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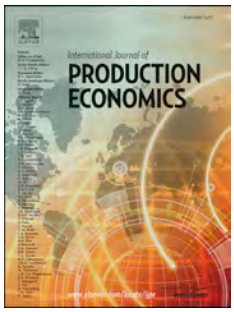

The role of supply chain orientation in achieving supply chain sustainability

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The Role of Supply Chain Orientation in Achieving Supply Chain Sustainability

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Abstract

Supply chain orientation (SCO) has the potential to contribute to supply chain sustainability performance. The literature, however, has not determined whether SCO has a direct effect on supply chain sustainability performance, nor has it differentiated between the effects of different categories of SCO on supply chain sustainability performance. A SEM analysis of data collected from supply chain managers determined that the SCO construct of supply chain collaboration and communication could directly affect both supply chain environmental and social sustainability performance. The SCO construct of internal supply chain coordination, however, affected only supply chain environmental sustainability performance and this effect was mediated by the organisation's internal supply chain sustainability practices. A second path between supply chain collaboration and communication and supply chain environmental sustainability performance, which was mediated by internal supply chain sustainability practices was also identified. These findings indicate that different SCO constructs have different effect pathways in relation to supply chain sustainability performance. The identification of the different effects of different categories of SCO and the SCO – performance relationship has important implications for SCO research design.

Keywords: supply chain social sustainability; supply chain environmental sustainability; supply chain orientation; sustainable supply chain management; supply chain collaboration; supply chain coordination

Introduction

The contribution of manufacturing supply chain activities to global warming and the depletion of natural, non-renewable resources by distribution, transportation and material disposal has drawn attention to the importance of addressing the sustainability of operations in the supply chain (Ageron, Gunasekaran, & Spalanzani, 2012; Klassen & Vereecke, 2012; Wong, Lai, Shang, Lu, & Leung, 2012). This has resulted in an increased focus on supply chain sustainability in the extant literature (Hassini, Surti, & Searcy, 2012) and the development of the concept of Sustainable Supply Chain Management (SSCM). The globalisation of supply chains has transformed the concept of social sustainability, in particular. Typical social sustainability issues in supply chains include child labour, forced labour, poor health and safety, discrimination and government rules and regulations (Andersen & Skjoett-Larsen, 2009). Luzzini, Brandon-Jones, Brandon-Jones, and Spina (2015) also identified a relationship between collaborative practices and combined environmental and social sustainability.

SSCM research is founded on supply chain management (SCM) concepts and views the supply chain as an integrated system (Mentzer et al., 2001a). It is also focused on sustainability performance and subsequently includes both strategic and implementation elements (Barratt, 2004). This supply chain performance perspective suggests a logical connection with the emergent SCM research domain called Supply Chain Orientation (SCO). SCO is based on the perspective that the organisation's supply chain is an independent entity and that a focus on achieving outcomes within the supply chain will lead to greater performance (Esper & Defee, 2010; Hult, Ketchen, Adams, & Mena, 2008; Signori, Flint, & Golicic, 2015). It is different from supply chain integration which is based on the concept of vertical integration of the supply chain

with the organisation (Stonebraker & Liao, 2004) and focuses on coordinating direct supply chain relationships for operational benefits (Flynn, Huo, & Zhao, 2010; Hefu, Weiling, Kwok Kee, & Zhongsheng, 2014).

The literature has suggested that it is time to consider the effect of SCO on Supply Chain Sustainability Performance (SCSP) (Chen et al., 2017). The extant literature, however, has not defined the variables necessary to test this effect (Esper & Defee, 2010; Kirchoff, Omar, & Fugate, 2016a). The SCO and SSCM literatures requires research which identifies and tests the effect of SCO constructs on SCSP. Identifying this relationship would also connect the two previously unconnected research domains of SCO and the sustainability performance literature. Even more importantly, it would introduce a new decision-performance relationship to the literature - the relationship between SCO and supply chain performance. Until now, the extant literature has considered SCO to be an 'organising' influence and has focussed on its effect on internal organisational capabilities, such as sustainable practices, eg. Esper and Defee (2010); Lee and Nam (2016); Satten and Grummer-Strawn (2005). The decision-external performance outcome relationship is unanticipated in the literature, which has not considered whether SCO can have a direct and significant effect on an external performance outcome. Identifying this relationship would create the opportunity for future research to examine the effect of SCO on other supply chain performance and externally located performance outcomes, as well as the effect of potential moderating factors, such as technology turbulence. This would open a new and important avenue for SCO research.

To guide future research considering the relationship between SCO variables and supply chain performance outcomes, research is required which identifies the SCO variables which have the

greatest impact on these external performance measures. One of the key issues in the extant literature is that the research has tested the combined effects of SCO variables, without considering whether the individual variables have different effect pathways, eg. Luzzini et al. (2015). Consequently, this literature has not been particularly successful at producing significant findings. Systematic research is required to identify the effects of different types of SCO variables on both internal practices, such as internal supply chain sustainability practices and on outcomes such as the sustainability performance of external supply chain members. The testing of the effects of different categories of SCO variables is particularly important. Although there has been some discussion of the existence of various categories of SCO variables, eg. Patel, Azadegan, and Ellram (2013) and Hult et al. (2008), no assessment has been made as to why or how they are different. In addition, the literature has not examined the differences in the ability of SCO to affect both social and environmental sustainability performance in the supply chain. As the supply chain activities which affect these two outcomes are different, it is likely that SCO will have different effects on these two performance measures.

Accordingly, the research question which will be answered by this research is: "What is the difference between the effects of different supply chain orientation constructs on external supply chain sustainability performance?". The identification of the influence of SCO decisions on SCSP also has a logical fit with the broader objective of the operations strategy literature. The relationship between decision variables such as SCO and supply chain performance outcomes is a fundamental relationship for operations strategy (Hayes, 2005; Skinner, 1969).

In the following sections of the paper, we will review the literature on SCO to identify two constructs; internal supply chain coordination and external supply chain collaboration and

communication as variables that may affect the external environmental and social sustainability performance of supply chains. We then describe how the survey used for this research was constructed from the literature, the data quality testing, structural equation modelling (SEM) analysis technique utilised and present the results, followed by a discussion on how our findings contribute to both the literature and practice.

Literature Review

This literature review evaluates the extant SCO and SSCM literature to identify SCO variables and potential relationships between SCO constructs and SCSP. Arguments for two SCO constructs comprising SCO variables that should logically affect SCSP are considered and hypotheses which test their relationship to SCSP are presented. The review commences with an overview of the state of development of the extant SCO literature.

Supply Chain Orientation

SCO constructs comprise customer, competitor, suppliers, logistics operations and supply chain oriented variables (Hult et al., 2008). They can be viewed as possessing strategic and structural dimensions (Esper & Defee, 2010; Mentzer et al., 2001b; Patel et al., 2013). Structural SCO represents the relational exchange between the supply chain and the internal operational activities (Hult et al., 2008; Patel et al., 2013). The concept of structural SCO has been interpreted in this research as the internal behaviours that facilitate relational exchanges across the internal supply chain (Mentzer et al., 2001b; Patel et al., 2013). Strategic SCO represents the relational exchange between external supply chain activities (Esper & Defee, 2010). Strategic SCO creates convergence amongst supply chain resources to improve performance (Cao & Zhang, 2011; Esper & Defee, 2010; Gold, Seuring, & Beske, 2010). SCO is also affected by a

number of organisational characteristics including organisational size, culture, structure and management decision making (Esper & Defee, 2010; Min, Mentzer, & Ladd, 2007) as they all influence the alignment of the organisation toward the supply chain and the resources available. Identifying the relationship between SCO and organisational characteristics is, however, outside the scope of this study. Table 1 provides a summary of the key SCO literature to position this study within the broader literature.

