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Original Paper

Contribution of Green Supply Chain Management Practices towards a Sustainable Development—Applied Study in the Food Industry in Lebanon

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Abstract

This paper explores the effect of Green Supply Chain Management (GSCM) practices on the dimensions of Sustainable Development (SD) in the context of the Lebanese food industry. It aimed to examine to what extent GSCM practices and SD schemes are perceived in the food industry. As there is a growing concern and raising awareness of traceability among consumers in the food supply, researches can have a contribution to develop sustainability in food industry.

As such, six GSCM practices, namely Eco-design (ED), Internal Environmental Management (IEM), Investment Recovery (IR), Green Purchasing (GP), Environmental Cooperation (EC) and Reverse Logistics (RL) were employed. These six GSCM variables were used to analyze structural relationships with the three dimensions of the SD, that is to say economic, environmental and social performances. The proposed model was tested using a questionnaire based survey via two modes of face to face and emails using a plant survey, senior managers of 88 food companies in Lebanon. The data were analyzed in SPSS and AMOS statistical programs. An Exploratory (Unrestricted) Factor Analysis (EFA), Confirmatory (Restricted) Factor Analysis (CFA) and multiple regressions were applied. The Structural Equation Modeling (SEM) revealed that the GSCM practices IR, GP, ED and IEM had significant relationships with one or more of the SD dimensions.

On the basis of the findings, implications that may ameliorate the effect of GSCM practices on the SD dimensions can be taken into consideration. For instance, the enhance of the environmental cooperation with the suppliers and customers, improving the image of the company in the mind of their customers, reinforcing the commitment of GSCM from managers, utilization of cleaner technology, activation of internal performance evaluation system, enhancing the labor conditions and performing special training for workers on environmental issues.

Keywords

green supply chain management, sustainable development, food industry sector

1. Introduction

There is a growing concern about the preservation of natural resources and prevention of unrecoverable costs on the planet. The costs incurred on the planet have augmented as a consequence of environmental impacts, societal hazards and economical failures. Several studies suggest that Green Supply Chain Management (GSCM) contributes to the development of sustainable goals (SDGs). The goals can be achieved by adopting GSCM scheme from a very preliminary stage of production to the consumption by the final user (Hervani et al., 2005; Walker et al., 2008).

The GSCM was defined as an extension of the traditional supply chains including activities that aim at reducing the environmental effects of a product throughout its life cycle. There are several activities related to GSCM such as green design, resource saving, harmful material reduction and product recycle or reuse (Beamon, 1999). Moreover, GSCM is the process of introducing environmental concerns into business activities (Gilbert, 2001). The term "innovative" supply chain management was used by introducing the concepts of green purchasing, green manufacturing, green packaging, and reverse logistics (Rao & Holt, 2005).

GSCM has emerged as an effective management tool and philosophy for proactive and leading manufacturing organizations. The scope of GSCM practices implementation ranges from green purchasing to integrated life-cycle management supply chains flowing from supplier to manufacturer, customer, and closing the loop with reverse logistics (Zhu et al., 2006).

GSCM covers all phases of the product's life cycle from design, production and distribution phases to the use of products by the end users and its disposal at the end of the life-cycle of the product (Zhu & Sarkis, 2006). Moreover, GSCM was created with the idea of inclusion of environmental thinking in supply chain management. It was described as a combination of environmental thinking and SCM over product life steps thoroughly (Srivastava, 2007). Furthermore, the green supply chain is said to be a multidisciplinary subject that emerges essentially from building environment-friendly management practices in the context of supply chains (Eltayeb, 2011).

The idea of greening the supply chain is becoming an organizational precedence as a result of international efforts. The depletion of natural resources and environmental pollution have drawn attentions towards green production and consumption and sustainability over the recent decades (Younis et al., 2015). Accordingly, the GSCM could be defined as an integration of environmental concerns and supply chain stages from scratch to the end.

Additionally, the concept of Sustainable Development (SD) explicitly defined as "Our Common Future", meaning meeting the needs of the present without compromising the ability of future generations to meet their needs (WCED, 1987). The SD encompasses the economic, environmental as well as social performances. Consequently, the achievement of SD goals and green practices need to be prioritized by every industry or firms (Diabat et al., 2013). Recently, due to virus outbreaks consumers' confidences towards the food they consume have vibrated. This coerces the Food Supply Chain (FSC) partners to implement a proper traceability system in their own supply chains to sustain the consumers' confidence (Haleem, et al., 2019).

