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How does sustainable development of supply chains make firms lean, green and profitable? A resource orchestration perspective

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Abstract

This paper theorizes and tests the effects of sustainable development of supply chains on cost-reduction (lean), environmental (green), and financial (profitable) performance. Based on the resource orchestration theory, we argue internal, supplier and customer sustainable development each orchestrates different types of resources and therefore their effects vary. Structural equation modeling of data from a survey of 203 Thai manufacturers was used to test a new theoretical model. Results confirm financial performance was achieved through cost-reduction created by sustainable development of customer supported by internal and supplier sustainable development. Instead, better environmental performance created by internal sustainable development generated no financial gains. However, internal, supplier and customer sustainable development positively affected each other; and, by acting together, they made firms lean, green, and profitable.

Keywords: Sustainable development, Supply chain management, Sustainability, Business performance.

Introduction

The creation of a sustainable corporation (Elkington, 1994) requires a strategy that integrates sustainable development into the extended supply chain (Ansari and Kant, 2017; Handfield et al., 2005; Matos and Hall, 2007). Sustainable development of supply chains is a strategy that incorporates economic, environmental and social goals into product design, operations, purchasing, logistics and other supply chain activities outside of a focal firm (Green et al., 2012, Narasimhan and Carter, 1998; Zhu and Sarkis, 2004). Especially for environmentally sustainable manufacturing supply chains (Chiarini, 2014), the incorporation of environmental goals into the extended supply chain (Handfield et al., 2005) is a complex endeavor (Ansari and Kant, 2017) because life-cycle impacts of a product can be costly to eliminate and it is a problem contributed and shared by all members of a supply chain (Seuring and Müller, 2008). Since no firm would implement a strategy that generates no economic benefits (Carroll, 1991), it is important to understand how efforts of a focal firm in developing sustainable suppliers and customers can make the firm greener, leaner and profitable.

Through sustainable development of supply chains many firms wish to realize both cost-reduction and environmental benefits, stimulated by the 'lean-is-green' claim (King and Lenox, 2001). Another desirable claim is 'green-is-profitable' (Porter and van der Linde, 1995; Rothenberg et al., 2001). But, it is unclear how these claims can be achieved in a supply chain.

Past studies that examined performance effects of sustainable supply chain development (SSCD) strategies have produced mixed results (e.g., Hart and Ahuja, 1996; Zhu and Sarkis, 2004; Gonzalez-Benito and Gonzalez-Benito, 2005; Rao and Holt, 2005; Zhu et al., 2007; Thun and Müller, 2010). Though some SSCD strategies are shown to positively related to environmental performance (e.g., Zhu and Sarkis, 2004; Vachon and Klassen, 2008), their effects on cost-saving and financial performance remain unclear (Pullman et al., 2009; Zhu and Sarkis, 2004; Zhu et al., 2005; Golicic and Smith, 2013). Supply chain managers remain skeptical of the economic benefits of SSCD (Preuss, 2005). The meta-analysis by Golicic and Smith (2013) highlights that only two out of ten empirical studies (20%) reported positive effects of SSCD practices on both 'accounting' (profitability related) and 'operational' performance outcomes (Rao and Holt, 2005; Zhu et al., 2007).

This paper attempts to refine our understanding of the environmental, cost-reduction and financial performance impacts of three SSCD strategies, namely internal, supplier, and customer sustainable development. Based on resource orchestration theory (Sirmon et al., 2011), we argue that different SSCD strategies can access and orchestrate different resources in a supply chain. Internal sustainable development emphasizes strategic and operational alignment within an organization such that internal resources (e.g., knowledge, skills, routines, information and technologies) are directed to integrate environmental goals into business strategy (Wong et al., 2015). Suppliers and customer resources are external resources that can be orchestrated by the focal firm to address environmental issues through certification, monitoring, assistance, information exchange and cooperation (Zhu and Sarkis, 2004; Vachon and Klassen, 2006; Sharfman et al., 2009; Wong et al., 2015). Supplier sustainable development involves procurement and sourcing of environmentally friendlier resources from upstream suppliers (Zuo et al., 2009) while customer sustainable development involves changing customer buying behaviors through cooperation (Vachon and Klassen, 2006), integration of processes and information exchange (Wong et al., 2015).

This paper presents a large-scale study to empirically examine the relationships amongst the three SSCD strategies and their abilities to make firms lean (cost reduction), green (environmental performance), and profitable (financial performance). Our resource orchestration theory argues that the internal, supplier, and customer resources vary but the three SSCD complement each other. Thus, while individually internal, supplier and customer SSCD might not be able to affect all the three performance outcomes (environmental, cost-reduction and financial), collectively the three strategies could make a firm lean, green, and profitable. We tested this hypothesis by specifying a theoretical model that reveals the multiple path dependencies between SSCD strategies and performance through structural equation modeling (SEM) of survey data collected from 203 Thai manufacturers.

Theoretical Model and Hypotheses

Literature Review

Sustainable development generally means economic development that is conducted without depletion of natural resources. Sustainable development from a supply chain strategy perspective represents a crucial view for understanding how human needs are fulfilled by a chain of economic activities that also creates sustainability issues related to society and depletion of the natural environmental. To achieve sustainable development in a supply chain, corporate strategies related to design, sourcing, production and logistics ought to consider environmental sustainability along the supply chain (Handfield et al., 2005; Shrivastava, 1995).

Some scholars argue sustainable supply chain issues can be managed (Ansari and Kant, 2017; Seuring and Müller, 2008), others suggest an emphasis in development (Chiarini, 2014; Tregidga and Milne, 2006). Seuring and Müller (2008: 1700) define sustainable supply chain management as "the management of material, information and capital flows as well as cooperation among companies along the supply chain while taking goals from all three dimensions of sustainable development, i.e., economic, environmental and social, into account which are derived from customer and stakeholder requirements". An emphasis on development is equally important because of the needs to influence, support and develop suppliers and customers, and view them as a part of the solutions such that they can continue improve cost efficiency, working conditions and the natural environment (Tregidga and Milne, 2006). Elkington (1994) once argued sustainable development policies are required to transform firms, their customers and the environment to all become winners. A Delphi study of Seuring and Müller (2008) found that suppliers is one of the major issues, suggesting the need for supplier sustainable development through creating awareness, integrating, cooperating and communicating with suppliers.

The questions are, what types of sustainable supply chain development strategies (SSCD) can help make firms lean, green and profitable? And, what are the underlying processes in which SSCD simultaneously generate multiple performance outcomes? The meta-analysis by Golicic and Smith (2013) suggest that there is no single SSCD strategy that positively affects environmental, cost-reduction and financial performance. In fact, the literature recognizes there are different direct and indirect paths in which SSCD may affect performance. Ambec and Lanoie (2008) argue it is possible for SSCD to directly improve environmental and financial performance through generating opportunities to reduce cost and generate revenue. While these direct effects are reflected in the theoretical model of Shi et al. (2012), the cost associated with SSCD make it hard to justify its direct effects on financial performance, or the claim that green is also profitable (Porter and van der Linde, 1995; Rothenberg et al., 2001).

Instead, Klassen and McLaughlin (1996) argue firms first generate better environmental performance, and by doing so, they can gain cost-saving and positive market responses as two ways to improve financial performance. The theoretical model of De Giovanni and Vinzi (2012) attempted to reflect the effects of SSCD on environmental and financial (economic) performance but it does not explain the effects of cost reduction and distinguish the differences between supplier and customer sustainable development. Lean or cost-reduction has been recognized as an effective supply chain strategy (Lamming, 1996) for firms relying on cost competitiveness. When greening the supply chains by reducing energy and material consumptions it is possible to also achieve cost saving (King and Lenox, 2002). There is therefore a need to gather more empirical evidence to verify the "lean-is-green" claim.

