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Examining the inter-relationship among competitive market environments, green supply chain practices, and firm performance

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Abstract

Purpose – The purpose of this paper is to assess the impact of competitive market environments on the firm's decision to adopt green supply chain management (GSCM) practices, while checking to see if the firm's commitment to particular types of GSCM practices improves its performance.

Design/methodology/approach – To confirm a positive link between the firm's GSCM practices to its performance, the authors collected the data from 322 Korean firms via questionnaire surveys and then analyzed these data using the structural equation model.

Findings – Among various types of GSCM practices, green purchasing has the greatest impact on both manufacturing and marketing performances. Also, internal environmental management positively influenced both manufacturing and marketing performances, whereas cooperation with customers and reverse logistics had no significant impact on the firm's manufacturing and marketing performances.

Originality/value – To provide a practical advice for firms which are hesitant to embrace green supply chain practices due to skeptical views about their true managerial benefits, this paper discerned more effective GSCM practices from less effective GSCM practices. In so doing, this paper is one of the few studies which pinpointed what types of specific GSCM practices are most effective in enhancing firm performance.

Keywords Green supply chain management, Structural equation model, Firm performance

Paper type Research paper

1. Introduction

Over the last decade, the planet earth has suffered from an unusual cycle of unprecedented heat waves, cold spells, droughts, floods and wildfires. For example, the summer of 2012 was the warmest summer on record, whereas the winter of 2014 was the coldest winter on record for the USA. Similarly, Australia, Japan, Korea, China and Europe experienced the record-setting heat waves in 2013 (Sheppard, 2014). The surface air temperatures on the average so far this decade are about 0.9°C higher than they were in the 1880s (*(The) Economist*, 2015). Many suspect that this extreme weather pattern is a vital sign of climate changes induced by human activities. Unless reversed, some scientists believe that this pattern can eventually destroy the livelihood of all species on earth by disrupting the biodiversity and causing serious food shortages (Pimm, 2009; Safont *et al.*, 2012). A main culprit for this concerning pattern is the emission of harmful carbon dioxide into air. Actually, the level of atmospheric carbon dioxide reached 399 parts per million in 2014,

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which was the highest record for 650,000 years of this planet's history (*(The) Economist*, 2015; NASA, 2015). This rapid rise of a carbon dioxide level in the air contributed to human activities associated with transportation (especially, use of gasoline-powered vehicles), inventory management, waste disposal, product manufacturing and energy creation (Piecyk and McKinnon, 2010; Sundarakani *et al.*, 2010; Hua *et al.*, 2011). Recognizing the detrimental impact of human activities (especially industrial activities) on environmental degradation, a growing number of today's customers have begun to appreciate the firm's commitment to environmental friendliness (greening initiatives) more than ever before. This changed attitude of customers has prompted firms to consider leveraging their environmental friendliness as the major selling point or the customer order-winning criterion. However, the firm's commitment to greening initiatives often create a dilemma in that the firm's environmental friendliness rarely comes free and its payoffs are not clearly known.

To handle this dilemma, a series of attempts have been made to assess the impact of greening initiatives (e.g. green supply chain practices) on the firm's performance. The focal point of these attempts is to determine whether greening initiatives are worthy of investment and managerial focus. For example, Klassen and McLaughlin (1996) discovered a strong link between the firm's greening initiatives and its financial performance, as measured by stock market performance. Similarly, Melnyk *et al.* (2003) observed that the extent/maturity of the firm's environmental management system was directly correlated with the firm's performance, as expressed by perceived cost saving, lead time reduction, product quality improvement, market position strength and corporate reputation enhancement. Later, Montabon *et al.* (2007) confirmed that the firm's environmental management practices such as remanufacturing, environment-friendly product design and surveillance of the market for environmental innovation were positively associated with the firm's performance, as expressed by sales growth and return on investment (ROI). A plethora of other studies including the ones conducted by Florida (1996), Berry and Rondinelli (1998), Claver *et al.* (2007), Yang *et al.* (2011), Schrettle *et al.* (2014) and Tseng *et al.* (2015) verified a causal relationship between the firm's environmental management practices and its performance.

While there is little doubt that the firm's environmental management practices could improve its performance, the aforementioned literature rarely explained which particular environmental management practices or strategies were more effective in improving the firm's performance than their alternative options. More importantly, the aforementioned literature did not examine how the collective environmental management efforts of multiple firms belonging to the same supply chain network affected those firms' performances. Recognizing the need for such examination, Zhu and Sarkis (2004) looked into the potential relationship between the adoption of green supply chain management (GSCM) practices such as internal and external environmental management, ISO 14000 certification, investment recovery and eco-design and the firm's operating performance such as cost control. Generally speaking, GSCM is referred to as an incorporation of environment-friendly initiatives into every aspect of supply chain activities encompassing sourcing, product design and development, manufacturing, transportation, packaging, storage, retrieval, disposal and post sales services including end-of-product life management (Min and Kim, 2012). Based on the empirical study of Chinese manufacturers, Zhu and Sarkis (2004) found that firms having higher levels (more mature stages) of GSCM practices tended to reap the greater economic benefits in terms of some operational cost savings (e.g. decrease in environmental compliance cost), while increasing other operating costs (e.g. increase in costs of purchasing environment-friendly materials). This finding was expected, but they also investigated the moderating effects of both quality management and just-in-time manufacturing practices on the firm's operational performance. They discovered that in some instances firms adopting GSCM practices along with quality management practices could benefit more due to the positive moderating effect of quality management practices, whereas JIT manufacturing practices could undermine the positive influence of GSCM practices. Following suit, a number of other studies (e.g. Zhu *et al.*, 2005; Vachon and Klassen, 2006; Chien and Shih, 2007; Zhu and Sarkis, 2007; Youn *et al.*, 2011; Chan *et al.*, 2012; Green *et al.*, 2012; Zhu *et al.*, 2012a,b, 2013; Graham and Potter, 2015; Lee, 2015; Crifo *et al.*, 2016; Jackson *et al.*, 2016; Kirchoff *et al.*, 2016) examined the relationship between GSCM practices and their adopters' organizational performances to confirm the influence of GSCM practices on organizational performance.

Although a vast majority of the existing literature reported the positive influence of GSCM practices on organizational performance, most of them did not clearly explain what motived GSCM practices and did not specify which GSCM practices were most effective in enhancing organizational performance. That is to say, the undisciplined adoption of GSCM practices without formulating enterprise-wise implementation strategies cannot only undermine their effectiveness, but also inflict damages to the firm's competitiveness and supply chain coordination. With this in mind, this paper aims to discern the most appropriate GSCM strategy by classifying various types of GSCM practice options into distinctive categories and then identifying the winning formula among them. Put simply, this paper attempts to answer two fundamental research questions:

RQ1. Does the competitive market environment motivate the firm to adopt GSCM practices? Which particular GSCM practices are significantly influenced by the competitive market environment, if any?

RQ2. Do GSCM practices improve the firm performance? If so, is there any significant difference in the extent of impact of the firm's chosen types of GSCM practices on the firm performance?

