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Mediating Effects of Green Innovations on Interfirm Cooperation

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Abstract

Previous empirical research has largely neglected the mediating role of green innovations on the top management commitment-customer cooperation relationship. This study examines effects of green process innovation and green managerial innovations on this relationship. An empirical analysis with a sample of 181 ISO 14001 Turkish manufacturing firms suggests that top management commitment positively affects customer cooperation, process innovation and managerial innovation. Green process innovation mediates the positive association between top management commitment and customer cooperation, whereas green managerial innovation does not. These findings suggest that green process innovation facilitates business partners to mitigate the external negative impact on environment. By contrast, green managerial innovation has a stronger in-house orientation and facilitates business firms to minimize their carbon footprints.

Keywords: Green innovation, mediating effects, top management commitment, interfirm cooperation, customer cooperation in business-to-business relationships, sustainability.

Highlights

- Examines the influence of a firm's commitment to sustainability on customer cooperation.
- Characterizes influences of process innovation on the commitment-cooperation relationship.
- Characterizes influences of managerial innovation on the commitment-cooperation relationship.

1. Introduction

A variety of global environmental policies directives such as WEEE (waste electronics and electrical equipment) and RoHS (the restricted use of hazardous substances in electrical and electronics equipment) demonstrate the growing need to reduce environmental pollution at the

world level (Barry & Kanematsu, 2016; Sakai *et al.* 2011). The recent Paris Agreement on Climate Change further demonstrates the high level of global mindfulness and commitment to fight the threat of climate change. Better environmental awareness of international customers has similarly compelled firms to become more environmentally sustainable, resulting in green products and brands. Development of international rules and increasing consumer consciousness for environmental protection has required firms to integrate environmental sustainability into their business models. Such strategic environmental integration provides an opportunity for business firms to green their innovation process (Porter & Reinhardt, 2007).

Recent research (Albort-Morant *et al.*, 2016) suggests that firms gain competitive advantage when they implement green innovations. For instance, when business firms initiate innovations, they enjoy several opportunities associated with “first move advantage” such as higher prices, enhanced corporate images, and new market access (Chen *et al.*, 2006). Green innovations also help business firms to attain superior performance and profitability (Chen, 2008). When companies foresee that they can achieve financial and operational benefits, they implement green practices (Bowen *et al.*, 2001). For successful environmental management, firms seek partners that are compliant with sustainable business practices (Lee & Lam, 2012). Accordingly, a company’s ultimate goal is to seek and strengthen customer cooperation through green innovations because these innovations simultaneously enhance the firms’ environmental image and competitive capabilities.

Studies (Lin *et al.*, 2013; Wong, 2012; Chen, 2008) using empirical datasets from singular industries show that implementation green innovations improves customer cooperation. However, the efficiency of green innovation in reducing firms’ environmental footprint and enhancing customer cooperation is dependent on a number of factors. For instance, research (Agi & Nishant, 2017) indicates that contextual elements such as the industry sector, dependence, and durability of

the relationship affect green practices. Due to similar reasons, the motivation to become greener varies across industries. For instance, the clothing industry is the second largest polluter in the world, but the emergence of better environmental awareness among consumers has forced many clothing companies to implement green innovations to make their supply chains sustainable (Sweeny, 2015).

This study frames green innovations as a subset of the sustainable efforts pursued by the firm. Firms that pursue sustainability outcomes address the ecological, social, and economic performance (Elkington 1997). By contrast, efforts to enhance green innovations focus on the ecological merits of the firm. We examine the firm's commitment to sustainability as the driver of green innovations. The firm's use of green process and managerial innovations should influence the level of cooperation in supply chain relationships.

Green innovations focus on mitigating or minimizing environmental damage due to different business activities. In the evolving environmental friendly business scenario, green innovations are critical for developing and maintaining customer satisfaction, as customers are likely to purchase a greater number of environmentally friendly products. For business firms, green innovations open opportunities for new products and business markets. Green innovations result in superior value creation for customers as well as firms and consequently, equalize the cost of environmental investments. In this way, investing in green innovations is a win-win game. For all these reasons, it is important for business firms to study how green innovations can simultaneously improve their environmental efficacy and customer satisfaction.

Empirical evidence (Hoejmose et al., 2012) suggests that comprehensive commitment by top management plays a key role in implementing green innovations as well as achieving customer cooperation. Chiou et al. (2011) illustrate how green innovations provide a clear solution to overcoming customers' pressures regarding compliance with environmental regulations. In this

manner, firms anticipate that green innovations may help meet customers' demands and achieve better customer cooperation.

