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Green Innovation and Performance: The View of Organizational Capability and Social Reciprocity

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Abstract Synthesizing insights from a dynamic capability perspective and social network theory, this study identifies the factors influencing green innovation and examines the relationships between influencing factors, green innovation, and performance. This study uses structural equation modeling to test the research hypotheses. The results indicate that dynamic capability, coordination capability, and social reciprocity are significant drivers of green innovation, including green product innovation and green process innovation. Green product and process innovation have positive effects on environmental performance and organizational performance. These findings are relevant to firms in quest of green management and innovation.

Keywords Green innovation · Organizational capability · Social reciprocity · Performance

Introduction

As consumer concern with the environment strengthens, and governmental environmental regulation widens, high-tech companies recognize the importance of environmental management and make environmental concerns integral to their corporate goals, practices, and strategies (Chen 2008; Peng and Lin 2008; Chang 2011). The characteristics of environmental management are the adoption of green practices or green products and processes that are less detrimental to the natural environment than their predecessors (Zhu and Sarkis 2004; Zhu et al. 2012). High-tech companies develop environmentally responsible and friendly innovations in order to comply with regulations and legislation related to environmental protection (Chen 2008; Chiou et al. 2011; Cai and Zhou 2014). Green innovation or eco-innovation deals with the environmental issues related to energy saving, pollution prevention, waste recycling, and eco-design (Chang 2011; Chiou et al. 2011; Bocken et al. 2014; Cai and Zhou 2014). Green innovation has become an important strategic tool by which high-tech firms can achieve sustainable development (Chen 2008; Chiou et al. 2011).

The traditional view of corporate environmentalism suggests that environmental management causes inefficiencies and productivity loss (Palmer et al. 1995). Preventive approaches have been adopted to minimize the problems related to environmental pollution. Palmer et al. (1995) argued that the benefits from investment in more efficient green technology will not be sufficient to compensate firms for the associated expenses. However, recent research has paid more attention to green management and green innovation associated with economic performance and sustainable development (Peng and Lin 2008; Huang and Wu 2010; Chiou et al. 2011; Cai and Zhou 2014; Przychodzen and Przychodzen 2015).

The concept of ecological modernization indicates the possibility of overcoming environmental crises without leaving the path of modernization (Janicke 2008; Mol et al. 2009). Ecological modernization theory suggests that green

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management serves as an innovation mechanism for firms to integrate environmental issues into their operation (Janicke 2008; Mol et al. 2009; Zhu et al. 2012). Green management involves consideration of how green practices affect the competitiveness and profitability of a firm (Banerjee 2002; Pane Haden et al. 2009). Companies can start green innovation or eco-innovation based on green product innovation and green process innovation. With more environmental concerns, firms can view green innovation or eco-innovation as a business opportunity (Zhu et al. 2012; Bocken et al. 2014). Green innovation indicates green product and process to modify an existing product design to reduce any negative impact on the environment during any stage of a product's life cycle (Chen et al. 2006; Chiou et al. 2011). Green innovation includes strategies intended to mitigate or reclaim environmental effects of pollution producers or resource users, or to decrease usage of resources in anticipation of negative effects. High-tech firms can develop green innovation to address the environmental concerns of their stakeholders and to reduce the environmental impact of their production and service activities (Chen 2008; Chiou et al. 2011; Weng and Lin 2011). The integration of green concept into the design and packaging of their products can improve product quality and increase the differentiation advantages associated with their products (Chen et al. 2006; Chen 2008; Hillestad et al. 2010). Companies can decrease production costs and increase economic efficiency by applying environmentally related practices, such as reduction of energy consumption, reuse of material, and redefinition of operation and production process (Zhu and Sarkis 2004; Huang and Wu 2010; Dong et al. 2014). Green innovation contributes substantial benefits for firms to enhance business performance and competitive advantage (Peng and Lin 2008; Chiou et al. 2011; Zhu et al. 2012) and further contributes to corporate reputation and image (Chen 2008).