In short, the above two questions remain unanswered due to the lack of consistent empirical evidence. Moreover, the existing studies suffered from a lack of theory. While the natural resource-based view (N-RBV) has been used to explain the performance effects of environmental management practices and strategies (Hart, 1995; Shi et al., 2012), this theory does not distinguish the different paths in which SSCD strategies generate performance. To address this issue, we offer a new theoretical perspective. On reflection, when it comes to the development of sustainable supply chains, we essentially develop resources, or the capabilities to reduce resource depletions of supply chain activities while coping with growth in demand in a profitable manner. Because such resources are dispersedly located within autonomous suppliers, customers and focal firms, they needed to be orchestrated into the right forms and right place (Wong et al., 2015). For example, some suppliers need financial and technical assistance. Some customers demand for more accurate information about environmental impacts. SSCD can therefore be viewed as a strategy to orchestrate supply chain resources, following the resource orchestration theory (Sirmon et al., 2011). With the resource orchestration theory, we explain how SSCD make firms lean, green and profitable in the following sections.

Theoretical Model

Figure 1 depicts our research model. Aiming to refine two existing theoretical models (De Giovanni and Vinzi, 2012; Shi et al., 2012), we propose a comprehensive model linking sustainable supply chain development (SSCD) strategies with performance. This model helps create insights into the ways different SSCD strategies associate with one another (hypotheses H4-H6) and with three performance outcomes (H1-H3). Three performance outcomes (environmental, cost reduction, and financial) are included to test and refine the 'lean-is-green' and 'green-is-profitable' claims. The model allows us to test four path dependencies that might, ultimately, explain whether financial performance: (1) is directly created by SSCD strategies (H1c-H3c); (2) is achieved through cost reduction (being lean) created by SSCD (H1b-H3b & H8); (3) is achieved through cost reduction (being lean) created by better environment performance (H9 & H8); (4) is realized by generating revenues or profit margins owing to better environmental performance (H1a-H3a & H7).

<<Insert Figure 1 here>>

The theoretical model can be explained by resource orchestration theory (Sirmon et al., 2011) and natural resource-based view (N-RBV) (Hart, 1995). The resource orchestration theory emphasizes actions that effectively structure, bundle, and leverage firm resources such as knowledge, skills, routines, finance, information and technologies (Sirmon et al., 2011; Liu et al., 2016). Such resources include internal resources owned by a firm and external resources owned by suppliers, customers and stakeholders accessible by the firm. The N-RBV argues access to rare resources can lead to competitive performance (Hart, 1995). Resource orchestration helps create a shared vision to achieve better performance across supply chains (Hart, 1995).

SSCD strategies can generate multiple benefits only when supply chain members have identified, combined, and leveraged the necessary resources in an integrative and coordinated manner. Such orchestrations of supply chain resources are triggered and supported by efforts and routines that share information, assist, collaborate, and integrate environmental goals into supply chain activities (Wong et al., 2015). Integrated intra- and inter-organizational business processes help bundle and leverage resources across the supply chain through information exchange and cooperation for reducing environmental impact while reducing cost reduction and achieving financial performance.

Hypotheses Development

Internal sustainable development focuses on the integration of environmental goals and responsibilities into business strategies, management systems, top management rewards, and attempts to balance commercial, societal, and environmental goals for achieving sustainable growth (e.g., Montabon et al., 2007; Pagell and Wu, 2009; Gond et al., 2012). Internal sustainable development is achieved through a single integrated management system (Margerum and Born, 2000; Montabon et al., 2007; Tari and Molina-Azorin, 2010), cross-functional communication, coordination, and collaboration (Zhu and Sarkis, 2004; Montabon et al., 2011; Zhu et al., 2012). Such an integrated system (Margerum and Born, 2000) enables an effective orchestration of resources. By addressing disparate views concerning environmental responsibilities and avoiding sub-optimization; it enables bundling and leveraging of resources across functions to reduce environmental impact while meeting commercial imperatives. When environmental goals are integrated into the business strategy and operations using a single system, staff from different functions may cooperate with a focus on orchestrating resources to jointly address problems related to cost, finance, and environment. Thus, we posit:

H1: Internal sustainable development is positively associated with (a) environmental performance, (b) cost reduction, and (c) financial performance.

Supplier sustainable development includes the exchange of information concerning goals, responsibilities, strategies, benefits, best-practices, and performance standards related to environmental issues with suppliers using an integrated environmental information system (Rao, 2002; Seuring and Müller, 2008; Solér et al., 2010; Zhu et al., 2012; Lai and Wong, 2012; Green et al., 2012; Kim and Rhee, 2012). Supplier sustainable development enables two-way information exchange (Solér et al., 2010) to create mutual understanding of environmental responsibilities and strategies between buyers and suppliers (Vachon and Klassen, 2006). The integration of information management systems across different suppliers helps reduce the costs of information exchange and normalize performance measurements and standards. Such integrated information systems (e.g., Carbon Disclosure Project) allow buyers and suppliers to better understand the overall environmental burdens such that more meaningful goals can be set and joint efforts can be established.

Supplier sustainable development orchestrates assistance, resources, support, and guidance to suppliers (Rao, 2002; Hu and Hsu, 2010; Kim and Rhee, 2012; Wong et al., 2012; Wong et al., 2013). Suppliers that are less financially and technically capable can benefit from different forms of assistance from buyers. Supplier assistance helps suppliers achieve cost efficient through energy and resource savings (Grant et al., 2015). Supplier sustainable development facilitates coordination, standardization, cooperation, and integration of closed-loop supply chain processes and related planning and performance measurement with suppliers (Kleindorfer et al., 2005; Montabon et al., 2007; Sharfman et al., 2009; Zuo et al., 2009; Yen and Yen, 2012). An integrated closed-loop system allows the use of resources including waste and end-of-life products and reduces waste across the supply chain. This helps reduce cost and environmental damages while providing the basis for designing sustainable products that meet and even exceed customer needs, resulting in financial gains (Ambec and Lanoie, 2008). Hence, we posit:

H2: Supplier sustainable development is positively associated with (a) environmental performance, (b) cost reduction, and (c) financial performance.

Customer sustainable development includes the exchange of information concerning environmental goals, practices and strategies and cleaner production technology, and product life-cycle impact with customers (Vachon and Klassen, 2006; Darnall et al., 2008; Zhu et al., 2008b; Hazen et al., 2011) so that the supplier and customer begin to share mutual environmental responsibilities and achieve environmental goals collectively (Vachon and Klassen, 2006 & 2008; Zhu et al., 2008a; Lee et al., 2012). Customer sustainable development represents suppliers proactively informing customers of newer and cleaner production technology and the environmental management strategies that help their customers to introduce environmentally friendlier products that may generate profits (Ambec and Lanoie, 2008). By receiving more information about upstream environmental burdens customers can become more aware of the problems and, therefore, appreciate the efforts of such proactive suppliers, leading to better and longer supplier-customer relationships (Dyer and Singh, 1998).

Customer sustainable development orchestrates customer resources by coordinating closed-loop processes, logistics planning and green supply chain activities, sharing environmental impact information, solving environmental-related problems and making joint decisions concerning reducing environmental impact (Wong et al., 2015). An integrated closed-loop supply chain returns all end-of-life natural resources to the producers for recycling and reuse. Xerox, for example, developed an integrated reverse logistics process for the entire supply chain to remanufacture, recycle and reuse components of photocopy machines (Grant et al., 2015). Thanks to the integrated closed-loop approach Xerox manages to help customers save energy, ink, and paper while avoiding disposal burdens. This exemplifies how end-to-end supply chain resource orchestration can be achieved through cooperation (Vachon and Klassen, 2006; Sharfman et al., 2009). Thus, we posit:

H3: Customer sustainable development is positively associated with (a) environmental performance, (b) cost reduction, and (c) financial performance.

