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Developing environmental and social performance: the role of suppliers' sustainability and buyer–supplier trust

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We explore how environmental and social performance of manufacturing firms can be improved as sustainable supply chain management (SSCM) develops and evolves within a firm from internal to external practices. Importantly, this study considers how key suppliers' sustainability performance and buyer–supplier trust mediate and moderate such a development. A conceptual framework is developed which relies on resource-based theories and emerging empirical evidence. Then, partial least square methodology is applied on survey data from a sample of Italian manufacturing firms. Results show that manufacturing firms' sustainability performance improves as SSCM develops; however, while internal practices have a direct impact on performance, the effect of external practices on a manufacturing firm's sustainability performance is fully mediated by key suppliers' sustainability performance. Yet, buyer–supplier trust significantly influences the scope of such gains. Since evidence suggests that manufacturing firms are still struggling with how to leverage supply chain innovation potential for sustainable development, this study provides a timely and valuable contribution.

Keywords: sustainable supply chain management; resource-based view; relational view; PLS

1. Introduction

Due to growing environmental and social expectations by regulators, investors, customers and non-governmental organisations, sustainability is becoming a major concern for any firm (Gualandris et al. 2015). This is especially the case of firms operating in manufacturing sectors, as they are perceived to generate stronger social and environmental impacts. To reduce their harm and regenerate natural and social systems, such firms have been suggested to undertake sustainable supply chain management (SSCM) (Carter and Rogers 2008; Seuring and Müller 2008). SSCM is advocated as a new archetype to improve ecological efficiency and social responsibility in supply chains while augmenting profitability and competitiveness (Ahi and Searcy 2013).

Recent research has demonstrated that SSCM develops within a firm and evolves from sustainable process management (SPM) to sustainable supply management (SSM) (De Giovanni 2012; Gualandris and Kalchschmidt 2014). SPM refers to sustainable practices typically applied within the firm's borders without direct suppliers' involvement. Differently, SSM refers to environmental and social assessment and collaboration in the supply chain. SSCM research has suggested that internal practices producing significant reductions in environmental harm build upon technical knowledge, which should be accumulated over time while engaging with total quality management practices (Wiengarten and Pagell 2012). The development of external practices delivering positive impacts on social and natural systems, differently, necessitates of relational expertise built upon a firm's willingness and ability to create interdependencies and participation throughout the supply chain (Gualandris, Golini, and Kalchschmidt 2014).

Despite the recommendations summarised above, manufacturing firms are not improving their sustainability at the speed natural and social systems would require. To illustrate, although monitoring and developing teams are continuously despatched, Apple and Samsung still struggle with how to enforce sustainable practices in their supply chain and leverage supply chain innovation potential for sustainability (Friends of the Earth 2012). In order to achieve true sustainability, environmental and social harm produced by manufacturing firms must still decrease by 50 times (Hansen, Grosse-Dunker, and Reichwald 2009). This evidence signals a lack of understanding as to how manufacturing firms should improve their sustainability performance. Specifically, the following issues regarding SSCM's relationship with manufacturing firms' sustainability performance should be tackled.

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First, resource-based research provides strong evidence about the benefits associated to SPM (e.g. Zhu and Sarkis 2004); contrasting results have been found for SSM, with some authors arguing for strong positive returns (Vachon and Klassen 2008; Klassen and Vereecke 2012) and some others that could not find proper empirical support for this (De Giovanni 2012; Zhu, Sarkis, and Lai 2012). More importantly, the complex interaction between SPM, SSM and a manufacturing firms' sustainability performance has been overlooked. In particular, it is not clear whether manufacturing firms should focus on internal practices, external practices or both to significantly improve their sustainability performance. Therefore, a first relevant research question is:

RQ1: Which form of SSCM between SPM and SSM is the main driver of manufacturing firms' sustainability performance?

Second, another characteristic of SSCM research is that much papers study the sustainability performance of manufacturing firms, while very few papers analyse SSCM implications for suppliers (Akamp and Müller 2011; Touboulic, Chicksand, and Walker 2014). Supply chain partners have been shown to play a pivotal role for manufacturing firms' success (Krause, Scannell, and Calantone 2000; Krause, Vachon, and Klassen 2009). The role supplier might play along the development of a firm's sustainability performance, however, is not completely clear. Thus, addressing the following research question provides support to manufacturing firms and enrich the current state of SSCM research:

RQ2: Does SSM impact manufacturing firms' sustainability performance directly, or indirectly through improved suppliers' sustainability performance?

Finally, while being extensively investigated in other areas of supply chain management (SCM) literature (Benton and Maloni 2005; Ireland and Webb 2007), the role of buyer–supplier trust is seldom introduced in SSCM research. Recent studies argue that there might be growing trust across the supply chain in response to stakeholders' social and environmental pressure such that knowledge transfer will be facilitated and suppliers will strive to perform up to buyer expectations to maintain the relationship (Simpson, Power, and Samson 2007; Parmigiani, Klassen, and Russo 2011; Huq, Stevenson, and Zorzini 2014). This suggests that trust (rather than power) could be leveraged to allow for higher sustainability performance and opens avenue for the following research question:

RQ3: Does buyer–supplier trust positively influence the impact of SSM on suppliers' sustainability performance?

Addressing the above research questions allows moving a step forward in understanding how manufacturing firms should improve their sustainability performance, thus providing a relevant and timely contribution to theory and practice. In an attempt to provide such a contribution, we developed a conceptual framework relying on resource-based theories (Dierickx and Cool 1989; Barney 1991; Dyer and Singh 1998) and emerging empirical evidence (e.g. De Giovanni 2012; Zhu, Sarkis, and Lai 2012; Gualandris and Kalchschmidt 2014); then, we applied partial least square (PLS) on survey data from a sample of Italian manufacturing firms. Results show that, at a first step, manufacturing firms' sustainability performance improves significantly as a consequence of the adoption of SPM. While evolving from SPM to SSM, SSCM does not generate further performance gains unless suppliers' sustainability performance is significantly improved. Interestingly, buyer–supplier trust significantly influences the scope of such gains. Theoretical and managerial implications from these findings will be discussed afterwards.