Identifying the factors influencing green innovation has become increasingly important in recent years (Cai and Zhou 2014). Several studies have proposed various explanations about certain organizational, technological, and environmental factors influencing green innovation or eco-innovation (Zhu et al. 2008; Huang and Wu 2010; Weng and Lin 2011; Cai and Zhou 2014). However, little research has considered the roles of dynamic capability and organizational social networks in green innovation. To fill this research gap, this study identifies dynamic capability, coordination capability, and social reciprocity as potential influencing factors that may have impacts on green innovation and examines the relevant theoretical rationales and empirical work. Green innovation not only relies on existing capabilities but also disrupts existing capabilities or requires building new ones. Firms need to develop dynamic capabilities that enable them to integrate and reconfigure internal and external resources in response to environmental challenges (Chen 2008; Gavronski et al. 2011). Eisenhardt and Martin (2000) define a dynamic capability as a firm's processes to integrate, reconfigure, gain, and release resources. Dynamic capability reflects the integration and reconfiguration of organizational skills and resources under conditions of environmental volatility (Eisenhardt and Martin 2000; Teece 2007; Li and Liu 2014). A firm can maintain a dynamic pool of complementary capabilities to transform an existing resource base and to internalize external resources in competitively intensive environments (Eisenhardt and Martin 2000; Teece 2007; Wu 2010; Li and Liu 2014). The dynamic capability perspective suggests that dynamic capability helps firms to sense and seize opportunities and to reconfigure crucial knowledge across levels of the organization (Teece et al. 1997; Teece 2007). Firms can modify existing assets and develop the new skills needed to address emerging threats and opportunities (Wu 2010; Li and Liu 2014). They are better able to integrate innovation into their internal operation and existing product portfolio (Teece 2007; Ellonen et al. 2009; Li and Liu 2014). Thus, dynamic capability might elicit more green products or processes that promote green innovation.

Social network theory emphasizes the importance of network relationships and ties (Dyer and Singh 1998; Tsai and Ghoshal 1998). Firms operate within a network of interdependent relationships. Networks are forums for firms to actually access and mobilize resources for social exchanges (Tsai 2002; Ruef 2002). Collaborative networks for mutual benefits significantly depend on the strength of social ties in a network (Ruef 2002; Salman and Saives 2005). Social network theory indicates that repeated and intense interactions are necessary to establish trust and to activate knowledge sharing (Tsai 2002; Adler and Kwon 2002; Vachon and Klassen 2008). Social networks help firms to offset resource dependence, introduce new knowledge, expand organizational boundaries, and adapt to the evolutionary process (Tsai 2002; Ruef 2002; Salman and Saives 2005; Shi et al. 2014). The relationship marketing literature also supports this assertion. Green innovation initiatives rely on the knowledge, expertise, and commitment of organizational members in the value creation process (Huang and Wu 2010). Firms require the coordination capability to integrate members from different functions into the innovation process (Jansen et al. 2005). Coordination capability facilitates an organization to blur the boundaries among units and stimulate the formation of common interests that, in turn, support the sharing and application of the needed knowledge within the organization (Noori and Chen 2003; Jansen et al. 2005). Organizational members can develop more trust and collaboration to coordinate green innovation practices, such as life cycle analysis and design for environment activities (Pujari 2006; Huang and Wu 2010). Thus, coordination capability can effectively integrate environmental issues into strategic planning and advance new green product innovations (Pujari 2006; Huang and Wu 2010).

In addition to organizational capability, inter-organizational relationships can also affect knowledge transfer and innovation (Tsai 2002; Ruef 2002; Salman and Saives 2005). Previous research has noted that social reciprocity helps to build, develop, and maintain successful relational exchanges (Pervan et al. 2009; Chen and Hung 2010). The norm of reciprocity usually refers to a set of socially accepted rules regarding a transaction in which a party extending a resource to another party obligates the latter to return the favor (Gouldner 1960; Pervan et al. 2009). The order and stability of the relationship are founded on the mutually contingent exchange of benefits between relationship participants (Lin et al. 2009; Phelps 2010). Social network theory indicates that strong social reciprocity has an influence on cooperative behavior in partner interactions (Wasko and Faraj 2005; Lin et al. 2009). Environmental challenges invariably demand numerous interactions between firms and their networks among the supply chain, regulators, and stakeholders (Wasko and Faraj 2005; Vachon and Klassen 2008). Firms and supply chain partners attempt to achieve shared environmental goals through collective efforts (Zhu et al. 2012). When implementing green management, strong social networks provide the motivation for partners to transfer and exchange knowledge (Lin et al. 2009; Phelps 2010). Through social reciprocity in a network, firms increase collaborative problem solving to develop new knowledge and technology underlying green innovation. They can improve the ability to manage risk, innovate, and adapt to change (Wasko and Faraj 2005; Vachon and Klassen 2008; Chen and Hung 2010; Wincent et al. 2010). Moreover, interacting partners exhibit greater efficiency in regard to certain improvements that facilitate green innovation.

Previous research has not considered the roles of organizational capability and social network in the relationship between green innovation and performance. This study identifies dynamic capability, coordination capability, and social reciprocity as the factors influencing green innovation. Based on the dynamic capability perspective and social network theory, the objectives of this study are to examine the effects of dynamic capability, coordination capability, and social reciprocity on green innovation and the effects of green innovation on environmental and organizational performance. This study advances the green management literature by describing how organizational capability and social reciprocity can be used to predict green innovation. This study also contributes the literature by integrating the dynamic capability perspective and social network theory. The synthesis of these two perspectives provides new insight into our understanding of how green innovation benefits performance. This study provides implications for practice and future research needed in this area.