Prior research categorizes green innovations under different aspects such as technology, managerial functions, manufacturing processes, product design, and production processes (Chen, 2008; Chiou et al., 2011; Tseng et al., 2013). This study considers *green process innovation* (GPI) and *green managerial innovations* (GMI). *Green process innovation* (GPI) refers to adaptation or innovations made to improve existing processes or/and developing new ones to minimize the negative impact of hazardous materials waste, operational pollution, hazardous emissions and energy consumption on environment (Tseng et al., 2013). Green process innovation addresses incremental enhancements to products and services designed to lower resource usage. For instance, firms engaged in green process innovation may replace shop-floor incandescent lamps with LED lighting. *Green managerial innovation* (GMI) refers to action undertaken to redesign and refine current operations, products, and services in order to meet internal green management efficiency considerations (Tseng et al., 2013). Green managerial innovation enables a firm to formulate and re-design internal processes that that address environmental standards or criteria. For example, firms engage in green managerial innovations when they redefine operations and production processes to ensure internal environmental efficiencies.

In this study, we frame *top management commitment* as internal pledges and support made by top management to pursue sustainable operations (Chiou et al., 2011). We examine *customer cooperation* as the extent to which a customer is willing to work with a trading partner to achieve sustainable outcomes (Sancha et al., 2014). Although ample research has examined these topics (e.g., Morgan & Hunt, 1994), scant efforts examine how different green innovation affects the top management commitment-customer cooperation relationship.

The goal of this study is to contribute to the study of green innovations in interfirm relationships. We examine the direct relationship between top management commitment and customer cooperation, and subsequently examine the mediating influence of green innovations on this relationship. The next section provides the conceptual framework and hypotheses. We subsequently present the research methodology followed by an empirical assessment of the model. We conclude by addressing the implication of this study.

2. Conceptual framework and hypotheses

According to green management literature (Chiou et al., 2011; Zhu et al., 2013), green innovations and top management commitment are part of a firm's internal environmental management practices. Green innovations consist of adopting of new technologies or processes that mitigate environmental damage. Existing literature examines the role of green innovations in different contexts such as environmental performance and competitiveness (Chiou et al., 2011; Chen et al., 2006), internal and external green supply chain practices (Zhu et al., 2013), uncertainty (Tseng et al., 2013), green competence and firm's green image (Chen, 2007) and operational practices and performance (Zhu & Sarkis, 2004).

Prior research contribute significantly towards our understanding of environmental management, green innovations, and corporate environmental performance. Within the context of sustainable supply chains, however, few studies (Zhu et al., 2013) provide empirical evidence about the direct relationship between top management commitment and customer collaboration. Scant research has examined the mediating role of green innovations in inter-firm relationships. Chen (2008) shows that process innovation partially mediates the relationship between green core competences and green images of firms. To the best of the knowledge of authors, however, no

other study has examined the mediating role of green innovations on the relationship between top management commitment and customer collaboration. This study addresses the research gap.

This paper introduces a conceptual model that identifies structural relationships linking the internal management practices, top management commitment and green innovations, with one external management practice, customer cooperation. Our model recognizes that initially the firm must make a commitment to sustainability. This commitment to sustainability should foster the development of green innovations. Managerial commitment and innovation enhance the level of customer cooperation. Figure 1 summarizes the model.