The development of internal supply chain management activities is the first stage of SCO implementation (Esper & Defee, 2010; Min et al., 2007). We have used the construct of *internal supply chain coordination* to represent the variables that act internally in the management of supply chain activities and on the coordination of internal supply chain members. It is a structural form of SCO and affects internal processes. Evidence for the existence of SCO variables which act on internal processes is to be found in Barratt (2004); Mentzer et al. (2001b) and Cao and Zhang (2011). The second stage of SCO implementation is the orientation of these activities toward the external operations of the supply chain (Hult et al., 2008; Kirchoff, Tate, & Mollenkopf, 2016b). We have used the construct of *supply chain collaboration and communication* to represent the variables that act externally. Supply chain collaboration and communication is a strategic SCO construct because it incorporates variables that can be categorised as focusing on direct interaction with the supply chain.

Support was also identified in the literature for the possible mediating role of *internal environmental sustainability practices* which may affect the relationship between these two SCO constructs and both *external environmental* and *external social supply chain sustainability performance*, eg. Marti and Seifert (2013). Internal supply chain sustainability practices are

concrete actions which occur internally and involve the procurement, marketing and R&D departments, as suggested by Carter and Dresner (2001); Sarkis, Zhu, and Lai (2011). Support was not identified in the literature for any other SCO constructs or relationships that related to SCSP. The meaning of each of these constructs and the source articles that lead to identifying them is provided in the Appendix. Each of the variables included was found to have some relevance to either SCO or supply chain sustainability performance in the literature.

Table 1. Status of the extant SCO literature

Focus	SCO Characteristics	Data Analysis	Key Findings	Source
Strategic and functional implications of managing the supply chain.	Structural: benevolence, knowledge, truthfulness, creditability, cooperative norms, skills and resources Strategic: top management support, commitment, partner focus and collaboration	Synthesis of literature and structural equation modelling	Strategic & structural SCO helps to improve supply chain collaboration and their combined effect is greater, especially in uncertain, dynamic environments.	(Barratt, 2004; Bowen, Cousins, Lamming, & Farnk, 2001; Gold et al., 2010)
Development of SCO from an intra-organisational to a strategic view of the supply chain.	Structural: organisational design, human resources, information technology Strategic: holistic view	Synthesis of literature	Strategy and structural SCO can support objectives of increasing organisational competitiveness. The literature needs a framework for future SCO research	(Esper et al., 2010)
Classification of SCO into elements	Elements include: Organisational design, human resource, information technology, strategic SCO, structural SCO	Structural equation modelling	Organisational SCO has a significant influence on strategic SCM and is affected by manager's SCO. Operational SCM is only affected by SCO information technology usage. Structural SCO mediates the effect of strategic SCO on meeting customer needs.	(Lee & Nam, 2016; Patel et al., 2013)
Measures of SCO	Measures include: Trust, commitment, organisational compatibly, top	Synthesis of literature	SCO differs from SCM by considering the strategic implications of tactical management of the various flows	(Mentzer et al., 2001)

	management support		in a supply chain.	
How supply chain collaboration affects firm performance	Elements which affect firm performance: Supply chain collaboration, supply chain orientation, intra- and inter-firm collaborative capabilities	Structural equation modelling	Supply chain collaboration improves business performance. Market, operations, value and supply chain collaboration combine to positively affect financial performance. Inter-firm collaborative capabilities positively affect business performance. Upstream and downstream collaboration can support different forms of business performance	(Cao & Zhang, 2011; Hult et al., 2008; Luzzini et al., 2015; Vachon & Klassen, 2008)
Strategic capabilities contributing to organisational performance.	Strategic capabilities which affect organisational performance: Market orientation, customer orientation, competitor orientation, value-chain collaboration, supplier orientation, logistics orientation, operations orientation	Structural equation modelling/ CFA	Strategic capabilities combine to positively affect business performance. Communication and senior management engagement with the supply chain has a positive effect on business performance	(Hult et al., 2008; Min et al., 2007)

Table 1 shows that the literature has indicated the potential for relationships between SCO and operational performance. It also demonstrates that the literature has not yet identified the nature of the relationship between different types of SCO and external sustainability performance.

Effect of Internal Supply Chain Coordination

The internal information and supply chain coordination activities making up internal supply chain coordination should affect internal supply chain sustainability practices. The literature provides some evidence, which, when the different views are combined, supports the logic of this contention. For example, Bowen et al. (2001) suggested that liaison between purchasing and other functions could lead to supplier management activities which incorporate environmental considerations. Klassen and Whybark (1999) and Signori et al. (2015) identified the link between

possessing a sustainability orientation and developing sustainable management practices in the organisation. There is also some evidence of interaction between departments in relation to building sustainable supply chain practices – Harms (2011) determined that coordinating knowledge sharing between departments to achieve sustainable supply chain practices will increase the interdependencies between those departments. To determine the complete relationship between internal supply chain coordination and internal supply chain sustainability practices, it is necessary to identify all the variables comprising the construct of internal supply chain coordination and determine which of these have a significant relationship with internal supply chain sustainability practices. This relationship can be represented in the following hypothesis:

H1a: Internal supply chain coordination positively affects the adoption of internal supply chain sustainability practices

Effect of Supply Chain Collaboration and Communication

Developing SCSP requires a focus on the supply chain and the active participation of supply chain members (Chen et al., 2017; Green, Toms, & Clark, 2015; Kirchoff et al., 2016b) and involves collaboration and communication. The increased joint planning and problem solving that can result from collaboration has been found to have a positive impact on supply chain waste elimination, material recycling, energy saving and environmentally friendly product design (Bowen et al., 2001; Gold et al., 2010), the development of innovative environmental improvement processes (Kusi-Sarpong, Sarkis, & Wang, 2016; Vachon & Klassen, 2008) and the environmental impact information on purchased materials and components (Birou, Fawcett, & Magnan, 1998; Carter & Rogers, 2008; Rivera-Camino, 2007). On the other hand, poor supply

chain communication leads to insufficient information transfer (Harms, 2011) and affects the goal alignment (Moses & Åhlström, 2008), which is required for implementing environmental sustainability practice in supply chains (Lorenzoni & Lipparini, 1999).

Supply chains are comprised of upstream and downstream members. The active participation of all parts of the supply chain in developing SCSP will require an adaptation of the SCSP objectives to suit both upstream and downstream members (Vachon & Klassen, 2008). Upstream supply chain members will have a greater motivation for cooperation with their customer's supply chain sustainability initiatives, both as part of the value they offer to their customer, as well as to ensure that the sustainability initiatives that they have undertaken are carried forward through the supply chain (Wong et al., 2012). Their engagement will be supported by joint decision making, communication, shared goals and vision and sharing the company's sustainability goals. Downstream members, on the other hand, are more likely to expect upstream members to reflect their sustainability priorities (Patel et al., 2013). Their involvement will be supported by communication, sharing operating philosophies and priorities and joint planning. The need to integrate up and downstream supply chain members in developing external sustainability performance in the supply chain indicates that all of these variables will potentially be part of the organisation's externally focussed SCO.