Research Background and Hypotheses

Green Innovation

In response to the trend toward environmentalism, companies face regulatory pressures and the environmental consciousness of consumers, and they need to actively engage in environmental management (Huang and Wu 2010; Cai and Zhou 2014). Research has used the term green innovation or eco-innovation to describe the contributions of businesses to sustainable development, while improving competitiveness (OECD 2010; Zhu et al. 2012; Bocken et al. 2014). Green innovation or eco-innovation can be generally defined as innovation that results in a reduction of environmental impact, regardless of whether or not that effect is intended (OECD 2010; Cai and Zhou 2014). Green innovation plays a key role in moving industries toward sustainable production, and the evolution of sustainable manufacturing initiatives has been facilitated by green innovation. Companies can enhance their environmental vigor by complying with international environmental conventions and applying new scientific and technological breakthroughs in ways that strengthen green innovation (Chen 2008; Chiou et al. 2011). Many green innovation or eco-innovation studies are concerned with incremental innovations such as products, processes, marketing methods, organizations, and institutions (OECD 2010, OECD 2012). The energy consumption of products and the redesign of production processes have led industry efforts to increasing recycling possibilities. Technological advances tend to be the primary focus of current green innovation efforts. These are typically associated with products or processes targeted for green innovation.

This study refers to previous research (Chen et al. 2006; Chen 2008; Chiou et al. 2011) to define green innovation. Green innovation includes the development of green products and green processes that modify an existing product design to reduce any negative impact on the environment during any stage of a product's life cycle (Chen et al. 2006; Chen 2008; Chiou et al. 2011). Green product innovation is related to the innovation of products involving environmentally friendly material, environmentally friendly packaging, recovery of products and recycling, and eco-labeling (Chen et al. 2006; Chen 2008). Green process innovation signifies a firm's ability to improve existing processes and develop new processes that create savings and prevent pollution. Green process innovation is related to energy savings, pollution prevention, waste recycling, or less toxicity in innovation processes (Chen et al. 2006; Chen 2008).

Dynamic Capability and Green Innovation

Dynamic capability refers to a firm's ability to integrate, learn, and reconfigure both internal and external resources (Teece et al. 1997; Teece 2007). Dynamic capability focuses on the adaptation and reconfiguration of resource employment in order to match the opportunities available in the marketplace (Teece et al. 1997; Eisenhardt and Martin 2000; Teece 2007). Previous studies have suggested that dynamic capabilities can help firms achieve performance and sustain competitive advantage that is difficult to unravel and imitate by their competitors (Teece 2007; Ellonen et al. 2009; Wu 2010; Li and Liu 2014). These capabilities represent intervening transformational competencies that reconfigure, combine, and transform existing resources into complex bundles (Teece 2007; Wu 2010; Li and Liu 2014).

Green innovation seeks to create processes and products that have minimal impact on the environment (Zhu and Sarkis 2004; Chen 2008). This encompasses many activities, from design for disassembly, such as joint and component designs, to broader lifecycle assessment practices. Design for the environment involves a different mindset and focuses on new, innovative practices (Johansson 2002). Managing societal expectations of environmental issues requires a firm to explore new routines for making decisions, performing tasks, and deploying resource combinations (Johansson 2002). Based on the dynamic capability perspective, firms require dynamic capabilities to adapt to changing environments and shape the ecosystems they occupy (Teece et al. 1997; Teece 2007). The dynamic capabilities developed in environmental initiatives have been found to be critical to green innovation (Chen 2008; Gavronski et al. 2011). Chen (2008) suggested that core competences of firms have positive impacts on green innovation. Gavronski et al. (2011) indicated that the deployment of capabilities is required to implement green supply management. Based on these arguments, dynamic capabilities may be important facilitators in the process of corporate environmental action (Johansson 2002; Chen 2008; Gavronski et al. 2011).

Dynamic capabilities of a firm can be grouped into three categories including sensing, seizing, and reconfiguring capabilities (Teece 2007). Following Teece's (2007) terminology, sensing capabilities denote a firm's activities directed toward identifying new opportunities and monitoring changes in the environment. Seizing capabilities are needed in activities such as designing product architecture, business models, and brand management. Reconfiguring capabilities are useful in the redeployment of existing assets and the management of complementary assets or reengineering processes (Teece 2007; Ellonen et al. 2009). Firms can sense opportunities and threats as markets and technologies evolve. They can further seize opportunities through the orchestration and reconfiguration of both existing and new resources to overcome inertia and path dependency (Teece 2007; Ellonen et al. 2009).

