Developing environmental and social performance:
The role of supplier sustainability and buyer-supplier trust

Abstract

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 (PLS) 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. Also, 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 of regulators, investors, customers and non-governmental organizations, sustainability is become a major concern for any firm (Gualandris *et al.* 2015). This is especially the case of firms operating in manufacturing sectors, as their internal and external operations have 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 Muller 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 (TQM) 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 *et al.* 2014).

Despite the recommendations summarized above, manufacturing firms are not improving their sustainability at the paste 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 *et al.* 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.

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 *et al.* 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 most of the papers study the sustainability performance of manufacturing firms, while very few papers analyse SSCM implications for suppliers (Akamp and Müller 2011, Touboulic *et al.* 2014). Supply chain partners have been shown to play a pivotal role for manufacturing firms' success (Krause *et al.* 2000, Krause *et al.* 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 provide 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 *et al.* 2007, Parmigiani *et al.* 2011, Huq *et al.* 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 for 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 *et al.* 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 performances are recognized as major pillars of sustainability, SSCM research mainly concentrates on their relationships with the economic pillar. At the best of our knowledge, very few studies concentrate on social and environmental performance and explore how they might simultaneously develop and evolve within a firm (Marshall *et al.* 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 maximize such outcomes.

As recently demonstrated, two different but complementary forms of SSCM exist (Paulraj 2011, De Giovanni 2012, Zhu *et al.* 2012, Gualandris and Kalchschmidt

2014): sustainable process management and sustainable supply management. SPM refers to the institutionalization 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 *et al.* 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 institutionalization (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, pp. 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 *et al.* 2014). SSM also tends to flourish when SPM is already institutionalized and the manufacturing firm has accumulated preliminary technical knowledge as to how manage internal sustainable operations (Gualandris and Kalchschmidt 2014). Thus, SSM can be seen as an higher-order relational capability that builds upon the combination of sustainability-specific technical knowledge, arising from a standardized 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 *et al.* (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 realizing 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 has on the manufacturing firm (Krause et al., 2000).

2.2 Buyer-supplier trust

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 *et al.* 1992); it is when buyer and supplier believe that their counterparty is honest or benevolent (Morgan and Hunt 1994), which reduces opportunistic behavior 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 *et al.* (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 *et al.* (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 *et al.* (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 I 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.

(Insert Figure 1 about Here)

(Insert Table I about Here)

(Insert Figure 2 about Here)

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 organizational routines and deployed into specific processes. 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 Sustainable process management 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 organizational routines deployed over time in a trial-and-error process (Parmigiani *et al.* 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 *et al.* 2008).

Having discussed the importance of SPM for FS, the second logical step is to rationalize 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, favoring 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. Also, as suggested by SSCM research (De Giovanni et al. 2012, Gualandris and Kalchschmidt 2014), without social and environmental management systems 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 Sustainable supply management 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 *et al.* (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 et al. (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 *et al.* 2000). Paulraj and Chen (2007), for instance, pointed out that strategic supply management, which includes inter-firm communication and cross-organizational 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 *et al.* 2007, Parmigiani *et al.* 2011, Huq *et al.* 2014). Empirical evidence is needed to prove that TR functions as complementary asset (moderator) for such practices. Here below the theoretical arguments that informe our last hypothesis.

TR represents a safeguard for future business, which provides buyers and suppliers with incentives and means for developing valuable relationship-specific capabilities. It functions as an effective norm governing information sharing processes and enabling 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-organizational practices by providing motivation – e.g., buyers and suppliers are encouraged to resist attractive short-term alternative in favor 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.