2. Literature review

2.1 *Sustainable supply chain management*

SSCM research points to the existence of synergies and trade-offs between economic, environmental and social dimensions of sustainability. Environmental improvements tend to translate into positive economic returns like enhanced reputation, eco-efficiency and environmental risk avoidance (Golicic and Smith 2013). Worker health and safety has been theoretically linked to productivity (Das et al. 2008), although subsequent empirical investigation shows that creating a safe and productive workplace is difficult and many firms fail because of their culture and management practices (Pagell et al. 2013). Wang and Sarkis (2013) recently found that firms' return on assets and return on equity flourish only if social and environmental practices are developed jointly. Overall, these studies suggest that environmental, social and economic priorities should be clearly defined and simultaneously pursued in order to gain competitive advantage.

Although environmental and social performance are recognised as major pillars of sustainability, SSCM research mainly concentrates on their relationship with the economic pillar. At the best of our knowledge, very few studies focus on social and environmental performance and explore how they might simultaneously develop and evolve within a firm

(Marshall, Cordano, and Silverman 2005; Pagell and Gobeli 2009). Thus, in line with recent recommendations (Pagell and Shevchenko 2014), the present study focuses on environmental and social performance and investigates how manufacturing firms should develop their practices and supplier relationships to maximise such outcomes.

As recently demonstrated, two different but complementary forms of SSCM exist (Paulraj 2011; De Giovanni 2012; Zhu, Sarkis, and Lai 2012; Gualandris and Kalchschmidt 2014): SPM and SSM. SPM refers to the institutionalisation of practices that (i) are within a firm's direct control, (ii) are commonly employed without direct supplier involvement and (iii) aim at improving a firm's environmental and social performance. Environmental management systems (EMS; Darnall, Jolley, and Handfield 2008), eco-design (Zhu and Sarkis 2004), health and safety standards (Robson et al. 2007) and social campaigns (Zairi and Peters 2002) have been shown to be part of this institutionalisation (Gualandris and Kalchschmidt 2014).

Differently, SSM refers to supplier assessment and collaboration, i.e. two complementary sets of activities that (i) are implemented at the firm level and (ii) require transactions with suppliers to assess and improve their environmental and social performance (Lee and Klassen 2009; Klassen and Vereecke 2012). While supplier assessment consists of activities such as establishing assessment criteria, gathering and processing information upon suppliers' sustainability, supplier collaboration is akin to joint decision-making and development efforts for sustainable products and operations. Supplier assessment and collaboration are deployed iteratively, as firms start with an evaluation of suppliers' ability in advancing sustainability, followed by collaboration to sponsor suppliers' environmental and social prowess, and closing the loop with supplier re-assessments to ensure that initiatives are in compliance with the ambitions of the manufacturing firm (Paulraj 2011, 23).

SSM is fostered in contexts where external integration is high i.e. when the manufacturing firm is capable at exchanging information and align goals with supply chain partners (Vachon and Klassen 2006; Gualandris, Golini, and Kalchschmidt 2014). SSM also tends to flourish when SPM is already institutionalised and the manufacturing firm has accumulated preliminary technical knowledge as to how manage its own sustainable operations (Gualandris and Kalchschmidt 2014). Thus, SSM can be seen as a higher order relational capability that builds upon the combination of sustainability-specific technical knowledge, arising from a standardised set of greener and safer manufacturing processes developed in house (SPM), and relational expertise, accumulated by grappling with traditional supply management practices.

Literature that has considered the complex interaction between SPM, SSM and manufacturing firms' sustainability performance is scant; furthermore, the few exemptions provide contrasting results. Zhu, Sarkis, and Lai (2012) found that internal green practices fully mediate the effect of external green practices on the environmental performance of the manufacturing firm, meaning that the adoption of supplier assessment and collaboration does not improve manufacturing firms' environmental performance directly. Conversely, Paulraj (2011) found empirical evidence suggesting that SSM allows to combine relationship-specific resources in unique ways, thereby realising positive environmental and social gains for the manufacturing firm. Notably, none of these studies has considered suppliers' performance as a factor that could eventually mediate the effect that SSM exerts on a firm's sustainability performance (Krause, Scannell, and Calantone 2000).

2.2 *Buyer–supplier trust*

Goodwill trust (TR) is defined as one party's confidence in the reliability and integrity of the other party in an exchange relationship based on cooperation expectations (Moorman, Zaltman, and Deshpande 1992); it is when buyer and supplier believe that their counterparty is honest or benevolent (Morgan and Hunt 1994), which reduces opportunistic behaviour in uncertain environments and facilitates complex exchanges (Benton and Maloni 2005; Ireland and Webb 2007).

SSCM research on TR is limited to few explorative studies, which provide complementary perspectives on its role. First, Carter and Jennings (2002) found that purchasing involvement in corporate social responsibility leads to improved buyer's trust on suppliers; here, trust is depicted as an 'outcome' of SSM. Second, Sharfman, Shaft, and Anex (2009) provided evidence that TR affects the extent to which firms in the supply chain engage in external green practices involving other partners; here, trust is suggested to be an 'antecedent' of SSM. A third view is presented by Parmigiani, Klassen, and Russo (2011), which suggested that there might be growing trust across the supply chain in response to stakeholders' social and environmental pressure such that knowledge transfer will be facilitated and suppliers will strive to perform up to buyer expectations to maintain the relationship. Similarly, with their case studies, Huq, Stevenson, and Zorzini (2014) found that a shift from power exploitation to open dialogues and trust between multinational firms and suppliers can foster social improvements in the supply chain. This emerging evidence suggests that trust might also be a 'moderator' that amplifies the effect of SSM on suppliers' environmental and social performance.

3. Conceptual framework and hypotheses

Our conceptual framework is shown in Figure 1, while Table 1 defines our constructs. The conceptual framework describes how SPM, SSM, TR and SS interact and finally impact FS. Specifically, we investigate the extent to which SPM impacts both SSM and FS. Additionally, we examine the extent to which SSM impacts FS, both directly and indirectly through SS. Finally, TR is hypothesised to alter the effect that SSM has on SS. Overall, our framework suggests a complex relationship between SSCM and FS, which is illustrated in Figure 2. At a first stage, FS is expected to increase as for the effect of SPM; further environmental and social gains arise when SSM develops and SS is augmented. The scope of such gains, however, depends upon TR.

Our framework is grounded into the resource-based view theory (RBV) (Barney 1991) and the relational view theory (RV) (Dyer and Singh 1998). RBV argues that variance in firms' performance is fundamentally due to heterogeneity in resources and capabilities that are owned and controlled by a single firm. Resources are defined as the inputs to a process (e.g. capital equipment, human capital, financial capital), while capabilities as clusters of resources coordinated by organisational routines and deployed into a process. RV complements RBV by suggesting that performance gains in the supply chain are possible when trading partners combine their resources in a unique way and develop relationship-specific capabilities. In the following sub-sections, RBV and RV are used to inform our hypotheses.