Past studies show effective internal environmental management makes it easier to implement external environmental management (De Giovanni and Vinzi, 2012). Thus, internal sustainable development is expected to form the basis of successful supplier and customer sustainable development (Shi et al., 2012). An integrated management system that incorporates environmental criteria into business strategies and operations created by internal sustainable development enables a firm to cooperate effectively with suppliers and customers. Firms that have implemented internal sustainable development are more capable of collaborating with external parties to enable pollution prevention (Darnall et al., 2008). With an integrated environmental management system Motorola could cooperate with suppliers and customers to successfully implement its Environmentally Preferred Products (EPPs) program (Grant et al., 2015). Thus, internal sustainable development is expected to positively affect supplier and customer sustainable development. Furthermore, to proactively collaborate with customers there is a need for supplier sustainable development to address environmental problems (Plambeck, 2012). Supplier sustainable development enables a firm to more effectively respond to customers' calls for reducing environmental impact. We therefore posit:

H4: Internal sustainable development is positively associated with supplier sustainable development.

H5: Internal sustainable development is positively associated with customer sustainable development.

H6: Supplier sustainable development is positively associated with customer sustainable development.

Resource orchestration of end-to-end supply chains fueled by internal, supplier, and customer sustainable development allows a firm to reduce cost (H1b-H3b) and environmental damages (H1a-H3a) as the basis for better profitability (H1c-H3c). According to the natural-resource-based view, a better environmental performance over competitors is instrumental to create a better reputation such that it is possible to ask for premium prices and set new rules in the industry to gain financial advantage (Hart, 1995). Thus, better environmental performance leads to financial advantages. Moreover, achieving extra cost savings over competitors creates a more competitive cost structure. Cost reduction because of SSCD creates better profit margins. Furthermore, additional cost is the main barrier when implementing pollution prevention and product stewardship (Zhu and Sarkis, 2004; Hart, 1995). Thus, we posit:

H7: Environmental performance is positively associated with financial performance.

H8: Cost reduction is positively associated with financial performance.

H9: Environmental performance is positively associated with cost reduction.

Methodology

Sample and Data Collection

Our samples are based on three major manufacturing industries in Thailand, namely the electronic, automotive, and food manufacturing industries. The supply chains of these three industries are well documented in previous research, and they have a clear mandate for supply chain implementation. These industries represent major manufacturing sectors in the country. We drew a sample of 1,325 manufacturers from a mass survey. Follow-up telephone calls were made to the late responders at two-month intervals. Ultimately, we received 203 completed and useable responses, indicating a response rate of 15%. The sample represents automotive (54%), electronic (30%), and food industries (16%). Of the sample, 88.2% were environmentally certified. Most (50.2%) have more than 500 employees, 42.9% have 101-500 employees, and the remaining (6.9%) have less than 100 employees. Furthermore, 31.8% have more than US$50M annual sales.

The survey was mailed to senior executives who have knowledge of SSCD and environmental management of their firms. Each respondent was asked to complete the questionnaire from the perspective of their primary supply chain management, environmental management activities, and firm capability. The informants consisted of Chief Operations Officers (COOs) (25.6%), Chief Executive Officers (CEOs) (25.1%), functional managers related to environment management (25.6%), and operations, logistics, and supply chain management (23.9%).

Measure Development

We define sustainable supply chain development (SSCD) as a set of strategies that embed environmental criteria into management systems, functions, suppliers, customers, and wider stakeholders across a supply chain. SSCD comprises a set of ten practices (as first-order constructs) covering information exchange, assistance, collaboration, and integration of environmental management systems and business strategies and processes. Following the systematic literature review of Wong et al. (2015) we identified ten first-order constructs with 57 measurement items. These first-order constructs form three second-order constructs, namely internal, supplier and customer sustainable development. Internal sustainable development consists of three first-order constructs (i.e., integration of environmental goal into business strategy; integration of environmental strategy into management systems; cross-functional collaboration). Supplier sustainable development is composed of four first-order constructs (i.e., exchanging environmental information with suppliers; collaborating with suppliers; assisting suppliers; integrating process with suppliers). Customer sustainable development contains three first-order constructs (i.e., exchange of environmental information with customers; collaborating with customers; integrating process with customers) (Solér et al., 2010; Wong, 2013).

Next, six industrial expert judges validated the scales using three rounds of Q-Sort method (Moore and Benbasat, 1991). Three steps were taken (Li et al., 2005). First, we counted the number of items the judges agreed to place in a certain category inter-judge agreement scores and reached 87.3% inter-judge agreement, which is greater than the recommended 70% (Moore and Benbasat, 1991). Second, we calculated the Cohen's Kappa coefficient (90.6%), which indicates a high proportion of joint judgement in which chance agreement is excluded (Cohen, 1960). Third, following Moore and Benbasat's (1991) approach, we analyzed how many items were placed by the judges for each round within the target construct and reached an overall placement ratio of 92.0%. These results indicate a high level of reliability and construct validity for further questionnaire development. Finally, 49 items were selected as measurement items.

The measurement items for environmental, cost reduction and financial performance were adapted from the existing operations management literature (Boyer and Lewis, 2002; Ward and Duray, 2000; Swink et al., 2007). As for the SSCD constructs, we consider these performance outcomes as reflective measures. They are based on respondents' perceptions because there were inadequate objective scores. Financial performance is measured in terms of the increase in return on investment, market share and profitability. Instead of measuring operating cost our interest is in the cost reduction (i.e., lean) of business transaction, energy, and waste disposal (Zhu et al., 2008a) elicited from SSCD strategies. Environmental performance reflects the reduction in the use of natural resources, pollution, and emissions (Zhu et al., 2008a).

We conducted a pilot test with a panel of academics and practitioners in the fields of supply chain, operations, and environmental management to improve the wording of measurement scales. Finally, we established ten SSCD first-order constructs with 49 measurement items (Supplementary A). The items were translated into Thai by two bilingual Thai researchers. A back-translation process was applied to ensure conceptual equivalence. The respondents were asked to assess the extent to which their firms implement the SSCD strategies on a five-point Likert scale of 1 = "almost never" to 5 = "almost always." They were asked to assess improvement in cost-reduction, financial, and environmental performance in the past-two years relative to the industry's average as we are interested in competitive rather than absolute performance. It helps eliminate potential bias due to different views of actual performance. The Kolmogorov-Smirnov test for normality was executed and found that the data is normally distributed.

Construct Validity and Reliability

Exploratory factor analysis (EFA) using the varimax rotation with Kaiser normalization was used to detect the underlying dimensions of the measurement items (Kaiser, 1958). The EFA helped detect if the measurement items were associated with their respective construct and were unidimensional. The EFA results confirm that all items load on their respective construct with loadings of greater than 0.5. This step enabled us to adopt the item-parceling technique to form composite constructs for hypotheses testing.

Following Gerbing and Anderson (1988), we performed confirmatory factor analysis (CFA) using the maximum likelihood estimation of AMOS 20.0 to test the psychometric properties of the first-order measurement scales. We had 203 respondents which met the adequate sample size (n >200) for CFA analysis to achieve "a convergent and proper solution" (Anderson and Gerbing 1984, pp. 170-171). We assessed the unidimensionality of the constructs by using Cronbach's alpha and composite reliability. Supplementary A shows that all constructs have Cronbach's alpha and composite reliability higher than the 0.70 threshold, suggesting adequate measurement scales reliability (Nunnally, 1984). The CFA results show that the comparative fit index (CFI), incremental fit index (IFI), and Tucker-Lewis index (TLI) are well above the recommended threshold of 0.90 and the root mean square residual (RMR) is below the recommended threshold of 0.08 (Hu and Bentler, 1999).

Table 1 summarizes the means and standard deviation of our constructs, and the correlations among them. The average variance extracted (AVE) of each construct exceeds the recommended value of 0.50; A high level of AVE indicates convergent validity, meaning our measurement scales measure mainly their respective constructs (Fornell and Larcker, 1981). We also tested the discriminant validity of the first-order constructs. Table 1 shows discriminant validity among the constructs is achieved because the square-root AVEs of all constructs are greater than the correlation between any pairing. That means measurement scales that are not supposed to be related are not related.