Below we discuss the six GSCM practices we the support of literature, the variables are categorized as internal and external. The internal GSCM practices are: Eco Design (ED), Internal Environmental Management (IEM) and Investment Recovery (IR). While the External GSCM practices are: Green Purchasing (GP), Environmental Cooperation (EC) and Reverse Logistics (RL).

1.1 Eco-Design (ED)

The eco-design practices fall into two main categories, namely product-related design and packaging-related design. The use of recyclable and reusable components in the production is very important (Tritos et al., 2013). The eco-design was defined as the actions taken during product development stage targeted toward minimizing a product's environmental impact during its whole life cycle. This life cycle starts from acquiring raw material to manufacturing, use and finally to its final disposal without compromising other essential product criteria such as performance and cost (Johansson, 2002). In addition, green design is closely related to environmental risk management, product safety, pollution prevention, resource conservation, and waste management (Younis et al., 2015; Zhu et al., 2007).

1.2 Internal Environmental Management (IEM)

The internal environmental management is the setting of environmental protection policies and environmental targets in order to protect the environment as much as possible. The scope of internal environmental management is identified as an action of upper-level and mid-level managers that aim to support the environmental practices, inter-departmental cooperation (Chan et al., 2012)

1.3 Investment Recovery (IR)

The investment recovery defined as reselling excess inventories/materials or the scrap/used materials. The investment recovery is considered as one of the most frequently investigated dimensions in GSCM studies (Zhu & Sarkis, 2004; Çankaya & Sezen, 2019).

1.4 Green Purchasing (GP)

The purchasing function is the first step and an important component of GSCM (Çankaya & Sezen, 2019).

The green purchasing is defined as an environmental purchasing initiative that aims to ensure that purchased products and material meet with environmental objectives. Some of the environmental objectives are set to reduce the sources of waste, encouraging recycling, reuse and substitution of materials. The success of green purchasing depends on the integration of environmental efforts, purchasing activities and environmental objectives of the firm (Carter & Ellram, 1998; Carter et al., 2000; Min & Galle, 2001; Zsidisin & Siferd, 2001).

1.5 Environmental Cooperation (EC)

Several studies used environmental cooperation as a GSCM practice. The EC was indicated either in the downstream with the customers or in the upstream with the suppliers (Zhu et al., 2007; Diabat et al., 2013).

The EC with customers contains firms' activities that aim to increase customers' environmental awareness level and motivate them to be friendlier with the environment. This can be done by presenting the characteristics of their green products and their positive impact on the environment.

The EC with suppliers aim to cooperate with the suppliers and impetus them to be more concerned about environmental issues. To evaluate their environment-friendly process and encourage them to receive ISO 14001 certification, and provide design specifications on environmental requirements (Diabat et al., 2013).

Since a good SCM needs trust, commitment and long term relationship with suppliers, the EC with suppliers would be more effective if those needs were satisfied.

1.6 Reverse Logistics (RL)

Reverse logistics is one of the most commonly used GSCM practices in the previous studies. It could be applied by returning products and materials from customers in order to reincorporate them in the supply chain for the purpose of recycling, reuse, remanufacture, repair, and/or safe disposal of the products and materials (Zhu et al., 2007). These practices are applicable to final products, their components (Das, 2012), and packaging material (Field & Sroufe, 2007). Accordingly, (RL) leads the firms to be more efficient by recycling, reusing, remanufacturing of products and materials which make a cost savings and decrease the consumption of raw materials and then affects positively the green supply chain Management.

1.7 GSCM and SD

The GSCM is a tool for enhancing social welfare; the eco-friendly practices generally exhibit decent social performance, such as gaining loyalty from customers (De Giovanni, 2012). The GSCM improve the social performance by improving corporate image (Eltayeb & Zailani, 2011).

In contradiction with the above, the GSCM may not be as effective as expected on social performance (Çankaya & Sezen, 2019). Regarding the impact of GSCM on environmental dimension, the organizations have to broad environmental management practices outside the internal limitations. This environmental management should coordinate suppliers and customers to maintain an ecological responsibility and to enrich their operations with green activities (Krause et al., 2009; Diabat et al., 2013). GSCM is considered as a tool of successful strategic management which enhances the environmental performance of industrial companies (Hassan et al., 2016; Geng et al., 2017). The GSCM practices affect positively environmental performance leading to environmental improvements (Vanalle et al., 2017; Çankaya & Sezen, 2019).

Regarding the economic performance, there is a significant positive impact of the adoption of GSCM practices on economic performance (Vanalle et al., 2017).

A positive relationship between the adoption of GSCM practices and the economic performance create a potential to promote the adoption of GSCM as a strategy in which leading to achieve a competitive advantage (Geng et al., 2017). The GSCM is considered as a unique strategy for providing economic benefits (De Giovanni, 2012).