3.1 *SPM and its outcomes*

At a first stage, the development of SPM impacts FS directly. SPM can be seen as a unique set of physical, financial, human, technological resources coordinated by organisational routines deployed over time in a trial-and-error process (Parmigiani, Klassen, and Russo 2011; Gualandris and Kalchschmidt 2014). SPM, thus, represents a technical capability that cannot be easily acquired in factor markets, as it requires a considerable amount of time to be nurtured and dispersed among firm's members. As postulated by RBV theory, being valuable, intangible and socially complex, SPM can impact FS significantly. Accordingly, manufacturing structural investments aiming to reduce pollution at the source, social standards (OHSAS 18001, SA8000) and facility-level resources conservation activities are all positively linked to environmental sustainability and have also contributed to the achievement of better employees' quality of life (Zhu and Sarkis 2004; Darnall, Jolley, and Handfield 2008).

Having discussed the importance of SPM for FS, the second logical step is to rationalise how SPM is instrumental in pursuing SSM. In accordance with the path-dependence model of Dierickx and Cool (1989), firms evolve along a path of resource acquisition and re-combination that constrains their future development, favouring those pathways which require resources and capabilities that have been already developed. As SPM is novel and requires resource endowments that often cross a firm's boundaries, firms pursuing SPM are more likely to engage with their supply partners so as to gain access to new resources and capabilities (Paulraj 2011). Consistently, Carter and Carter (1998) found that the implementation of internal environmental practices exerts a positive influence on the degree of vertical coordination in the supply chain, making firms good candidates for collaborating with suppliers in joint environmental initiatives.

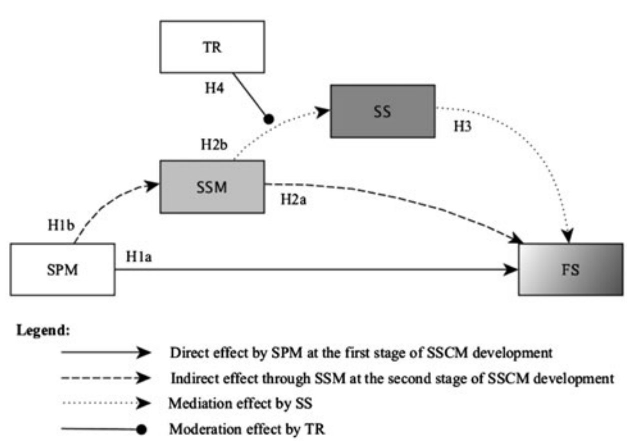

Figure 1. Conceptual framework.

Table 1. Constructs definition.

Short name	Construct definition	Based on
Firm sustainability (FS)	*Environmental and social performance of the manufacturing firm* The extent to which the manufacturing firm has reduced its harm and produced regenerative impacts on natural and social systems	Pagell and Shevchenko (2014)
Supplier sustainability (SS)	*Environmental and social performance of key suppliers* The extent to which the manufacturing firm's key suppliers have reduced their harm and produced regenerative impacts on natural and social systems	
Sustainable supply management (SSM)	*External SSCM practices adopted by the manufacturing firm* The institutionalisation of two complementary sets of activities that (i) are implemented at the firm level and (ii) require transactions with suppliers to assess and improve their environmental and social performance (i.e. supplier assessment and collaboration)	Gualandris and Kalchschmidt (2014), Klassen and Vereecke (2012), Lee and Klassen (2009)
Sustainable process management (SPM)	*Internal SSCM practices adopted by the manufacturing firm* The institutionalisation of practices that (i) are within a firm's direct control, (ii) are commonly employed without direct supplier involvement and (iii) aim at improving a firm's environmental and social performance (i.e. EMS, eco-design, health and safety standards, social campaigns)	Gualandris and Kalchschmidt (2014), Parmigiani, Klassen, and Russo (2011)
Buyer–supplier trust (TR)	*Key suppliers' trustworthiness as perceived by the manufacturing firm* One party's confidence in the reliability and integrity of the other party in an exchange relationship based on cooperation expectations	Moorman, Zaltman, and Deshpande (1992), Morgan and Hunt (1994), Benton and Maloni (2005)

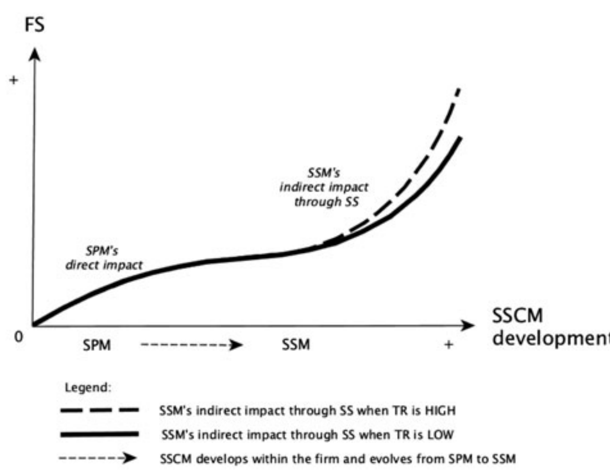

Figure 2. Firm sustainability under SSCM.

Also, as suggested by SSCM research (De Giovanni 2012; Gualandris and Kalchschmidt 2014), without social programs and a EMS in house, the manufacturing firm may be disinclined or unable to help suppliers assessing and improving their sustainability. Based on these arguments, we consider the following hypotheses:

H1a. SPM has a positive effect on FS.

H1b. SPM has a positive effect on SSM.

3.2 *SSM and its outcomes*

At a second stage, manufacturing firms tap their resources and capabilities to detect supply chain innovation potential for sustainable development (De Giovanni 2012; Gualandris and Kalchschmidt 2014). At this stage, appropriate supplier assessment can help firms to identify complementary resources that can be potentially useful to address social and environmental challenges in the supply chain. Subsequent collaboration can then facilitate the formation of interaction routines enabling the exchange of idiosyncratic assets and knowledge for a concrete and effective improvement of environmental and social performance throughout the supply chain.