2. Theory building and hypotheses development

To examine which exogenous factor drives the GSCM practices and assess how much those practices affect the firm performance, we employed two well-known theories in the strategic management literature: a contingency theory and a resource-based view of the firm. To elaborate, contingency theory, which was developed in the late 1960s, is one of the behavioral theories that study how environmental variables influence the behaviors of organizations (Lawrence and Lorsch, 1967; Chandra and Kumar, 2000). Contingency theory is predicated on the premise that the firm's strategy such as GSCM adoption strategy depends on its endogenous and exogenous business environments (Donaldson, 2001). Contingency theory also posits that the more organizational structures and processes can adapt to uncertain environments, the more successful the firms will be (Miller, 1992). In other words, the firm's ability to embrace GSCM practices can be seen as a competitive differentiator in unstable and uncertain business environments where the environment friendliness of the firm's products and services has gained more popularity and importance (e.g. favorable image) from today's customers. As such, the GSCM adoption/investment can be essential for the improvement of the firm's performance in highly turbulent business environments. On the other hand, a firm that is resistant to any managerial changes such as GSCM practices, or reluctant to bear risk for economic or technical reasons, may not be able to improve its competitive position in the market and the subsequent organizational performance. Therefore, the contingency theory may help the firm understand what truly drives the GSCM adoption and then identify a set of external and internal environmental variables influencing the firm's organizational performance.

A resource-based view of the firm theorizes that the firm, which possesses a bundle of unique resources (e.g. assets, human capitals, capabilities, organizational process, information, knowledge), can improve its performances and subsequently achieve competitive advantages in the market (Wernerfelt, 1984; Barney, 1991). Put simply, the

RBV theory is predicated on a premise that the firm competes on the basis of "unique" corporate resources that are valuable, rare, difficult to imitate, and non-substitutable by competitors (Barney, 1991). Considering that GSCM practices can be regarded as a unique organizational capability (i.e. corporate resource), the RBV theory may be useful for explaining how the adoption of GSCM practices improves the firm's performance.

2.1 Defining the hypothetical model and constructs

Under the contingency and RBV theories described earlier, we develop a research framework that is comprised of eight constructs: a competitive market environment, internal environmental management, green purchasing, eco-design, cooperation with customers, reverse logistics, manufacturing performance and marketing performance. Herein, a competitive market environment is generally referred to as exogenous factors that form the context for organizational actions and decision making (Li *et al.*, 2006). These factors may include institutional pressure (e.g. a government's tougher environmental standards, stricter emission control), peer pressure (e.g. industry norms for environmental friendliness), the level of competition in the market and demand uncertainty (e.g. customer preference for green products). Even though the firm has little or no control over its external market environment, a greater awareness of its external market environment helps the firm better adapt and execute appropriate GSCM practices. For example, Sony once lost 20bn Yen and relinquished a chunk of the market share to its rival, Microsoft, in the gaming industry after its PlayStation products failed to meet tougher environmental standards set by the European Union (EU) countries. After such a loss, Sony decided to toughen up its environmental standards including parts/components (e.g. coated wires) provided by its suppliers (Lee and Choi, 2006). As this example illustrates, the failure to adopt or execute environmental management practices could undermine the firm's competitiveness in the market. In other words, the higher level of competition in the market may motivate the firm to take environmental management practices (e.g. GSCM practices) more seriously and adopt such practices to gain competitive edges over its rivals.

Internal environment management is referred to as an organization's endogenous resources and capabilities dedicated to the environmental friendliness or sustainability of its products and/or services. Since the successful implementation of GSCM practices requires effective, committed and persistent leadership to achieve the goals of an entire firm, the firm should consider its organizational readiness and resource capabilities defined by endogenous factors such as top management support, cooperative organizational culture and ISO 14000 certification. Indeed, Hoejmose *et al.* (2012) found that top management support was a crucial driver for the firm's engagement with GSCM practices. In addition, cooperative organizational culture may have profound effects on the GSCM planning and implementation process. The rationale being that cooperative organizational culture can facilitate the communication between different departments and thus increase the firm's ability to share knowledge and perspectives of environmental management initiatives across the different functional units of the firm.

Green purchasing is defined as a firm's environmentally responsible buying practices geared toward the conservation of natural resources, sustainment of eco-system quality, the minimum use of water and energy sources, pollution prevention, a reduced disposal of wasted materials to landfills and encouragement of suppliers for the development of environment-friendly products. Green purchasing typically involves the cooperation between the buying firm and its suppliers in reducing waste through recycling, reusing, low-density packaging, and input material purification and substitution (Min and Galle, 1997; Min and Galle, 2001).

Eco-design is defined as the firm's ability to design and develop eco-friendly (green) products which can be reused, recycled or packaged with bio-degradable materials

(Donnelly *et al.*, 2006; Knight and Jenkins, 2009). Its ability includes the use of materials and parts/components, which are not harmful (hazardous) to human health or made with less energy consumption. Such ability can be developed from the firm's organization-specific competencies such as cross-functional or cross-organizational coordination of green product development, process improvement, green manufacturing and life cycle assessment.

Cooperation with customers is referred to as the firm's effort to actively solicit and consider customer feedback for developing green products, adopting eco-friendly manufacturing process and using eco-friendly packaging materials (Zhu *et al.*, 2010). One example of such an effort includes the coordination of the firm's production and distribution operations based on the end-customer demand information provided by its downstream supply chain partners (e.g. retailers). As such, the customer can participate in green product development by passing on its feedback/suggestions about eco-friendly products (e.g. elimination of sulfate from shampoos) to the manufacturer and its suppliers.

Reverse logistics is generally referred to as a series of distribution activities involved in product returns, source reduction/conservation, recycling, substitution, reuse, disposal, refurbishment, repair and remanufacturing (Stock, 1992; Min *et al.*, 2006). In this paper, reverse logistics is narrowly defined as the firm's effort to reclaim and take back products whose life cycles were ended rather than disposing those to landfills. Such an effort includes the reuse and recycling of collected used products and their packages as well as the utilization of information and communication technology (e.g. radio frequency identification) to trace used products throughout their life cycles. Herein, we did not include the environmental impact of forward logistics such as the impact of carbon footprints caused by vehicle emission during the outbound movements, since a vast majority of the company's environmental initiative/policy focused on reverse logistics activities (Murphy and Poist, 2000; Ahi and Searcy, 2013; Govindan *et al.*, 2015; Fahimnia *et al.*, 2015). Another rationale being that, due to the nature of reverse logistics which primarily aimed to recapture the value of end-of-life cycle or defective products through collecting, recycling (to have more raw materials or raw parts), remanufacturing (to resell them to secondary markets), repairing, and disposing them properly, the main focus of our study will be reverse logistics.

Manufacturing performance is referred to as the extent of the firm's ability to deliver ordered products to its customers in accordance with each customer's specific needs, schedules and requirements (Kaplan, 1983; Klassen and Whybark, 1999). It also indicates how much of the company's total resources (total manufacturing output capacity) are fully utilized at a given point in time (Gunasekaran *et al.*, 2001; Gomes *et al.*, 2004). Since manufacturing performance reflects the manufacturing firm's operational success in terms of reduced product quality failures and order backlogs, its higher manufacturing performance will lead to a smaller percentage of returned products and a lower level of inventory, which, in turn, can contribute to production cost savings (e.g. reduction in product recalls, safety stocks, and the volume of replaced products in exchange for defects). For example, sound environmental practices can reduce material waste by recycling some of the salvageable materials and thus help the firm better utilize its material resources. The better utilization of the firm's resources, in turn, can enhance manufacturing performance.