Nonetheless, the GSCM practices may not significantly affect the economic performance, but the improvement of environmental and operational performance could achieve economic performance over a longer term (Zhu et al., 2013). Moreover, a firm's profitability may become vulnerable as a result of larger spending and investments in technology to protect environment (Li et al., 2015). The GSCM practices may not be as effective as expected in moving forward economic enactment (Çankaya & Sezen, 2019).

Consequently, the paradox in the literature shows the relationship between GSCM and economic performance varies between indirect relationship, direct and positive relationship and negative relationship.

2. Method

This study follows (Çankaya & Sezen, 2019) stakeholder theories in which examines the effects of GSCM on sustainable development factors. On the basis of the Natural Resource-Based View (NRBV) perspective (Li et al., 2015; Çankaya & Sezen, 2019) the linkage between environmental orientation, green supply chain capabilities and performance is hypothesized. The NRBV is adopted in conjunction with the stakeholder theory because both theories suggest that the environmental orientation help firms to improve their green supply chain capabilities (Li et al., 2015).

2.1 Hypotheses

2.1.1 GSCM Practices and Economic Performance

This paper proposes the following hypotheses:

H1a. There is a positive relationship between implementation of eco-design practice and corporate economic performance.

H1b. There is a positive relationship between implementation of green purchasing practice and corporate economic performance.

H1c. There is a positive relationship between implementation of environmental cooperation practice and corporate economic performance.

H1d. There is a positive relationship between implementation of reverse logistics practice and corporate economic performance.

H1e. There is a positive relationship between implementation of internal environmental management practice and corporate economic performance.

H1f. There is a positive relationship between applying of investment recovery practice and the corporate economic dimension.

2.1.2 GSCM Practices and Environmental Performance

This paper proposes the following hypotheses:

H2a. There is a positive relationship between applying of eco-design practice and corporate environmental dimension.

H2b. There is a positive relationship between applying of green purchasing practice and corporate environmental dimension.

H2c. There is a positive relationship between applying of environmental cooperation practice and corporate environmental dimension.

H2d. There is a positive relationship between applying of reverse logistics practice and the corporate environmental dimension.

H2e. There is a positive relationship between applying of internal environmental management practice and the corporate environmental dimension.

H2f. There is a positive relationship between applying of investment recovery practice and the corporate environmental dimension.

2.1.3 GSCM Practices and Social Performance

This paper proposes the following hypotheses:

H3a. There is a positive relationship between implementation of eco-design practice and corporate social performance.

H3b. There is a positive relationship between implementation of green purchasing practice and corporate social performance.

H3c. There is a positive relationship between implementation of environmental cooperation practice and corporate social performance.

H3d. There is a positive relationship between implementation of reverse logistics practice and corporate social performance.

H3e. There is a positive relationship between implementation of internal environmental management practice and corporate social performance.

H3f. There is a positive relationship between applying of investment recovery practice and the corporate social dimension.

2.2 Sampling and Data Collection

The surveyed respondents were randomly selected from top level managers of food companies in Beirut, Bekaa and Tripoli regions of Lebanon. This industry is used because it has been traditionally associated with resource consumption, waste generation, and implementation of environmental management practices above the average. Moreover, due to raising awareness of traceability in the food production and supply, there is need of achieveing sustainable development in food industry.

Thus, the primary data were collected by distributing questionnaires to the top level manager of each food company. All respondents held plant-level management position (Çankaya & Sezen, 2019) in a food production firm, namely CEO, Quality managers, SCM manager, Financial managers and Production managers. According to, Nassiuma's (2000) formula, the number of sample study has to be at least 85 companies from a total population of 540 food companies. However, the questionnaires were sent to 450 companies, and in the next week a date was appointed by telephone to collect the completed questionnaire in person. Consequently, 88 questionnaires were completely filled and appropriate to be used to test the hypothesis of this study.

For the non-response bias test, the participants who responded immediately to the questionnaire and those who responded later were compared using homogeneity of variance test. For this purpose, the 88 questionnaires were divided into two groups; each group is consisted of 44 questionnaires. There was no statistical difference in the comparison between the data in the earlier and later time.

2.3 Construction of the Instrument and Measure

This research adopted the most used and relevant GSCM practices on the basis of previous studies. Figure 1 depicts the conceptual model of the study. The three internal practices of: Eco Design (ED), Internal Environmental Management (IEM) and Investment Recovery (IR), along with the three external practices: Green Purchasing (GP), Environmental Cooperation (EC) and Reverse Logistics (RL) are represented in Figure 1.

To measure each of these practices and test their correlation with the SD dimensions, 61 questions were included in the questionnaire.