Although this evidence implies that there may be a relationship, the literature has not yet identified a direct relationship between external supply chain orientation and external supply chain environmental sustainability performance. The extant literature either considers SCO as an 'organising' relationship between supply chain orientation and internal practices or considers the relationship between a small number of specific supply chain sustainability practices and

sustainability outcomes in the entire supply chain. The direct relationship between external SCO and external supply chain environmental sustainability performance needs to be identified and can be represented by the following hypothesis:

H2a: Supply chain collaboration and communication positively affects external supply chain environmental sustainability performance

Mechanisms such as codes of conduct are used to establish social standards and principles in supply chains (Jenkins, 2001; Mamic, 2005) and require communication to convey those standards throughout the supply chain (Spence & Bourlakis, 2009). This would also suggest that an orientation towards supply chain communication could directly affect the external social sustainability performance of the supply chain. A finding of a significant relationship between the SCO collaboration and communication and the external supply chain social sustainability performance would introduce a strategic perspective to the literature which currently focuses on the relationship between practice and supply chain social sustainability outcomes. This relationship can be represented by the following hypothesis:

H2b: Supply chain collaboration and communication positively affects external supply chain social sustainability performance

Supply chain collaboration and communication influences internal supply chain sustainability practices through its effect on knowledge transfer and problem-solving associated with supply chain members (Carter & Jennings, 2004; Harms, 2011; Kassinis & Soteriou, 2003; Sarkis et al., 2011; Seuring & Müller, 2008; Vachon & Klassen, 2008). The extant literature currently considers the combined effect of internal and externally focused SCO variables on internal

supply chain sustainability practices, without considering whether the effects of these two constructs should be separated (eg Kirchoff et al, 2016, Marti et al, 2013, Min et al, 2007, Patel et al, 2013, Signori et al, 2013 and Thornton et al, 2016). The different effects of internal and external SCO on external environmental and social sustainability performance hypothesised in these two sections suggests that it is possible that they will also have different effects on internal supply chain sustainability practices. The potential for different relationships suggests the following hypothesis should be examined to determine whether both groups of SCO constructs have an effect on internal supply chain sustainability practices:

H2c: Supply chain collaboration and communication positively affects the adoption of internal supply chain sustainability practices

Effect of Internal supply chain sustainability practices

Interestingly, although the literature calls for more research investigating the relationship between environmental practices and performance, empirical findings for this relationship are limited (Acosta, Acquier, & Delbard, 2014; Kusi-Sarpong et al., 2016; Vachon & Klassen, 2008). Pullman, Maloni, and Carter (2009) identified relationships between some very specific internal supply chain sustainability practices, such as land management practices, and environmental sustainability performance. This research did not consider the internal supply chain sustainability practices relevant to other types of organisations, such as manufacturing companies. Other studies have identified supply chain sustainability practices as the dependent variable, rather than considering their effect on SCSP, eg. Dargusch and Ward (2010). This may reflect a focus on internal 'organising' as an outcome in relation to environmental sustainability in the supply chain, eg. Marti and Seifert (2013). The identification of a relationship between

internal supply chain sustainability practices and external supply chain environmental sustainability performance will provide a basis for research focusing on SCSP as the dependent variable. As internal supply chain sustainability practices are likely to be influenced by other strategic and structural factors such as SCO, identifying a relationship between internal supply chain sustainability practices and external SCSP also introduces its potential role as a mediator in the relationship between SCO and SCSP. This relationship is represented by the following hypothesis:

H3a: Internal supply chain sustainability practices positively affects external supply chain environmental sustainability performance

Corporate social responsibility within the organisation is associated with supply chain social sustainability in the literature (Andersen & Skjoett-Larsen, 2009; Carter & Jennings, 2004; Eriksson & Svensson, 2016; Spence & Bourlakis, 2009). Dargusch and Ward (2010) also identified a relationship between corporate social responsibility and internal supply chain sustainability practices, however, the literature is unresolved about the relationship between internal supply chain sustainability practices and external supply chain social sustainability (Seuring & Müller, 2008). Supply chain sustainability practices that may affect supply chain social sustainability could include: compliance with human rights, labour practices, codes of conduct, social audits and supplier monitoring development programs (Acosta et al., 2014; Ageron et al., 2012; Awaysheh & Klassen, 2010; Klassen & Vereecke, 2012). The identification of a relationship between internal supply chain sustainability practices and external supply chain social sustainability performance will focus the literature on the role of internal supply chain sustainability practices in influencing external supply chain social sustainability performance. In

addition, H1a and H2c suggest that, if internal supply chain sustainability practices are a contributing factor, then they may mediate the effect of SCO on external supply chain social sustainability performance. This relationship can be represented by the following hypothesis:

H3b: Internal supply chain sustainability practices positively affect external supply chain social sustainability performance

The literature did not provide a basis for identifying moderating or mediating effects which relate to the research question beyond the variables described in the appendix and the relationships represented by the hypotheses. As the effect of SCO on performance is a new area of research, it is conceivable that other variables may affect the relationships represented by the hypotheses. This is an area for consideration in future research, although the high correlations identified between the variables in the findings suggests that their effects would be limited.

Methods and Results

Data Collection and Sample Context

Based on the relevant SCO, SSCM, SCM and sustainability literature, five constructs were identified which represented the key independent, dependent and mediating variables – internal supply chain coordination, supply chain collaboration and communication, internal supply chain sustainability practices, external supply chain environmental sustainability performance and external supply chain social sustainability performance. The literature was then exhaustively reviewed to identify the variables that may represent each of these constructs. The constructs, the variables comprising each construct, a brief justification of each and the sources from which they

were drawn are provided in the Appendix. All constructs or variables that were found to be relevant to the research question were included.

The survey items were then generated from the variables and developed into a web based survey. The survey questionnaire consisted of five point Likert scale questions, which were the most suitable measures for determining how these constructs were related to performance measures (Starks & Brown, 2007). As the items were predominantly objective, a web based survey was utilised to collect the data to remove the potential of interviewer bias (Van Selm & Jankowski, 2006). The survey tool QuestionPro Survey was used to collect the data from mid-July to mid-September 2016. A single response for each organisation was collected because most of the data were objective and so only a single response was required per organisation as the respondents can be considered to be subject matter experts (Podsakoff & Organ, 1986). This is consistent with the approach taken by other research in this area, e.g. (Blome, Paulraj, & Schuetz, 2014).

A pilot of two supply chain managers and two operations management researchers was used to test the survey. Supply chain managers from two randomly selected manufacturers were approached to participate in the study to trial the survey. Both accepted the invitation. Two operations management academics were selected through convenience. All were asked to complete the survey using the same invitation and website that would be used for the main sample. They were then asked to identify any terms or concepts which were not clear and any variables which they felt were missing. All four completed the survey satisfactorily and, in a follow-up interview, indicated that they could not identify any other variables which should be included. They also indicated that all questions and concepts were objective, clear and easily

understood and indicated that there would be a low likelihood of differences in interpretation by supply chain managers.

The Australian manufacturing industry was selected for the research sample because of the prevalence of environmental management in Australia (Conacher & Conacher, 2000; Daian & Ozarska, 2009). This experience can be expected to lead to a high degree of consistency in the interpretation of external supply chain sustainability constructs and items. This expectation was supported by the pilot study findings. In addition, the demand for sustainable supply chains in Australia because of Australia's fragile ecosystems, such as the Great Barrier Reef, and the sustainability challenges resulting from the large transportation distances between suppliers, manufacturers and customers in Australia suggests that the survey sample would have been extensively exposed to the items under investigation. This provides assurance that the survey respondents would have been well informed regarding their SSCM activities and their effect on SCSP.