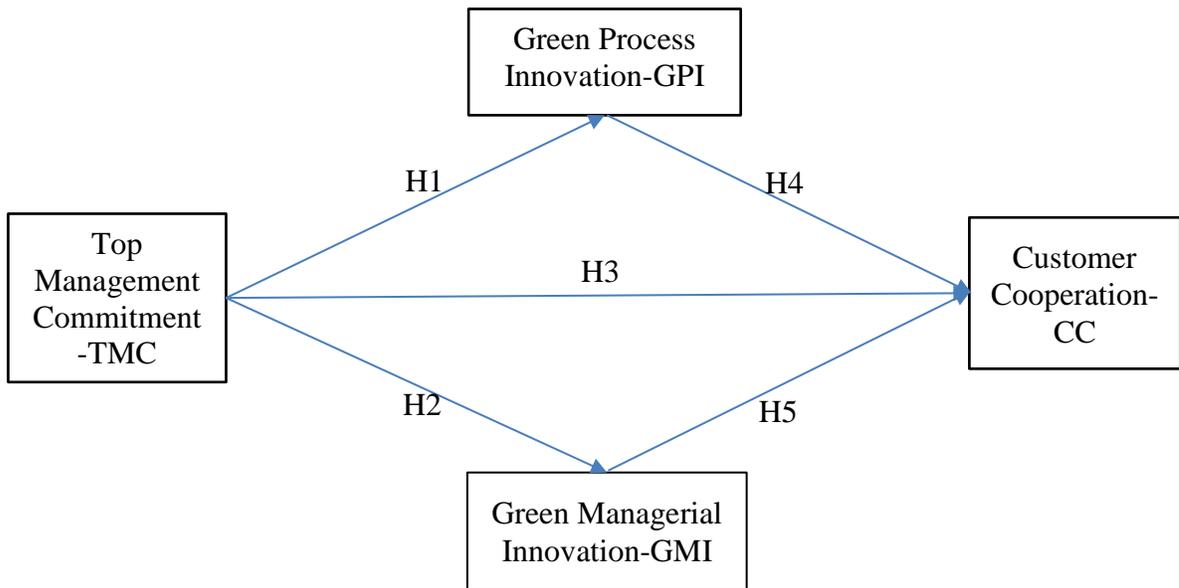


Figure 1: The research model

2.1 Top management, green innovations, and customer cooperation

Prior research (Zhu et al., 2013) indicates that top management commitment is a key factor in achieving successful sustainable management. The reason is simple: top management commitment creates and nurtures the necessary vision and organizational vigor to achieve sustainability. Zhu & Sarkis (2004) indicate that getting a commitment from top management plays a crucial role in the

successful implementation of green managerial practices. Top management commitment is essential to developing a firm's organizational structures (Daily & Huang, 2001) and securing the support necessary to undertake and achieve sustainability (Hoejmose et al., 2012).

Generally, a firm's top management is encouraged by ethical and commercial motivations to implement sustainability into their operations (Testa & Iraldo, 2010). Under the ethical motivation perspective, top management employs an environmental focus as a motivation to innovate and achieve better sustainability. The firm's vocal commitment to sustainability, however, has limited influence on a business partner's efforts to become more sustainable. When environmental ethics is a key part of business firms' culture, it acts as the driving force for green innovation (Peng & Lin, 2008). The commercial motivation perspective argues that firm's top management should execute sustainable strategies that reduce the cost of production and hazardous materials and generate operational and economic benefits (Ittner *et al.*, 2003).

Top management has an important influence on innovations pursued by the firm. Bansal (2003) indicates that top management ecological concerns are associated with the speed and scope of response to environmental issues. Consistent with this perspective, Eiadat *et al.* (2008) illustrate that managerial concerns lead to the adoption of innovative environmental strategies. Noci and Verganti (1999) similarly offer evidence that corporate proactive strategic attitudes foster higher levels of innovation. These studies suggest that when top management recognizes that sustainability supplements both ethical and commercial objectives, green innovations are adopted to improve a firm's overall performance (Ferguson & Langford, 2006; Tseng et al., 2013). When top management supports sustainable initiatives, it leads to more green innovations and better performance (Rao, 2002; Chiou et al., 2011). Hence, we propose:

H1: Top management commitment to sustainability has a positive effect on green process innovation.

H2: Top management commitment to sustainability has a positive effect on green managerial innovation.

Business firms characterized by high environmental mindfulness demand similar levels of compliance from their transacting partners (Lee & Lam, 2012). When companies foresee that they can achieve financial and operational benefits, they implement green practices (Bowen et al., 2001). Empirical evidence (Hoejmose et al., 2012) suggests that comprehensive commitment by top management plays a key role in implementing green innovations as well as achieving customer cooperation. In accordance with the relationship marketing perspective (Morgan & Hunt, 1994), commitment is a sign of firm's desire to maintain a valuable relationship and fulfill the anticipated level of trust. As trust develops, opportunistic tendencies decline and collaboration between business partners flourishes (Hoejmose et al., 2012). Zhu et al. (2005) reports that when inter-firm governance mechanisms promote trust, they reduce risk and sequentially increase innovation. When business partners demonstrate solid commitment to comply with environmental requirements, both parties achieve mutual benefits (Sancha *et al.*, 2014).

Research (Ilker, 2012) shows that the environmental concern demonstrated by top management positively affect green channel performance. Similarly, other studies (Qi et al., 2010; 2013) outline that when one of the dyadic partners embraces green practices, others follow suit and adopt green practices. When managers perceive pressure to adopt green innovations from their external stakeholders, they implement internal green initiatives in order to provide competitive advantages to external holders (Huang et al. 2009; Chiou et al. 2011). Hence, we propose:

H3: Top management commitment to sustainability has a positive effect on customer cooperation.