The survey questions were translated into Arabic. The measurement items related to GSCM practices and SD dimensions are appended in the annex 1. All items were assessed using a five-point Likert-scale (1-Strongly Agree, 2-Agree, 3-Neutral, 4-Disagree, 5-Strongly Disagree).

Prior to the main survey, a pilot survey was conducted from 17 respondents to evaluate the reliability of the questions. As a result of Cronbach's Alpha test, 12 items with low correlations were eliminated and the questionnaire finalized with 49 questions.

After collecting 88 data, the reliability level of each scale of the GSCM and the SD dimensions were measured (Cronbach, 1951). As reported in Table 1 the reliability level of the questions were acceptable (Nunnally & Bernstein, 1994).

Table 1. Reliability Test Result

Case Processing Summary		N	%
Cases	Valid	88	100.0
	Excluded[a]	0	.0
	Total	88	100.0

Note. Listwise deletion based on all variables in the procedure.

Table 2. Reliability Statistics

Cronbach's Alpha	N of Items
0.942	49

Moreover, an Exploratory (Unrestricted) Factor Analysis (EFA) and Confirmatory (Restricted) Factor Analysis (CFA) were carried out. To measure the unidimensionality of the factors, an EFA was conducted using principal component extraction with a varimax rotation. The results revealed that out of thirteen factors of GSCM, seven of them had a suppressing loadings less than 0.5 and the others six factors had a suppressing loadings greater than 0.5. Accordingly, the six practices of GSCM are accepted. As a result of EFA, there were no questions with low factor loads and no questions were removed from the questionnaire. This result conformed with the outcome of Cronbach's Alpha test.

The Structural Equation Modeling (SEM) was applied to test the proposed hypothesis. Referring to Çankaya and Sezen (2019), AMOS software was employed to test the research model. The fit indices used in this study were the ratio of chi-square to the degree of freedom, Root Mean Square Error of Approximation (RMSEA) and the Comparative Fit Index (CFI). The model fit was as follows: Chi-square/df of 1.983; CFI=0.908; RMSEA=0.1. Accordingly, the fit indices and CFA results were at an acceptable level (Schermelleh-Engel et al., 2003).

3. Result

The SEM results of the relationship between the GSCM practices and SD dimensions are reported in Table 3.

Table 3. Correlation

Correlations

		EcP	EnP	SP
GP	Pearson Correlation	.277**	.546**	.257*
	Sig. (2-tailed)	0.009	0.000	0.016
	N	88	88	88
ED	Pearson Correlation	.450**	.502**	.271*
	Sig. (2-tailed)	0.000	0.000	0.011
	N	88	88	88
IEM	Pearson Correlation	.438**	.567**	.447**
	Sig. (2-tailed)	0.000	0.000	0.000
	N	88	88	88
ECoop	Pearson Correlation	.471**	.420**	.362**
	Sig. (2-tailed)	0.000	0.000	0.001
	N	88	88	88
IR	Pearson Correlation	.544**	.395**	.232*
	Sig. (2-tailed)	0.000	0.000	0.030
	N	88	88	88
RL	Pearson Correlation	.464**	.410**	.256*
	Sig. (2-tailed)	0.000	0.000	0.016
	N	88	88	88

Note. **. Correlation is significant at the 0.01 level (2-tailed). *. Correlation is significant at the 0.05 level (2-tailed).

As summarized in Table 3, the IR practice was positively related to economic. The practices GP, ED and IEM were positively related to the environmental performance. In addition, IEM had a significant and positive relationship with the dimension of social performance.

This study examined the GSCM practices which affect the dimensions of the sustainable development particularly in the food industry. The effects of the six GSCM variables on the three SD performance dimensions were tested in order to provide practical implications for both manufacturers and policy makers.

3.1 GSCM Practices and Economic Performance

This study found that there is a significant correlation between investment recovery and economic performance IR (p=0.544). This may be because of the higher awareness and caring from the majority of people, which reflects positively the behavior of the food industrial companies with regards to the environmental issues. This can enhance the image of the companies in the mind of their customers as a result of increasing their sales and profits.

3.2 GSCM Practices and Environmental Performance

The study found a positive and significant relationship between internal environmental management and environmental performance IEM (p=0.567). This finding is in line with studies by (Çankaya & Sezen, 2019; Geng et al., 2017). One possible explanation for this positive relationship can be because of the implementation of an internal performance evaluation system and the generation of environmental reports for internal evaluation.

Moreover, the relationship between eco-design and environmental performance was significant ED (p=0.502). This can be elucidated in terms of production and packaging the products which are designed by reused or recycled materials. The finding of strong and significant relationship between eco-design practice and environmental performance is in line with previous studies (Geng et al., 2017; Li et al., 2015).