A quality professional industry mailing list was utilised for the contact addresses for the survey. It was purchased from a reputable professional survey list development organisation, which provides lists for Australian surveys such as these. This organisation provided a random selection of participants from each of the manufacturing categories in the list, representing a total of 3800 names. The lists were highly specified and enabled the research to target the audience accurately. The mailing list was also guaranteed for currency and accuracy. The selection strategy applied to the population had two key objectives. The first was to target the senior supply chain manager in the organisation. As the data collected were objective, senior supply chain managers were expected to have the most comprehensive knowledge of the phenomena and be able to provide

the most complete description. The list enabled the senior supply chain manager in the organisation to be targeted. The second selection strategy objective was to ensure that there was variation in organisational size and the type of manufacturing industry in the sample to ensure that it represented the range of the population and that there was significant variation in all of the SCO variables measured. Good variation in the variables improves the study's ability to identify significant relationships. The list covered a large variety of organisation sizes. When the survey raw data was examined, the score value variation in each of the SCO variables in the raw data was found to be large and well distributed across the scale range, providing good response ranges for each of the SCO variables and indicating that this strategy produced high-quality data. The data validity tests described in the findings section confirmed the validity of the data. They included a Harmon's single factor test and a common latent factor method test for common method bias due to collecting data from single respondents (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003; Podsakoff, MacKenzie, & Podsakoff, 2012).

The survey was distributed to 3800 Australian manufacturing supply chain managers. Two follow-up reminder emails were sent to the sample and a total of 154 usable responses were received. The response rate of 4% was considered reasonable, given the focus on expert respondents. The non-response bias was investigated by comparing the respondents' questionnaire completion dates (Fullerton, Kennedy, & Widener, 2014). The early respondents (n=65) who completed the survey before the reminders were classified as one group, whereas those who responded (n=89) after the email reminders formed the late respondents group. We conducted a Mann-Whitney U test to check for any statistically significant differences between the two data subsets. None of the variables included in the survey were found to be statistically

significant (p value > 0.05). We repeated the Mann-Whitney U test to compare the first quarter (first 25% of the 154 respondents, i.e n = first 39) to the last quarter (last 25% of the 154 respondents, i.e n = last 39) of respondents to confirm our findings that there are no differences between multiple subsets of the respondents. The second Mann-Whitney U test also reported no statistically significant differences (p value > 0.05 for all survey variables) across the first and last quarter of respondents. To determine whether there was any common method bias, we initially conducted a Harmon's single factor test by constraining all variables onto a single factor during the exploratory factor analyses. The total variance accounted for by a single factor was only 23%, which was less than the benchmark of 50%, indicating that a substantial level of common method variance was not present (Podsakoff et al., 2003). To further determine whether there was any common method bias during the confirmatory factory analyses, a 'common latent factor' was introduced into the measurement model to check for differences in the standardized regression weights for all the variables with and without the common latent factor in the measurement model. Our analyses did not reveal any statistically significant differences (p value > 0.05), providing confidence that there are no common method bias issues associated with the survey instrument (Podsakoff et al., 2012).

Table 2 describes the demographics of the respondents and shows that the respondents represented 5 manufacturing sectors. As different manufacturing sectors will use the same supply chain members (e.g. transport providers), data can be collected for this type of research from the related sectors represented by the respondents (Karan & Biswal, 2017). Seventy percent of the firms were either product or raw material/component manufacturers with the reminder classifying themselves as manufacturers that also engaged in activities such as wholesale and

service provision. The breadth of the sample also ensured sufficient variation in the dependent variable to support the structural equation modelling analysis. Data collected from respondents in a single manufacturing sector can have a limited variation in key dependent variables such as sustainability practices (Satten & Grummer-Strawn, 2005).

Table 2. Respondent Demographics

Business Description	Percentage of firms	Number of responses received	Number of Employees
Raw material manufacturer	8.2	12	17% Small (less than 20 employees) 50% Medium (20-199 employees) 33% Large (200 or more employees)
Intermediate product manufacturer	16.2	28	25% Small (less than 20 employees) 43% Medium (20-199 employees) 32% Large (200 or more employees)
Product Manufacturer	44.5	62	34% Small (less than 20 employees) 44% Medium (20-199 employees) 22% Large (200 or more employees)
Product Manufacturer and Distributor	25.4	33	28% Small (less than 20 employees) 36% Medium (20-199 employees) 36% Large (200 or more employees)
Product Manufacturer and Retailer	4.6	19	5% Small (less than 20 employees) 42% Medium (20-199 employees) 53% Large (200 or more employees)
Total		154	

The data were analysed using structural equation modelling (SEM). SEM is a confirmatory approach to data analysis, which statistically tests a hypothesised model to determine the extent to which the proposed model is consistent with the sample data and assesses its predictive validity. This analysis resulted in a structural equation model which specifies the direct and indirect relationships among the latent variables (Byrne, 2016; Hoyle, 1995). The results were then reviewed to determine the correlation and strengths of the relationship between the variables.

Exploratory Factor Analyses (EFA)

Henson and Roberts (2006) advocated the use of Exploratory Factor Analyses (EFA) in the initial stage of analysis because the a priori expectations from the initial theoretical constructs can be incorrect. Furthermore, EFA can also be employed to reduce the number of independent variables before structure equation modelling is applied to the complete data set (Del Missier, Mäntylä, & Bruine de Bruin, 2010; Miyake et al., 2000). Therefore, EFA was used as the first analysis method. The theoretical construct items were initially examined for their coalescence on factors, also known as the factorability of factors. The Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy was used to evaluate the correlations and partial correlations to determine if the data were likely to coalesce on factors. Williams, Brown, and Onsman (2012) recommends a KMO value ≥ 0.5 for factor analyses. Kaiser (1974) gives a more categorized sampling adequacy measure with a KMO > 0.6 as mediocre, 0.7 as middling, 0.8 as meritorious and 0.9 as marvellous. The KMO measure of sampling adequacy for this data was recorded at 0.812 for the 154 responses – well above the recommended values of the aforementioned criteria (see Table 3). Bartlett's test of sphericity is also recommended to test the appropriateness of factor analyses (Bartlett, 1950). This tests the hypothesis that the correlation matrix is an identify matrix; i.e. all diagonal elements are 1 and all off-diagonal elements are 0, implying that all of the variables are uncorrelated. There were co-relations in the data implying data coalescing and so this test result was significant, as shown in Table 3.