Market sensing capabilities help firms to identify potential environmental issues relevant to their businesses. Firms can seize opportunities to respond to changing market needs and meet competitive pressure. They can further integrate and reconfigure collective knowledge and resources in order to react to environmental issues. Accordingly, dynamic capabilities enable firms to renew their competences related to sensing and seizing opportunities, and they help firms combine and reconfigure their intangible and tangible assets (Teece 2007; Ellonen et al. 2009; Li and Liu 2014). The development and leveraging of dynamic capabilities have a positive relationship with green innovation. Thus, this study proposes the following hypotheses:

Hypothesis 1a Dynamic capability is positively related to green product innovation.

Hypothesis 1b Dynamic capability is positively related to green process innovation.

Coordination Capability and Green Innovation

Innovation is a complex social process involving social interaction between the various members of a firm (Huang and Wu 2010). The success of innovation depends on effective communication and collaboration among people from different backgrounds and functional areas. The dynamic capabilities perspective suggests that dynamic capability relies more on cross-functional relationships and intensive communication among those involved in the process (Eisenhardt and Martin 2000; Teece 2007; Li and Liu 2014). Social network theory indicates that repeated and intense interactions can build trust and social capital (Dyer and Singh 1998; Tsai and Ghoshal 1998; Adler and Kwon 2002; Ruef 2002). Social capital represents the relational resources attainable by actors through social relationships (Tsai and Ghoshal 1998; Adler and Kwon 2002). Coordination and cooperation depend significantly on the strength of the social capital in a network (Ruef 2002; Salman and Saives 2005). Accordingly, both the dynamic capability perspective and social network theory emphasize interaction and cooperation in social relationships.

Coordination capability relates to the involvement of individuals and other firm resources across a company in regard to creating value for customers and other stakeholders (Noori and Chen 2003; Pujari 2006). Firms need coordination capability to take advantage of multiple viewpoints in the innovation process (Jansen et al. 2005). Smooth and efficient coordination constitutes information channels that reduce the time and investment required to seek necessary information from members (Jansen et al. 2005). Through coordinated assignment of expertise, members can better identify and exploit distributed knowledge and explore new knowledge. Thus, coordination capability facilitates the integration and combination of knowledge, competency, and technology across disciplinary and hierarchical boundaries (Pujari 2006; Huang and Wu 2010). Common features of coordination capability include cross-functional interfaces, participation in decision making, and job rotation (Jansen et al. 2005). Cross-functional interfaces such as liaison personnel, task forces, and teams enable employees to orchestrate knowledge exchange. Participation in decision making allows for interplay among various perspectives and leads to knowledge acquisition and assimilation. In addition, job rotation enhances organizational contacts that promote awareness of employee knowledge and skills in different areas (Jansen et al. 2005).

In the context of green innovation, cross-functional coordination is essential in accordance with a shared mission or vision. Green initiatives inevitably involve several functional areas (Noori and Chen 2003; Pujari 2006). For example, R&D personnel, designers, and environmental technicians collaborate in investigating the environmental and health impacts of products prior to entering into the design stage (Noori and Chen 2003). Firms require cooperation and coordination among members serving different functions to implement green practices, such as life cycle analysis and design for environment activities (Pujari 2006; Huang and Wu 2010). Social network theory indicates that social interaction between organizational members can increase their access to other members' knowledge (Tsai 2002; Ruef 2002; Wincent et al. 2010; Shi et al. 2014). Coordination capability can be seen as a dynamic capability intended to integrate the different expertise of organizational members (Jansen et al. 2005; Huang and Wu 2010). Coordination capability facilitates lateral communication that deepens knowledge flow across functional boundaries and lines of authority (Jansen et al. 2005; Huang and Wu 2010). Pujari (2006) showed that cross-functional coordination enhances the diffusion of market and customer knowledge and leads to the discovery of environmental product solutions. Recent research by Huang and Wu (2010) suggested that the coordination of relevant corporate functions can effectively integrate environmental issues into strategic planning and advancements in new green product innovation and financial performance.

Effective green management requires a company to develop coordination capability and to establish a vision based on strong integration among members of the organization. This study argues that coordination capability can stimulate not only the sharing and dissemination of market knowledge, but also the incorporation of market knowledge into products and processes aimed at environmental management and improvement. Thus, the following hypotheses are developed:

Hypothesis 2a Coordination capability is positively related to green product innovation.

Hypothesis 2b Coordination capability is positively related to green process innovation.

Social Reciprocity and Green Innovation

Social networking serves many functions beyond socialization, such as resource sharing, inter-organizational learning, knowledge transfer, and other cooperative activities (Tsai 2002; Adler and Kwon 2002; Vachon and Klassen 2008). This study applies the concept of reciprocity to the relationship between partners in strategic networks. Strategic networks represent an attempt to achieve shared goals through collective efforts among multiple partners (Wincent et al. 2010). Reciprocity describes the social capital between constituents in networks (Phelps 2010). Constituents are interlinked through complex mutual obligations to behave reciprocally and to maintain solidarity (Wasko and Faraj 2005; Lin et al. 2009; Phelps 2010). Social reciprocity has been defined as the degree to which the recipient of benevolence reciprocates the benevolence in the relationship (Gouldner 1960). A basic norm of reciprocity is a social cognition of indebtedness where there is an expectation that good is returned for good received (Gouldner 1960; Pervan et al. 2009). Social reciprocity serves as social control mechanism that mitigates risks of opportunism and free-riding in networks (Phelps 2010; Wincent et al. 2010). Wincent et al. (2010) indicated that the efforts to establish and reinforce reciprocity will reduce opportunistic behavior, reduce transaction cost, and contribute to enhanced performance in participating firms.