2.2 *Green innovations and customer cooperation*

When business firms embrace green innovations to minimize the negative impact on environment, close cooperation enables them to achieve environmental performance objectives (Chiou et al., 2011; Rao & Holt, 2005). For instance, a firm's overall performance improves when transacting partners are integrated more closely into the product innovation process (Lau et al., 2010). This integration improves the firm's green image and provides new business opportunities (Chen, 2008). Rao (2002) identifies that firms develop closer relationships with their partners when they want to make their supply chains green. Close collaboration leads to close involvement in product development and, consequently, enhanced environmental performance and competitive advantage. Prior research (Chiou et al., 2011; Chen, 2008; Chen et al., 2006; Rao & Holt, 2005) shows how green innovations and green image affect performance, but it is tacit with respect to the role of green innovations in an inter-firm context.

The firm can innovate by changing processes or products via managerial innovation. Product modifications and enhancements to production processes should foster greater cooperation with customer. When they have ecologically-oriented obligations, they will seek out new products that offer environmentally-friendly advantages. Similarly, firms that focus on transforming operating processes will find merit from establishing closer working relationships with suppliers. As firms get more innovative with the measures they take to conserve resources, they recognize the role that transacting partners play in the value chain. Hence, we propose:

H4: Green process innovation has a positive effect on customer cooperation.

H5: Green managerial innovation has a positive effect on customer cooperation.

2.3 *Mediation analysis*

In the current global business environment, business firms face constant demands from industrial customers as well as from ordinary consumers for better greener products. Research (Zhu, et. al., 2008) suggests that superior collaboration between business partners positively affect the management of environment sustainability issues. Research (Kushwaha & Sharma, 2016) shows that adopting green initiative such as green innovations affect firm performance. Studies (Qi et al., 2013; Rao and Holt, 2005) outline that green process innovation improves firms' economic performance. Similarly, green managerial innovation underlines that top and senior managers' clear and active actions to minimize the negative impact of environmental pollution and waste (Banerjee, 2001). When business firms adopt environmental ethics in their business activities, it results in improving their competitive advantage (Chang, 2011).

The aforesaid arguments suggest that firms achieve better performance objectives in relation to their customers when they implement green innovations. When firms dynamically adopt environment friendly strategies and greener innovations in their daily business operations, they become strategically more attractive for current as well as future customers who are interested in improving green performance and green competitive advantage parameters in an exchange relationship. Hence, this study examines the mediating role of green process and green managerial innovations on the relationship between top management commitment and customer cooperation.

Green process innovations help business firms to reduce their costs and minimize the negative impact on the environment. Previous literature argues that by investing in green process innovation, business firms can minimize production waste and enhance resource efficiency (Chang, 2011; Chen, 2011). Implementing continuous process innovation improves material efficiency and

productivity (Chen, 2008). Active implementation of green process innovation demonstrates firm's environmental competence in satisfying customers' demands at competitive prices. On the other hand, green managerial innovation enables firms to formulate timely policies and budgetary allocations for processes to ensure internal environmental efficiencies. Through managerial innovations, business firms proactively strategize, implement and monitor internal efficiency measures, and alleviate the impact on environment (Tseng et al., 2013). Managerial innovations give business firms the required strategic flexibility to adjust their innovation initiatives in response to customers' requirements. Moreover, managerial innovations demonstrate organization's pledge towards better environmental management.

In sustainable problems setting, it is important for business firms to nurture solid relationships with their external partners to realize successful performance of green innovations (Ngai et al., 2008). Firms that modify operations and managerial initiatives signal partners about their sincerity in achieving sustainable outcomes. Cooperation with external transacting partners should increase when sustainable actions demonstrate commitment. Hence, we propose:

H6a: Green process innovation mediates the relationship between top management commitment to sustainability and customer cooperation.

H6b: Green managerial innovation mediates the relationship between top management commitment to sustainability and customer cooperation.

3. Methodology and measurement

Turkish exporting firms in the Izmir region were selected as the empirical setting for a number of reasons. First, Turkey was chosen due to the strategic importance in terms of their exports to

European Union countries. Second, there are more than 4000 exporting firms that are operating in Izmir and its adjoining areas (as reported by Izmir development agency, IZKA). A majority of these exporting firms fulfill essential sustainable and environment friendly requirements such as ISO14001 series certifications. Third, the Turkish government prioritizes developing sustainable infrastructures such as water conservation, transportation, and solid waste management. Prioritizing environmentally friendly and sustainable measures at the national levels resulted in lowering general greenhouse gas emissions in Turkey. That is why the average level of annual greenhouse gas emissions in Turkey is quite low in comparison to the EU average (OECD, 2012).