Table 3. KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.812
Bartlett's Test of Sphericity	Approx. Chi-Square	2657.340
	df	630

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.812
Bartlett's Test of Sphericity	Approx. Chi-Square	2657.340
	df	630
	Sig.	.000

Principal components analysis (PCA) was used as the factors extraction method which maximises the amount of variance accounted for in the observed variables by a smaller group of variables called 'components'(Williams et al., 2012). As the next step, the anti-image matrix was generated, and all items that were below 0.5 were removed (Marshall et al., 2007). The suggested Varimax technique of orthogonal rotation (Fullerton et al., 2014) was used, resulting in five factors with eigenvalues higher than 1 and also suppressing all loading values below 0.5. The initial 32 items (see the Appendix for these items) were reduced to 27 items (loading >=0.5) within 5 factors accounting for 50.2% of the variance. The variance explained meets the suggested threshold of >50% for humanities (Hair, Black, Babin, & Anderson, 2013; Pett, Lackey, & Sullivan, 2003). In the Rotated Factor Matrix, a clear factor structure is displayed i.e. each item loads predominantly on one factor (Table 4). The cross loading information can be provided on request from the authors. The individual examination of Factor 1 items revealed a common theme of the focal company's internal supply chain sustainability practices in the data, therefore, Factor 1 was labelled as the Internal Supply Chain Sustainability Practices (IS). Similarly, 4 items coalesced on Factor 2 which reflected the external supply chain social sustainability performance, therefore, Factor 2 was labelled as External Supply Chain Social Sustainability Performance (ES). Factor 3 coalesced on items relating to Internal Supply Chain Coordination (IC) whereas the Factor 4 items 20, 21, 22 and 23 represented Collaboration and Communication (CC) with the external supply chain partners for sustainability. Factor 5 items

represented the External Supply Chain Environmental Sustainability Performance (EE) and was labelled accordingly.

Table 4. Exploratory Factor Analyses: Factor loadings for explanatory variables

Item #	Factor loadings					Extracted Communalities
	1 (IS)	2 (ES)	3 (IC)	4 (CC)	5 (EE)	h^2
2			.829			0.723
3			.832			0.738
5			.765			0.651
6			.646			0.458
8	.607					0.530
9	.726					0.584
10	.769					0.667
11	.748					0.583
12	.556					0.413
13	.705					0.571
14	.760					0.615
15	.668					0.480
16	.644					0.443
18	.640					0.483
19	.595					0.403
20				.714		0.602
21				.666		0.509
22				.687		0.589
23				.710		0.617
26					.705	0.662
27					.726	0.658
29					.694	0.565
30					.639	0.572
32		.661				0.483
33		.855				0.781
34		.850				0.781
35		.719				0.609
% of Variance	16.870%	8.949%	8.949%	8.128%	7.280%	50.173%

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalisation.
a. Rotation converged in 7 iterations.

Validity and Reliability Testing

The degree of consistency of a measure is referred to as its reliability. The reliability coefficient, Cronbach's α (Cronbach, 1951) is generally used to test the reliability of a scale. α values of 0.70 or greater are deemed to be indicative of good scale reliability (O'Leary-Kelly & Vokurka, 1998). The reliability test was applied to the data from the 154 responses resulting in values of .887, .839, .828, .772, .803 indicating that the items can be a measure of the underlying factors as all alpha values are greater than 0.70 (DeVellis, 2012; Spooren, Mortelmans, & Denekens, 2007) (see Table 5). Furthermore, composite reliability, convergent and divergent validity tests were conducted to determine the adequacy of the data collection method. The convergent validity was confirmed by the strong factor loadings (see Table 4) and by the large values of the Average Variance Extracted (AVE) which exceeded the construct's correlation with other constructs (Alumran, Hou, Sun, Yousef, & Hurst, 2014). The five constructs also fulfilled the composite reliability benchmark of 0.7 (Fornell and Larcker, 1981). For discriminant validity, we compared the square root of the average variance extracted (AVE) with the correlations between the five factors. The square root of AVE is shown as bold in the diagonal in Table 5 and is greater than the factors correlation, confirming that the individual factors are discrete (Fornell & Larcker, 1981; Fullerton et al., 2014). Furthermore, the data also conforms to the discriminate validity criterion of Crocker and Algina (1986) as all factors correlations are less than the Cronbach alpha value.

Table 5. Reliability & Discriminate Validity Tests

	No. of Items	**IS**	**ES**	**IC**	**CC**	**EE**	**Composite Reliability**	**Cronbach Alpha**
Internal Sustainability Practices (IS)	11	**0.678**					0.89	0.887

External Supply Chain Social Performance (ES)	4	0.196*	**0.776**				0.857	0.839
Internal Coordination (IC)	4	0.253**	0.067	**0.772**			0.854	0.828
Collaboration and Communication (CC)	4	0.444**	0.393**	0.245**	**0.699**		0.788	0.772
External Supply Chain Environmental Performance (EE)	4	0.501**	0.351**	0.093	0.479**	**0.691**	0.785	0.803

Square root of Average Variance Extracted (AVE) shown as bold in diagonal.

The Measurement Model

The standard structural equation modelling approach of first constructing a measurement model to determine if the constructs and their relationships meet the model fitness recommended thresholds was followed by an examination of a full structural equation model. The measurement model was constructed with the EFA survey items in AMOS 24 using the maximum likelihood (ML) approach. Overall goodness of fit was measured using different types of fit measures (Bollen, 1989; Hair, Anderson, Tatham, & William, 1998; Hoyle, 1995; Kline & Santor, 1999); namely $\chi 2$/ degree of freedom ratio (CMIN/DF), Comparative Fit Index (CFI), the Tucker–Lewis Fit Index (TLI), the Incremental Fit Index (IFI) and root mean square error of approximation (RMSEA). The recommended values for IFI, CFI and TLI should be higher than 0.9 and close to 1.00 (Bollen, 1989; Byrne, 2016; Kline & Santor, 1999). RMSEA values for good model fit should be less than or equal to 0.06 (Hu & Bentler, 1999). Our measurement model resulted in CMIN/DF = 1.512, TLI= .910, CFI=.919, IFI=0.921 and RMSEA =0.057. This indicates that the model offers a good model fit and the five factors provide a good structure with which to continue the structure equation modelling. Table 6 shows the standard coefficients and the t-values for all construct indicators.

Table 6. CFA Results for Individual Construct Indicators

Construct Indicators	Standard Coefficients	t- Values ***
Internal Sustainability Practices (IS)		
8	0.606	_a
9	0.667	6.817
10	0.739	7.350
11	0.736	7.332
12	0.599	6.301
13	0.725	7.252
14	0.742	7.372
15	0.631	6.555
16	0.644	6.655
18	0.554	5.916
19	0.558	5.953
External Supply Chain Social Performance (ES)		
32	0.529	6.106
33	0.936	9.648
34	0.950	9.676
35	0.643	_a
Internal Coordination (IC)		
2	0.856	_a
3	0.905	10.419
5	0.736	10.646
6	0.447	5.374
Collaboration and Communication (CC)		
20	0.559	6.677
21	0.535	6.375
22	0.813	9.411
23	0.812	_a
External Supply Chain Environmental Performance (EE)		
26	0.759	7.424
27	0.817	7.694
29	0.621	6.415
30	0.638	_a

*** all significant to $p < 0.000$

_a indicates a parameter that was fixed at 1.0.

n=154 , Estimation Method = Maximum Likelihood

Model fit indices: CMIN/DF =1.513, TLI=0.910, CFI=0.919, IFI=0.921 RMSEA=0.057

The Structural Equation Model (SEM) and the Hypothesised Findings

Before the path coefficients can be assessed for hypothesis testing, the fitness of the structural equation model has to be evaluated. Overall goodness of fit for structure model was calculated using all EFA survey items which resulted in CMIN/DF = 1.590, IFI=0.907, TLI=0.90, CFI=0.905, RMSEA =.06 (see Table 7). All these fit indices meet the acceptable fit level of IFI ≥ 0.90, CFI ≥ 0.90, TLI ≥0.90 and CMIN/DF≤ 2 (Bollen, 1989; Hair et al., 1998; Hoyle, 1995; Kline & Santor, 1999) and RMSEA ≤ 0.08 (Browne, Cudeck, Bollen, & Long, 1993).