Marketing performance is referred to as the degree of benefits gained by the firm as a result of offering eco-friendly products, which customers perceive as products of greater value as compared to their alternative products (Sousa, 2004; O'Sullivan and Abela, 2007). In other words, customers perceive the firm's eco-friendly products as ones with higher value and thus their degree of satisfaction with those products would be higher. Increased customer satisfaction and more increased value for customers are expected to improve the firm's market position and subsequently enhance its brand image, market share and sales revenue.

2.2 Developing hypotheses

As discussed in the previous sub-section, a competitive market environment can motivate the firm to adopt GSCM practices. Indeed, Kumar *et al.* indicated that firms, which initiated strategic innovations, such as GSCM practices and then changed the rules of competition tended to create greater market opportunities. In other words, GSCM practices can be motivated by the firm's conscious effort to stay competitive in the market under increased government and industry peer pressures for adopting environmental management initiatives (Bergh, 2002). Based on these premises, we theorize that the firm can take different forms of GSCM practices depending on its strategic reaction to the competitive market environment and different choices of GSCM practices may have influenced the firm's performances to the varying extent. To elaborate, our review of the existing literature (e.g. Carter and Ellram, 1998; Tibben-Lembke and Rogers, 2002; Zhu and Sarkis, 2004; Zhu *et al.*, 2005) suggests that five constructs (internal environmental management, green purchasing, eco-design, cooperation with customers and reverse logistics) can potentially influence the firm's organizational performance, as shown in Figure 1. To identify factors that are essential for the successful implementation of GSCM practices and assess their impact on the firm's manufacturing and marketing performances, we developed a number of hypotheses and then tested their validity using empirical data. In the following section, the rationale for these hypothesized relationships is described in detail.

2.2.1 A competitive market environment and GSCM practices. An external environment such as the presence of a high level of competition in the market is known to be one of the key drivers for GSCM practices (Walker *et al.*, 2008; Diabat and Govindan, 2011). The rationale being that the increased competition would compel firms to learn more about the changing demands and preferences of customers and thus increase the need for adopting innovative management practices such as GSCM practices. Especially, given that GSCM practices are known to improve the firm's competitive edge, those practices will provide an important leverage for a firm seeking a competitive differentiator in the market (Rao and Holt, 2005;

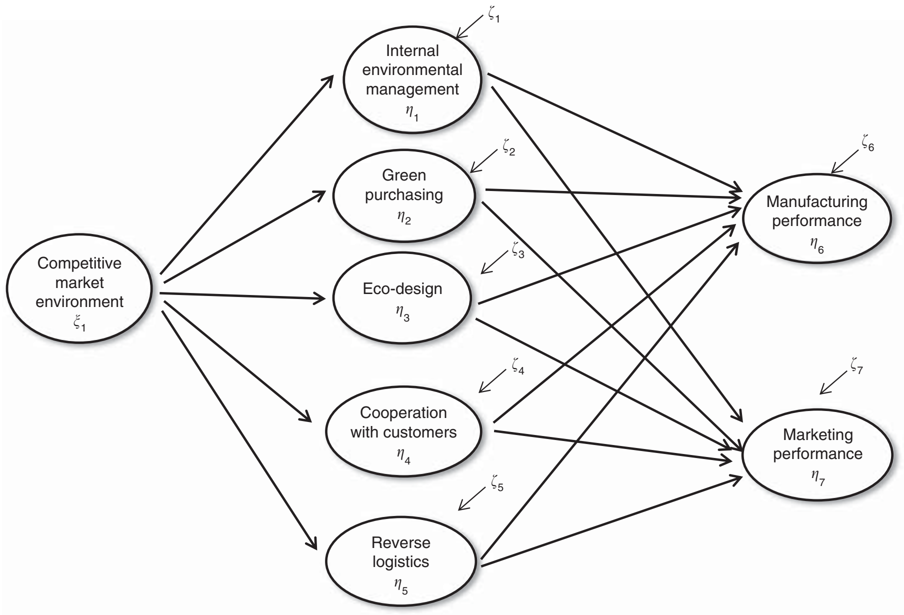


Figure 1.
The hypothetical model

Uchida and Ferraro, 2007; Masoumik *et al.*, 2014). In addition, the increased institutional pressure such as stricter environmental guidelines, rules and regulations imposed by the government forced some companies to adopt and implement GSCM practices (Seman *et al.*, 2012). For example, after the EU enacted a series of environmental regulations such as the Waste Electrical and Electronic Equipment (WEEE), Restriction of Hazardous Substances and Eco-design for Energy using Products (EUP) directives which forbade manufacturers from selling products that contained hazardous materials onto the markets, many European firms started to execute a number of corporate environmental management practices. Similarly, after the Korean Government induced a certification by Environment-Friendly Company Designation System, ISO 14001, and the Low Carbon Product Certificate System which took effect in November of 2011, a growing number of Korean firms have begun to recognize their ability to meet stricter environmental standards as the important prerequisite for joining the global supply chain network and thus embraced GSCM practices (Jang and Jo, 2006). In fact, with a greater role of the government in the export-driven economy such as Korea, coercive pressures mainly originated from the government can be a catalyst for the firm's adoption of environmental management practices (Rivera, 2004). To summarize, both peer pressures from the competitive industry rivals and social normative pressures from environment-conscious customers may force the firm to adopt environmental management practices such as GSCM practices (Ball and Craig, 2010; Sarkis *et al.*, 2011). In light of the above discussions, we hypothesized that:

H1a. A firm, which operates in a highly competitive market environment, will have a high level of commitments to and participation in internal environment management practices.

For the same reason, we can add the following hypotheses based on the various different types of GSCM practices:

H1b. A firm, which operates in a highly competitive market environment, will have a high level of commitments to and participation in green purchasing practices.

H1c. A firm, which operates in a highly competitive market environment, will have a high level of commitments to and participation in eco-design practices.

H1d. A firm, which operates in a highly competitive market environment, will have a high level of commitments to and participation in environmental cooperation initiatives with its customers.

H1e. A firm, which operates in a highly competitive market environment, will have a high level of commitments to and participation in reverse logistics practices.

2.2.2 GSCM practices and manufacturing performance. These goals can be higher productivity, customer service, employee morale, shareholder returns, competitiveness and financial gains such as a greater ROI. In this view, a number of prior studies (e.g. Carter *et al.*, 2000; Bowen *et al.*, 2001; Zhu and Sarkis, 2004; Rao and Holt, 2005; Zhu *et al.*, 2005; Chien and Shih, 2007; Koh *et al.*, 2007; Vachon and Klassen, 2008; Youn *et al.*, 2011; Green *et al.*, 2012; Laosirihongthong *et al.*, 2013) found that GSCM practices had positive influences on organizational performance. However, most of these studies (e.g. Carter *et al.*, 2000; Rao and Holt, 2005) focused on the assessment of impact of a particular GSCM practices such as green purchasing and green manufacturing on financial (or economic) performance measures including profitability, net income, and cost of goods sold. To take into account both financial and non-financial performances (e.g. faster order fulfillment and manufacturing speed), we would measure organizational performance at a disaggregated manufacturing level.

From a financial standpoint, the firm's ability to perform GSCM practices would help reduce material waste and energy consumption needed to produce green (eco-friendly) products and thus increase production cost savings. For example, Commonwealth Edison saved $50m by managing its materials and equipment based on the eco-friendly life cycle management approach. Also, the production and distribution of green products can be translated into higher environmental quality. A decrease in quality failures will reduce the need for rework, repair, and product recall and thus improve manufacturing efficiency as a result of faster order fulfillment and shorter order cycle time. From the above discussion, GSCM practices, which play a key performance driver role, can enhance manufacturing performance. Therefore, we hypothesize that:

H2a. The greater the firm's involvement in internal environmental management practices, the higher the level of manufacturing performance.