Initially, we selected all those exporting firms whose websites showed clear commitment towards sustainable and environmental friendly practices. This study mainly surveyed respondent firms from textile, chemical, food, electrical, electronics, manufacturing, and medical industries. Generally, these industries produce/discharge higher than average environmental pollution and waste and hence are more likely to implement environmental management practices.

The selected firms employed a number of initiatives to achieve environmental sustainability during diverse manufacturing and/or handling procedures for a diverse range of products. Personal visits to the selected firms' operational/manufacturing units were undertaken to ensure respondents met our selection criterion. The number of fulltime employees and the number of years an exporting firm has been doing business were used to select 250 manufacturing and services providing firms. All the selected firms had ISO 14001 series certifications. During the questionnaire administration process, local industry connections were applied to achieve maximum number of respondent firms. Hence, 181 useable responses were collected from a diverse set of exporting firms (see table 1) and provided an extraordinary response rate of 72 percent.

Table 1
Sample profile of the respondent firms

| Characteristic | Percentage |
|--------------------------------------|------------|
| Industry | |
| Textile | 55 |
| Electronics | 31 |
| Auto Parts Manufacturing | 15 |
| Medical Equipment | 12 |
| Chemical Products | 10 |
| Food Products | 08 |
| Energy Products | 05 |
| Others | 52 |
| Total | 181 |
| Size (employees) | |
| 1-20 | 31.3 |
| 21-50 | 32.9 |
| 51-100 | 16.8 |
| 101-500 | 12.9 |
| >500 | 6.1 |
| Total | 100 |
| Years Doing Business Together | |
| 1-5 | 52.5 |
| 6-20 | 44.2 |
| 20-30 | 3.3 |
| Total | 100 |

This study followed the key informant approach to collect primary data. All the key informants were CEOs, export directors, operations managers, environmental and supply chain managers, and have been working in the respective respondent firm for more than five years. They had a good knowledge about different environment related practices adopted or implemented in their business units. The unit of analysis is the relationship between these exporting firms and their most important customers.

The original structured questionnaire was in English. During the questionnaire-testing phase, language difficulties became apparent and two university instructors who teach marketing and supply chain management translated the questionnaire into Turkish. After the modifications, experts from academia and business firms reviewed the questionnaire and reported no ambiguity

in the language and the structure of the questionnaire. Furthermore, a close communication link between respondents firms and the researcher team mitigated any translation difficulty that arose during the questionnaire administration process. All questions were measured using a five point Likert scale.

When primary data are collected from a single informant, common method variance can be an issue. We took steps to minimize this problem. First, the questions pertaining to the dependent and independent variables in the questionnaire were separated into sections (Podsakoff et al., 2003). Second, we conducted Harman's one-factor test by performing factor analysis on the items of dependent variable and independent variables. Four factors were extracted with Eigen values greater than one, and no single factor accounted for more than 39% of the total variance. The results suggest that common method variance is not an issue in this study.

3.1 Measures and control variables

This study modified existing measures to assess the four constructs. Four items proposed in previous studies (e.g., Zhu & Sarkis, 2004; Hoejmose et al., 2012) are modified to measure *top management commitment* (TMC). The respondents report about the levels of commitment and support provided by the top and senior management concerning sustainability. Items for the two innovations, *green process innovation* (GPI) and *green managerial innovation* (GMI) are adopted from previous studies (e.g., Chen, 2008; Chiou et al., 2014). Process innovation items report about energy saving and pollution prevention processes, whereas managerial innovation items report about the practical attitude towards environmental protection by the respondent firms. *Customer cooperation* (CC) is measured by modifying the items proposed by previous studies (Zhu & Sarkis, 2004; Zhu et al., 2013). The respondent firms reported about the level of cooperation with their most important customers regarding green innovations.

Two control variables are incorporated in our theoretical model to check its robustness. First, we included time duration, which represents the number of years a manufacturer has been doing business with a particular customer and reflects the stake and leverage of business partner (Heidi & John, 1992). Therefore, it may impact customer cooperation in business relationships. The natural logarithm of the number of years of doing business (LogT) with the focal customer was incorporated in our model to account for this effect. Second, we incorporated firm size, which characterizes the number of fulltime workers employed by a manufacturing firm to capture the strategic position of a manufacturing firm and its relationship with a specific customer. A natural logarithm of the number of fulltime workers (LogF) was incorporated into the research model.