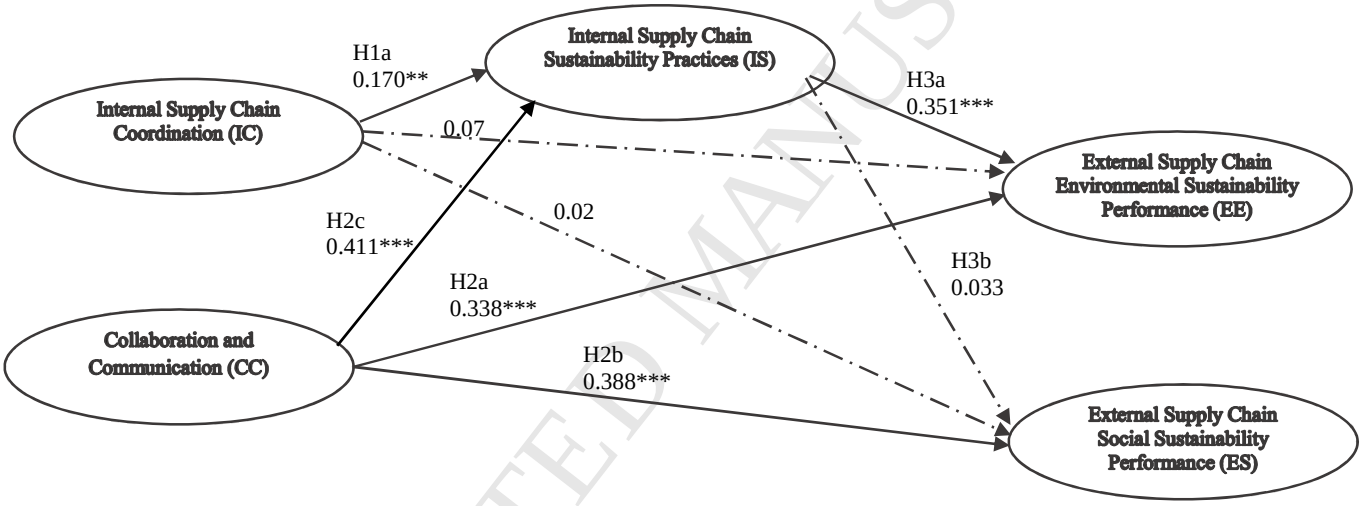

Figure 1. Results from the Structural Equation Model

Table 7 presents the results of the structural equation modelling analysis which demonstrated the significance of the relationships represented by each of the hypotheses. Table 7 indicates that 5 of the 6 hypotheses were supported ($p < .05$ or .005) which suggests that the respondents identified a strong relationship between both the constructs of internal supply chain coordination and collaboration and communication and external supply chain sustainability performance. As

shown in Figure 1, both internal supply chain coordination (IC) and collaboration and communication (CC) are positively and significantly related to internal supply chain sustainability practices (IS). Internal supply chain sustainability practices (IS) is positively and significantly related to external supply chain environmental sustainability performance whereas collaboration and communication (CC) positively and significantly influences both external supply chain social (ES) and external environmental sustainability performance (EE) (as shown in Table 7). The results do not support H3b which hypothesised a positive relationship between internal supply chain sustainability practices (IS) and external supply chain social sustainability performance (ES).

Table *7*: Significance of the Relationships Identified for the Hypotheses

Relationships	Hypothesis	Standard Coefficients	t-Values
IC → IS	H1a	0.170	2.020**
CC → EE	H2a	0.338	3.295***
CC→ ES	H2b	0.388	3.704***
CC→ IS	H2c	0.411	4.108***
IS → EE	H3a	0.351	3.326***
IS → ES	H3b	0.033	0.723

, * indicates the significance of the p value at < 0.05, < 0.005
n=154 , Estimation Method = Maximum Likelihood
Model fit indices: CMIN/DF =1.592, TLI=0.90, CFI=0.905, IFI=0.907, RMSEA=0.06

A number of other effects were found not to be significant, as shown in Table 8. In particular, IC was found not to have a significant indirect effect on EE. In addition, IC was found not to have a significant direct effect on either EE or ES. CC was also not found to have a significant indirect effect on ES. While IS was not found to mediate the relationship between CC and ES, it was found to partially mediate the relationship between CC and EE.

Table 8. Significance of Indirect Relationships

Relationships	Direct Effect (c')	Indirect Effect (a.b)	Total Effect (c)	Cohen's Indirect Effect Measure	Proportion of Total Effect Mediated (c-c')/c
CC→ EE	0.338***	0.144***	0.482***	Partial Mediation - Medium	29.90%
CC → ES	0.388***	-	0.388***	No Mediation	-
IC → EE	-	0.060**	0.060**	No Mediation	-
IC → ES	-	-	-	No Mediation	-

We only report statistically significant relationships
- indicates not significant at p<0.10. **, *** indicates the significance at p values of < 0.05, < 0.005
Cohen's Indirect Effect Measure = 0.01-0.09 (Small), 0.10-0.25 (Medium) and >0.25 (Large)

As the Cohen's Indirect Effect Measure shows, there was only a medium level scope for mediation between CC and EE and very little or no scope for the other relationships. The absence of other significant indirect relationships is explained by the strong correlation coefficients identified for the relationships between several of the independent and dependent variables. The statistical significance of the relationships between the independent variable (CC) and both of the dependent variables (ES and EP) also contributed to the absence of other significant indirect relationships. The lack of scope for mediation also explains why other moderating and mediating variables were not identified in other research.

Discussion

Internal Supply Chain Coordination Effects

The positive significant relationship identified for hypothesis H1a and the finding that internal supply chain coordination factors into a single group indicates that a significant relationship

exists between internal supply chain coordination and internal supply chain sustainability practices. This is a significant finding for the literature because, although Signori et al. (2015) and Kirchoff et al. (2016a) have considered the effects of some uncategorized SCO variables on supply chain sustainability initiatives, the literature has not identified the effect of SCO variables on internal supply chain sustainability practices, or the effects of different SCO constructs. The SCO construct of internal supply chain coordination is focused on internal activities, whilst the second SCO construct considered in this study (externally focused supply chain collaboration and communication) is focused on external activities. It is likely, therefore, that these two constructs will have different effects and so their individual relationship with internal supply chain practices needs to be considered independently. It is important to identify the effects of the construct of internal supply chain coordination. The levels of internal supply chain coordination in the organisation are likely to be affected by characteristics such as size and decision-making, as discussed in the literature review. The effects of the second SCO construct are considered in the following section. The variables making up both these constructs are described in the Appendix.

The most interesting finding relating to this construct is that, whilst internal supply chain coordination has a significant effect on internal supply chain sustainability practices, it does not have a significant direct effect on external supply chain environmental or external social sustainability performance. This means that internal supply chain coordination is a significant contributor to the development of internal practices, but does not provide a direct decision area – performance outcome. The capacity of this SCO construct to directly affect internal processes, but indirectly affect external supply chain sustainability performance will be shown to be quite

different to the effect of the collaboration and communication SCO construct. The differences in effects should be included in future research designs. This finding informs the debate in the literature over which aspects of SCO directly affect external supply chain sustainability performance.