In other words, manufacturing firms leverage their SSM and create a range of tacit relationship-specific capabilities that are socially complex and not easily tradable (Paulraj 2011), thus likely resulting in competitive advantages for the parties involved in the exchange relationship. Pagell, Krumwiede, and Sheu (2007) showed that sustainable purchasing approaches can result in a more integrated supply chain and in the overall decrease in waste that includes water, energy, fuel consumption and packaging disposal for the manufacturing firm. Vachon and Klassen (2008) found that, while pushing and supporting suppliers towards the adoption of environmental and social practices, manufacturing firms develop interaction routines that significantly fostered product responsibility.

Yet, empirical research has shown that, by assessing suppliers' compliance with internally or externally endorsed sustainability standards (e.g. EMAS and RoHS certification), manufacturing firms actively contribute to the diffusion of valuable resources such as environmental technologies and safety measures throughout the supply chain (Lee et al. 2014). This diffusion process is then strengthened by supplier collaboration; including education, training and co-development, supplier collaboration engenders interaction routines that enact serious environmental and social improvements for suppliers (Lee and Klassen 2009; Akamp and Müller 2011).

For these reasons, we consider the following hypotheses:

H2a. SSM has a positive effect on FS.

H2b. SSM has a positive effect on SS.

3.3 *The mediating role of supplier sustainability*

According to Krause, Vachon, and Klassen (2009), 'a firm is only as sustainable as its suppliers', meaning that SS is a mediator (a necessary resource) for manufacturing firms to gain superior environmental and social performance. When suppliers have poor performance, they can either be replaced or collaboration can be initiated to improve their skills; in both the first and the second scenario, however, the performance of the manufacturing firm will not improve unless well-performing suppliers are engaged or existing suppliers augment their performance in the first place. Therefore, the link between SSM and FS is the result of the increase in SS that is sparked by SSM.

Empirical research demonstrated that only well-developed suppliers are key determinants of a firm's ability to overcome its limits (Krause, Scannell, and Calantone 2000). Paulraj and Chen (2007), for instance, pointed out that strategic supply management, which includes inter-firm communication and cross-organisational team working initiatives, enhances suppliers' operational performance and benefits the manufacturing firm mostly 'indirectly'. Carter (2005) found a significant mediation effect linking purchasing involvement in corporate social responsibility, suppliers' performance (i.e. quality, efficiency) and manufacturing firms' performance (i.e. reduced waste and associated costs). Similarly, one must consider that manufacturing firms' employees enhance their satisfaction only if supplier's environmental and social performance, locally or in a developing economy, are significantly upgraded (Ehrgott et al. 2011). Thus, we consider the following hypothesis:

H3. SS mediates the positive effect SSM has on FS.

3.4 *The moderating role of buyer–supplier trust*

SSCM research suggests that there should be growing TR across the supply chain in order to amplify environmental and social returns from SSM (Simpson, Power, and Samson 2007; Parmigiani, Klassen, and Russo 2011; Huq, Stevenson, and Zorzini 2014). Empirical evidence is needed to prove that TR functions as complementary asset (moderator) for such practices.

TR represents a safeguard for future business, which provides buyers and suppliers with incentives and means for developing valuable relationship-specific capabilities. It represents an effective norm that fosters information sharing processes and that enables the development of partner-specific absorptive capacity, which easy knowledge acquisition, co-development and exploitation into performance outcomes (Benton and Maloni 2005; Ireland and Webb 2007). Thus, TR amplifies the success of inter-organisational practices by providing motivation – e.g. buyers and suppliers are encouraged to resist attractive short-term alternative in favour of the higher long-term benefits of staying with the counter-part – and exacerbating the ability of buyers and suppliers to combine their resources for the achievement of superior accomplishments (Morgan and Hunt 1994; Dyer and Chu 2003). Conversely, SSM will be of little value when TR is low, as the lack of safeguards and coordination mechanisms will impede to fully capture the benefits associated to its adoption. Based on these arguments, we consider the following hypothesis:

H4. TR positively moderates the positive effect SSM has on SS.

4. Methodology

This study was configured as an explanatory survey research because the studied phenomenon could be articulated in a conceptual framework using well-defined concepts, theories and hypothesis. By means of the following sections, we create methodological transparency as to how our conceptual model was operationalized, how sample selection and data collection were performed and how we checked for the absence of biases. This study is part of a larger research program to investigate the path through which manufacturing firms develop their environmental and social practices and performance (Gualandris and Kalchschmidt 2014, 2015).

4.1 *Measures development*

The stepwise procedure of item generation (Churchill 1979) was used to operationalize our conceptual model into a questionnaire, which is available for scrutiny in Appendix 1. We established content validity by grounding the questionnaire in prior literature through the identification of standing reflective items (Table 3). When necessary, identified items were aggregated and re-formulated to reflect recent developments in constructs' definitions (Table 1). Yet, the questionnaire was designed and iteratively improved to maintain a reasonable survey length. Face validity and trait validity were also established by receiving feedback on earlier versions of the questionnaire by 10 experts working for different Italian manufacturing firms. The resulting measurement scales are illustrated here below.

4.1.1 *FS and SS*

A number of reflective items used by previously published papers (Pagell, Krumwiede, and Sheu 2007; Gualandris, Golini, and Kalchschmidt 2014) were identified, aggregated and re-formulated to reflect at best the definition of sustainability performance employed in this study. Our definition captures both 'harm reduction' and 'regenerative impacts firms might have on social and natural systems' (Pagell and Shevchenko 2014), while prior research was mainly focused on 'harm reduction'. After pre-testing the questionnaire with experts, our measurement for sustainability performance constituted of a four-item, five-point Likert scale capturing changes in (i) resources efficiency and regeneration, (ii) health and safety of employees, (iii) avoidance of hazardous materials and bad emissions, and (iv) employees satisfaction. Such a measurement scale is consistent with quantitative studies (Pagell, Krumwiede, and Sheu 2007; Gualandris, Golini, and Kalchschmidt 2014) and qualitative research (Marshall, Cordano, and Silverman 2005; Pagell and Gobeli 2009) that show how firms' environmental and social performance strongly covary – e.g. the adoption of greener production processes improves the working conditions for employees, while the improvement of employees' welfare and satisfaction also results in the reduction of the number of damaging environmental actions undertaken by the firm.