What's more, green purchasing revealed a significant relationship GP (p=0.546). This result can be interpreted as there are companies which purchase products composed of green attributes such as recycled or reusable items.

Generally, regarding the relationship between green purchasing and the environmental performance from the other side, this study is inconsistent with the previous studies. The green purchasing is not significantly related to environmental performance (Kenneth et al., 2012). This contradiction between the findings may have observed a result of the special nature of the food industry which is varied from other industries.

3.3 GSCM Practices and Social Performance

According to the study results, the most important practice having a significant relationship with the social performance was the practice of internal environmental management. This practice had positive relationship with the dimension of social performance IEM (p=0.447). This was also found by (Geng et al., 2017; Çankaya & Sezen, 2019).

Finally, the results of this study revealed that the GSCM practices IR, GP, ED and IEM had significant and strong relationship with one or more of the SD dimensions.

4. Discussion

This study suggests solutions regarding the internal level and the external level of the company.

Regarding the external level, this study suggests that enhancing the environmental cooperation with the suppliers aiming at of reducing the cost of the green purchases would be needed. This matter leads to decrease the eco-design cost on one hand and increasing the profitability of the company on the other hand.

Moreover, the companies can improve the environmental cooperation with their customers to ameliorate their environmental comportments. In addition, it is required to enhance the image of the companies in the mind of their customers regarding environmental and social issues which can increase their sales and profits. The cooperation with customers is needed to collect back the used products and packaging for recycling, remanufacturing or reusing of the materials. It is important to coordinate with customers and suppliers for using less energy during product transportation.

Another form of environmental cooperation is to make sure that the purchased products and packaging contain green attributes such as recycled or reusable, degradable and non-hazardous items.

Regarding the internal level, the reinforcing of the commitment of GSCM from senior managers and support for GSCM from mid-level managers is highly required for the success of the internal environmental management. The use of cleaner technology process is recommended to make savings on clean production and packaging. The optimization of processes is very important to reduce air emissions, water use, solid waste, and/or noise. One of the most significant keys is to activate the internal performance evaluation system and generate internal environmental report process. These activities may lead to an ambiance of environmental friendly procedures in the companies. Furthermore, enhancing the labor conditions and satisfactions can increase the productivity of the company. The performing of special training for workers on environmental issues would enhance the social performance of the company.

Last but not least, Eco-label designed products is desirable in that recycled materials, such as glass and plastics are utilized in the production process and packaging. This can enhance the sustainability of the company due to increasing consumer confidence in the society. Furthermore, the implementation of a proper traceability system, by evaluating the environmental load of products and life cycle assessment helps to sustain the consumers' confidence, maintain the company competitive advantage.

5. Managerial Implications

When the GSCM practices are applied by the companies' managements, a balance between the goal of profit maximization and environmental responsibility need be determined. However, the decisions related to such matters are not easy to take. The company's management may need to consider the advantages and disadvantages of every decision bearing in mind not to harm the society and the environment.

This study provides practical implications for both practitioners in the manufacturing context and policy makers. Every producer's priority is to maximize profit and minimize the cost of production by avoiding risks. However, firms whose aims to pursue short-term profits by ignoring the environmental and societal impacts cannot be sustained in the pursuit of long term success.

Based on the results of this study, the food industry companies have to focus on the GSCM practices of IR, GP, ED and IEM in order to achieve sustainable development in the sector of food industry.

Accordingly, many actions could be implemented with the purpose of achieving the goals. For instance, enhancing the application of GP is about ensuring that the purchased products must contain green attributes such as recycled or reusable items. By producing products and packaging that have reused or recycled materials in their contents such as recycled plastics and glass are more preferred compared with products that are contaminated by substances such as lead, mercury, chromium, and cadmium. Moreover, another issue is selling the excess inventories, scraps and used materials and establishing a recycling system for used and defective products would increase the credibility. Furthermore, raising workers awareness about safety and risk of hazardous inputs or outputs through training and vocational workshops can support and underpin the consumer confidence.

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Appendix

Annex1. Measurement Items Related to GSCM Practices and SD Dimensions

Green Purchasing	Items	Source
	Provides design specifications to suppliers that include environmental requirements for purchased items.	Abdullah et al. (2014) Eltayeb et al. (2011) Diabat et al. (2014) Zhu et al. (2013) Zhu and Sarkis (2005) Younis et al. (2016) Zaid et al. (2018) Laosirihongthong et al.