<<Insert Table 1 here>>

Common Method Variance and Non-Response Bias

Non-response bias was evaluated in two ways. First, early responses were compared with late response (Armstrong and Overton, 1977). Although this method does not investigate non-response directly, a comparison was made between early and late responses. The χ^2 difference test results indicate no significant difference in any criterion with significant levels below 0.1. Second, another χ^2 test was applied to check for any significant difference between respondents and non-respondents. We contacted non-respondents and asked them to return the questionnaires; they were considered as non-respondents. The results also indicate no significant difference between the respondents and non-respondents. Therefore, non-response bias was not a major issue.

We took two steps to reduce common method variance. We first conducted the Harman's one-factor test that is widely followed by the extant operations management literature (Craighead et al., 2011). We examined the χ^2 difference between a single latent factor and the hypothesized construct model. A significant χ^2 difference at $p < 0.05$ of the two models indicates that the fit of the single-factor model is significantly worse than the hypothesized model. These ex-post 'test results' do not mean there is no common method variance; instead, some ex ante measures are adopted (Guide and Ketokivi, 2015). Thus, in the design of the questionnaire, we separated the variables into sections to overcome the shortcomings of common method bias.

Item Parceling

Since our data-item ratio is small, we used a parceling-item technique (Bandalos, 2002) which is found to be useful as it will result in identical deattenuated structural coefficient estimates if the items are unidimensional (Sass and Smith 2006). The Cronbach's alpha of each construct is greater than 0.50 (Pedazur and Schmelkin 1991) suggesting we have unidimensional constructs. We followed Kishton and Widaman's (1994) technique of averaging the measurement items corresponding to each construct. We had a total of 49 items of SSCD, 15 items for internal sustainable development (three dimensions), 20 items for supplier sustainable development (four dimensions) and 14 items for customer sustainable development (three dimensions). We parceled the items at the first-order levels, resulting in ten item-parceled latent variables, resulting in a 9:1 data-item ratio, which is above the recommended ratio of 5:1 (Kline 2005).

Empirical Results

To test the hypotheses, we created a structural model following the theoretical framework. The results show that the model has a good fit with the data (χ^2 = 605.69, df = 275; RMR = .08; IFI = .91; CFI = .91; RMSEA = .08). Figure 2 summarizes the results of our structural equation model; where significant paths are represented by straight arrows and insignificant paths as arrows with dotted lines. The overall pattern of the structural model provides support for only our hypotheses for indirect effects.

The results for each hypothesis are as follow. Internal and customer sustainable development are positively associated with environmental performance (H1a) and cost-reduction performance (H3b), respectively. The other sub-hypotheses, H1-H3, are rejected. Interestingly, the results support the positive relationships between internal and supplier sustainable development (H4), internal and customer sustainable development (H5), and supplier and customer sustainable development (H6). Even though supplier sustainable development does not directly affect performance, it enables customer sustainable development to reduce cost. In addition, the results provide no support for the positive link between environmental and finance performance (H7) but there is full support for the cost-reduction-financial performance relationship (H8) and environmental-cost-reduction relationship (H9).

<<Insert Figure 2 here>>

As shown in Figure 2, two interesting path dependencies emerge. The first path relies heavily on customer sustainable development to reduce cost and subsequently improve financial performance. This path is supported by internal and supplier sustainable development. The second path does not involve supplier and customer sustainable development. Internal sustainable development improves environmental performance and, in turn, reduces cost and financial performance. Ultimately, cost reduction is the major route towards better financial performance. Cost reduction is partly contributed by lowering environmental damages (β = 0.53 at $p<0.001$) and implementing customer sustainable development (β = 0.36 and $p<0.001$), supported by internal and customer sustainable development. The non-significant environmental-financial performance path suggests that the environmental performance generated by SSCD strategies (and other unobserved factors) was not able to generate new revenues or higher profit margins. In short, although none of the second-order SSCD can individually and directly explain all three performances, they can positively affect all of them in a collective manner.

Discussion and Implications

This paper provides four major areas of novelty and theoretical contributions. First, this paper extends the theoretical models of De Giovanni and Vinzi (2012) and Shi et al. (2012) by adding cost reduction as another performance measure of SSCD and distinguishing the difference between supplier and customer sustainable development. This provides crucial evidence concerning the paths by which SSCD generates financial performance. By comparing four possible paths SSCD generate financial performance, we expose mechanisms new to the sustainable supply chain literature that explain how the three SSCD strategies ultimately improve financial performance through cost reduction. The results indicate it is still not possible for a single SSCD strategy (i.e., internal, supplier, or customer sustainable development) to directly affect all three performance outcomes (i.e., environment, cost, and finance). This new findings supplement the findings of a recent meta-analysis (Golicic and Smith, 2013). Internal, supplier, and customer sustainable development are unable to directly affect financial performance because they are more oriented to reduce cost and environmental damages, rather than generating products and services that lead to new revenues, better profit margins, or market share (Ambec and Lanoie, 2008). Moreover, internal and supplier sustainable development could not directly lead to cost saving possibly due to the high cost of implementing such practices (Zhu and Sarkis, 2004). Nevertheless, there are, possibly, some time-lag effects (Hart and Ahuja, 1996).

Second, we reveal two effective path dependences to explain the mechanisms by which SSCD strategies ultimately generate better financial performance. Through orchestrating internal resources (internal sustainable development) and suppliers' resources (supplier sustainable development) and efforts to integrate environmental management with customers (customer sustainable development), it is possible to collectively become leaner in transactions, materials, waste, and energy, subsequently leading to better financial positions (SSCD→lean→profit). This path dependency depends on efforts to develop customers through collaboration, closed-loop process integration and bi-directional information exchange with customers. Moreover, the implementation of an integrated business strategy and environmental management system while enabling cross-function collaboration (internal sustainable development) helps reduce environmental damage while saving costs as the indirect means to increase profitability (Internal sustainable development→green→lean→profit). The results show that these two paths are effective, and the fact that internal sustainable development is equally important. That means, in addition to integrating sustainable development strategies with suppliers and customers, thereby eventually realizing cost saving, internal sustainable development is also the basis for reducing environmental damage (through supplier and customer sustainable development).

These two crucial path dependencies are revealed because we added cost-reduction into the theoretical model as a dependent variable. Otherwise, we could conclude that sustainable development and environmental performance are not able to affect financial performance. Our model that incorporated cost-reduction represents a novel contribution, even though the effects of SSCD on cost has previously been studied; past studies show that there are no significant effects of environmental management initiatives on cost (Christmann, 2000; Zhu et al., 2005) and they frequently produce no financial gains (Golicic and Smith, 2013). These past findings might discourage scholars and managers to consider cost saving as a crucial motivation for investment in sustainable development. With our newer evidence and more comprehensive theoretical model, we show that cost reduction is the only path through which SSCD generated financial performance. This informs future studies on SSCD to incorporate cost reduction to fully understand the ways SSCD generate performance.

Third, our results reinforce the resource orchestration argument (Sirmon et al., 2011) and introduce a new perspective to the SSCD literature. While past sustainable supply chain studies use a relational (Dyer and Singh, 1998) or natural-resource-based view to explain the mechanisms where SSCD strategies affect performance, this paper shows that, essentially, the attempts to integrate suppliers, customers, and internal functions by creating a management system are meant to identify, bundle, and leverage all the resources and knowledge required to make the supply chain lean, green, and profitable. This paper unveils how the 'lean-is-green' and 'green-is-profitable' argument popularized by King and Lenox (2001) and Porter and van der Linde (1995) can be made possible if members of a supply chain successfully orchestrate their resources by implementing all three SSCD strategies. Our results explain a single SSCD strategy cannot generate multiple performance outcomes (Golicic and Smith, 2013) because of the resources they have access to and orchestrate are different and inadequate. An integrative approach to SSCD, supported by a unified management system spanning from suppliers to customers across internal functions from strategic to tactical levels, is required to orchestrate all the necessary resources from the entire supply chain. This requires capacity to orchestrate natural resources, human resources, knowledge, and other physical resources for achieving a balanced set of environmental, societal, and economic goals. This new insight can only be revealed using our theoretical model.