4.1.2 *SSM*

We employ a six-item, five-point Likert scale capturing the effort the manufacturing firm devotes to (i) 'sending questionnaires to evaluate suppliers' socially and environmentally friendly practices', (ii) 'employing environmental and social criteria in periodic evaluation of suppliers', (iii) 'performing environmental and social audits of suppliers' plants', (iv) 'cooperating with suppliers to reduce the social and environmental impacts of their products and activities', (v) 'collaborating with them to develop socially and environmentally friendly products and operations' and (vi) 'engaging in joint planning to anticipate and resolve sustainability-related problems' (Gualandris and Kalchschmidt 2014).

4.1.3 *SPM*

We employ a four-item, five-point Likert scale measuring the effort the manufacturing firm devotes to (i) 'developing EMS', (ii) 'improving workplace health and safety', (iii) 'designing environmentally friendly products' and (iv) 'developing social campaigns'. As for SSM, see Gualandris and Kalchschmidt (2014) for a more detailed description of the development of our instruments.

4.1.4 *TR*

A three-item, five-point Likert scale is employed, which captures the extent the manufacturing firm believes that (i) key suppliers are concerned about its welfare, (ii) key suppliers consider how their decisions/actions affect the firm and (iii) key suppliers look for the firm's best interest. Benton and Maloni (2005) developed and tested this instrument in the first place.

4.1.5 *Control variables*

Similar to Gualandris and Kalchschmidt (2014), we controlled for two confounding factors, namely firm size and firm priority. First, the extent environmental and social capabilities and performance develop within a firm might be explained by firm size, rather than the relationship modelled in our framework. In fact, large firms might have substantial resources to invest in SSCM and also maintain higher bargaining power to influence suppliers and achieve better performance. Therefore, we control for the natural logarithm of firm size, measured as number of employees. The second possible confounding effect relates to the importance that top management attributes to environmental and social priorities. Thus, we control for the relative importance of sustainability compared with other priorities (cost, quality, delivery, flexibility and innovation).

4.2 *Sample selection and data collection*

We focused on Italian manufacturing firms. Manufacturing industries are generally accountable for significant negative impacts on social and natural systems along all stages of a product's life cycle. In Italy, such firms have recently faced several critical changes in environmental and social regulations. Therefore, this population target offered significant potential for new insights on how the development of SSCM impacts FS.

To limit sampling error and facilitate replicability, a listing of all Italian manufacturing firms was drawn from widely available sources (Aida database – www.aida.bvdep.com). Then, sample design was based on probabilistic sampling; specifically, the 'disproportionate stratified random sampling' method was applied (Forza 2002). This method involved the division of the population into strata and a random selection of each case (firm) from each stratum. Strata were identified on the basis of meaningful criteria – we considered the sector as identified by the ISIC code. Within each stratum, sample randomisation was performed using the random number function in MS Excel and selecting the database entries for which the highest random numbers were generated. The number of selected firms for each stratum followed the proportion of manufacturing firms per each sector, calculated based on data made available by the National Institute for Statistics (ISTAT). Finally, assuming a response rate of 20% and a target sample size of 100 firms to guarantee adequate statistical power (Malhotra and Grover 1998), we calculated that a total of 500 cases (firms) must be contacted in the first place.

Firms were contacted by phone calls in order to identify a reference person (i.e. chief procurement officer, purchasing manager or buyer) and to describe the research intent. Manufacturing firms that agreed to participate to our research were first provided with an electronic form and, if necessary, answer where solicited two weeks after. Overall, 86 firms participated to our study, which gave us a response rate of 17.2%. Those cases with more than 15% of items left unanswered were discarded (9 firms). Differently, when the proportion of items left unanswered was between 1 and 15% (5 firms), we applied the mean value replacement method because the percentage of missing values per item was always less than 5% (Hair et al. 2013, 147). At the end, 77 questionnaires could be used to test our hypotheses. The sample is heterogeneous in terms of size (Table 2). Although different manufacturing industries were considered, the firms mainly belonged to the manufacturing of machinery and equipment sector. Responders' demographics are provided in Appendix 1 (Table A2). Invariance tests based on responders' role and years in the firm demonstrated that all responders perceive our research constructs similarly.

4.3 *Non-response bias and common method bias*

First, we kept track of non-responders and surveyed some of them using a telephone call to understand how much bias was introduced in our sample (Forza 2002). Most of the firms declined due to the fact that they had no time to

Table 2. Descriptive statistics in terms of (a) size and (b) industrial sector.

(a) Number of employees	n	%
Less than 100	4	5.02
100–249	28	36.36
250–500	18	23.38
Over 500	27	35.06
Total	77	100

(b) ISIC*	n	%
Chemicals	3	3.90
Rubber and plastics	4	5.19
Fabricated metal products, except machinery and equipment	7	9.09
Computers and electronics	5	6.49
Electrical equipment	16	20.78
Machinery and equipment not elsewhere classified	33	42.86
Motor vehicles	6	7.79
Other transport means	3	3.90
Total	77	100

*ISIC: International Standard Industrial Classification.

participate in our study or their policy didn't allow participation in any survey. Then, comparing the number of employees, ROS and ROA between responders and 77 non-responders randomly selected offered evidence that the non-response bias is not a concern in this study. Furthermore, comparing questionnaire's items between later responders ($n_{lr} = 24$) and earlier responders ($n_{er} = 24$) provided evidence for the absence of a late-respondent bias (Armstrong and Overton 1977). Note that we identified later responders and earlier responders based on the first and the latest 30% of collected questionnaires.

In order to minimise common method bias, questions about our DVs were positioned at the end of the questionnaire (Podsakoff et al. 2003). Once data were collected, we conducted a Harman's single factor test: proving evidence that common method bias does not represent a serious issue in this study, the 'general methods factor' explained only 41% of the variance in our items, while five factors with eigenvalue greater than one explained 78.5% of total variance in the data. This result was further validated using the partial correlation procedure with 'general methods factor' (Podsakoff et al. 2003). The 'general methods factor' did not affect the path loadings or statistical significance of the paths between items and their respective constructs, suggesting that CMV did not affect our path analysis.

5. Hypotheses testing

We used SmartPLS 2.0 software (Ringle, Wende, and Will 2005) to perform a PLS analysis and test our conceptual framework. Our decision to perform this type of analysis is based on a number of considerations: (i) our sample size is limited, (ii) discrete variables are employed, (iii) prediction is our main goal, (iv) we employ reflective constructs with high number of items and (v) our framework involves independent equations that need to be estimated simultaneously (Peng and Lai 2012). A growing number of researchers from a variety of disciplines have applied PLS, with growing SCM research approaching this methodology in the last few years (e.g. Gualandris and Kalchschmidt 2013).