To overcome environmental challenges, firms need to establish and reinforce their dynamic capability related to green innovation. The dynamic capability perspective discusses how a firm mobilizes and deploys resources and distinctive competences to gain an advantageous position (Teece 2007; Wu 2010; Li and Liu 2014). Inter-firm relationships are considered a strategic asset and a source of competitive leadership in dynamic environments (Teece et al. 1997; Eisenhardt and Martin 2000). Social network theory in part relies on cooperation and community among those characterized by the dynamic capability perspective. Many organizations are attempting to gain a competitive advantage by integrating their supply chain partners into environmental management processes (Vachon and Klassen 2008; Chiou et al. 2011; Zhu et al. 2012). This calls for greater strategic and operational cooperation between partners (Zhu et al. 2012). The availability of valuable knowledge flow between partners will impact a firm's approach toward the development of green innovation. However, a firm may be reluctant to share knowledge with other firms if it establishes a proprietary advantage around green innovation. Competition might conflict with cooperation or community in social networks (Tsai 2002).

Social network theory suggests that strong ties and frequent interaction between partners will evoke reciprocation of the social support and resource they receive from others in network relationships (Wasko and Faraj 2005; Lin et al. 2009). Social reciprocity provides an additional motivation, over and above economic incentives, to develop and maintain relationships (Pervan et al. 2009). That is, transactions occur not as a result of discrete exchanges or administrative fiat but through relations based on trust and reputation between the constituents (Lin et al. 2009; Phelps 2010). The norm of social reciprocity could underline the motivation and commitment of community members to share knowledge (Wasko and Faraj 2005; Lin et al. 2009). Wasko and Faraj (2005) indicated that knowledge sharing in electronic networks is facilitated by a strong sense of reciprocity. Chen and Huang (2010) also suggested that the norm of reciprocity has a significant effect on knowledge sharing behavior.

Social network theory indicates that social interaction ties and reciprocity are associated with higher levels of trust, which facilitates ongoing knowledge sharing and exchange (Wasko and Faraj 2005; Chen and Hung 2010). In a context of green supply chain, social reciprocity increases cooperation and decrease exchange hazards among partners (Phelps 2010). Green innovation involves a new combination of existing knowledge and routine. Given the theoretical basis of dynamic capability, it is important to consider the alternative form of a network, i.e., the strength of weak ties (Granovetter 1973; Ruef 2002). Weak ties lead to more efficient transmission and availability of disparate information because weak ties serve as bridges between otherwise disconnected social groups (Ruef 2002). Weak ties can reduce redundancy and conformity of information or resources more than strong ties. Weak ties are critical in facilitating information dissemination in a social network through voluntary knowledge sharing behavior (Ruef 2002; Salman and Saives 2005; Shi et al. 2014). Shi et al. (2014) suggested that weak ties are more likely result in people engaging in the social exchange process related to content sharing. Partners in weak-tie networks have access to disparate ideas and routines to develop innovation (Ruef 2002; Salman and Saives 2005; Shi et al. 2014). Thus, the tendency of firms to engage in green innovation relates to the strength of their social ties. Strong ties and weak ties between supply chain partners might work to spur innovation because firms seek to be green.

Accordingly, social reciprocity in social interaction ties provides firms with more diverse information and broader knowledge contained in the network. Firms can develop more ideas to identify environmental trends and opportunities and determine which product attributes and designs are favorable in the environment. Reciprocal relationships across the production and supply chain facilitate the adoption of advanced manufacturing practices needed to develop new green products or processes. Strategic partners jointly explore new opportunities for improvements in green innovation and environmental outcomes. Thus, this study proposes the following hypotheses:

Hypothesis 3a Social reciprocity is positively related to green product innovation.

Hypothesis 3b Social reciprocity is positively related to green process innovation.

Green Innovation and Performance

Innovation is considered to be a critical mechanism to enhance the ability of the firm to maintain competitive advantage (Eisenhardt and Martin 2000). The ability of green innovation or eco-innovation plays a critical role in creating corporate competitive advantage in an era of environmentalism (OECD 2010; Bocken et al. 2014; Przychodzen and Przychodzen 2015). Green innovation or eco-innovation can provide customer value and business value that contribute to sustainable development and decrease environmental costs and impacts (Hillestad et al. 2010; Zhu et al. 2012; Bocken et al. 2014; Cai and Zhou 2014). Companies can embody green concepts in the design and packaging of their products to increase the differentiation advantages of their products (Chen et al. 2006; Chen 2008).