3.2 Validation of constructs

For all the multi-item constructs (TMC, GPI, GMI and CC), an exploratory factor analysis (EFA) was performed, and items that showed low or insignificant loading relating to the dependent and independent variables were rejected. The convergent validity was analyzed by assessing the loading and significant level of each measurement item on its respective construct. All the measurement items loaded on their respective constructs and factor loadings ranged from 0.51 to 0.90, providing convergent validity of the theoretical constructs. Cronbach's alpha and composite reliability values for the all constructs were equal or greater than 0.69, indicating suitable reliability for all the measurement scales (Nunnally & Bernstein, 1994).

In order to verify unidimensionality (i.e. internal consistency) and reliability of our measurement model, we applied AMOS 22 to assess factor structures (CFA) and relationships among independent and dependent variables. The CFA results of the measurement model show a reasonable fit to the four-factor solution. The chi-square/degree of freedom ratio was 1.93 of

Chisquare, $\chi^2 = 137.09$ and the degrees of freedom, $df = 71.00$. All the fit indices (CFI = 0.96, IFI = 0.96, TLI = 0.95 and RMSEA = 0.072) values endorsed an acceptable fit for our model (Hu & Bentler, 1999). Table 2 provides the respective values for Cronbach's alpha, composite reliability (CR) and average variance extracted (AVE).

Table 2
Description of items and validity measures

| Constructs | Sample of items. <i>Response format:</i> 5-Point Likert-type scales with end points indicating strongly disagree and strongly agree. |
|--|--|
| Top Management Commitment (TMC) 4 items, $\alpha = .87$, CR = .88 | TMC1: Our firm's top management strongly support efforts to develop sustainable practices. TMC2: Our firm's top management consider sustainable practices as a vital part of corporate strategy. TMC3: Our firm's top managers strongly implement sustainable practices during procurement procedures. TMC4: Our firm's senior management strongly support sustainable practices efforts. |
| Green Managerial Innovation (GMI) 2 items, $\alpha = .67$, CR = .68 | GMI1: Our firm has redesigned operation and production processes to meet internal environmental efficiency. GMI2: Our firm has redesigned and improved products and services to meet new environmental criteria. |
| Green Process Innovation (GPI) 3 items, $\alpha = .93$, CR = .93 | GPI1: Our firm has taken measures to lower the consumption of water, electricity, gas, and petrol during the production or disposal process. GPI2: Our firm has taken measures to recycle, reuse and remanufacture materials or parts. GPI3: Our firm has taken measures to achieve savings in the usage of energy, water and waste. |
| Customer Cooperation (CC) 5 items, $\alpha = .83$, CR = .82 | CC1: Our firm cooperates closely with this customer for green packaging. CC2: Our firm cooperates closely with this customer to achieve green handling procedures. CC3: Our firm cooperates closely with this customer to evaluate green sustainable practices. CC4: Our firm cooperates closely with this customer to implement green sustainable practices. CC5: Our firm cooperates closely with this customer to do recycle procedures. |
| Firm Size (LogF): 1 item | The number of fulltime workers employed by the manufacturing firm (natural logarithm). |
| Time Duration (LogT): <u>1 item</u> | The length of business relationship that the manufacturing firm has been doing business with the focal customer in the relationship (natural logarithm). |

4. Empirical analysis and results

4.1 Structural equation modelling

To test the hypothesized associations between the constructs, a structural model was conducted by using AMOS 22. The analysis revealed a satisfactory structural equation model fit, as indicated by the ratio ($\chi^2/df = 1.74$) of Chi-square ($\chi^2 = 192.95$) and the degrees of freedom ($df = 111.00$) and the fit indices (CFI = 0.95, IFI = 0.95, TLI = 0.93 and RMSEA = 0.064). The results indicate that top management commitment is positively related to green process innovation ($\beta = 0.61, p < 0.00$), green managerial innovation ($\beta = 0.22, p < 0.00$) and customer cooperation ($\beta = 0.13, p < 0.02$). Hence, hypotheses H1, H2 and H3 are supported.

Concerning hypotheses H4 and H5, the statistical results show that green process innovation has a positive effect on customer cooperation ($\beta = 0.28, p < 0.00$), whereas green managerial innovation has an insignificant effect on customer cooperation ($\beta = 0.02, ns$). Table 3 show the correlation matrix of the model and respective AVE (average variance extracted) for individual constructs are shown with bold numbers.