H2b. The greater the firm's involvement in green purchasing practices, the higher the level of manufacturing performance.

H2c. The greater the firm's involvement in eco-design practices, the higher the level of manufacturing performance.

H2d. The greater the firm's involvement in cooperation with its customers, the higher the level of manufacturing performance.

H2e. The greater the firm's involvement in reverse logistics practices, the higher the level of manufacturing performance.

2.2.3 GSCM practices and marketing performance. The firm's implementation of GSCM practices reflects the firm's flexibility to customize its products to meet the customer's specific environmental needs. In other word, the firm's commitment to GSCM practices would help the firm portray itself as a customer-friendly or customer-centric organization in the customer's eye. As such, the firm can strengthen its brand image (or reputation) and subsequently increase its sales revenue and market share by attracting more customers who favor green products over regular (environmentally harmful) products. In fact, Klassen and McLaughlin (1996) observed that environmental management practices improved market positions against competitors. Similarly, Zhu and Sarkis (2007) discovered that green products helped the firm increase sales revenue and market share *vis-a-vis* less environmentally committed competitors. Therefore, we hypothesize that:

H3a. The better the firm performs internal environmental management practices, the higher the level of marketing performance.

H3b. The better the firm performs green purchasing practices, the higher the level of marketing performance.

H3c. The better the firm performs eco-design practices, the higher the level of marketing performance.

H3d. The higher the level of the firm's cooperation with its customers, the higher the level of marketing performance.

H3e. The better the firm performs reverse logistics practices, the higher the level of marketing performance.

2.2.4 Differences in the extent of impact of GSCM practices on organizational performance. Considering the diverse options of GSCM practices (e.g. green purchasing, eco-design, reverse logistics) discussed earlier, it may be worth examining whether or not each option has a different level of impact on organizational performance. For example, green purchasing may have the greater positive impact on manufacturing performance than eco-design, depending on product characteristics, supplier capability and supplier network. Nevertheless, a vast majority of the GSCM literature simply examined the causal relationship between GSCM practices and firm performances without explaining the possibility that a different type of GSCM practices will have the different level of impact on firm performance (Srivastava, 2007; Min and Kim, 2012). The identification of particular GSCM practices which are more effective in improving organizational performance than the others would help the firm develop the more potent or best-in class GSCM practices. With that in mind, we postulate:

H4a. The extent of impact of GSCM practices on manufacturing performance differs depending on the choice of a particular GSCM practice.

H4b. The extent of impact of GSCM practices on marketing performance differs depending on the choice of a particular GSCM practice.

3. Research methodology

To test the hypotheses described in the previous section, we carried out the current study in three phases: a pre-pilot, a pilot and a large-scale questionnaire survey. In the pre-pilot phase, we generated potential survey items through theory development and a literature review. In the pilot phase, we develop a structural equation model (SEM) along with the identification of valid constructs. At the final stage, we conducted a large-scale survey via mail questionnaires primarily targeting the Korean industry comprised of manufacturers and their suppliers. Using the data obtained from this survey, we tested the validity of the proposed SEM. Specific details of the current research methodology are described below.

3.1 Research sample

To validate above research propositions, we randomly targeted 330 multinational Korean manufacturing firms listed on the KOSPI and KOSDAQ Stock Market that had been engaged in export activities and adopted GSCM practices as a potential sample. To increase a response rate from these firms, we hired a professional survey research organization (The Statistics and Korea Information) in Korea and set up appointments with potential survey respondents, followed by a personal visit from a group of surveyors. The surveys were conducted between March 10, 2012 and May 15, 2012. Among 373 target survey respondents, 322 survey responses were collected. Of these, 37 were considered invalid due to missing or unreliable/unusual data. This produced 285 valid responses, with a response rate of 76.4 percent, which far exceeded the targeted overall response rate of over 20 percent for a valid assessment. Malhotra and Grover (1998) observed that a response rate over 20 percent was needed for a positive assessment of questionnaire survey results. To check the presence of any non-response bias, which might favor certain outcomes due to differences in opinions between survey participants and non-participants, we compared the early responses (25 percent of the sample who responded the earliest) to late responses (25 percent of the sample who responded the latest). As suggested by Armstrong and Overton (1977) and Lambert and Harrington (1990), we conducted the *t*-test to see any significant statistical differences in means between the first wave (early) responses and the second wave (late) responses for all constructs. Our test results summarized in Table I indicated that there was no presence of any non-response bias at $\alpha = 0.05$.

As summarized in Table II, this sample consisted of firms from a wide array of industries. These industries included pharmaceuticals (15.7 percent of the sample); electronics and communications (15.0 percent); chemicals and plastics (11.7 percent); electrical, mechanical, and appliances (10.0 percent); textiles and leather (9.3 percent); metals (9.0 percent) and automotive (7.3 percent). With regard to firm size, firms with 500–799 employees were the most common (21.3 percent of the sample), followed by smaller firms with 50–99 employees (18.7 percent) and the ones with 1–49 employees (15.7 percent). Large firms with employees more than 1,000 accounted for 8.0 percent of the sample. More than one-tenth (13.4 percent) of the responding firms had annual sales revenue exceeding $50m. About one-third (34.7 percent) of the responding firms reported the annual revenue of $10–49.9m. More than one-fifth (27.6 percent) had sales revenue in the range of $5–9.9m; while another one-fifth (24.3 percent) reported sales revenue below $4.9m. With respect to the individual survey respondents, about one-third (34.3 percent) were general managers, 30.7 percent were directors and 15.0 percent of respondents were assistant managers. Approximately two-fifths of the respondents represent general affairs departments (40.0 percent), followed by management support departments, which encompass accounting, human resource, and purchasing units (30.3 percent), production departments (12.0 percent), and research and development (R&D) departments (10.7 percent). In this departmental classification, we did not break down the general affairs department into smaller sub-units with specific functions, because a growing number of Korean firms used the matrix organizational structure where many managers were not clearly assigned to specific tasks or roles as their daily work duties.

3.2 Questionnaire items

A survey questionnaire was comprised of 26 items divided into eight subsections. Among these subsections, one of them was related a potential motivating factor for GSCM practices, five of them deal with to different categories of GSCM practice types, while two of them were designed to measure outcome-related variables including manufacturing and marketing performances as shown in Table III. All items were scored on seven-point Likert-type scales measuring the degree of agreement with item descriptions, ranging from 1 (not at all) to 7 (strongly).

To measure the responding firm's competitive strength in the market with its rivals, we developed questionnaire items similar to the ones used by Chandler and Hanks (1994) and O'Cass and Weerawardena (2010). To measure the extent to which a responding firm performed specific type of GSCM practices, we developed the items proposed by Carter and Ellram (1998), Ronald *et al.*, Zhu and Sarkis (2004), Zhu and Sarkis (2007) and Ninlawan *et al.* (2010). In addition, we developed four items gauging manufacturing performance and three items gauging marketing performance based on performance indicators proposed by Vachon and Klassen (2008) and Youn *et al.* (2011). All of these items were summarized in Table III.