4.1 Construct measurement

The stepwise procedure of item generation (Churchill Jr 1979) was used to operationalize our conceptual model into a survey instrument (Table A1). Before data collection, content validity was established by grounding our survey instrument in the existing literature and by identifying existing and appropriate reflective items (Table III). When necessary, identified items were aggregated and re-formulated to reflect recent developments in constructs' definitions (Table I) – also, the questionnaire was designed and iteratively improved to maintain a reasonable survey length. Pre-testing the model and the survey instrument before the gathering of data guarantees face, trait and content validity. Specifically, we conducted field interviews with ten experts working for different Italian manufacturing firms presenting a good heterogeneity in terms of size and industry. Such experts were asked to fill in the questionnaire in the presence of the researchers and put into words any issue or ambiguity about the instrument. This procedure was iteratively repeated until the manager at the last firm recommended no changes. The resulting measurement scales are illustrated here below.

FS and SS. A number of reflective items used by previously published papers (Pagell et al. 2007, Gualandris et al. 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 et al. 2007, Gualandris *et al*. 2014) and qualitative research (Marshall *et al.* 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.

SSM. A six-item, five-point Likert scale that captures 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. Items are formulated and grouped together in accordance with existing literature (De Giovanni 2012, Gualandris and Kalchschmidt 2014).

SPM. A four-item, five-point Likert scale is employed that captures 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, items are formulated and grouped together in accordance with recent literature (De Giovanni 2012, Gualandris and Kalchschmidt 2014).

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. Such a measurement scale was employed by Benton and Maloni (2005).

Control variables. Two controls are employed in this work. First, the extent environmental and social capabilities and performance develop with a firm might be explained by firm size, rather than the relationship modeled below. In fact, large firms might have substantial resources to invest in SSCM and being able to leverage 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 performance. 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 SSCM development 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 randomization 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 (Dillman, 2007). An electronic version of the questionnaire was provided to the respondents who agreed to participate in the survey and, where appropriate, a reminder was sent after a few weeks. 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 number of missing values per item was always less than 5% (Hair et al. 2013, pp. 147). At the end, 77 questionnaires could be used to test our hypotheses. The sample is etherogeneous in terms of size (Table II). Although different manufacturing industries were considered, the firms mainly belonged to the manufacturing of machinery and equipment sector. Responders’ demographics are provided in appendix (Table A2). Invariance tests based on responders' role and years in the firm demonstrated that all responders perceive our research constructs similarly.

(Insert Table II about Here)

4.3 Assessment of biases

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 participate in our study or their policy didn't allow participation in any survey. Then, comparing the number of employees, ROS and ROA across responders and a randomly selected group of non-responders assessed the non-response bias. Furthermore, under the assumption that later responders would be more similar to non-responders (Armstrong and Overton 1977), comparing questionnaire's items between later responders (n_{lr} = 24) and earlier responders (n_{er} = 24) assessed the late-respondent bias. Because the survey was managed smoothly (i.e., no waves of telephone calls but rather a constant effort), these groups were identified based on the earliest and the latest 30% of collected questionnaires. T-test analyses reveal that these groups (responders *vs.* non-responders; earlier respondents *vs.* later respondents) did not differ from each other at the 0.01 level of statistical significance.

Ex-ante, to minimise common method variance (CMV), the dependent variables were placed after the independent variables in the survey instrument, which helps diminish, if not avoid, the effect of consistency artefacts (Podsakoff *et al.* 2003). Ex-post, a Harman's single factor test was also conducted to test for CMV. Proving evidence that CMV does not represent a serious issue in this study, the 'general methods factor' explains only 41% of the variance in our items, while exploratory factor analysis (EFA) revealed five factors with eigenvalues greater than 1 explaining

78.5% of the variance. 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 path between the items and their respective construct, suggesting that CMV did not affect our path analysis.

5. Data analysis and results

We performed PLS algorithms as implemented in the SmartPLS 2.0 software (Ringle *et al.* 2005) to test our conceptual framework. PLS is most appropriate when sample size is small, assumptions of multivariate normality and interval scaled data cannot be made, and when the study is primarily concerned with predicting the dependent variable. 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 2015, Peng and Lai 2012).