Environmental performance is a concern of managers due to reasons ranging from regulatory and contractual compliance to public perception and competitive advantage (Zhu and Sarkis 2004). Recent literature has offered insight into potential patterns of green innovation occurring in supply chain relationships that may improve environmental performance (Zhu and Sarkis 2004; Chiou et al. 2011; Zhu et al. 2012). Green innovation in products and processes not only reduces the negative impact on the environment, but also increases the competitive advantage of firms (Chen et al. 2006; Chiou et al. 2011). Green product innovation allows firms to respond to the environmental needs of the market and the government and to improve the resource effectiveness necessary to achieve the optimization of environmental benefits in a product's life cycle (Chiou et al. 2011; Dong et al. 2014). Green process innovation requires firms to reduce clean production costs and lower pollutant emissions in order to comply with the requirements of environmental regulations (Chiou et al. 2011; Dong et al. 2014). Firms investing a lot of effort toward green innovation can minimize production waste and increase productivity to make up for environmental costs (Huang and Wu 2010; Chiou et al. 2011). On the other hand, green innovation helps firms satisfy the requirement of environmental protection and avoid protests or punishment from government regulators (Chen 2008; Zhu et al. 2008; Chang 2011). Thus, green product innovation and green process innovation are positively associated with environmental performance (Huang and Wu 2010; Chiou et al. 2011; Dong et al. 2014). The following hypotheses are developed:

Hypothesis 4a Green product innovation is positively related to environmental performance.

Hypothesis 5a Green process innovation is positively related to environmental performance.

Ecological modernization theory emphasizes the need for companies to recognize ecological issues as a means of enhancing competitive advantage (Janicke 2008; Zhu et al. 2012). Companies can adopt proactive strategies for green innovation to integrate the goals of ecological protection with economic performance (Chen et al. 2006; Janicke 2008; Zhu et al. 2012). Research has indicated that investment in green innovation evokes positive economic improvements and benefits (Chen 2008; Peng and Lin 2008; Huang and Wu 2010; Chiou et al. 2011; Przychodzen and Przychodzen 2015). For example, Chen (2008) suggested that companies pioneering in green innovation can have the first mover advantage, and they can charge relatively high prices for their green products. Green innovation further improves corporate image. Huang and Wu (2010) showed that high-tech firms can develop green product and process innovation to make their operations and product lines more environmentally efficient. Such green innovation has a positive influence on financial performance. Chang (2011) suggested there to be a positive relationship between green innovation and competitive advantage. Chiou et al. (2011) indicated that green innovation can improve a firm's environmental performance and can enhance its competitive advantage in the market.

According to the above, this study expects that green product innovation and green process innovation will have positive relationships with organizational performance. The following hypotheses are developed:

Hypothesis 4b Green product innovation is positively related to organizational performance.

Hypothesis 5b Green process innovation is positively related to organizational performance.

Research Method

Data Collection and Sample

This study attempted to identify the factors influencing green innovation and to examine the effects of green innovation on environmental and organizational performance. The empirical study employed a questionnaire approach designed to collect data used to test the validity of the model and to verify the research hypotheses. Data were collected from CEOs or managers of the information and communication technology industry (ICT industry) in Taiwan. With the rise of international environmental regulations such as the waste electrical and electronic equipment (WEEE), restriction of hazardous substances (RoHS), and eco-design for energy using products (EuP), companies in the ICT industry have adopted green standards for their production processes (Peng and Lin 2008; Huang and Wu 2010). ICT firms are facing increasing pressure to become greener (Chen 2008; Huang and Wu 2010). In addition, Taiwan is a major player and contributor to the world ICT industry. The semiconductor industry and the information and electronics industry especially have evolved to prominence in Taiwan's economy. Research evidence from Taiwanese ICT firms provides rich information and implications for managers (Wu 2010).

The research sample was randomly selected from two sources including the database of the Taiwan Stock Exchanges (TSE) and the online Business Directory, which lists the firms in Taiwan according to different industry sectors. TSE and Business Directory are the totality of sources. The survey instrument contained instructions for completion, demographic information for the companies, and research variables including dynamic capability, coordination capability, social reciprocity, green innovation, and environmental and organizational performance. See Appendix for details about the survey items. Respondents were the CEOs or the managers of environmental protection, marketing, or R&D departments who were familiar with the company's environmental activities. The respondents answered each of the items using five-point Likert-type scales and indicated their degree of agreement with each item.