4. Analysis and results

The preliminary statistical validity of all the hypotheses presented earlier was checked, using the Pearson correlation. For each construct, a composite score was computed by taking the average scores of all items. The results are presented in Table IV. All correlations but three between eco-design and marketing performance (with a correlation coefficient of 0.086), cooperation with customers and marketing performance (with a correlation coefficient of 0.030)

Construct	Mean differences	*p*-value
Competitive market environment	−0.2622	0.154
Internal environment management	−0.2533	0.129
Green purchasing	−0.3422	0.051
Eco-design	0.2946	0.170
Cooperation with customers	−0.1482	0.566
Reverse logistics	−0.1333	0.442
Manufacturing performance	−0.2488	0.147
Marketing performance	0.0533	0.763

Table I.
A summary of the non-response bias test

Category	Industry characteristics	Number of respondents	Percentage
Business type	Chemical, fabric, plastic	35	11.7
	Pharmaceutical	47	15.7
	Fabric, leather, fur, shoes	28	9.3
	Paper, pulp	16	5.3
	Metal material	27	9.0
	Assembled metal products	14	4.7
	Electronics and communication equipment	45	15.0
	Electric, mechanical, appliance	30	10.0
	Automobile and automotive parts	22	7.3
	Ship machinery equipment, precision machinery	17	5.7
	Others	19	6.3
	Sub-total	300	100.0
Firm size	1–49 employees	47	15.7
	50–99 employees	56	18.7
	100–299 employees	46	15.3
	300–499 employees	35	11.7
	500–799 employees	64	21.3
	800–999 employees	28	9.3
	1,000 or more employees	24	8.0
	Sub-total	300	100.0
Sales revenue	Less than $5m	73	24.3
	$5–9.9m	83	27.6
	$10–49.9m	104	34.7
	$50–99.9m	32	10.7
	$100 million or more	8	2.7
	Sub-total	300	100.0
Years of experience	Less than 10 years	15	5.0
	10–29 years	108	36.0
	30–49 years	135	45.0
	50 years or longer	42	14.0
	Sub-total	300	100.0
Managerial position	Section chief	103	34.3
	Sub-section chief	92	30.7
	Assistant Dept. Manager	45	15.0
	Staff	42	14.0
	Department Manager	11	3.7
	Executive	7	2.3
	Sub-total	300	100.0
Department	General Affairs	120	40.0
	Management Support	91	30.3
	Research and Development	32	10.7
	Production	36	12.0
	Overseas Marketing	9	3.0
	Others	12	4.0
	Sub-total	300	100.0

Table II.
Profile of the respondents

and manufacturing performance and marketing performance (with a correlation coefficient of 0.104) are statistically significant at the 0.01 level. It appears that there are high correlations among some of the constructs. In particular, the correlation coefficients are 0.611 (competitive market environment and green purchasing), 0.585 (internal environment management and green purchasing), 0.568 (competitive market environment and manufacturing performance) and 0.547 (eco-design and cooperation with customers). To further examine causal relationships among the constructs, we tested the proposed hypotheses with valid and reliable scales that measured some critical dimensions of the constructs.

Items	Mean	SD
Competitive market environment (three items)	*4.6589*	*1.1088*
CME1. Many competitors in the product market	5.0567	1.3807
CME2. Much institutional and market pressure for eco-friendly initiatives	4.1500	1.4239
CME3. Big market uncertainty related to environmental problems	4.7700	1.4319
Internal environmental management (four items)	*4.3242*	*1.0958*
IEM1. Active participation and involvement of CEOs inn GSCM	4.5533	1.6842
IEM2. Middle managers' support for GSCM	3.7367	1.3736
IEM3. Cooperation among departments to improve the eco-friendliness of products	4.7167	1.4340
IEM4. Obtaining ISO 14001 certificates	4.2900	1.3828
Green purchasing (three items)	*5.2067*	*1.0478*
GRP1. Cooperation with suppliers to enhance environmental quality	4.9867	1.3136
GRP2. Use ISO 14001 as an important factor for selecting suppliers	5.3933	1.1958
GRP3. Evaluate green practices of subcontractors (e.g. second-tier) suppliers	5.2400	1.2732
Eco-design (three items)	*4.1833*	*1.2669*
ED1. Design products to reduce material waste or energy consumption	4.1267	1.4156
ED2. Design products to increase the reuse and recycle of material and parts	4.2400	1.3864
ED3. Design to remove or reduce hazardous material throughout the manufacturing process	3.8700	1.3635
Cooperation with customers (three items)	*4.0444*	*1.1862*
CC1. Cooperate with customers for eco-design	3.9733	1.4280
CC2. Cooperate with customers for cleaner production (eco-friendly production)	3.8533	1.4348
CC3. Cooperate with customers for green packaging	4.3067	1.6416
Reverse logistics (three items)	*4.0267*	*1.2360*
RL1. Collect and take back end-of-life cycle products and parts	4.4467	1.4926
RL2. Collect and take back packaging materials and other used (non-virgin) materials	4.1233	1.4241
RL3. Use information systems to handle reverse logistics (e.g. waste collection)	3.9300	1.3507
Manufacturing performance (four items)	*4.1989*	*1.0345*
POM1. Reduction in production cost as compared to competitors	4.2100	1.4257
POM2. Faster order fulfillment	4.0633	1.1989
POM3. Faster manufacturing process	4.3233	1.2344
POM4. Improved capacity to meet the manufacturing schedule and deadline	4.3000	1.2390
Marketing performance (three items)	*4.5044*	*1.0644*
MP1. Improved corporate brand image	4.4633	1.3118
MP2. Increased sales	4.9167	1.4618
MP3. Increased market share	4.1333	1.4197

Table III.
Description of items

Constructs	Mean	SD	CME	IEM	GRP	ED	CC	RL	POM	MP
1. CME	4.6589	1.1088	1							
2. IEM	4.3242	1.0958	0.412**	1						
3. GRP	5.2067	1.0478	0.611**	0.585**	1					
4. ED	4.1833	1.2669	0.295**	0.211**	0.343**	1				
5. CC	4.0444	1.1862	0.351**	0.344**	0.298**	0.547**	1			
6. RL	4.0267	1.2360	0.356**	0.305**	0.373**	0.374**	0.405**	1		
7. POM	4.1989	1.0345	0.568**	0.406**	0.409**	0.236**	0.102**	0.144*	1	
8. MP	4.5044	1.0644	0.138*	0.280**	0.337**	0.086	0.030	0.145*	0.104	1
AVE (average variance extracted)			0.444	0.409	0.513	0.642	0.474	0.589	0.471	0.416

Notes: CME, competitive market environment; IEM, international environmental management; GRP, green purchasing; ED, eco-design; CC, cooperation with customers; RL, reverse logistics; POM, manufacturing performance; MP, marketing performance. $*p < 0.1$; $**p < 0.01$

Table IV.
The correlation matrix of each construct

4.1 The causal model

An SEM was used to test and estimate the causal relationships amongst various constructs (Bollen and Long, 1993). In general, the SEM is comprised of two elements: the measurement model and the structural model. The measurement model in SEM is used to measure and assess the reliability and validity of latent variables, whereas the structural model is applied to investigate the complex interrelations among latent variables (Jöreskog and Sörbom, 1989). After measurement scales were checked for reliability and validity, we conducted path analysis as a testing procedure using the AMOS 17.0 program (Kim, 2008). Also, a covariance matrix was used for structure analysis, while reviewing the goodness of fit index through the confirmatory factor analysis. In SEM, the goodness of fit index establishes whether the model is acceptable. If the model is acceptable, we can check to see whether specific paths are significant. A result of the initial model showed the indices of $\chi^2 = 429.592$ (df = 271, p-value = 0.000), χ^2/df = 1.585, GFI = 0.903, AGFI = 0.875, CFI = 0.920, TLI = 0.904 and RMSEA = 0.044. This result indicates a relatively good fitness of the model (with the GFI exceeding 0.90). However, three variables including ECDN3, RL1 and POL4 were excluded from the model, since their factor loading was less significant and empirical loading was noticeably lower than the cut-off value of 0.5 (Hair *et al.*, 2006). A goodness of fit index of the model after recalculation was $\chi^2 = 419.485$ (df = 202, $p = 0.190$), χ^2/df = 1.087, GFI = 0.990, AGFI = 0.920, CFI = 0.990, TLI = 0.988 and RMSEA = 0.017. In particular, we accepted a null hypothesis ($\Sigma = \Sigma(\theta)$), since χ^2 value was insignificant. Other fitness indices were excellent and thus strongly supported the theoretical model of this study, which matched well with the actual data.