Table 3
Correlation matrix

| | CC | GPI | GMI | TMC | LogT | LogL |
|------|-----------------------|-----------------------|-----------------------|-----------------------|--------|--------|
| CC | 1.000 (0.51) | | | | | |
| GPI | 0.630 | 1.000 (0.81) | | | | |
| GMI | 0.114 | 0.115 | 1.000 (0.52) | | | |
| TMC | 0.473 | 0.490 | 0.235 | 1.000 (0.65) | | |
| LogT | 0.101 | 0.125 | 0.060 | 0.256 | 1.000 | |
| LogL | 0.241 | 0.130 | 0.063 | 0.266 | 0.301 | 1.000 |
| Mean | 2.8033 | 2.8803 | 3.7551 | 3.6119 | 1.7255 | 3.8855 |
| S.D. | 0.8749 | 1.3371 | 0.9220 | 1.0499 | 0.7797 | 1.3807 |
| N | 181 | 181 | 181 | 181 | 181 | 181 |

4.2 The mediation analysis

We applied the bootstrapping bias-corrected confidence interval procedure in structural equation modelling (SEM) in AMOS 24 to test our mediation effects (Strizhakova et al., 2011; Preacher & Hayes, 2008). In order to obtain confidence intervals, we used 2000 samples in our study and the bias-corrected method percentile method generated 95% confidence intervals. Table 4 reports the mediation effects. We applied the phantom model approach (Macho & Ledermann, 2011) to calculate the specific indirect effect because this approach disentangles the specific indirect effect and thereby generates bootstrap estimates.

Regarding the mediating effects, the results (see table 4) show a significant indirect effect of top management commitment (TMC) on customer cooperation (CC) through green process innovation (GPI), supporting H6a, whereas the results show an insignificant indirect effect of TMC on CC through GMI and hence, H6b is not support.

Table 4

Mediation analysis results using a bootstrapping bias-corrected procedure

| Effect | Point of estimates | S. E | BC 95% CI | |
|---|--------------------|-------|-----------|-------|
| | | | Lower | Upper |
| Total effect of TMC | 0.311*** | 0.199 | 0.202 | 0.444 |
| Direct effect of TMC on CC | 0.133** | 0.054 | 0.029 | 0.247 |
| Indirect effect ^a of TMC on CC through GPI | 0.179*** | 0.145 | 0.106 | 0.278 |
| Direct effect of TMC on CC | 0.294*** | 0.061 | 0.192 | 0.434 |
| Indirect effect ^a of TMC on CC through GMI | 0.010 (ns) | 0.138 | -0.013 | 0.057 |

^a Assessment of individual indirect effects was conducted by the phantom model approach (Macho & Ledermann, 2011). ***
 $p < 0.001$, ** $p < 0.0$, ns = non significant.

As predicted in hypothesis H6a, green process innovations would mediate the relationship between top management commitment and customer cooperation in interfirm relationships. Our mediation results demonstrate a significant positive direct effect of TMC on green process

innovation and of green process innovation on customer cooperation. The phantom model approach indicates that TMC has a significant and positive indirect effect on customer cooperation through green process innovation (*unstandardized estimates* = 0.179, *SE*= 0.054, *p* < 0.001). The hypothesis H6b predicts the mediation effect of green managerial innovation on the relationship between top management commitment and customer cooperation. The phantom model technique shows that TMC has an insignificant effect on customer cooperation via green managerial innovation (*unstandardized estimates* = 0.110, *SE*= 0.055, *p* > 0.05).

Table 5
The results of the structural model

| Hypothesis | Proposed Effect | Path Coefficient | Results |
|---|-----------------|------------------|---------------|
| H1: Top management commitment to sustainability has a positive effect on green process innovation. | Positive | 0.610** | Supported |
| H2: Top management commitment to sustainability has a positive effect on green managerial innovation. | Positive | 0.216** | Supported |
| H3: Top management commitment to sustainability has a positive effect on customer cooperation. | Positive | 0.129* | Supported |
| H4: Green process innovation has a positive effect on customer cooperation. | Positive | 0.280** | Supported |
| H5: Green managerial innovation has a positive effect on customer cooperation. | Positive | 0.015 | Not Supported |

***p* < 0.001, **p* < 0.01

5. Limitations, implications, and conclusions

The goal of this study has been to contribute to the study of sustainable business practices in supply chain relationships. The results indicate that top management commitment to sustainability yields higher levels of green process innovation, green managerial innovation, and customer cooperation. In addition, green process enhances customer cooperation. Prior to examining the implications of this research, consider the limitations of the study.

Our analysis underscores the role of top management in achieving interfirm cooperation, but it is tacit with respect to other sustainable outcomes. Firms clearly value customer cooperation, but

the firm must also assess the economic and ecological performance of a relationship (Esty & Winston, 2005). Follow-up research that examines influences of top management on triple bottom line performance can contribute to supply chain theory and practice. A focus on triple bottom line outcomes provides the opportunity to assess trade-offs among facets of relational, economic, and ecological performance.