Members of the sample received a questionnaire along with a cover letter that explained the purpose and intention of the survey to the sample firms. The anonymity of both the respondent and the company in the research report was promised to appeal for participation. In order to maximize the response rate, follow-up letters and phone calls were done 2 weeks later to remind respondents to respond and to thank them for their cooperation. Questionnaires were sent to 600 companies. Of the 427 returned questionnaires, 9 were incomplete. The remaining 418 valid and complete questionnaires were used for the following analysis, which represented a useable response rate of 69.67 %. To examine the potential nonresponse bias, the characteristics of the respondents were compared to those of the original sample. The calculated t statistics for firm size, firm age, and industry sector were all statistically insignificant ($p > 0.1$), suggesting that no significant differences existed between the respondent and non respondent groups.

The Harman's one-factor test was conducted on all items to examine the threat of common method bias. The results of the Harman's one-factor test extracted six distinct factors with eigenvalues greater than 1.0 that accounted for 86 % of the total variance, with factor 1 accounting for 24 % of the variance. A single factor did not emerge, and one general factor did not account for most of the variance (Podsakoff et al. 2003). Thus, common method bias is unlikely to be a serious problem in the data (Podsakoff et al. 2003).

Measures

Dependent Variables

Green innovation indicates the process used to modify an existing product design to reduce any negative impact on the environment during any stage of the product's life cycle (Chiou et al. 2011). Adapted from previous research (Chen et al. 2006; Chen 2008; Chiou et al. 2011), the green innovation in this study included green product innovation and green process innovation. Four items of green product innovation were related to environmentally friendly material, environmentally friendly packaging, recovery of products and recycling, and eco-labeling. Four items were developed to assess green process innovation related to energy savings, pollution prevention, waste recycling, and less toxicity in manufacturing process.

Environmental performance is of concern to managers due to reasons ranging from regulatory and contractual compliance to public perception and competitive advantage (Zhu and Sarkis 2004; Chiou et al. 2011). Respondents were asked to answer six questions about the extent of reduction of air emission, reduction of waste water, reduction of solid wastes, decrease of consumption for hazardous/harmful/toxic materials, decrease of frequency for environmental accidents, and improvement of environmental situation (Zhu and Sarkis 2004).

Organizational performance concerns the outcome or perceived success of a firm in regard to meeting the goals related to sales growth, profit growth, market share growth, operational efficiency, cash flow from market operations, and market reputation. (Cao et al. 2009). Drawing upon previous research (Cao et al. 2009), this study measured organizational performance with six items that included sales growth, profit growth, market share growth, operational efficiency, cash flow from market operations, and market reputation.

Independent Variables

Dynamic capability represents a firm's ability to integrate, learn, and reconfigure internal and external resources (Teece et al. 1997; Teece 2007; Wu 2010). Dynamic capability allows a firm to create difficult-to-imitate competencies and leads to sustainable competitive advantage in the marketplace (Teece et al. 1997; Eisenhardt and Martin 2000). The method used to measure dynamic capability was primarily based on the definition of Teece et al. (1997). The respondents were asked to respond to four questions about resource integration capability, resource reconfiguration capability, learning capability, and ability to respond to changes (Wu 2010).

Coordination capability refers to the involvement of individuals and other firm resources across a company in creating value for customers and other stakeholders (Noori and Chen 2003; Pujari 2006). Based on Jansen et al. (2005), this study measured coordination capability with six items that included the use of liaison personnel, temporary task forces, permanent teams to coordinate activities, participation in decision making, and rotation between different functions within and between subunits.

Social reciprocity refers to the degree to which the recipient of benevolence reciprocates the benevolence in the relationship (Gouldner 1960). Adapted from the scale of Chen and Huang (2010), social reciprocity stresses the attitudes of the cooperating parties toward the mutual exchange of resources, fair distribution of benefits, mutual understanding and trust (Wasko and Faraj 2005; Chen and Hung 2010).

Control Variables

This study controlled for possible confounding effects by including three relevant variables. Firm size was measured by the natural log of total number of employees. Firm age was assessed by the number of years from the firm's founding date. Dummy variables were included to indicate the industry sector.

Data Analysis

Since the scales were adapted, this study estimated the measurement model prior to examining the proposed structural equation model. To investigate the construct validity and the goodness-of-fit indices of the scales, a confirmatory factor analysis (CFA) was performed using maximum likelihood estimation in LISREL 8.80 (Anderson and Gerbing 1988; Jöreskog and Sörbom 1993). Following this, this study tested the adequacy of the structural equation model and further examined the hypothesized relationships.