	(2013)
Requires your suppliers to develop and maintain an environmental Management System (EMS).	Abdullah et al. (2014) Eltayeb et al. (2011) Laosirihongthong et al. (2013)
Requires your suppliers to have a certified EMS such as ISO 14001.	Abdullah et al. (2014) Eltayeb et al. (2011) Diabat et al. (2014) Zhu et al. (2013) Laosirihongthong et al. (2013)
Uses a questionnaire to collect information about your suppliers' environmental aspects, activities and/or management systems.	Abdullah et al. (2014) Eltayeb et al. (2011) Laosirihongthong et al. (2013)
Makes sure that your purchased products must contain green attributes such as recycled or reusable items.	Abdullah et al. (2014) Eltayeb et al. (2011) Laosirihongthong et al. (2013)
Makes sure that your purchased products must not contain environmentally undesirable items such as lead or other hazardous or toxic materials.	Abdullah et al. (2014) Eltayeb et al. (2011) Zaid et al. (2018) Laosirihongthong et al. (2013) Younis et al. (2015)
Evaluates your suppliers based on specific environmental criteria.	Abdullah et al. (2014) Eltayeb et al. (2011) Zhu et al. (2013) Zhu and Sarkis (2005)

	Younis et al. (2016)
	Zaid et al. (2018)
	Laosirihongthong et al. (2013)
Evaluates the environmental aspects of your suppliers.	Abdullah et al. (2014)
	Eltayeb et al. (2011)
	Laosirihongthong et al. (2013)
Makes sure that your suppliers meet its environmental objectives.	Abdullah et al. (2014)
	Eltayeb et al. (2011)
	Diabat et al. (2014)
	Zhu et al. (2013)
	Laosirihongthong et al. (2013)
Second-tier supplier environmentally friendly practice evaluation	Diabat et al. (2014)
	Zhu et al. (2013)
	Younis et al. (2016)
	Zaid et al. (2018)
	Laosirihongthong et al. (2013)
Eco labeling of products (GP1)	Zhu et al. (2007)
	Zhu and Sarkis (2004)
Environmental audit for suppliers' internal management (GP3)	Zhu and Sarkis (2007)
	Younis et al. (2016)
Adopting just-in-timelogisticssystem	Zhu et al. (2013)
	Zhu and Sarkis (2005)
Cooperating with supplier to reduce packaging	Zhu et al. (2013)
	Zhu and Sarkis (2005)
Require supplierstouse environmental packaging (degradable andnon-hazardous)	Zhu et al. (2013)
	Younis et al. (2016)
	Zaid et al. (2018)
	Laosirihongthong et al.

		(2013)
Eco Design	Items	Source
	Produces products that have reused or recycled materials in their contents such as recycled plastics and glass.	Abdullah et al. (2014) Tritos et al. (2013) Laosirihongthong et al. (2013) Zailani et al. (2012)
	Uses life cycle assessment to evaluate the environmental load of your products.	Abdullah et al. (2014) Zhu and Sarkis (2007) Zailani et al. (2012) Zaid et al. (2018) Laosirihongthong et al. (2013)
	Produces products that are free from hazardous substances such as lead, mercury,chromium, and cadmium.	Abdullah et al. (2014) Eltayeb and Zailani (2009) Diabat et al. (2014) Zhu et al. (2013) Younis et al. (2016) Zaid et al. (2018) Laosirihongthong et al. (2013)
	Produces products that reduce the consumption of materials or energy during use.	Abdullah et al. (2014) Diabat et al. (2014) Zhu et al. (2013) Younis et al. (2016) Zaid et al. (2018) Laosirihongthong et al. (2013)
	Makes sure that product's packaging has recyclable contents.	Abdullah et al. (2014) Eltayeb and Zailani (2009) Zailani et al. (2012) Laosirihongthong et al. (2013)
	Makes sure that product's packaging is reusable.	Abdullah et al. (2014) Zailani et al. (2012) Laosirihongthong et al. (2013) Younis et al. (2015)
	Minimizes the use of materials in product's packaging.	Abdullah et al. (2014) Eltayeb and Zailani (2009) Zailani et al. (2012) Laosirihongthong et al.