After evaluating the fitness of the model, we verified the reliability and validity of the measuring items. These results are recapitulated in Table V. First, the internal consistency method based on the Cronbach's α coefficient was used to verify the reliability of the items measuring each construct. The reliability test results showed that α coefficients were in the range of 0.636–0.777 which mostly exceeded an acceptable reliability criterion of 0.7 (Nunnally, 1978). Next, the convergent validity of measuring items was verified. The convergent validity turned out to be significant for all path coefficients with the composite reliability (C.R $\geqslant$ 0.6~0.7) and the average variance extracted (AVE $\geqslant$ 0.5) value (Bagozzi and Yi, 1988; Hair *et al.*, 2006). Herein, it is noted that the Cronbach's α value can be reduced if the test length is either short or the number of items tested is small (Nunnally, 1978; Streiner, 2003; Hair *et al.*, 2006). For example, the Cronbach's α value (0.636) for the small (only three) number of items considered for that construct adversely affected market performance. Table V shows, all path coefficients are statistically significant. Also, the CR value exceeded 0.6 and AVE was above or near 0.5 verifying the convergent validity of this study. The discriminant validity was checked using the stringent method proposed by Fornell and Larcker (1981) which examined if AVE was greater than the correlation squared values of all constructs (AVE > Φ^2). The results indicated a robust discriminant validity of the study unit, since AVEs of the two latent factors were higher than the squares of the correlation coefficients of the two latent factors as summarized in Table IV. For example, the correlation coefficients of CME factor and GRP factor, which had the highest correlation with the correlation coefficient of 0.611 and its square of 0.3733. Those two factors' square is smaller than both the AVE of CME factor (Φ (CME and GRP)^2 = 0.3733 < AVE of CME = 0.444) and the AVE of GRP factor (Φ (CME and GRP)^2 = 0.3733 < AVE of GRP = 0.513).

4.2 Results of hypotheses testing

The research hypotheses were tested using the SEM displayed in Figure 2. A goodness of fit for the path analysis model was $\chi^2 = 330.039$ (df = 215, $p = 0.000$), χ^2/df = 1.535, GFI = 0.910, AGFI = 0.885, CFI = 0.936, TLI = 0.924 and RMSEA = 0.042. This result indicates an excellent level of goodness of fit of the model. Accordingly, detailed hypotheses tests were performed.

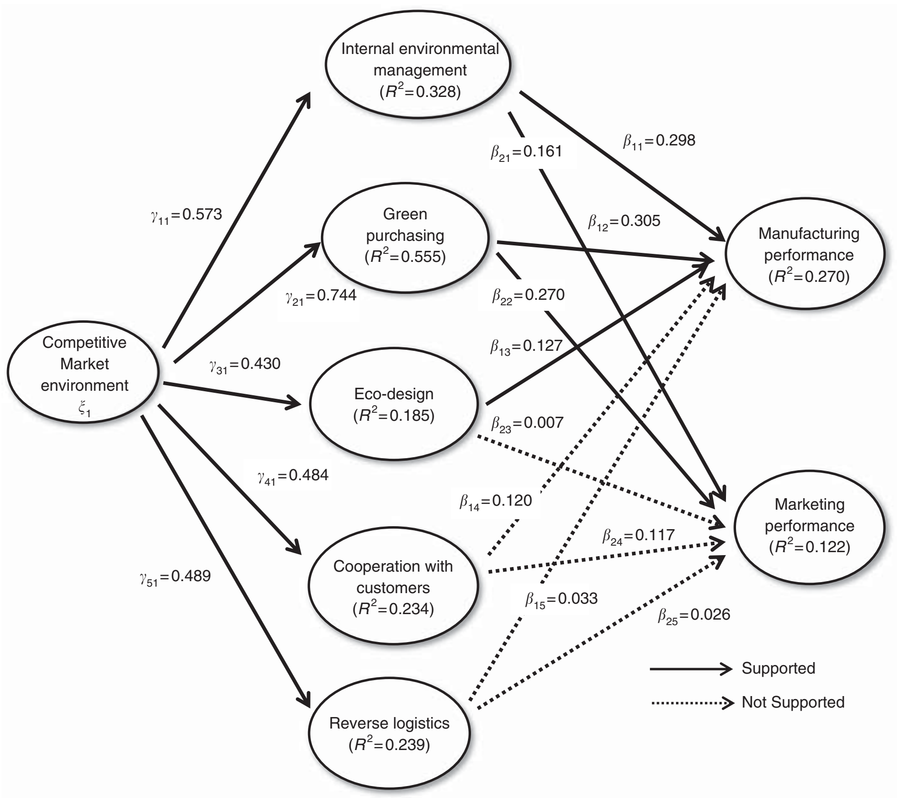
Constructs	Items	Standardized loading	t-value	Cronbach's α	CR	AVE
Competitive market environment	CME 1	0.596	–	0.689	0.701	0.444
	CME 2	0.587	7.603***			
	CME 3	0.796	8.643***			
Internal environmental management	IEM 1	0.690	–	0.730	0.733	0.409
	IEM 2	0.548	7.732***			
	IEM 3	0.648	8.800***			
	IEM 4	0.663	8.939***			
Green purchasing	GRP 1	0.713	–	0.775	0.808	0.513
	GRP 2	0.749	10.755***			
	GRP 3	0.738	10.657***			
Eco-design	ECDN 1	0.742	–	0.777	0.781	0.642
	ECDN 2	0.856	8.771***			
Cooperation with customers	CC 1	0.735	–	0.695	0.723	0.474
	CC 2	0.798	9.893***			
	CC 3	0.496	7.400***			
Reverse logistics	RL 2	0.797	–	0.739	0.741	0.589
	RL 3	0.737	7.073***			
Manufacturing performance	POL 1	0.649	–	0.722	0.728	0.471
	POL 2	0.722	8.682***			
	POL 3	0.687	8.541***			
Marketing performance	MP 1	0.470	–	0.636	0.661	0.416
	MP 2	0.883	5.289***			
	MP 3	0.497	5.986***			
Fit statistics						
χ^2			219.485 (df = 202, p = 0.190)			
Normed χ^2			1.087			
Goodness-of-fit index (GFI)			0.990			
Adjusted goodness of fit (AGFI)			0.920			
Comparative fit index (CFI)			0.990			
Tucker–Lewis index (TLI)			0.988			
Root mean-square error of approximation (RMSEA)			0.017			

Note: ***$p < 0.001$

Table V. Confirmatory factor analysis of overall constructs

Our test results confirmed that the competitive market environment was the major driving force for GSCM practices adopted by Korean firms. To elaborate, the competitive market environment has a positive impact on the execution of internal environmental management (standardized $\beta = 0.573$, t-value = 5.934, p-value = 0.0001), green purchasing (standardized β = 0.744, t-value = 7.032, p-value = 0.0001), eco-design (standardized $\beta = 0.430$, t-value = 4.295, p-value = 0.0001), cooperation with customers (standardized $\beta = 0.484$, t-value = 5.350, p-value = 0.0001), and reverse logistics (standardized $\beta = 0.489$, t-value = 5.190, p-value = 0.0001). In particular, green purchasing turned out to be most commonly used GSCM practices (Mean = 5.2067, SD = 1.0478) as shown in Table III. Also, the ISO 14001 certification was the most important factor for selecting the eco-friendly suppliers as part of green purchasing practices (Mean = 5.3933, SD = 1.1958).