While our hypotheses could be tested using a standard procedure such as EFA and hierarchical regression models, this would be not totally appropriate given that our framework involves independent equations that need to be estimated simultaneously. Consequently, to obtain unbiased and consistent estimates, our model must be analyzed using a multivariate estimation technique such as two-stage least squares, structural equations modeling based on the covariance matrix (SEM), or PLS. While these techniques provide acceptable parameter estimates, the first requires the use of single measures for all dependent variables and the second requires large sample size. In contrast, PLS permits small sample size and reflective constructs with high number of items (Peng and Lai 2012)

The general rule of thumb regarding an appropriate sample size when using PLS is to multiply by ten the greater number of paths leading to a dependent variable. In this study the highest number of paths leading to a dependent variable is five (i.e., FS), meaning that a minimum sample size of 50 cases is necessary. We also conducted a power analysis, as proposed by Cohen (1988) for the F-test, pertaining to R^2 for the endogenous constructs. Assuming a medium effect size ($f^2 = 0.25$) for five predictors, a significant level of 0.05 and a desired power of 0.80, our analysis would require a sample of 58 cases.

5.1 Measurement model

Reliability and validity of our measures are guaranteed by many criteria. First, individual items reliability is testified by measures consistently loading on their respective construct at nearly or greater than 0.7 (Table III). Second, the results of construct reliability (i.e., Cronbach's Alpha) (Nunnally *et al.* 1967) and internal consistency (Fornell and Larcker 1981) show that all items refer consistently to their respective construct, thus guaranteeing composite reliability. Third, uni-dimensionality for all the constructs was confirmed by showing significant standardized item loadings on their underlying constructs in a simultaneous estimation of the measurement and structural models in PLS (Anderson and Gerbing 1988). In support to convergent validity, the Average Variance Extracted (AVE) of constructs is always higher than the recommended minimum of 0.5 (Fornell and Larcker 1981) (Table III). Finally, concerning to discriminant validity, Table IV shows that the correlations among the different constructs in the lower left off-diagonal of the matrix are lower than the square roots of the average variance extracted values calculated for each of the constructs along the diagonal (i.e., diagonals elements).

(Insert Table III and IV about here)

5.2 Structural model

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).

(Insert Figure 3 about here)

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 hypothesized 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 V.

(Insert Table V about here)

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 III) and not directly linked to FS (Table VI). 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 *et al.* 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.

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 'SSMxTR' 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 et al. 2000, Maloni and Benton 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 an higher-order, sustainability-specific relational capability that impacts SS and FS, specially 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 institutionalization of eco-design, EMS, health and safety standards and social campaigns (Zairi and Peters 2002, Zhu and Sarkis 2004, Robson *et al.* 2007, Darnall *et al.* 2008). Nevertheless, SPM alone appears to be quite reductive; it explains only 26.9 of variance in FS (Table V). At a second stage of SSCM's development, supply chain managers are in a position to seek out opportunities for reducing harm and producing regenerative impacts on social and natural systems as they can find appropriate support within the organization (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 *et al.* 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 et al., 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 *et al.* 2007).

Finally, based on SCM literature (Moorman *et al.* 1992, Benton and Maloni 2005, Ireland and Webb 2007) and most recent SSCM literature (Simpson *et al.* 2007, Parmigiani *et al.* 2011, Huq *et al.* 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 multi-faceted role: (i) it is an enabler or a fertile ground for the initiation of SSM (Sharfman *et al.* 2009); (ii) it is a facilitator or a norming condition amplifying SSM's impact on SS (Simpson *et al.* 2007, Parmigiani *et al.* 2011, Huq *et al.* 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 *et al.* (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 *et al.* 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 has 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-organizational practices such as SSM (Cai *et al.* 2010). Further data collection in other countries and/or industries could verify whether our findings could be generalized.

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 et al., 2012; Zhu et al., 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 (Gualandris *et al.* 2015, Parmigiani *et al.* 2011), only firms that associate their success to that of their suppliers might be able to get full stakeholder support.