A sample size of 77 cases can be considered sufficient to test our conceptual framework. First, our sample size is greater than 50 cases i.e. the sample size that reflects the rule of thumb of multiplying by ten the greatest number of paths leading to a dependent variable (five paths for FS). Second, according to a power analysis that assumed (i) a medium effect size ($f^2 = 0.25$) for five predictors, (ii) a significant level of 0.05 and (iii) a desired power of 0.80, testing our conceptual framework would require a sample of 58 cases.

5.1 *Measure validity and reliability*

First, individual items reliability is attested by items loading on their respective constructs at more than 0.6 (Table 3). Second, in accordance with the literature (Anderson and Gerbing 1988), constructs uni-dimensionality is attested by

Table 3. Measurement model.

Construct name and measurement source	Items	Mean	SD	Loading	Internal consistency	α	AVE
Firm sustainability (Paulraj 2011; De Giovanni 2012; Gualandris, Golini, and Kalchschmidt 2014)	FS1	2.78	1.01	0.72	0.83	0.73	0.56
	FS2	2.83	0.90	0.85			
	FS3	2.80	0.75	0.79			
	FS4	2.35	0.95	0.60			
Supplier sustainability (Paulraj 2011; De Giovanni 2012; Gualandris, Golini, and Kalchschmidt 2014)	SS1	2.51	0.85	0.78	0.91	0.86	0.71
	SS2	2.51	0.72	0.86			
	SS3	2.45	0.81	0.83			
	SS4	2.43	0.76	0.90			
Sustainable supply management (De Giovanni 2012; Gualandris and Kalchschmidt 2014)	SSM1	2.62	1.32	0.84	0.95	0.94	0.77
	SSM2	2.34	1.18	0.88			
	SSM3	2.34	1.22	0.87			
	SSM4	2.54	1.16	0.90			
	SSM5	2.51	1.10	0.86			
	SSM6	2.62	1.16	0.90			
Sustainable process management (De Giovanni 2012; Gualandris and Kalchschmidt 2014)	SPM1	3.39	1.42	0.84	0.90	0.86	0.70
	SPM2	2.74	1.41	0.82			
	SPM3	2.93	1.28	0.82			
	SPM4	2.98	1.18	0.86			
Buyer–supplier trust (Benton and Maloni 2005; Carter and Jennings 2002)	TR1	3.51	0.83	0.92	0.89	0.83	0.74
	TR2	3.31	0.83	0.89			
	TR3	3.49	0.77	0.75			

obtaining significant item loadings from the simultaneous estimation of our structural model in PLS. Third, composite reliability is signalled by Cronbach's α (Nunnally, Bernstein, and Berge 1967) and internal consistency (Fornell and Larcker 1981) greater than 0.7 for all constructs. Fourth, the Average Variance Extracted (AVE) of constructs is always higher than the recommended minimum of 0.5 (Fornell and Larcker 1981) (Table 3), suggesting that convergent validity for our constructs is at acceptable levels. Lastly, we obtain proof of high discriminant validity: correlations among constructs show to be smaller than the square roots of the AVE values computed for each individual construct (see Table 4).

5.2 *Path analysis*

To test our hypotheses, four different models have been considered (Figure 3). In accordance with Baron and Kenny (1986), the first three models have been performed to test indirect (mediating) effects. The moderation effect of TR was tested in a fourth model using the 'interaction term' approach in PLS (Henseler and Fassott 2010).

Bootstrapping was used to test the statistical significance of paths in each model. This procedure entails generating 200, 500 and 1000 sub-samples of cases randomly selected, with replacement, from the original data-set. The analysis showed that the hypothesised model (i.e. Model 4) represents the best solution because R^2 in FS is highest among the tested models. The Goodness of Fit for this model, calculated following Tenenhaus et al. (2005), is 0.58, which is above the large effect size cut-off value of 0.36 (Fornell and Larcker 1981). Results for the four models are detailed in Table 5.

First, it is noteworthy that the impact of SPM on FS was always positive and strongly significant across the considered models. Nonetheless, SPM was positively and significantly related to SSM. Therefore, H1a and H1b are supported.

Second, SSM appeared to be less developed than SPM (Table 3) and not directly linked to FS (Table 4). Nevertheless, it was significantly related to SS, which in turn was positively and significantly associated to FS. A Sobel test was conducted to confirm that the indirect path 'SSM-SS-FS' was significant (Holcomb, Holmes, and Connelly 2009); this test corroborated the mediating effect (Sobel *t*-statistic: 2.47). Thus, we can conclude that SSM constitutes a rare higher order relational capability able to generate performance gains in the supply chain (SS) and, in return, for the manufacturing firm (FS). Of importance, the inclusion of SS in Model 3 produced a huge increase of FS's explained variance (+33.9%). Overall, H2b and H3 are supported, while H2a is rejected.

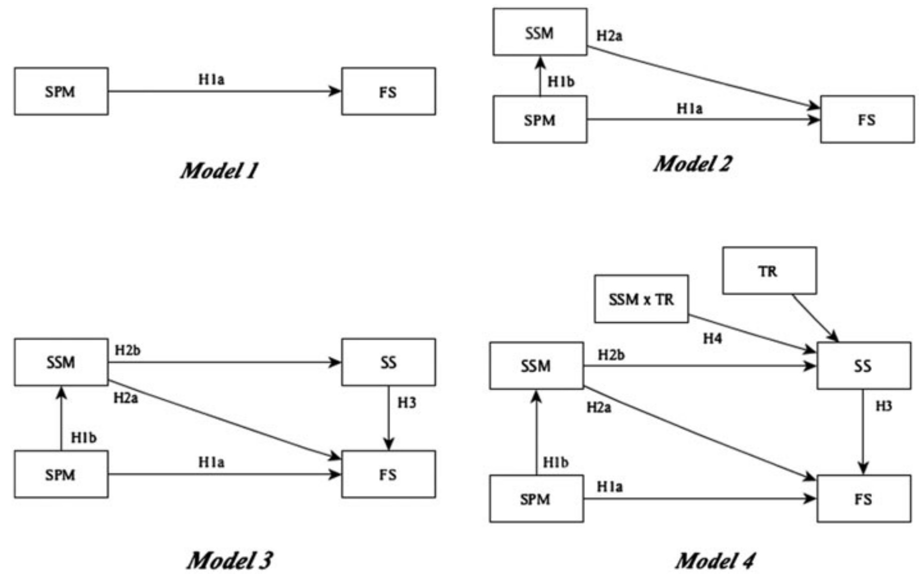

Figure 3. Structural models.