		(2013)
	Avoids or reduces the use of hazardous materials in product's packaging.	Abdullah et al. (2014) Zailani et al. (2012) Laosirihongthong et al. (2013)
	Design for remanufacturing (a design that facilitates repair, rework,and refurbishment activities aiming at returning the product to the new and better condition)	Diabat et al. (2014)
	Design for recycling (a design that facilitates disassembly of the waste product, separation of parts according to material, and reprocessing of the material)	Abdullah et al. (2014) Diabat et al. (2014) Zhu et al. (2013) Younis et al. (2016) Zaid et al. (2018) Laosirihongthong et al. (2013)
	Design for reuse (a design that facilitates reuse of a product or part of it)	Diabat et al. (2014)
	Design of processes for minimization of waste	Zhu et al. (2013) Zhu and Sarkis (2005) Younis et al. (2016)
Internal Environmental Management	Items	Source
	Commitment of GSCM from senior managers	Diabat et al. (2014) Zhu et al. (2013) Zaid et al. (2018)
	Support for GSCM from mid-level managers	Diabat et al. (2014) Zhu et al. (2013) Zaid et al. (2018)
	Cross-functional cooperation for environmental improvements	Diabat et al. (2014) Zhu et al. (2013) Zaid et al. (2018)
	Total quality environmental management	Diabat et al. (2014) Zhu et al. (2013) Zaid et al. (2018)
	Environmental compliance and auditing programs	Diabat et al. (2014) Zhu and Sarkis (2007)
	ISO 14000 certification	Zhu et al. (2013)

		Diabat et al. (2014)
	Eco-labeling of products	Zhu et al. (2013) Diabat et al. (2014) Zhu and Sarkis (2005)
	Environmental Management Systems exist (IEM7)	Zhu and Sarkis (2007) Zhu and Sarkis (2004)
	In the past two years, to what extent did your firm engage in the following IEM activities?	Pietro De Giovanni (2010) Rao (2002)
	Environmentally friendly raw materials	Pietro De Giovanni (2010) Rao (2002)
	Substitution of environmentally questionable materials	Pietro De Giovanni (2010) Rao (2002)
	Taking environmental criteria into consideration	Pietro De Giovanni (2010) Rao (2002)
	Optimization of processes to reduce air emissions, water use, solid waste, and/or noise	Pietro De Giovanni (2010) Rao (2002)
	Use of cleaner technology process to make savings (IEM5)	Pietro De Giovanni (2010) Rao (2002)
	Special training for workers on environmental issues	Zhu et al. (2013) Zhu and Sarkis (2005)
	Existence of Pollution Prevention Programs	Zhu et al. (2013) Zhu and Sarkis (2005)
	The internal performance evaluation system incorporates environmental factors	Zaid et al. (2018) Zhu et al. (2013)
	Generate environmental reports for internal evaluation	Zaid et al. (2018) Zhu et al (2013)
Environmental Cooperation	Items	Source
	Cooperation with customer for eco-design	Diabat et al. (2014) Zhu et al. (2013) Younis et al. (2016) Vachon and Klassen (2008) Zaid et al. (2018)

	Cooperation with customers for cleaner production	Diabat et al. (2014) Zhu et al. (2013) Zaid et al. (2018) Younis et al. (2015)
	Cooperation with customers for green packaging	Diabat et al. (2014) Zhu et al. (2013) Younis et al. (2016) Zaid et al. (2018)
	Cooperation with customers for using less energy during product transportation	Diabat et al. (2014) Zhu et al. (2013) Younis et al. (2016) Zaid et al. (2018)
	Adopting third-party-logistics	Zhu et al. (2013) Zhu and Sarkis (2004)
	Cooperation with customers for product take back	Zhu et al. (2013) Zhu and Sarkis (2004)
	Cooperation with customers for reverse logistics relatioships	Zhu et al. (2013) Zhu and Sarkis (2004)
	Developing a mutual understanding of responsibilities regarding environmental performance	Younis et al. (2016) Vachon and Klassen (2008)
	Working together to reduce environmental impact of our activities	Younis et al. (2016) Vachon and Klassen (2008)
	Conducting joint planning to anticipate and resolve environmental-related problems	Younis et al. (2016) Vachon and Klassen (2008) Zaid et al. (2018)
	Making joint decisions with other supply chain members about ways to reduce overall environmental impact of our products	Younis et al. (2016) Zaid et al. (2018)
Investment Recovery	Items	Source
	Investment recovery (sale) of excess inventories/material	Diabat et al. (2014) Zhu et al. (2013)