In the next phase, we tested to see which types of GSCM practices helped the responding firms improve their manufacturing performance. Our test results revealed that internal environmental management, green purchasing and econ-design have positive effects on manufacturing performance. Indeed, we found a positive relationship between the internal environment management and manufacturing performance with the standardized β coefficient of 0.298 and t-value of 3.237 (p-value = 0.001).



Notes: Goodness-of-fit indices: χ^2 = 330.039 (df = 215, p = 0.000); Normed χ^2 = 1.535; GFI = 0.910; AGFI = 0.885; CFI = 0.936; TLI = 0.924; RMSEA = 0.042

Figure 2.
Structural model results

Similarly, there is a strong positive relationship between green purchasing and manufacturing performance with the standardized β coefficient of 0.305 and t-value of 3.142 (p-value = 0.002). Though not strong, we also found a positive relationship between eco-design and manufacturing performance with the standardized β coefficient of 0.127 and t-value of 1.727 (p-value = 0.084). On the contrary, we found that cooperation with customers (standardized $\beta =$ 0.120, t-value = 1.481, p-value = 0.139) and reverse logistics (standardized $\beta =$ 0.033, t-value = 0.401, p-value = 0.688) do not improve manufacturing performance.

Our test result showed that not all of GSCM practices significantly contributed to the improvement of marketing performance as shown in Figure 2. To elaborate, we found that internal environmental management has a positive impact on the firm's marketing performance (standardized β = 0.161, t-value = 1.753, p-value = 0.080). Also, we discovered that green purchasing has a positive impact on the firm's marketing performance (standardized β = 0.270, t-value = 2.583, p-value = 0.010). On the other hand, eco-design has no significant impact on marketing performance (standardized $\beta =$ 0.007, t-value = 0.097, p-value = 0.923). Neither cooperation with customers (standardized $\beta =$ 0.117, t-value = 1.398, p-value = 0.162) nor reverse logistics (standardized $\beta =$ 0.026, t-value = 0.316, p-value = 0.752) has any significant impact on marketing performance.

Going a step further, we evaluated the relative impact of each type of GSCM practices on the firm's manufacturing and marketing performances by estimating the path coefficients in the basic model and χ^2 changes in the constrained model. As shown in Table VI, internal environmental management had a slightly different path coefficient from green purchasing. Table VI showed that there was a distinctive difference in the extent of impact on manufacturing performance among different types of GSCM practices. In particular, it should be noted that green purchasing has the greater impact on manufacturing performance than eco-design ($\Delta\chi^2 = 5.316 > \chi^2 0.05(1) = 3.84$, $\Delta df = 1$), cooperation with customers ($\Delta\chi^2 = 11.959 > \chi^2 0.05(1) = 3.84$, $\Delta df = 1$) and reverse logistics ($\Delta\chi^2 = 9.054 > \chi^2 0.05(1) = 3.84$, $\Delta df = 1$).

Similar results were obtained when we examined the statistical differences in the relative magnitude of impact of each GSCM practice on marketing performance as summarized in Table VII. Once again, green purchasing turned out to be more effective in improving the firm's marketing performance than eco-design, cooperation with customers and reverse logistics. However, it should be noted that although internal environmental management ($\beta =$ 0.161) showed the lower absolute value of impact on marketing performance than green purchase ($\beta =$ 0.270), their path difference was statistically insignificant.

To summarize, among various types of GSCM practices, green purchasing has the greatest impact on both manufacturing and marketing performances. That is to say, green purchasing turned out to be most effective in improving both manufacturing and marketing performances. The possible explanation for this finding is that green purchasing precedes the cooperative partnership with the buying firm's suppliers (including lower-tier suppliers) which ensures inter-organizational efforts and thus is more likely to practice eco-friendly practices with the synergistic effect. In addition, green purchasing can be translated into environmental quality at the source, which can be more effective in reducing quality failure costs, which, in turn, lower overall production cost, while helping to build positive corporate image for customers. In addition, internal environmental management positively influenced both manufacturing and marketing performances, but not as much as green purchasing.

Table VI. Path differences of GSCM practices for manufacturing performance

Path comparison	Estimate	Unconstrained χ^2 (df)	Constrained χ^2 (df)	$\Delta\chi^2$ (df = 1)	Results
IEM	0.298	22.373 (32)	22.434 (33)	0.061	IEM = GRP
GRP	0.305				
IEM	0.298	21.235 (24)	23.714 (25)	2.479	IEM = ED
ED	0.127				
IEM	0.298	36.257 (32)	46.543 (33)	10.286	IEM > CC
CC	0.120				
IEM	0.298	16.837 (24)	23.235 (25)	6.498	IEM > RL
RL	0.033				
GRP	0.305	15.765 (17)	21.081 (18)	5.316	GRP > ED
ED	0.127				
GRP	0.305	33.999 (24)	45.958 (25)	11.959	GRP > CC
CC	0.120				
GRP	0.305	11.967 (17)	21.021 (18)	9.054	GRP > RL
RL	0.033				
ED	0.127	25.880 (17)	28.776 (18)	2.896	ED = CC
CC	0.120				
ED	0.127	10.673 (11)	12.077 (12)	1.404	ED = RL
RL	0.033				
CC	0.120	29.251 (17)	29.478 (18)	0.227	CC = RL
RL	0.033				

Notes: IEM, international environmental management; GRP, green purchasing; ED, eco-design; CC, cooperation with customers; RL, reverse logistics

Path comparison	Estimate	Unconstrained χ^2 (df)	Constrained χ^2 (df)	$\Delta\chi^2$ (df = 1)	Results
IEM	0.161	25.322 (32)	26.128 (33)	0.806	IEM = GRP
GRP	0.270				
IEM	0.161	17.126 (24)	21.241 (25)	4.115	IEM > ED
ED	0.007				
IEM	0.161	30.592 (32)	38.065 (33)	7.473	IEM > CC
CC	0.117				
IEM	0.161	29.555 (24)	32.931 (25)	3.376	IEM = RL
RL	0.026				
GRP	0.270	13.743 (17)	24.736 (18)	10.993	GRP > ED
ED	0.007				
GRP	0.270	29.630 (24)	42.230 (25)	12.600	GRP > CC
CC	0.117				
GRP	0.270	24.351 (17)	30.437 (18)	6.086	GRP > RL
RL	0.026				
ED	0.007	10.918 (17)	11.434 (18)	0.516	ED = CC
CC	0.117				
ED	0.007	14.952 (11)	15.449 (12)	0.497	ED = RL
RL	0.026				
CC	0.117	27.759 (17)	29.611 (18)	1.852	CC = RL
RL	0.026				

Table VII. Path difference of GSCM practices for marketing performance

On the other hand, cooperation with customers and reverse logistics had no impact on manufacturing and marketing performances. In other words, neither the cooperation with customers nor reverse logistics was effective in improving manufacturing and marketing performances. The complete results of hypotheses testing are summarized in Table VIII.