Appendix

(Insert Tables A1 and A2 about here)

Reference

Ahi, P. & Searcy, C., 2013. A comparative literature analysis of definitions for green and sustainable supply chain management. *Journal of Cleaner Production,* 52, 329-341.

Akamp, M. & Müller, M., 2011. Supplier management in developing countries. *Journal of Cleaner Production*.

Amaeshi, K.M., Osuji, O.K. & Nnodim, P., 2008. Corporate social responsibility in supply chains of global brands: A boundaryless responsibility? Clarifications, exceptions and implications. *Journal of business ethics,* 81 (1), 223-234.

Anderson, J.C. & Gerbing, D.W., 1988. Structural equation modeling in practice: A review and recommended two-step approach. *Psychological bulletin,* 103 (3), 411-423.

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

Barney, J., 1991. Firm resources and sustained competitive advantage. *Journal of management,* 17 (1), 99.

Baron, R.M. & Kenny, D.A., 1986. The moderator-mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of personality and social psychology,* 51 (6), 1173-1182.

Benton, W. & Maloni, M., 2005. The influence of power driven buyer/seller relationships on supply chain satisfaction. *Journal of Operations Management,* 23 (1), 1-22.

Carter, C.R., 2005. Purchasing social responsibility and firm performance: The key mediating roles of organizational learning and supplier performance. *International Journal of Physical Distribution & Logistics Management,* 35 (3), 177-194.

Carter, C.R. & Carter, J.R., 1998. Interorganizational determinants of environmental purchasing: Initial evidence from the consumer products industries*. *Decision Sciences,* 29 (3), 659-684.

Carter, C.R. & Jennings, M.M., 2002. Social responsibility and supply chain relationships. *Transportation Research Part E: Logistics and Transportation Review,* 38 (1), 37-52.

Carter, C.R. & Rogers, D.S., 2008. A framework of sustainable supply chain management: Moving toward new theory. *International Journal of Physical Distribution & Logistics Management,* 38 (5), 360-387.

Churchill Jr, G.A., 1979. A paradigm for developing better measures of marketing constructs. *Journal of Marketing Research*, 64-73.

Cohen, J., 1988. *Statistical power analysis for the behavioral sciences*: Lawrence Erlbaum.

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

Das, A., Pagell, M., Behm, M. & Veltri, A., 2008. Toward a theory of the linkages between safety and quality. *Journal of Operations Management,* 26 (4), 521-535.

De Giovanni, P., 2012. Do internal and external environmental management contribute to the triple bottom line? *International Journal of Operations & Production Management,* 32 (3), 265-290.

Dierickx, I. & Cool, K., 1989. Asset stock accumulation and sustainability of competitive advantage. *Management Science,* 35 (12), 1504-1511.

Dyer, J.H. & Chu, W., 2003. The role of trustworthiness in reducing transaction costs and improving performance: Empirical evidence from the united states, japan, and korea. *Organization Science,* 14 (1), 57-68.

Dyer, J.H. & Singh, H., 1998. The relational view: Cooperative strategy and sources of interorganizational competitive advantage. *Academy of Management Review*, 660-679.

Ehrgott, M., Reimann, F., Kaufmann, L. & Carter, C.R., 2011. Social sustainability in selecting emerging economy suppliers. *Journal of business ethics,* 98, 99-119.

Fornell, C. & Larcker, D.F., 1981. Evaluating structural equation models with unobservable variables and measurement error. *Journal of Marketing Research*, 39-50.

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

Gualandris, J., Golini, R. & Kalchschmidt, M., 2014. Do supply management and global sourcing matter for firm sustainability performance? An international study. *Supply Chain Management: An International Journal,* 19 (3), 258 - 274.

Gualandris, J., Klassen, R., Vachon, S., & Kalchschmidt, M., 2015. Sustainable evaluation and verification in supply chains: aligning and leveraging accountability to stakeholders. *Journal of Operations Management* doi:10.1016/j.jom.2015.06.002.