Collaboration and Communication Effects

The next significant finding supported hypothesis H2a and H2b makes an important contribution to the literature by determining that the construct of external supply chain collaboration and communication has a significant effect on two types of external supply chain sustainability performance. This finding contrasts interestingly with the previous finding that internal supply chain orientation does not have a significant effect on either type of external supply chain sustainability performance. These two findings suggest that future research examining the impact of supply chain constructs on SCSP should be designed with separate relationships for these two constructs. As discussed in the previous section, the extant literature combines variables from both of these constructs in the same relationships, e.g. Kusi-Sarpong et al. (2016) and Vachon and Klassen (2008). These findings suggest that this research design practice has probably been the cause of a lack of significant findings in previous studies.

A second important finding is that this SCO construct has a direct relationship with external supply chain sustainability performance. It confirms that SCO can have a direct decision – performance relationship with external supply chain sustainability performance. This is a significant contribution to the literature which has, to date, focused on SCO as an 'organising' effect, rather than a decision variable. This finding introduces a decision area – performance

relationship to the supply chain literature and significantly increases the scope for future SCO research.

The finding in support of H2c was an interesting outcome as well. Not only does the construct of supply chain collaboration and communication directly affect external supply chain sustainability performance, it also affects the internal operational construct of internal supply chain sustainability practices. As discussed in the following section, these practices also have a significant effect on external supply chain environmental sustainability performance. This means that the construct of supply chain collaboration and communication not only directly affects both types of external supply chain sustainability performance; its effect on external supply chain environmental sustainability performance is also mediated by the construct of internal supply chain sustainability practices. This interesting dual path relationship is worthy of future research. It also indicates that organisations have the option of directly affecting external supply chain sustainability performance through supply chain collaboration and communication activities, however, this construct can also be used to affect the internal supply chain sustainability practices and, subsequently, external supply chain environmental sustainability performance. This is an important finding for the literature which has focused on the relationship between external capabilities and external supply chain environmental initiatives, e.g. Chen et al. (2017) and Cao and Zhang (2011).

Internal Supply Chain Sustainability Practices Effects

The confirmatory finding for H3a, that internal supply chain sustainability practices have a strong positive and significant effect on external supply chain environmental sustainability performance, together with the finding that internal supply chain sustainability practices do not

significantly affect external supply chain social sustainability performance (rejecting H3b), makes the important contribution to the literature that internal supply chain sustainability practices only affect external supply chain environmental sustainability performance. The assumption (untested by the literature) that internal supply chain sustainability practices affect external supply chain social sustainability performance is to be found in a number of papers, eg. Ageron et al. (2012). Clarifying the relationships between the different areas of external supply chain sustainability performance and internal supply chain practices will improve the focus of future research in this area.

This finding and the confirmatory finding for H1a also indicates that the effect of internal supply chain coordination on external supply chain environmental sustainability performance is mediated by internal supply chain sustainability practices. This is an intuitive finding, however, the literature has not tested this relationship, although it has assumed that a relationship between internal supply chain sustainability practices and external supply chain environmental sustainability performance exists, eg. Carter and Rogers (2008). The finding that internal supply chain sustainability practices do not affect external supply chain social sustainability performance is less intuitive. This brings a valuable focus to the extant SSCM literature, which does not differentiate between the effect of internal supply chain sustainability practices on external supply chain environmental and social sustainability performance, eg Bowen et al. (2001); Kusi-Sarpong et al. (2016).

In addition, the finding that internal supply chain coordination only has a mediated effect on external supply chain environmental sustainability and no effect on external supply chain social sustainability performance further confirms the difference in the effects of the constructs of

internal supply chain coordination and collaboration and communication. It is important that future research design recognises the different effects of these two SCO constructs. As noted previously, the extant literature does not allow for the different effects of the SCO variables that make up these two constructs.

Implications for practice

These findings indicate that communication and information flow, knowledge sharing routines, the capability to integrate external resources and senior management support are significant contributors to achieving internal supply chain sustainability practices. In order to improve external supply chain environmental performance by developing internal supply chain practices, managers will need to align their functional and strategic objectives with their supply chain environmental sustainability outcomes. Most importantly, however, this research indicates that a focus on collaboration and communication will be the most effective approach for improving both external supply chain environmental and external supply chain social sustainability performance. Naturally, collaboration and communication will not be the only condition required to establish external environmental sustainability practices; key resources and knowledge will also be required. These key resources and knowledge may be available from within a collaborative and sustainability focused supply chain, which would also make collaboration and communication the most effective approach for accessing these resources.

Research Limitations

A limitation of the study was that the findings were based on data collected from a single respondent per organisation. To minimise the effects of the single respondent data collection, the data was collected from the senior supply chain managers who would have the most knowledge

about the status of these constructs in the organisation and the external environmental performance of the organisation's supply chain. Although the data conformed to the discriminate validity criterion, as well as passing a non-response bias, Harmon's single factor and a common latent factor method test for common method bias (Podsakoff et al., 2003; Podsakoff et al., 2012), examination of the effect of these constructs on external supply chain environmental and external supply chain social sustainability performances using multiple respondent or qualitative data would be an important future extension to this research. Another valuable extension to this research would be to take a longitudinal perspective and identify the timeframes for the effect of both constructs on external supply chain environmental and external supply chain social sustainability performances. Finally, although the literature review and analysis did not identify the effect of other moderating or mediating variables on the identified relationships, other variables may affect the relationship between SCO and other performance dependent variables. The potential existence of other unidentified moderating or mediating variables which could affect relationship between SCO and SCSP is a limitation of this research and future research should seek to identify these variables.

Conclusion

This study tested the effects on SCSP of two new SCO constructs developed from the literature. The construct of external supply chain collaboration and communication was found to directly affect both external supply chain environmental and external supply chain social sustainability performance. This introduces the decision – performance concept for the relationship between SCO and supply chain performance to the literature. The construct of internal supply chain coordination was found only to significantly affect external supply chain environmental

sustainability performance and this effect was found to be mediated by internal supply chain sustainability practices. Supply chain collaboration and communication was also found to have a second, mediated effect on external supply chain environmental sustainability performance.

The findings indicate that both internally and externally focused constructs can affect external supply chain environmental and social sustainability performance, but according to different pathways. The extant literature does not focus on the direct relationship between SCO and external supply chain performance, eg Mariadoss, Chi, Tansuhaj, and Pomirleanu (2016) and Signori et al. (2015). In addition, it does not consider the different types of effects of these two categories of SCO or the mediating effect of internal supply chain sustainability practices on this relationship identified in this research. Combining variables from the two construct groups without considering their different effects is likely to affect the result of the relationships they are used to test.

These findings answered the research question: “What is the difference between the effects of different supply chain orientation constructs on external supply chain sustainability performance?” by identifying significant relationships between external supply chain sustainability performance and two different constructs not previously identified in the extant literature.