Hypothesis sign	Path	Estimate	*t*-value	Results
H1 (+)	*Competitive market environment → GSCM practices*			
H1a	Competitive market environment → Internal environment management	0.573	5.934	◌
H1b	Competitive market environment → Green purchasing	0.744	7.032	◌
H1c	Competitive market environment → Eco-design	0.430	4.295	◌
H1d	Competitive market environment → Cooperation with customers	0.484	5.350	◌
H1e	Competitive market environment → Reverse logistics	0.489	5.190	◌
H2 (+)	*GSCM practices → Manufacturing performance*			
H2a	Internal environment management → Manufacturing performance	0.298	3.237	◌
H2b	Green purchasing → Manufacturing performance	0.305	3.142	◌
H2c	Eco-design → Manufacturing performance	0.127	1.727	◌
H2d	Cooperation with customers → Manufacturing performance	0.120	1.481	×
H2e	Reverse logistics → Manufacturing performance	0.033	0.401	×
H3 (+)	*GSCM practices → Marketing performance*			
H3a	Internal environment management → Marketing performance	0.161	1.753	◌
H3b	Green purchasing → Marketing performance	0.270	2.583	◌
H3c	Eco-design → Marketing performance	0.007	0.097	×
H3d	Cooperation with customers → Marketing performance	0.117	1.398	×
H3e	Reverse logistics → Marketing performance	0.026	0.316	×
H4	*Evaluation of GSCM practices for a path difference in manufacturing performance*			*Δ*
H5	*Evaluation of GSCM practices for a path difference in marketing performance*			*Δ*

Notes: ◌ = supported; *Δ* = partially supported; and × = not supported

Table VIII. A summary of hypotheses test results

5. Key findings and managerial implications

This section summarizes key findings of our GSCM study and their practical implications for firms, which cope with the challenges of more volatile supply chain operations in an era of environmental crisis. Noteworthy findings include.

First, a competitive market environment was found to have a direct positive impact on GSCM practices encompassing internal environmental management, green purchasing, eco-design, cooperation with customers and reverse logistics. This finding makes sense in that more competitive market structures are associated with the firm's higher productivity and its subsequent performance improvement. This finding implies that competitive pressure (especially in the export market) encourages firms to adopt GSCM practices because such pressure allows them to stay competitive with their rivals by offering eco-friendly products and highlighting company-wide environment commitments. For example, according to the Waste Electrical and Electronic Equipment (WEEE) Directive and the Compliance in Advance and Supporting System (COMPASS) mandated by the EU, firms exporting their electronic products to the EU market are required to specify the percentage of their recycled and/or reused parts/components. Thus, the exporting firm that fails to comply with these directives cannot compete in the EU market. Likewise, a number of other countries such as the United Arab Emirates (UAE), Sweden and Taiwan required that the electronic manufacturers reveal the use of hazardous materials for electronic devices. Thus, the firm's adoption of GSCM practices can make a difference in its competitive position in export markets with tougher environmental standards. Another possible explanation for this finding is that tougher environmental standards in the import country became the additional export barrier for Korean firms competing in that country and thus those Korean firms tended to embrace GSCM practices to overcome such a barrier. In fact, Ederington and Minier (2003) discovered that the import country's tough environmental standards could become the significant secondary export barrier for exporting firms. In addition, while synthesizing the past decades of the literature identifying various factors influencing export performance, Zou and Stan (1998) observed that export barriers could have a significant adverse impact on the export performance. As such, exporting Korean firms had to meet the import country's environmental standards by making commitments to GSCM practices.

However, this finding also indicates that the firms are more reactive to sustainability causes than being proactive. The possible explanation for this tendency is that the firms are often concerned about the upfront cost associated with a GSCM practices and a difficulty in realizing hidden values (e.g. improved public relation, brand image, reduced penalty for pollution) of the GSCM practices. In other words, viewing GSCM practices as a cost center not as a profit center seems to be the hindrance to GSCM practices and the firm's inability to articulate the clear business value of GSCM practices forces its management to take a less proactive stance for GSCM practices. To change this stance, the firm needs to develop multi-dimensional performance metrics such as the balanced scorecard that can help the firm evaluate the outcomes of GSCM practices from a number of different angles and potential payoffs.

Second, among various GSCM practices, both internal environmental management and green purchasing were found to influence both manufacturing and marketing performances to the greater extent than the others did. To elaborate, eco-design has a weak positive effect on manufacturing performance, while not affecting marketing performance at all. Neither of cooperation with customers and reverse logistics has any significant impact on manufacturing and marketing performances. This finding defies the conventional wisdom that the efficient and effective deployment of the firm's resources (e.g. returned products) through reverse logistics can increase the firm's competitive advantage and subsequently enhance its performance (Daugherty *et al.*, 2005). Somewhat incongruent with the finding of the earlier study by Green *et al.* (2008) indicating that customer satisfaction can positively impact firm performance, this finding also implies that the firm's consideration of customer feedback for the improvement of GSCM practices and its efforts to provide the customer with extended life cycle support did not pay any dividend for enhancing manufacturing and marketing performances. Given this varying degree of impact of GSCM practices on firm performance, the firm should prioritize the more effective GSCM practices such as internal environmental management and green purchasing over the less effective GSCM practices such as eco-design, cooperation with customers and reverse logistics. That is to say, a greater amount of resource investment and managerial efforts should be geared toward internal environmental management and green purchasing practices to maximize the GSCM payback.

Finally, when pairwise comparisons of GSCM practices are made with respect to their extent of impact on manufacturing and marketing performances, green purchasing was found to dominate all but one GSCM practices, whereas internal environmental management dominated two other GSCM practices. As such, we can conclude that green purchasing is the most effective GSCM practice among five different options of GSCM practices. Considering this finding, green purchasing should be at the forefront of GSCM practices. As such, there is a need to develop more specific green purchasing strategies amenable to company-wide environment guidelines and government rules/regulations. These strategies may include:

- the development of clear green purchasing criteria such as the use of highly reusable, recyclable, recoverable and salvageable product components and the selection of suppliers with proven records of environmental compliances or environmental certificates;
- constant communication with suppliers, raise of their awareness of environmental issues, solicitation of their feedback on environmental practices and their early involvement in new green product development; and
- continuous monitoring of green purchasing practices and the periodic assessment of green purchasing efforts in terms of their impact on firm performance.

The investigation of the aforementioned strategies for their impact on firm performance can be an intriguing future research agenda. In addition, the current study can be further extended to consider the different categories of firm performance such as financial performance or the firm's public image and brand recognition. Another line of future research that is worth pursuing includes the cross-cultural (national) comparison of the impact of GSCM practices on firm performance. Speaking of the firm performance which often relied on the self-assessment of survey respondents in the existing literature, it would be intriguing to see if future research can develop a new yardstick for objectively assess the firm performance in non-financial terms.

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