Gualandris, J., & Kalchschmidt, M., 2015. Mitigating the effect of risk conditions on supply disruptions: the role of manufacturing postponement enablers. *Production Planning and Control,* 26 (8), 637-653.

Gualandris, J. & Kalchschmidt, M., 2014. Customer pressure and innovativeness: Their role in sustainable supply chain management. *Journal of Purchasing and Supply Management,* 20 (2), 92-103.

Hansen, E.G., Grosse-Dunker, F. & Reichwald, R., Year. Sustainability innovation cube–a framework to evaluate sustainability of product innovationsed.^eds. *XXth ISPIM Conference" The Future of Innovation*, 21-24.

Henseler, J. & Fassott, G., 2010. Testing moderating effects in pls path models: An illustration of available procedures. *Handbook of Partial Least Squares*, 713-735.

Holcomb, T.R., Holmes Jr, R.M. & Connelly, B.L., 2009. Making the most of what you have: Managerial ability as a source of resource value creation. *Strategic management journal,* 30 (5), 457-485.

Huq, F.A., Stevenson, M. & Zorzini, M., 2014. Social sustainability in developing country suppliers: An exploratory study in the ready made garments industry of bangladesh. *International Journal of Operations & Production Management,* 34 (5), 610-638.

Ireland, R.D. & Webb, J.W., 2007. A multi-theoretic perspective on trust and power in strategic supply chains. *Journal of Operations Management,* 25 (2), 482-497.

Klassen, R.D. & Vereecke, A., 2012. Social issues in supply chains: Capabilities link responsibility, risk (opportunity), and performance. *International Journal of Production Economics,* 140 (1), 103-115.

Krause, D.R., Scannell, T.V. & Calantone, R.J., 2000. A structural analysis of the effectiveness of buying firms' strategies to improve supplier performance. *Decision Sciences,* 31 (1), 33-55.

Krause, D.R., Vachon, S. & Klassen, R.D., 2009. Special topic forum on sustainable supply chain management: Introduction and reflections on the role of purchasing management. *Journal of Supply Chain Management,* 45 (4), 18-25.

Lee, S.-Y., Klassen, R.D., Furlan, A. & Vinelli, A., 2014. The green bullwhip effect: Transferring environmental requirements along a supply chain. *International Journal of Production Economics*.

Lee, S.Y. & Klassen, R.D., 2009. Drivers and enablers that foster environmental management capabilities in small- and medium-sized suppliers in supply chains. *Production and Operations management,* 17 (6), 573-586.

Moorman, C., Zaltman, G. & Deshpande, R., 1992. Relationships between providers and users of market research: The dynamics of trust. *Journal of marketing research,* 29 (3), 314-328.

Morgan, R.M. & Hunt, S.D., 1994. The commitment-trust theory of relationship marketing. *the journal of marketing*, 20-38.

Nunnally, J.C., Bernstein, I.H. & Berge, J.M.F., 1967. *Psychometric theory*: McGraw-Hill New York.

Pagell, M., Johnston, D., Veltri, A., Klassen, R. & Biehl, M., 2013. Is safe production an oxymoron? *Production and Operations Management,* 23 (7), 1161–1175.

Pagell, M., Krumwiede, D. & Sheu, C., 2007. Efficacy of environmental and supplier relationship investments—moderating effects of external environment. *International Journal of Production Research,* 45 (9), 2005-2028.

Pagell, M. & Shevchenko, A., 2014. Why research in sustainable supply chain management should have no future. *Journal of Supply Chain Management,* 50 (01), 44–55.

Parmigiani, A., Klassen, R.D. & Russo, M.V., 2011. Efficiency meets accountability: Performance implications of supply chain configuration, control, and capabilities. *Journal of Operations Management,* 29 (3), 212-223.

Paulraj, A., 2011. Understanding the relationships between internal resources and capabilities, sustainable supply management and organizational sustainability. *Journal of Supply Chain Management,* 47 (1), 19-37.