Table 4. Constructs' discriminant validity.

	FS	SS	SSM	SPM	TR
Firm sustainability	0.75				
Supplier sustainability	0.71	0.84			
Sustainable supply management	0.44	0.37	0.88		
Sustainable process management	0.61	0.33	0.82	0.84	
Buyer–supplier trust	0.12	0.16	0.30	0.26	0.86

Note: The square root of the AVE is reported on the diagonal, while the latent construct correlations are reported off-diagonals.

TR significantly and positively moderated the relationship between SSM and SS. In other words, the impact of SSM on SS is stronger for manufacturing firms that rely on trust to govern supplier relationships. Notably, the inclusion of the 'SSM × TR' interaction factor in Model 4 increased SS's explained variance (+7.6%). Thus, H4 is also supported.

6. Discussion

6.1 *Theoretical implications*

Following resource-based theories (Dierickx and Cool 1989; Barney 1991; Dyer and Singh 1998), SCM literature (Krause, Scannell, and Calantone 2000; Benton and Maloni 2005) and SSCM literature (De Giovanni 2012; Gualandris and Kalchschmidt 2014), we developed a conceptual framework positing that SPM is a fundamental, sustainability-specific technical capability that drives initial improvements (low-hanging fruits), while SSM is a higher order, sustainability-specific relational capability that impacts SS and FS, especially when combined with trust. Therefore, the main theoretical contribution of this paper is the understanding of how the complex interaction between SPM, SSM, TR and SS leads to better FS. No previous study considered such a complex interaction to explain how manufacturing firms should build their environmental and social performance.

Noteworthy, our empirical analysis provides enough evidence to advance SSCM theory as regards to our research questions. In relation to the first research question (*RQ1: Which form of SSCM between SPM and SSM is the main driver of manufacturing firms' sustainability performance?),* both SPM and SSM represent relevant drivers of FS. At a first stage, manufacturing firms can grab low hanging fruits by the effect of the internal institutionalisation of eco-design, EMS, health and safety standards and social campaigns (Zairi and Peters 2002; Zhu and Sarkis 2004; Robson et al. 2007; Darnall, Jolley, and Handfield 2008). Nevertheless, SPM alone appears to be quite reductive; it explains only 26.9 of variance in FS (Table 5). At a second stage of SSCM's development, supply chain managers are in a position to seek

Table 5. Structural models.

Paths	Model 1		Model 2		Model 3		Model 4	
	Stz. coeff.	*t*-value	Stz. coeff.	*t*-value	Stz. coeff.	*t*-value	Stz. coeff.	*t*-value
SPM → FS	**0.518**	5.620	**0.469**	2.284	**0.406**	2.335	**0.407**	2.332
SPM → SSM	–	–	**0.828**	23.829	**0.806**	24.124	**0.828**	25.395
SSM → FS	–	–	0.059	0.219	−0.123	0.671	−0.124	0.684
SSM → SS	–	–	–	–	**0.364**	2.633	**0.275**	2.053
SS → FS	–	–	–	–	**0.623**	8.880	**0.622**	8.567
TR → SS	–	–	–	–	–	–	0.029	0.262
SSM * TR → SS	–	–	–	–	–	–	**0.234**	1.993
Variance explained in FS	26.9%		26.9%		59.9%		59.9%	
Variance explained in SSM	–		68.6%		68.6%		68.6%	
Variance explained in SS	–		–		13.2%		20.8%	
Effect size of (SSM × TR) → SS	–		–		–		0.09[a]	

[a]The effect size is calculated using the equation $f^2 = \left(R^2_{\text{included}} - R^2_{\text{excluded}}\right)/\left(1 - R^2_{\text{included}}\right)$.

out opportunities for reducing harm and producing regenerative impacts on social and natural systems as they can find appropriate support within the organisation (SPM; Gualandris and Kalchschmidt 2014). At this stage, manufacturing firms can look for ways of enhancing the overall competitive advantage of the supply chain, which results in beneficial buyer–supplier engagements (Paulraj 2011).

Then, as regards to the second research question (*RQ2: Does SSM impact manufacturing firms' sustainability performance directly, or indirectly through improved suppliers' sustainability performance?*), SSM turned out to impact FS only indirectly, through SS. Based on recent literature (Krause, Vachon, and Klassen 2009; Akamp and Müller 2011), we included SS in our framework to better understand how manufacturing firms benefit from SSM. Given the increasing tendency to concentrate on core competencies and outsource design and production of relevant parts and services, it is understandable that manufacturing firms' performance are much more dependent on suppliers: 'manufacturing firms that do experience suppliers' performance and/or capabilities deficiencies are hampered in their ability to compete in their respective markets' (Krause, Scannell, and Calantone 2000). Our findings complement such research and suggest that as suppliers develop relationship-specific capabilities and performance outcomes, manufacturing firms improve their sustainability – e.g. only if suppliers improve packaging and remove harmful materials from components, buyers will reduce waste and provide healthier working conditions for employees (Pagell, Krumwiede, and Sheu 2007).

Finally, based on SCM literature (Moorman, Zaltman, and Deshpande 1992; Benton and Maloni 2005; Ireland and Webb 2007) and most recent SSCM literature (Simpson, Power, and Samson 2007; Parmigiani, Klassen, and Russo 2011; Huq, Stevenson, and Zorzini 2014), we included the moderating role of TR in our framework so to address our third research question (*RQ3: Does buyer–supplier trust positively influence the impact of SSM on suppliers' sustainability performance?)*. Borrowing theoretical arguments from RV (Dyer and Singh 1998; Dyer and Chu 2003), our framework suggests that TR warrants the success of SSCM. Interestingly, we found evidence that TR moderates the relationship between SSM and SS. Thus, our research complements prior studies in clarifying TR's complex and multifaceted role: (i) it is an enabler or a fertile ground for the initiation of SSM (Sharfman, Shaft, and Anex 2009); (ii) it is a facilitator or a norming condition amplifying SSM's impact on SS (Simpson, Power, and Samson 2007; Parmigiani, Klassen, and Russo 2011; Huq, Stevenson, and Zorzini 2014); (iii) it is an outcome or a relationship-specific attribute which grows over time as SSM proves to be successful for the parties involved (Carter and Jennings 2002).