Research that examines dyadic relationships in the supply chain can also augment this research (Kumar et al., 1993). Measuring cooperation from the supplier's perspective amplifies the need to consider customer sentiments, but it may not completely capture the customer's vantage point (John & Reve, 1982). Dyadic research offers the ability to assess differences between reports provided by suppliers and customers. Like other dyadic studies, this study was collected data from one side of the dyad, the manufacturer side. The empirical analysis shows that common method bias is not a serious issue in this study. Nevertheless, collecting data about cooperation for greening activities from the customer side would further augments our results and lessen the possibility of common method bias.

In addition, it would be useful to do a comparative study across emerging economies such as India, Pakistan, and Bangladesh. Economic growth rates of these emerging economies are strongly dependent on exports products such as textiles products that are known environmental pollutants.

The roles of commitment and cooperation can also be augmented in future research. Our assessment of commitment examines whether top management supports sustainable action, but it does not elaborate on the mechanisms employed by management. Firms may be sustainable concerning some aspects of operations (e.g., sustainable procurement), yet they may not emphasize other factors that influence the firm's carbon footprint (i.e., transportation choices) (Esty & Winston, 2006). Future research can also benefit from taking a more refined look into cooperation

and collaboration in a supply chain. For example, Vachon and Klassen (2006) illustrate conditions under which logistical and technical integration influence levels of collaboration. Broader examination of the drivers and barriers to top management sustainability efforts offers insight to supply chain practice and theory (Giunepero et al., 2012).

Despite the limitations of this research, it does provide some managerial insight. Firms are increasingly faced with greater expectation concerning their abilities to secure sustainable outcomes (Crittenden et al., 2011), yet few studies address antecedents to sustainable outcomes. Lubin & Esty (2010) recognize that the firm's chief sustainability officer must help the executive team to visualize goals and align business strategies. Consistent with this perspective, our research underscores how management can enhance customer cooperation. Top management commitment to sustainable practices fosters an environment conducive to cooperation. When management makes these commitments to sustainability, they enhance innovation along with cooperation.

This study applied green process innovation and green managerial innovation. Green process innovation has the potential to provide business firms with new opportunities in areas such as green product development, environmental efficiency, cost savings and green image and green reputation. Contextually, green process innovation is more external in its dimension as its objective is to mitigate the negative impact on environment. Top management commitment coupled with process innovation fosters cooperation. By contrast, green managerial innovation has a stronger internal orientation. We find an insignificant mediation effect on customer cooperation, but a strong positive relationship with top management commitment. Collectively, these findings suggest that when firms adopt and implement green innovations, they achieve better environmental management, both internally and externally.

Our research also contributes to the study of sustainable innovations. Prior research (van Berkel, 2007) suggests that when top management supports the adoption and implementation of green

manufacturing strategies, they realize economic and environmental benefits. Our study's findings supplement the argument that green innovations facilitate achieving resource efficiency and environmental compliance. As a result, we suggest that top management support for sustainability can act as a catalyst to produce green products and services, and help attain sustainability goals in inter-firm dyads. Epstein (2008) indicates that managers are increasingly probing ways to identify, manage, and improve green sustainability drivers that also delivers better performance. Emerging marketing trends for green innovations are compelling business managers to work closely on ecological matters. Managerial commitments to green innovations enable firms to lower their carbon footprints

Consistent with Chen (2008) and Chiou *et al.* (2014), we illustrate the merits of discrete analysis of green process innovation and green managerial innovation. We augment Chen's (2008) analysis of green image by illustrating conditions under which green innovation influences customer cooperation. Our study complements Chiou *et al.*'s (2014) study of green innovation by examining top management sustainability practices as determinant of green process and managerial innovation. Our findings are consistent with Chiou *et al.* (2014) concerning top management influences on process and managerial innovation, but we only find support for process innovation as a determinant of customer cooperation.

Our findings have implications for the application of marketing theory to supply chain relationships. Morgan & Hunt (1994) indicate that top management commitment signals a desire to maintain a relationship leading to higher levels of collaboration. We illustrate that when a firm makes vocal commitment to sustainability, customer cooperation increases. Although cooperation is enhanced via these commitments, prior studies (Hoejmose *et al.*, 2012) also suggest a decline in opportunism. Research can augment our findings by examining conditions under which management commitment to sustainability influences opportunism.

In conclusion, the goal of this study has been to contribute to the study of sustainable business practices. We characterize and assess relationships among top management commitment, green innovations, and customer cooperation. Our findings indicate that top management commitment yields higher levels of green innovations and customer cooperation. We hope that these results offer insight into the marketing thought and practice.

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