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Appendix

Constructs* and Variables	**Description**	**Source**
Internal Supply Chain Coordination (IC)	The SCO activities that build the capability of the organisation to manage its internal supply chain responsibilities, viewing the organisation as a segment of the supply chain.	
strategic meetings of internal supply chain members	allow for planning and resource allocation for internal supply chain capability development	(Esper & Defee, 2010)
problem-solving initiatives taken by internal supply chain members	supports performance improvement of internal supply chain capability	(Harms, 2011)
communication and information exchange amongst internal supply chain members	provides supporting information for planning, resource allocation and performance improvement of internal supply chain capability	(Lee & Nam, 2016)
top management support for internal supply chain members	provides supporting information for planning, resource allocation and performance improvement of internal supply chain capability	(Min et al., 2007; Patel et al., 2013)
collaborative work between internal supply chain members	ensures the cooperation across departments introducing all opportunities for perspectives on internal supply chain capability development	(Bowen et al., 2001; Esper & Defee, 2010; Luzzini et al., 2015)
communication between internal supply chain members	ensures the coordination of planning and development activities as they are implemented	(Esper & Defee, 2010; Luzzini et al., 2015)
Collaboration and Communication (CC)	the SCO activities undertaken by the organisation that build the capability of the supply chain to manage its operations, but not the practices themselves.	
joint decision making	ensures that decisions are made as a group in the supply chain to increase the representativeness and acceptance of the decisions,	(Cao & Zhang, 2011; Vachon & Klassen, 2008)
Communication channels	establish communication with the supply chain to support participation in joint decision making and provide the information necessary for those decisions	(Cao & Zhang, 2011; Lee & Nam, 2016; Min et al., 2007)
establishing shared goals and vision	ensure that the goals are consistent with those of the other members of the supply chain	(Cao & Zhang, 2011; Lee & Nam, 2016; Min et al., 2007; Patel et al., 2013)
establishing shared operating philosophies and priorities	ensure that the operating approaches are consistent with the other members of the supply chain, which is necessary for the effective implementation of joint decisions	(Lee & Nam, 2016; Min et al., 2007; Patel et al., 2013)

joint planning	ensures that plans for implementation are consistent with those of other members of the supply chain	(Lee & Nam, 2016; Patel et al., 2013) (Blome et al., 2014; Cao & Zhang, 2011; Vachon & Klassen, 2008)
sharing of the company's sustainability goals	is necessary for the establishment of shared goals so that each supply chain member understands the sustainability objectives of the other members	(Ageron et al., 2012)
Internal Supply Chain Sustainability Practices (IS)	The sustainability practices of the organisation that affect the organisation's contribution to the sustainability of the supply chain.	
IT support for information exchange across internal supply chain	provides the necessary resources to support the information exchange required for the strategic meetings of internal supply chain members problem-solving initiatives	(Lee & Nam, 2016)
monitoring and measuring internal supply chain processes	provide the necessary information to support the problem-solving initiatives of the internal supply chain members,	(Harms, 2011)
implementation of sustainability policies	provides the rule-based context for the implementation of internal supply chain sustainability initiatives	(Blome et al., 2014)
contribution of internal supply chain members to sustainability policies	provides the connection between the decisions made in strategic meetings and problem-solving initiatives of the internal supply chain members to the rule-based context for internal supply chain sustainability initiatives,	(Blome et al., 2014; Kirchoff et al., 2016b)
benchmarking of sustainability practices for the internal supply chain	provides the necessary reference points for the problem-solving initiatives of the internal supply chain members and joint decision-making in the supply chain	(Kirchoff et al., 2016b)
waste elimination practices	are an important practice which would result from problem-solving initiatives taken by internal supply chain members and which would affect the waste elimination performance of the supply chain,	(Bowen et al., 2001; Kirchoff et al., 2016b)
energy efficient practices	are important practices that would result from problem-solving initiatives taken by internal supply chain members and which would affect the energy efficiency performance of the supply chain,	(Kirchoff et al., 2016b)
renewable energy usage	is an important practice which would result from problem-solving initiatives taken by internal supply chain members and which would affect the renewable energy utilisation performance of the supply chain	(Blome et al., 2014)
recycled materials practices	re an important practice which would result from problem-solving initiatives taken by internal supply chain members and which would affect the use of recycled materials	(Blome et al., 2014; Bowen et al., 2001; Kirchoff et al.,

	performance of the supply chain,	2016b)
CO2 emissions management	is an important practice which would result from problem-solving initiatives taken by internal supply chain members and which would affect the CO2 minimisation performance of the supply chain,	(Kirchoff et al., 2016b)
community engagement	is an important practice which would result from problem-solving initiatives taken by internal supply chain members and which would affect the reduction of discriminatory employment practices, elimination of inappropriate labour and community engagement performance of the supply chain,	(Klassen & Vereecke, 2012; Spence & Bourlakis, 2009)
supplier codes of conduct	is an important practice which would result from problem-solving initiatives taken by internal supply chain members and which would affect the compliance with government regulations	(Awaysheh & Klassen, 2010; Blome et al., 2014; Bowen et al., 2001)
Ensuring commitment of suppliers to supplier code of conduct	will increase the extent to which the supplier code of conduct affects the government regulations, community engagement and external supply chain environmental sustainability performance.	(Bowen et al., 2001; Kirchoff et al., 2016b)
External Supply Chain Environmental Sustainability Performance (EE)	The performance measure representing the environmental sustainability performance of the supply chain as a whole, comprising outcomes, not practices.	
waste elimination	is the performance of the supply chain in reducing the amount of waste produced through its joint actions	(Blome et al., 2014)
energy usage efficiency	is the combined performance of the supply chain in maximising the output relative to its energy consumption and reflects the ability of the supply chain to coordinate its energy consumption,	(Blome et al., 2014)
utilisation of renewable energy supplies	is the performance of the supply chain in reducing the amount of waste produced through its joint actions	(Kusi-Sarpong et al., 2016)
water usage efficiency	is the combined performance of the supply chain in maximising the output relative to its water consumption and reflects the ability of the supply chain to coordinate its water consumption,	(Blome et al., 2014)
incorporation of recycled materials	is the performance of the supply chain in maximising the percentage of recycled materials used by the supply chain through its joint actions	(Kusi-Sarpong et al., 2016)
CO2 production resulting from transportation	is the performance of the supply chain in reducing the amount of CO2 produced by the supply chain through its joint actions	(Blome et al., 2014; Vachon & Klassen, 2008)

External Supply Chain Social Sustainability Performance (ES)	The performance measure representing the social sustainability performance of the supply chain as a whole, comprising outcomes, not practices.	
reduction of discriminatory employment practices	is the ability of the supply chain as a coordinated system to reduce the amount of discriminatory employment practices in which the supply chain engages and is a reflection of the shared goals and practices of the supply chain in reducing the amount of waste produced through its joint actions	(Awaysheh & Klassen, 2010)
elimination of child labour	is the ability of the supply chain as a coordinated system to eliminate the child labour employment practices in which the supply chain engages and is a reflection of the shared goals and practices of the supply chain in reducing child labour employment through its joint actions,	(Awaysheh & Klassen, 2010; Klassen & Vereecke, 2012)
elimination of bonded and compulsory labour	is the ability of the supply chain as a coordinated system to eliminate the bonded and compulsory labour employment practices in which the supply chain engages and is a reflection of the shared goals and practices of the supply chain in reducing bonded and compulsory labour employment practices through its joint actions	(Awaysheh & Klassen, 2010)
compliance with government regulations	is the ability of the supply chain as a coordinated system to increase its total compliance with social government regulations and is a reflection of the shared goals and practices of the supply chain	(Klassen & Vereecke, 2012)
community engagement	is the ability of the supply chain as a coordinated system to engage with the community and is a reflection of the shared goals and practices of the supply chain.	(Klassen & Vereecke, 2012; Spence & Bourlakis, 2009)

** Constructs are in bold*