6.2 *Managerial implications*

Simpson, Power, and Samson (2007) suggested that a firm

> should remain conscious of the old adage 'Do as I say and not as I do' such that suppliers may become less responsive to the manufacturing firm's environmental requirements where it does not demonstrate a level of commitment toward its environmental performance that exceeds its own requirements for the supplier.

In a similar fashion, the business ethics literature suggests that 'virtue is lived and not acted since one "does not offer what one does not possess"' (Amaeshi, Osuji, and Nnodim 2008), meaning that the success of SSCM is to a large extent dependent on the institutional context within which it develops and evolves.

Our study complements these views in suggesting manufacturing firms to develop sustainability-specific technical and relational capabilities (SPM and SSM) as well as relational norms based on trust. Manufacturing firms such as Apple and Samsung, which are unable to find effective ways to augment environmental and social performance in their supply chains, must be aware that only by ‘doing something’ (SPM and SSM) and ‘having something to offer’ (i.e. technical and relational capabilities, trustworthiness), they can walk with their suppliers along paths that lead to superior sustainability performance.

6.3 *Limitations*

As with all empirical research, this study has some limitations that need to be taken into account when interpreting its findings and conducting further research. First of all, our research design, a cross-sectional survey, does not allow the temporal sequence necessary to assess causality. Future research should include longitudinal designs to provide conclusive evidence of our framework. Second, in accordance with RV, our analysis suggests that a singular focus on the manufacturing firm as unit of analysis may limit the explanatory power of the employed framework. Therefore, future studies should collect data from both firms and suppliers, providing further support to our thesis.

Third, even if our measurements were derived rigorously, some of our concepts would require using multi-dimensional constructs (e.g. Paulraj 2011). Also, although a proper resampling procedure was adopted to test our model, the limited sample size didn’t allow to cross verify the validity and reliability of our measurements. Future studies based on more complex measurements and larger samples could be useful to validate our findings.

Finally, data have been collected only in the Italian manufacturing industry and thus, even if the data collection process was properly and accurately designed, still country and/or industry effects could be possible. Particular attention could be paid to the role of national culture in influencing our findings – for instance, buyer–supplier trust might play a stronger role in the case of emerging economies, where an emphasis on collectivism and *guanxi* may facilitate the development of inter-organisational practices such as SSM (Cai, Jun, and Yang 2010). Further data collection in other countries and/or industries could verify whether our findings could be generalised.

7. Conclusion and future research

This study aimed at moving a step forward in understanding how manufacturing firms should improve their sustainability performance. To this aim, we have explored the complex relationships involving SPM-SSM-TR-SS-FS (Figure 1). Results showed that, at a first stage, SSCM in the form of SPM (technical capability) directly impacts FS (Figure 2). At a later stage, SSCM in the form of SSM (relational capability) directly impacts SS, which in turn positively influences FS. Yet, TR positively affects the relationship between SSM on SS.

Recent studies suggest that while SPM strongly impacts a firm’s TBL, SSM produces only marginal gains (De Giovanni 2012; Zhu, Sarkis, and Lai 2012). These studies, however, did not consider SS as a significant mediator in such a relationship. Our research provides evidence that omitting SS resulted in spurious analysis and biased conclusions, thus opening several avenues for future research. First, it would be interesting to undertake further qualitative research so as to better understand how SS translates in FS and which specific sustainability indicators are subjected to this relationship. On a contingency perspective, it would also be interesting to test whether the role of SS and TR changes significantly according to the industrial and/or cultural context. Another avenue would be to study how SS influences a manufacturing firm’s economic performance. As primary and societal stakeholders held manufacturing firms accountable for SS (Parmigiani, Klassen, and Russo 2011; Gualandris et al. 2015), only firms that associate their success to that of their suppliers might be able to get full stakeholder support.

Disclosure statement

No potential conflict of interest was reported by the authors.

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Appendix 1.

Table A1. Multi-items measurement scales.

In the last three years, to what extent has your organisation's performance changed in the following areas (1: much worse; 5: much better)	
FSP	FS1. Resources efficiency and regeneration (energy, water, non-renewables)
	FS2. Health and safety of employees
	FS3. Avoidance of hazardous materials and bad emissions (air and water emission, solid disposal)
	FS4. Employee satisfaction
In the last three years, to what extent has your key suppliers' performance changed in the following areas (1: much worse; 5: much better)	
SSP	SS1. Resources efficiency and regeneration (energy, water, non-renewables)
	SS2. Health and safety of employees
	SS3. Avoidance of hazardous materials and bad emissions (air and water emission, solid disposal)
	SS4. Employee satisfaction
Indicate the effort put into implementing the following action programs in the last three years (1: none; 5: high)	
SSM	SSM1. Sending questionnaires to suppliers in order to assess their environmental and social performance
	SSM2. Having supplier environmental and social criteria in periodic evaluation
	SSM3. Auditing suppliers' plant to assess their environmental and social performance
	SSM4. Working together with suppliers to reduce social and environmental impacts of products
	SSM5. Collaborating with suppliers to reduce social and environmental impacts of processes and operations
	SSM6. Conducting joint planning to anticipate and resolve sustainability related problems
SPM	SPM1. Environmental management systems (e.g. ISO 14001)
	SPM2. Workplace health and safety (e.g. OHSAS 18001)
	SPM3. Environmentally friendly product design (e.g. design for environment, life cycle assessment)
	SPM4. Corporate responsibility through social campaigns (e.g. codes of conduct, corporate social activities, etc.)
Please, indicate how much do you agree with the following statements (1: strongly disagree; 5: strongly agree)	
TR	TR1. When making important decisions, our suppliers are concerned about our welfare
	TR2. Our suppliers consider how their decisions/actions affect us
	TR3. Our suppliers look out for our best interest
Size	Approximately, how many employees (full-time equivalent) work in your company?
Importance of Sustainability	*For each of the following competitive goals, please indicate the importance senior management places on each for your company. Allocate 100 points across the six priorities below to indicate their relative importance:*
	(i) Manufacturing cost (ii) Quality (iii) Delivery speed and timeliness
	(iv) Manufacturing flexibility (v) New product design/innovation (vi) Sustainability

Table A2. Responders' demographics.

		Gender		Years in the firm		
		M	F	1–5	6–10	11+
Role	Chief procurement officer: 45	44	1	14	17	14
	Purchasing manager: 7	6	1	6	0	1
	Buyer: 25	23	2	16	6	3