Paulraj, A. & Chen, I.J., 2007. Environmental uncertainty and strategic supply management: A resource dependence perspective and performance implications. *Journal of Supply Chain Management,* 43 (3), 29-42.

Peng, D.X. & Lai, F., 2012. Using partial least squares in operations management research: A practical guideline and summary of past research. *Journal of Operations Management*.

Podsakoff, P.M., Mackenzie, S.B., Lee, J.Y. & Podsakoff, N.P., 2003. Common method biases in behavioral research: A critical review of the literature and recommended remedies. *Journal of applied psychology,* 88 (5), 879-903.

Ringle, C.M., Wende, S. & Will, A., 2005. Smartpls, release 2.0 (beta). *SmartPLS, Hamburg, Germany. URL* http:// www. *smartpls. de*.

Robson, L.S., Clarke, J.A., Cullen, K., Bielecky, A., Severin, C., Bigelow, P.L., Irvin, E., Culyer, A. & Mahood, Q., 2007. The effectiveness of occupational health and safety management system interventions: A systematic review. *Safety Science,* 45 (3), 329-353.

Seuring, S. & Muller, M., 2008. From a literature review to a conceptual framework for sustainable supply chain management. *Journal of Cleaner Production,* 16 (15), 1699-1710.

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

Simpson, D., Power, D. & Samson, D., 2007. Greening the automotive supply chain: A relationship perspective. *International Journal of Operations & Production Management,* 27 (1), 28-48.

Tenenhaus, M., Vinzi, V.E., Chatelin, Y.M. & Lauro, C., 2005. Pls path modeling. *Computational Statistics & Data Analysis,* 48 (1), 159-205.

Touboulic, A., Chicksand, D. & Walker, H., 2014. Managing imbalanced supply chain relationships for sustainability: A power perspective. *Decision Sciences,* 45 (4), 577-619.

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

Vachon, S. & Klassen, R.D., 2008. Environmental management and manufacturing performance: The role of collaboration in the supply chain. *International Journal of Production Economics,* 111 (2), 299-315.

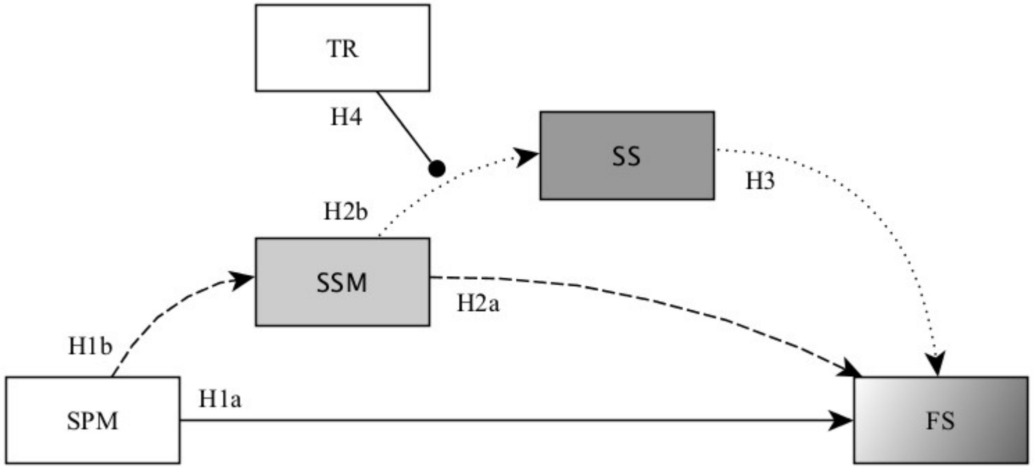
Wiengarten, F. & Pagell, M., 2012. The importance of quality management for the success of environmental management initiatives. *International Journal of Production Economics,* 140 (1), 407-415.

