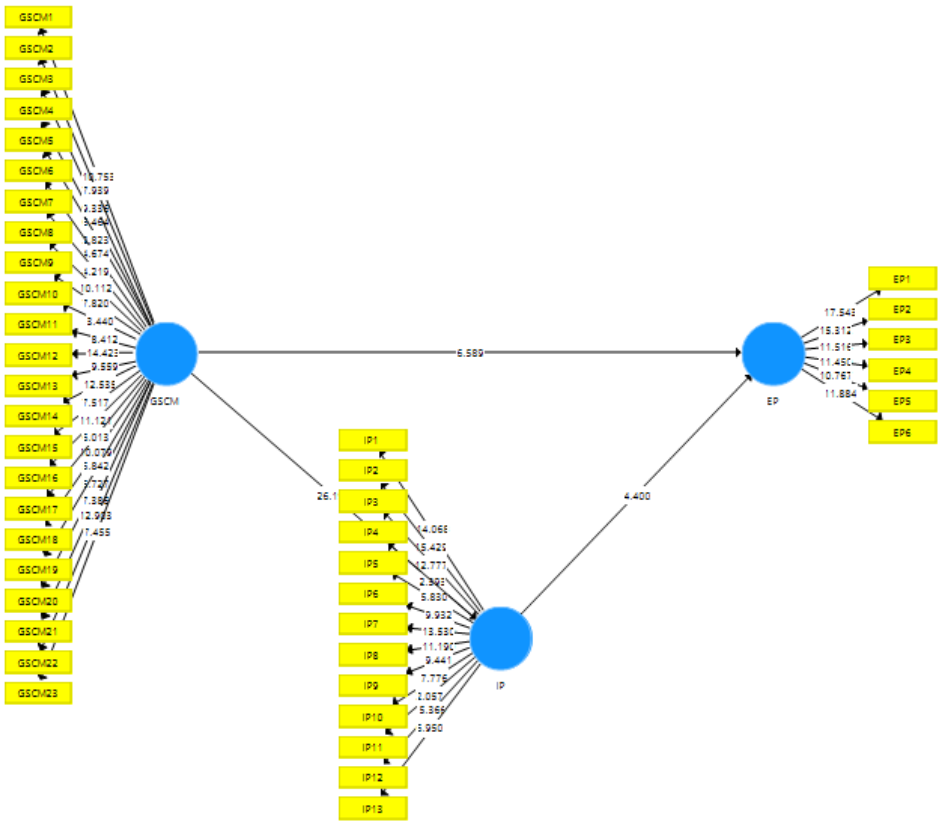

Figure 5.2 ***Structural Model Assessment***

After checking the direct relationships between the variables, the mediation test is used to check the indirect relationships between the variables. Bootstrapping procedures (300 subsamples) was used to test mediation effects of innovation performance between the relationships of GSCM skills and environmental performance. Table 5.4 shows the indirect relationships among the variables used in current study. The findings are indicated that innovation performance has significantly mediated the links between "GSCM skills" and "environmental performance" (β = 0.266; t = 4.040; LL = 0.161, UL = 0.375), and has supported the hypothesis (H4).

6. Discussion

The section of the study provides a discussion on the results that are mentioned above in the study. Moreover, results are compared with past studies in this section, and in the last conclusion, limitations and directions for future research are presented.

The basic aim of the firm is to increase the wealth for shareholders in the contemporary market economy. Thus, to fulfill this goal, the firm should be greener and must understand how "GSCM skills" effect on the firm performance. The results are similar with past studies and confirm that the GSCM skills are very imperative for companies in Thailand to improve their performance. The results are similar with Sarkis [40]; Zhu, et al. [19] and Zhu, et al. [18] who investigated the positive relationship among GSCM skills, innovation performance, and environmental performance. In addition, innovation

performance mediates the link between GSCM skills and environmental performance. The innovation can move the institutions to adopt the GSCM skills that are helpful for environmental performance. Innovation can explore the ways and ideas to adopt modern skills that remove environmental pressure. The finding of the studies is similar to Mena, et al. [41] and Stewart [42] who also found a positive association among GSCM skills and innovation performance. However, lack of innovativeness had been observed in the manufacturing companies of Russia that is against the development, efficiency, and improvement for the firms of the nation.

This study finally concluded the positive link between the GSCM skills and environmental performance. Moreover, the innovation performance mediates the relationship between GSCM skills and environmental performance in the companies of Thailand. The present study facilitates the regulators and managers that they must bring innovation in their business that increases the performance of the institution through GSCM skills. The study also enriches the literature of GSCM innovation and environmental performance. This study helps the implementation authorities on how GSCM skills are fruitful to enhance the performance of the institution.

The current study also has some limitation that would be helpful for future researcher to investigate this area in the future. First, the focus of current study only on the impact of GSCM skills on environmental performance and ignore the financial performance that can be an interesting opportunity for future researchers. This study also ignores the impact of competitors and other factors on the environmental performance of the firm. This study investigated only the manufacturing sector of Thailand and ignored the other sector that needs to improve performance through innovation and GSCM skills. Finally, this study examined the association between "green supply chain management skills" and performance SCM skills only in one country. [43-45] Thus, this study suggested that future research can include more countries that would make the results of the study more reliable and generalizable.

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