Fourth, this paper informs business strategy literature that it is possible to implement sustainable supply chain strategies to become lean, green and profitable but there is a need for an integrative approach, recognizing the facts that different sustainable supply chain strategies can access to and orchestrate different types of resources. Upstream suppliers require assistance and rich information about technical solutions (Vachon and Klassen, 2006) because they do not have all the technical and financial resources. Therefore, sustainable supply chain strategies cannot focus only on internal sustainable development as suggested by some scholars (Handfield et al., 2005). By doing so, then only suppliers are readier to cooperate (Vachon and Klassen, 2006). Moreover, our results suggest internal and sustainable supplier development is inadequate because sustainable customer development is the key to cost-saving that led to financial gain. The end goal of a firm's strategy is financial gain, and our results indicate that financial performance comes from cost-saving, and better environmental performance did contribute to cost reduction. That means corporate environmental or sustainable supply chain strategies that integrate cost and resource efficiency efforts are more effective in making a firm lean, green and profitable.

In addition, there are some practical implications. The study shows the need for integrating all three SSCD strategies to effectively create 'lean-green-profitable' competitive outcomes. Manufacturers need to develop an integrated management system that ties all internal functions and top management with external suppliers and customers at strategic, operations, and process levels to enable effective collaboration and orchestration of resources. Otherwise, there will remain sub-optimization behavior owing to lack of integration. Also, managers need to understand where performance occurs and which SSCD strategies to begin with. Our results suggest that the improvement of manufacturers' environmental performance originates mostly from internal sustainable development. Internal sustainable development is also the basis for developing capacity to integrate with suppliers and customers. Internal sustainable development may eventually lead to some cost saving but it is important to integrate with suppliers and customers to achieve sustainable cost saving and, subsequently, better financial performance. Customer sustainable development is particularly pivotal. It often drives upstream members to consider cost saving activities that benefit customers. It may also help to create greener products that add margins or create new markets and, hence, contribute to financial performance (Ambec and Lanoie, 2008).

Conclusion and Future Research

This paper empirically verifies the performance impact of three supply chain sustainable development (SSCD) strategies. We introduce resource orchestration theory to conceptualize SSCD, bringing a new perspective to the sustainable supply chain strategy literature. By dividing the SSCD construct into three dimensions (i.e., internal, supplier, and customer sustainable development), this paper distinguishes their influences on environmental, cost reduction and financial performance but, collectively, they lead to 'lean-green-profitable' competitiveness. The new insight we create, here, is the need for integrated management systems that drive top management, internal functions, suppliers, and customers to orchestrate the required resources to achieve aligned and balanced environmental, cost, and financial goals. Our empirical analyses show that only when all three dimensions of SSCD are successfully orchestrated firms can improve environmental performance while reducing cost and improving financial performance.

As with other survey-based research, this paper has some limitations. Single industry studies such as firms in the automotive industry, food industry, textile industry, and electronic industry in Thailand can be separately studied as they represent those industries in which the environmental pressures are at different levels. Also, comparisons of studies in emerging and developed countries can be used in a cross-national synthesis of studies that examine sustainable supply chain issues in those contexts. Further theoretical and applied research is needed to better understand the mechanisms of SSCD that supply chains take as they move toward more sustainable approaches. Our study shows that the three SSCD dimensions must co-exist, suggesting that there may be some complementarity, mediation, or moderating effects. Future studies of other countries and industries are also needed on how and why the evolution of SSCD varies in different countries and industries.

References

Anderson J.C, Gerbing D.W. 1984. The effect of sampling error on convergence, improper solutions, and goodness-of-fit indices for maximum likelihood confirmatory factor analysis. Psychometrika 49: 155-173.

Ansari, Z.N., Kant, R. 2017. Exploring the framework development status for sustainability in supply chain management: a systematic literature synthesis and future research directions. Business Strategy and the Environment

Ambec S, Lanoie P. 2008. Does it pay to be green? A systematic overview. Academy of Management Perspective, November: 45-62.

Armstrong J.S, Overton T.S. 1977. Estimating nonresponse bias in mail surveys. Journal of Marketing Research 14, 396-402.

Bandalos D.L. 2002. The effects of item parceling on goodness-of-fit and parameter estimate bias in structural equation modelling. Structural Equation Modeling 9: 78–102.

Boyer K.K, Lewis M.W, 2002. Competitive priorities: investigating the need for trade-offs in operations strategy. Production and Operations Management 11(1): 9-19.

Carroll, A.C. 1991. The pyramid of corporate social responsibility: toward the moral management of organizational stakeholders. Business Horizons 34(4), 39-48.

Chiarini, A., 2014. Strategies for developing an environmentally sustainable supply chain: differences between manufacturing and service sectors. Business Strategy and the Environment 23(7), 493-504.

Christmann, P. 2000. Effects of “best practices” of environmental management on cost advantage: the role of complementary assets. Academy of Management Journal 43(4), 663-680.

Cohen J. 1960. A coefficient of agreement for nominal scales. Educational and Psychological Measurement, Spring: 37-46.

Craighead C.W, Ketchen D.J, Dunn K.S, Hult G.T.M. 2011. Addressing common method variance: guidelines for survey research on information technology, operations, and supply chain management. IEEE Transactions on Engineering Management 58(3): 578-588.

Darnall N, Jolley G.J, Handfield R. 2008. Environmental management systems and green supply chain management: complements for sustainability? Business Strategy and the Environment 17(1): 30-45.

De Giovanni P, Vinzi V.E. 2012. Covariance versus component-based estimations of performance in green supply chain management. International Journal of Production Economics 135: 907-916.

Dyer J.H, Singh H. 1998. The relational view: cooperative strategy and sources of interorganizational competitive advantage. Academy of Management Review 23(4): 660-679.

Elkington, J. 1994. Towards the sustainable corporation: win win win business strategies for sustainable development, California Management Review 36(2), 90-100.

Fornell C, Larcker D.F. 1981. Evaluating structural equation models with unobserved variables and measurement errors. Journal of Marketing Research 18(1): 39-50.

Gerbing D.W, Anderson J.C. 1988. An updated paradigm for scale development incorporating unidimensionality and its assessment. Journal of Marketing Research 25(2): 186–192.

Golicic S.L, Smith C.D. 2013. A meta-analysis of environmentally sustainable supply chain management practices and firm performance. Journal of Supply Chain Management 49(2): 78-95.

Gond J, Grubnic S, Herzig C, Moon J. 2012. Configuring management control systems: Theorizing the integration of strategy and sustainability. Management Accounting Research 23(3): 205-223.

Gonzalez-Benito J, Gonzalez-Benito O. 2005. A study of the motivations for the environmental transformation of companies. Industrial Marketing Management 34: 462-475.

Grant D.B, Trautrims A, Wong C.Y. 2015. Sustainable logistics and supply chain management*:* principles and practices for sustainable operations and management, Kogan Page: London.

Green K.W. Jr, Zelbst P.J, Meacham J, Bhadauria V.S. 2012. Green supply chain management practices: impact on performance. Supply Chain Management*:* An International Journal 17(3): 290-305.

Guide V.D.R, Ketokivi M. 2015. Notes from the Editors: Redefining some methodological criteria for the journal. Journal of Operations Management 37: v-viii.

Handfield, R., Sroufe, R., Walton, S. 2005. Integrating environmental management and supply chain strategies. Business Strategy and the Environment 14, 1-19/

Hart S.L. 1995. A natural-resource-based view of the firm. The Academy of Management Review 20(4): 986-1014.