Zairi, M. & Peters, J., 2002. The impact of social responsibility on business performance. *Managerial Auditing Journal,* 17 (4), 174-178.

Zhu, Q. & Sarkis, J., 2004. Relationships between operational practices and performance among early adopters of green supply chain management practices in chinese manufacturing enterprises. *Journal of Operations Management,* 22 (3), 265-289.

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

Figure 1. Conceptual framework



Legend:

Direct effect by SPM at the first stage of SSCM development
Indirect effect through SSM at the second stage of SSCM development
Mediation effect by SS
Moderation effect by TR

Figure 2. Firm sustainability under SSCM

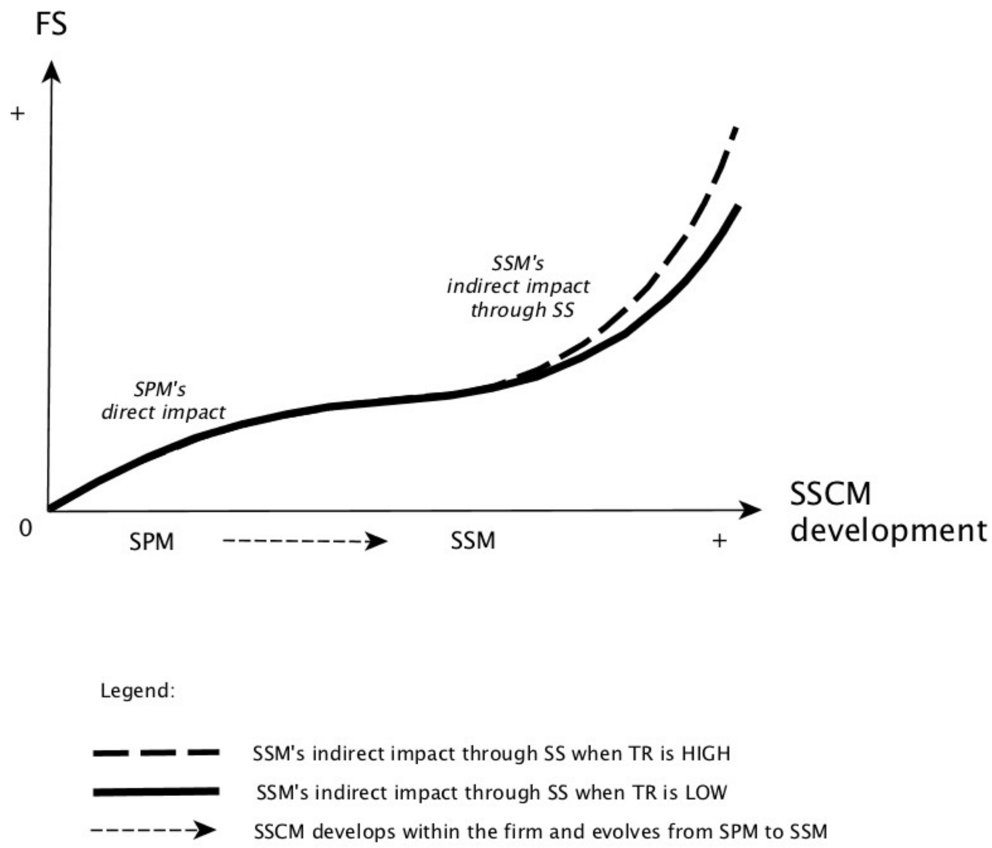


Figure 3. Structural models

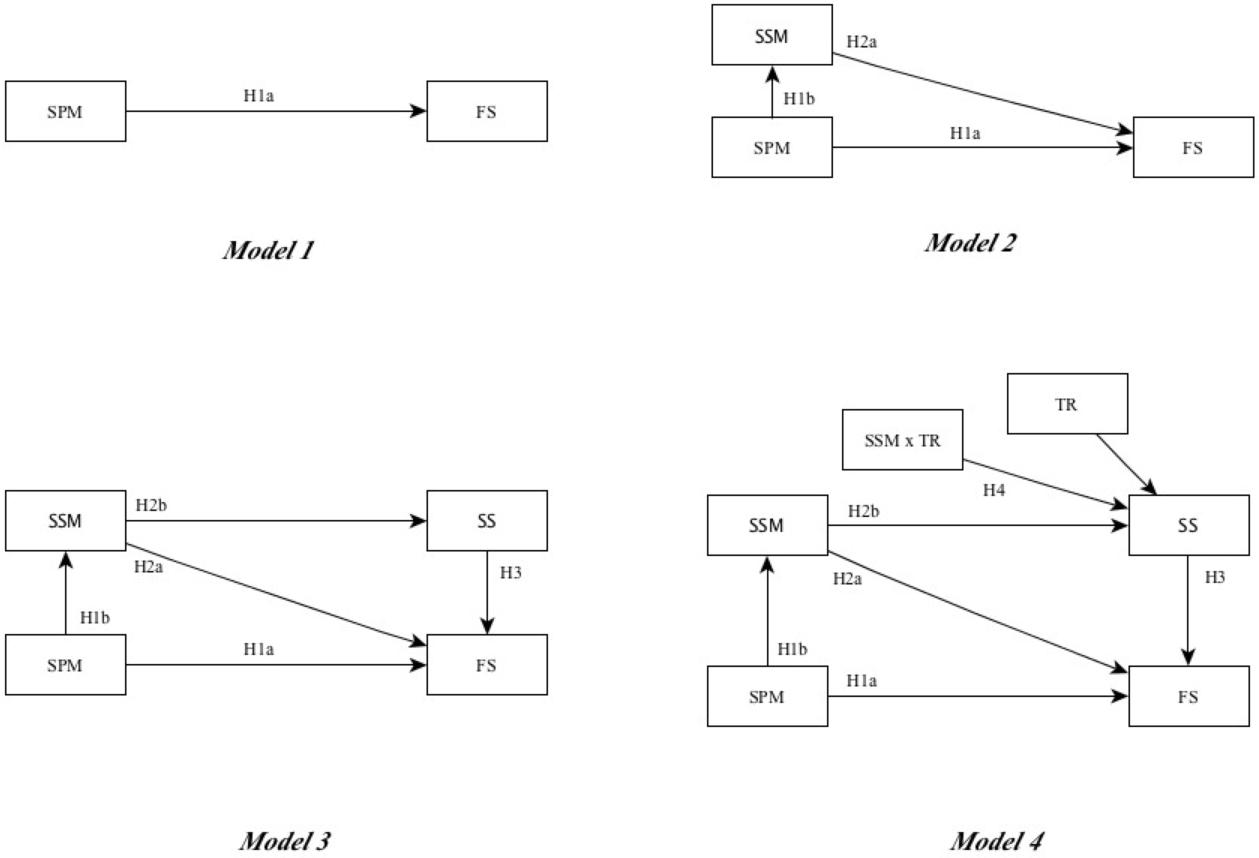


Table I. Constructs definition

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 Shevchencko (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 institutionalization 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 (SSM)	*Internal SSCM practices adopted by the manufacturing firm* The institutionalization 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 et al. (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 et al. (1992); Morgan and Hunt (1994); Benton and Maloni (2005).

Table II. 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**

Table III. Measurement model

Construct name and measurement source	*Items*	*Mean*	*SD*	*Loading*	*Internal consistency*	*Alpha*	*AVE*
Firm sustainability (Paulraj 2011, De Giovanni 2012, Gualandris *et al.* 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 *et al.* 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, 2004)	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			

Table IV. 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

Table V. 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 x TR) → SS	-		-		-		0.09[+]	

[+] *the effect size is calculated using the equation* $f^2 = (R^2_{included} - R^2_{excluded})/(1 - R^2_{included})$

Table A1. Multi-items measurement scales

In the last three years, to what extent has your organization'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:Strogly 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

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