	Sale of scrap and used materials	Diabat et al. (2014) Zhu et al. (2013)
	Sale of excess capital equipment	Diabat et al. (2014) Zhu et al. (2013)
	Collecting and recycling end-of-life products and materials	Zhu et al. (2013) Zhu and Sarkis (2005)
	Establishing a recycling system for used and defective products	Zhu et al. (2013) Zhu and Sarkis (2005)
Reverse Logistics	Items	Source
	Collects back used products from customers for recycling, reclamation of materials, or reuse.	Abdullah et al. (2014) Rogers and Tibben-Lembke (2001) Laosirihongthong et al. (2013)
	Collects back used packaging from customers reuse or recycling.	Abdullah et al. (2014) Laosirihongthong et al. (2013)
	Requires suppliers to collect back their packaging materials.	Abdullah et al. (2014) Laosirihongthong et al. (2013)
	Returns back its products to suppliers for retaining of materials, or remanufacturing.	Abdullah et al. (2014) Laosirihongthong et al. (2013)
	Returns back its packaging to suppliers for reuse and recycling.	Abdullah et al. (2014) Laosirihongthong et al. (2013)
	Returns back the products from customers for safe refill	Abdullah et al. (2014) Laosirihongthong et al. (2013)
	Reuse (the process of collecting used products, and distributing or selling them)	Diabat et al. (2014)
	Remanufacturing (the process of collecting a used product and replacing defective or outdated parts with new or renovated parts)	Diabat et al. (2014) Zaid et al. (2018) Younis et al. (2016)
	Recycling (the process of collecting, disassembling, separating, and processing used products into recycled products and materials)	Diabat et al. (2014)

	D5. Collects used packaging from customers for recycling	Laosirihongthong et al. (2013) Zaid et al. (2018) Younis et al. (2016)
	Use of remanufacturing	Younis et al. (2016) Rao (2007)
	Recovery of the company's end-of-life products	Zaid et al. (2018) Younis et al. (2016)
Economic Performance	Items	Source
	Decrease of cost for materials purchasing.	Abdullah et al. (2014) Zhu et al. (2013) Younis et al. (2016) Zaid et al. (2018) Laosirihongthong et al. (2013)
	Decrease of cost for energy consumption.	Abdullah et al. (2014) Zhu et al. (2013) Younis et al. (2016) Zaid et al. (2018) Laosirihongthong et al. (2013)
	Decrease of fee for wste treatment.	Abdullah et al. (2014) Zhu et al. (2013) Younis et al. (2016) Zaid et al. (2018) Laosirihongthong et al. (2013)
	Decrease of fine/penalties for environmental accidents.	Abdullah et al. (2014) Zhu et al. (2013) Younis et al. (2016) Zaid et al. (2018) Laosirihongthong et al. (2013)
	Profit (EC1)	Abdullah et al. (2014) Zhu et al. (2013) Younis et al. (2016) Zaid et al. (2018) Laosirihongthong et al. (2013)
	Market share (EC2)	Maxwell et al. (2006) Pietro De Giovanni (2010) Younis et al. (2016) Zaid et al. (2018)

	Cost savings	Pietro De Giovanni (2010) Laosirihongthong et al. (2013)
	G4. Decrease in packaging costs	Zhu and Sarkis (2007) Laosirihongthong et al. (2013)
Environmental Performance	Items	Source
	Reduction of air emission.	Abdullah et al. (2014) Zhu et al. (2013) Younis et al. (2016) Zaid et al. (2018) Laosirihongthong et al. (2013)
	Reduction of solid/liquid wastes	Abdullah et al. (2014) Zhu et al. (2013) Younis et al. (2016) Zaid et al. (2018) Laosirihongthong et al. (2013)
	Decrease of consumption for hazardous/ harmful/ toxic materials.	Abdullah et al. (2014) Zhu et al. (2013) Younis et al. (2016) Laosirihongthong et al. (2013)
	Decrease of frequency for environmental accidents.	Abdullah et al. (2014)
	Improvement of a firm's environmental situation.	Abdullah et al. (2014)
	Reduction of amount of energy used	Pietro De Giovanni, 2010
	Improved compliance to environmental standards	Laosirihongthong et al. (2013)
	Reduction in material usage	Laosirihongthong et al. (2013)
Social	Items	Source

Performance	Employees' health and safety.	Abdullah et al. (2014) Zaid et al. (2018) Pietro De Giovanni (2012)
	Incentives and engagement for local employment.	Abdullah et al. (2014) Zaid et al. (2018) Pietro De Giovanni (2012)
	Development of economic activities.	Abdullah et al. (2014) Zaid et al. (2018) Pietro De Giovanni (2012)
	Improvement of community health and safety.	Abdullah et al. (2014) Zaid et al. (2018) Pietro De Giovanni (2012)
	Reduction of the negative impact of products and processes on the local community.	Abdullah et al. (2014) Zaid et al. (2018) Pietro De Giovanni (2012)
	Improved corporate image	Abdullah et al. (2014) Rao (2002)
	Social commitment	Abdullah et al. (2014) Rao (2002)
	Preserve environment	Abdullah et al. (2014) Rao (2002)
	Enhanced employee job satisfaction	Abdullah et al. (2014) Rao (2002)