Hart S.L, Ahuja G. 1996. Does it pay to be green? An empirical examination of the relationship between emission reduction and firm performance. Business Strategy and the Environment 5: 30-37.

Hazen B.T, Cegielski C, Hanna J.B. 2011. Diffusion of green supply chain management. International Journal of Logistics Management 22(3): 373-389.

Hu A.H, Hsu C-W. 2010. Critical factors for implementing green supply chain management practice. Management Research Review 33(6): 586-608.

Hu L.T, Bentler P.M. 1999. Cutoff criteria for fit indices in covariance structure analysis: Conventional criteria versus new alternatives. Structural Equation Modeling 6(1): 1-55.Kaiser, H. F. 1958. The varimax criterion for analytic rotation in factor analysis. Psychometrika 23: 187-200.

Kim J, Rhee J. 2012. An empirical study on the impact of critical success factors on the balanced scorecard performance in Korean green supply chain management enterprises. International Journal of Production Research 50(9): 2465-2483.

King A.A, Lenox M.J. 2001. Lean and green? An empirical examination of the relationship between lean production and environmental performance. Production and Operations Management 10(3): 244-256.

Kishton J.M, Widaman K.F. 1994. Unidimensional versus domain representative parceling of questionnaire items: An empirical example. Educational and Psychological Measurement 54: 757-765

Kleindorfer P.R, Singhal K, van Wassenhove L.N. 2005. Sustainable operations management. Production and Operations Management 14(4): 482-492.

Kline T.J.B. 2005. Psychological Testing: A Practical Approach to Design and Evaluate. Sage Publications, Thousand Oaks, California.

Lai K.H, Wong C.W.Y. 2012. Green logistics management and performance: Some empirical evidence from Chinese manufacturing exporters. Omega 40(3): 267-282.

Lamming, R. 1996. Squaring lean supply with supply chain management. International Journal of Operations & Production Management 16(2), 183-196.

Lee S.M, Kim S.T, Choi D. 2012. Green supply chain management and organizational performance. Industrial Management & Data Systems 112(8): 1148-1180.

Li S, Rao S.S, Ragu-Nathan T.S, Ragu-Nathan B. 2005. Development and validation of a measurement instrument for studying supply chain management practices. Journal of Operations Management 23(6): 618-641.

Liu H, Wei S, Ke W, Wei K.K, Hua Z. 2016. The configuration between supply chain integration and information technology competency: A resource orchestration perspective. Journal of Operations Management 44, 13-29.

Margerum R.D, Born S.M. 2000. A co-ordination diagnostic for improving integrated environmental management. Journal of Environmental Planning and Management 43(1): 5-21.

Matos, S, Hall, J. 2007. Integrating sustainable development in the supply chains: the case of life cycle assessment in oil and gas and agricultural biotechnology. Journal of Operations Management 25(6), 1083-1102.

Montabon F, Sroufe R, Melynk S, 2011. Integration of environmental management into manufacturing planning. Production & Inventory Management Journal 47(1): 43-55.

Montabon F, Sroufe R, Narasimhan R. 2007. An examination of corporate reporting, environmental management practices and firm performance. Journal of Operations Management 25: 998-1014.

Moore G.C, Benbasat I. 1991. Development of an instrument to measure the perceptions of adopting an information technology innovation. Information Systems Research 2: 492-222.

Narasimhan R, Carter C.R. 1998. Linking business unit and material sourcing strategies. Journal of Business Logistics 19(2), 155-171.

Nunnally J. 1984. Psychometric theory. New York: McGraw-Hill.

Pagell M, Wu Z. 2009. Building a more complete theory of sustainable supply chain management using case studies of 10 exemplars. Journal of Supply Chain Management 45(2): 37-56.

Pedazur E.J, Schmelkin L. 1991. Measurement, design, and analysis*:* An integrated approach, Hillside, NJ: Erlbaum

Plambeck E. 2012. Reducing greenhouse gas emissions through operations and supply chain management. Energy Economics 34: 564-574.

Porter M.E, van der Linde C. 1995. Green and competitive: an underlying logic links the environment, resource productivity, innovation and competitiveness. Harvard Business Review 73(5): 120-134.

Preuss L. 2005. Rhetoric and reality of corporate greening: a view from supply chain management function. Business Strategy and the Environment 14: 123-19.

Pullman M, Maloni M, Carter C. 2009. Food for thought: Social versus environmental sustainability practices and performance outcomes. Journal of Supply Chain Management 45(4): 38-54.

Rao P. 2002. Greening the supply chain: A new initiative in South East Asia. International Journal of Operations & Production Management 22(5/6): 632-655.

Rao P, Holt D. 2005. Do green supply chains lead to competitiveness and economic performance? International Journal of Operations and Production Management 25(9): 898-916.

Rothenberg S, Pil F.K, Maxwell J. 2001. Lean, green, and the quest for superior environmental performance. Production and Operations Management 10(3): 228-243.

Sass D.A, Smith P.L. 2006. The effects of parcelling unidimensional scales on structural parameter estimates in structural equation modelling. Structural Equation Modeling 3(4): 566-586.

Seuring S, Müller M. 2008. Core issues in sustainable supply chain management: A Delphi study. Business Strategy and the Environment 17(8): 455-466.

Sharfman M.P, Shaft T.M, Anex R.P. Jr. 2009. The road to cooperative supply-chain environmental management: trust and uncertainty among pro-active firms. Business Strategy and the Environment 18: 1-13.

Shi V.G, Koh L.S.C, Baldwin J, Cucchiella F. 2012. Natural resource based green supply chain management. Supply Chain Management: An International Journal 17(1): 54-67.

Shrivastava, P. 1995. Environmental technologies and competitive advantage. Strategic Management Journal 16: 183-200.

Sirmon D., Hitt M.A, Ireland D.R, Gilbert B.A, 2011. Resource orchestration to create competitive advantage: Breadth, depth, and life cycle effects. Journal of Management 37(5): 1390-1412.

Solér C, Bergström K, Shanahan H. 2010. Green supply chains and the missing link between environmental information and practice. Business Strategy and the Environment 19, 14-25.

Swink M, Narasimhan R, Wang C. 2007. Managing beyond the factory walls: Effects of four types of strategic integration on manufacturing plant performance. Journal of Operations Management 25: 148-164.

Tari J.J, Molina-Azorin J.F. 2010. Integration of quality management and environmental management systems. TQM Journal 22(6): 687-701.

Thun J-H, Müller A. 2010. An empirical analysis of green supply chain management in the German automotive industry. Business Strategy and the Environment 19: 119-132.

Tregidga, H., Milne, M. 2006. From sustainable management to sustainable development: a longitudinal analysis of a leading New Zealand environmental reporter. Business Strategy and the Environment 15, 219-241.

Vachon S, Klassen R.D. 2008. Environmental management and manufacturing performance: The role of collaboration in the supply chain. International Journal of Production Economics 111: 299-315.

Vachon S, Klassen R.D. 2006. Extending green practices across supply chain: the impact of upstream and downstream integration. International Journal of Operations & Production Management 26(7): 795-821.

Ward P.T, Duray R. 2000. Manufacturing strategy in context: environment, competitive strategy and manufacturing strategy. Journal of Operations Management 18: 123-138.

Wong C.W.Y. 2013. Leveraging environmental information integration to enable environmental management capabilities and performance. Journal of Supply Chain Management 49(2): 114-136.

Wong C.W.Y, Lai K, Shang K, Lu C. 2013. Uncovering the value of green advertising for environmental management practices. Business Strategy and Environment 23(2): 117-130

Wong C.W.Y, Lai K, Shang K, Lu C, Leung T. 2012. Green operations and the moderating role of environmental management capability of suppliers on manufacturing firm performance. International Journal of Production Economics 140(1): 283-294.

Wong C.Y, Wong C.W.Y, Boon-itt S. 2015. Integrating environmental management into supply chains: A systematic literature review and theoretical framework. International Journal of Physical Distribution and Logistics Management 45(1/2): 43-68.

Yen Y, Yen S, 2012. Top-management's role in adopting green purchasing standards in high-tech industrial firms. Journal of Business Research 65(7): 951-959.

Zhu Q, Sarkis J. 2004. Relationships between operational practices and performance among early adopters of green supply chain management practices in Chinese manufacturing enterprises. Journal of Operations Management 22: 265-289.

Zhu Q, Sarkis J, Geng Y. 2005. Green supply chain management in China: pressures, practices and performance. International Journal of Operations & Production Management 25(5): 449-468.

Zhu Q, Sarkis J, Lai K.H. 2007. Initiatives and outcomes of green supply chain management implementation by Chinese manufacturers. Journal of Environmental Management 85: 179-189.

Zhu Q, Sarkis J, Cordeiro J.J, Lai, K.H. 2008a. Firm-level correlates of emergent green supply chain management practices in the Chinese context. Omega 36(4): 577-591.

Zhu Q, Sarkis J, Lai K.H. 2008b. Confirmation of a measurement model for green supply chain management practices implementation. International Journal of Production Economics 111(2): 261-273.

Zhu Q, Sarkis J, Lai K.H. 2012. Examining the effects of green supply chain management practices and their mediations on performance improvements. International Journal of Production Research 50(5): 1377-1394.

Zuo K, Potangaroa R, Wilkinson S, Romiti J.O.B. 2009. A project management prospective in achieving a sustainable supply chain for timber procurement in Banda Aceh, Indonesia. International Journal of Managing Projects in Business, 2(3), 386-400.

Figure 1. Conceptual Model

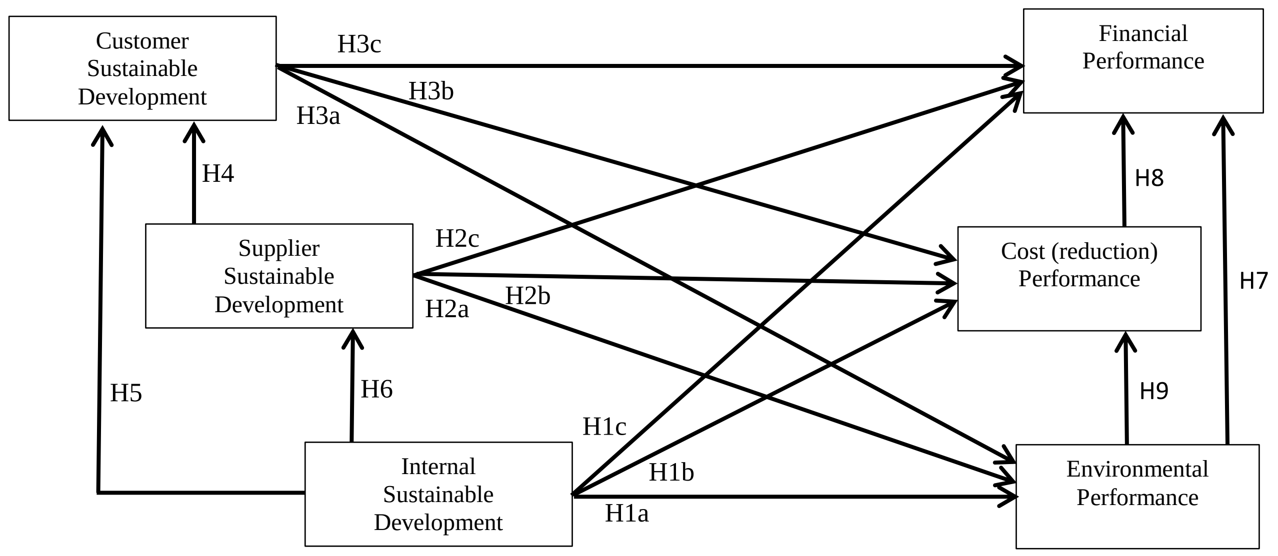
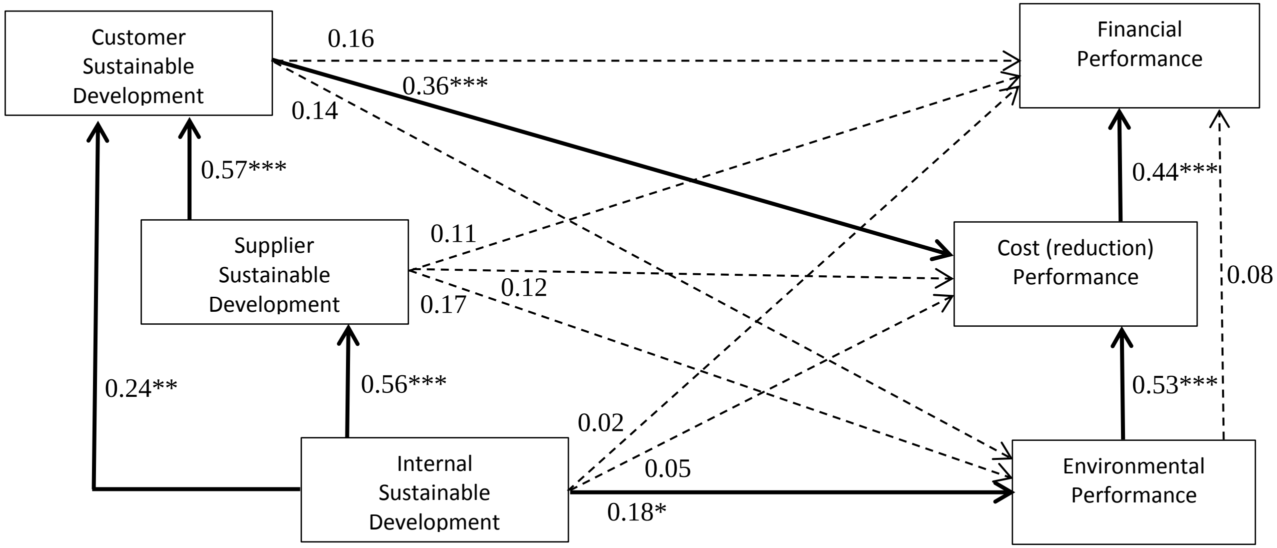


Figure 2. Structural Model



Notes: ***P<0.001; **P<0.01; *P<0.05; Firm size (no. of employees) and annual sales as control variables.

Table 1. Descriptive Statistics and Discriminant Validity

	Mean	SD	1	2	3	4	5	6
1. Internal sustainable development	3.84	.73	.889$^{\gamma}$					
2. Supplier sustainable development	3.12	.92	.571**	.911$^{\gamma}$				
3. Customer sustainable development	3.51	.92	.555**	.666**	.943$^{\gamma}$			
4. Financial Performance	3.20	.62	.266**	.344**	.367**	.806$^{\gamma}$		
5. Cost-reduction performance	3.26	.69	.219**	.309**	.308**	.557**	.787$^{\gamma}$	
6. Environmental performance	3.44	.69	.303**	.345**	.257*	.419**	.536**	.768$^{\gamma}$

Note: *p<0.05; **p<0.01; $^{\gamma}$Square-root of AVE; SD = standard deviation.

Supplementary A. SSCD Construct Reliability and Validity Analysis

Construct / Indicator	Loading	S.E.	t-value	Reliability and validity
Internal Sustainable Development				
I-SSCD-1: Integrated environmental and business strategy				$\chi2$ =7.35, df = 2, p < 0.001; CFI= .99; IFI = .99; TLI = .96; RMR = .04; RMSEA = .03 Cronbach's alpha = .83; Composite reliability = .86 AVE = .61
Integrate environmental responsibility in business strategy	.83	-	-	
Establish business strategy based on the balance between commercial and environmental goals	.92	.07	14.35	
Establish a unified environmental and business strategy	.80	.08	12.68	
Establish business strategy which reward top management based on successful achievement of environmental goals	.53	.07	4.39	
I-SSCD-2: Internal integrated environmental management system				$\chi2$ =28.86, n= 9, p < 0.001; CFI=.96; IFI = .96; TLI =.93; RMR = .05; RMSEA = .04 Cronbach's alpha = .86; Composite reliability = .87; AVE = .53
Environmental management system integrates environmental responsibility into employee codes of conduct	.81	-	-	
Environmental management system includes environmental criteria into commercial decisions	.72	.08	10.53	
Environmental management system integrates environmental criteria into resource management decisions	.83	.07	12.37	
Integrate environmental, quality and other standards into one management systems	.67	.08	9.72	
Environmental management system based on life-cycle approach	.70	.09	10.15	
Environmental management system supported by an integrated information system	.62	.09	7.37	
I-SSCD-3: Cross-functional collaboration for environmental management				$\chi2$ =23.51, df = 5, p < 0.001; CFI = .97; IFI = .97; TLI = .93; RMR = .04; RMSEA = .03 Cronbach's alpha = .91; Composite reliability = .90; AVE = .65
All functions cooperate to achieve environmental goals collectively	.70	-	-	
Develop mutual understanding of environmental responsibilities among functions	.68	.07	13.82	

All functions work with each other to reduce environmental impacts	.83	.11	11.01	
All functions jointly plan to resolve environmental-related problems	.92	.12	11.95	
All functions jointly make decisions about ways to reduce overall environmental impacts	.86	.12	11.36	
Supplier Sustainable Development				
S-SSCD-1: Exchange environmental information with suppliers				χ2 =34.62, df = 5, p < 0.001; CFI= .95; IFI = .96; TLI =.90; RMR = .05; RMSEA = .05 Cronbach's alpha = .89; Composite reliability = .89; AVE = .63
Exchange information about environmental goals with suppliers	.77	-	-	
Exchange information about environmental practices with suppliers	.76	.05	16.42	
Exchange information about cleaner production and technologies with suppliers	.74	.07	10.62	
Exchange information about product environmental requirements with suppliers	.87	.08	12.50	
Exchange information about life-cycle environmental impacts of products with suppliers	.82	.08	11.77	
S-SSCD-2: Provide environmental assistance to suppliers				
Help suppliers to improve environmental awareness	.70	-	-	χ2 = 63.76, df = 9, p < 0.001; CFI = .94; IFI = .94; TLI = .90; RMR = .06; RMSEA = .04 Cronbach's alpha = .92; Composite reliability = .92; AVE = .67
Guide suppliers to establish their own environmental programmes	.80	.11	10.67	
Provide resources to help suppliers to purchase equipment for pollution prevention, wastewater and recycling	.78	.12	10.44	
Facilitate learning among suppliers in the same industry	.86	.11	11.46	
Assist suppliers to improve the environmental performance of supplier processes	.90	.12	11.91	
Help supplier to share environmental best practice information with each other	.87	.11	11.57	
S-SSCD-3: Integrate environmental management process with suppliers				χ2 =21.04, df = 2, p < 0.001; CFI= .95; IFI = .95; TLI =.90; RMR = .08; RMSEA = .06 Cronbach's alpha = .84;
Integrate management of closed-loop return process with suppliers	.50	-	-	

Integrate process of measuring environmental impact with suppliers	.90	.28	6.87	Composite reliability = .84; AVE = .59
Integrate process of managing environmental initiatives with suppliers	.92	.28	6.88	
Integrate process of managing distribution and outbound logistics planning with suppliers	.67	.22	6.16	
S-SSCD-4: Environmental collaboration with suppliers				χ2 = 65.901 df = 5, p < 0.001; CFI = .94; IFI = .94; TLI = .90; RMR = .07; RMSEA = .06 Cronbach's alpha = .92; Composite reliability = .93; AVE = .72
Cooperate with suppliers to achieve environmental goals collectively	.80	-	-	
Work with suppliers to gain mutual understanding of environmental responsibilities	.78	.07	12.68	
Work with suppliers to reduce environmental impacts	.93	.06	16.19	
Jointly plan with suppliers to resolve environmental-related problems	.96	.06	16.97	
Jointly make decisions with suppliers about ways to reduce overall environmental impacts	.87	.06	14.61	
Customer Sustainable Development				
C-SSCD-1: Exchange environmental information with customers				χ2 = 8.92 df = 4, p < 0.001; CFI = .99; IFI = .99; TLI = .98; RMR = .02; Cronbach's alpha =.92; Composite reliability = .92; AVE = .71
Exchange information about environmental goals with customers	.91	-	-	
Exchange information about environmental practices with customers	.98	.04	25.25	
Exchange information about cleaner production and technologies with customers	.88	.05	19.53	
Exchange information about product environmental requirements with customers	.71	.06	12.61	
Exchange information about life-cycle environmental impacts of products with customers	.68	.06	11.90	
C-SSCD-2: Integrate environmental management process with customers				χ2 = 3.80, df = 3, p < 0.001; CFI = .99, IFI = .99; TLI = .96; RMR = .02; RMSEA = .03 Cronbach's alpha =.84; Composite reliability = .84; AVE = .58
Integrate management of closed-loop return process with customers	.62	-	-	
Integrate process of measuring environmental impact with customers	.90	.16	9.34	

Integrate process of managing environmental initiatives with customers	.86	.15	9.34	
Integrate process of managing distribution and outbound logistics planning with customers	.63	.11	9.13	
C-SSCD-3: Environmental collaboration with customers				χ2 = 15.68, df = 4, p < 0.001; CFI = .99; IFI = .99; TLI = .97; RMR = .05; RMSEA = .04 Cronbach's alpha =.93; Composite reliability = .94; AVE = .76
Cooperate with customers to achieve environmental goals collectively	.85	-	-	
Work with customers to gain mutual understanding of environmental responsibilities	.91	.06	17.22	
Work with customers to reduce environmental impacts	.90	.06	16.76	
Jointly plan with customers to resolve environmental-related problems	.86	.07	15.49	
Jointly make decisions with customers about ways to reduce overall environmental impacts	.85	.07	15.34	
FP: Financial Performance				χ2 = 32.65, df = 2, p < 0.001; CFI = .93; IFI = .93; TLI = .90; RMR = .02; RMSEA = .02 Cronbach's alpha =.88; Composite reliability = .88; AVE = .65
Increase in return on investment	.74	-	-	
Increase in market share	.84	.10	11.58	
Increase in total profit from products/services	.86	.10	11.82	
Increase in profit from environmentally friendly products/services	.77	.10	10.55	
CP: Cost (reduction) Performance				Goodness-of-fit indices: N/A Cronbach's alpha =.83; Composite reliability = .83; AVE = .62
Cost reduction per business transaction	.65	-	-	
Cost reduction on energy savings	.88	.16	9.00	
Cost reduction on waste disposal	.82	.16	9.15	
EP: Environmental Performance				χ2 = 92.65, df = 12, p < 0.001; CFI = .92; IFI = .92; TLI = .90; RMR = .03; RMSEA = .03 Cronbach's alpha =.92; Composite reliability = .92; AVE = .59
Reduction in hazardous/harmful materials used in manufacturing product/service delivery	.77	-	-	
Reduction in the use of electricity	.79	.13	9.49	
Reduction in total fuel consumption used in transportation of products/services	.84	.13	9.69	
Reduction in total paper used	.79	.13	10.07	
Reduction in total packaging materials used	.87	.13	9.66	
Reduction in air emissions	.75	.13	10.39	
Reduction in solid waste disposal	.65	.13	9.34	

Overall goodness-of-fit indices: χ2 = 3065.39, df = 1823, p < 0.001; CFI = .90; IFI = .90; TLI = .90; RMR = .08; RMSEA = .06