Analysis and Results

Analysis of the Measurement Model

The fit indexes of CFA for the proposed model were adequate ($\chi^2 = 1099.68$, $d.f. = 474$, p value $= 0.00$, IFI $= 0.94$, CFI $= 0.94$, GFI $= 0.95$, AGFI $= 0.91$, RMSR $= 0.03$), suggesting that the model provided a reasonably good fit for the data (Hair et al. 2010). Moreover, the standardized loadings of all the measurement items ranged from 0.60 to 0.98. All items loaded significantly on their posited underlying construct ($p < 0.05$) with the t value exceeding 2.0 (Anderson and Gerbing 1988) and none of the confidence intervals for each pairwise correlation estimate contained a value of one (Anderson and Gerbing 1988). The average variance extracted (AVE) measured the variance captured by the indicators relative to measurement error. In Table 1, the values of AVE ranged from 0.60 to 0.93, with a satisfactory threshold value of 0.50 (Barclay et al. 1995). In addition, this study constrained the correlation between each pair of constructs, one at a time, to be equal to 1 (Anderson and Gerbing 1988; Hult et al. 2000). The χ^2 test comparing this model to the model freeing that correlation was significant ($p < 0.001$). These results indicated that the constructs demonstrate both convergent and discriminant validity (Anderson and Gerbing 1988; Hult et al. 2000).

The reliability measures are listed in Table 1. The Cronbach's Alpha of each scale ranged from 0.91 to 0.98. The values are greater than the recommended value of 0.7. The composite reliabilities of each scale ranged from 0.90 to 0.99, which exceeded the 0.70 threshold for acceptable reliability (Hair et al. 2010). Thus, the measures utilized in the study demonstrate high reliability and internal consistency.

Test of the Structural Model

Table 2 presents the mean, standard deviation, and the correlation matrix of the research variables. In this study, LISREL was employed to test the hypotheses in the path-analytic framework (Anderson and Gerbing 1988; Jöreskog and Sörbom 1993). The LISREL analysis of the proposed model showed a χ^2 of 1137.58 ($d.f. = 482$). In addition to this χ^2 value, the various goodness-of-fit indices (GFI $= 0.98$, AGFI $= 0.92$, NFI $= 0.93$, CFI $= 0.94$, RMSR $= 0.03$) indicated the structural model was acceptable and therefore presented a reasonable explanation of the observed covariance among the variables. The analysis also provided support for the study's hypotheses. Table 3 reports the results of the standardized path estimates, and Fig. 1 depicts the path coefficients and construct relationships.

As hypothesized, dynamic capability has a positive relationship with green product innovation ($\gamma_{11} = 0.13$, $t = 2.90$) and green process innovation ($\gamma_{21} = 0.17$, $t = 3.08$). Therefore, H1a and H1b are supported. Positive relationships between coordination capability and green product innovation ($\gamma_{12} = 0.48$, $t = 9.94$) and green process innovation are established ($\gamma_{22} = 0.36$, $t = 7.12$), supporting of H2a and H2b. The findings indicate that dynamic capability matters more for green process innovation, while coordination capability matters more for green product innovation. As postulated, social reciprocity

Table 1 Reliability measures

Variables	Cronbach's alpha	Composite reliability	Average variance extracted
Dynamic capability	0.93	0.92	0.73
Coordination capability	0.91	0.90	0.60
Social reciprocity	0.96	0.97	0.93
Green product innovation	0.98	0.98	0.92
Green process innovation	0.96	0.97	0.90
Environmental performance	0.91	0.91	0.63
Organizational performance	0.98	0.99	0.93

Table 2 Means, SD and correlations

Variables	Mean	SD	1	2	3	4	5	6
Dynamic capability	3.38	0.52						
Coordination capability	3.51	0.67	0.64					
Social reciprocity	3.33	0.68	0.58	0.48				
Green product innovation	3.99	0.88	0.72	0.74	0.70			
Green process innovation	3.94	0.72	0.66	0.72	0.66	0.55		
Environmental performance	3.78	0.37	0.62	0.44	0.76	0.63	0.61	
Organizational performance	3.39	0.73	0.44	0.73	0.48	0.47	0.65	0.35

$n = 418$ (two-tailed test). Correlations with absolute value greater than 0.10 are significant at $p < 0.05$, and those greater than 0.13 are significant at $p < 0.01$

Table 3 Standardized path estimates

Hypothesized relationships				
Hypothesis	Variables	Path coefficient	*t* value	Result
H1a	Dynamic capability and green product innovation	0.13**	2.90	Supported
H1b	Dynamic capability and green process innovation	0.17**	3.08	Supported
H2a	Coordination capability and green product innovation	0.48***	9.94	Supported
H2b	Coordination capability and green process innovation	0.36***	7.12	Supported
H3a	Social reciprocity and green product innovation	0.47***	13.81	Supported
H3b	Social reciprocity and green process innovation	0.46***	11.04	Supported
H4a	Green product innovation and environmental performance	0.38***	7.13	Supported
H4b	Green product innovation and organizational performance	0.13*	2.42	Supported
H5a	Green process innovation and environmental performance	0.40***	7.44	Supported
H5b	Green process innovation and organizational performance	0.57***	10.65	Supported

$n = 418$ (two-tailed test)

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

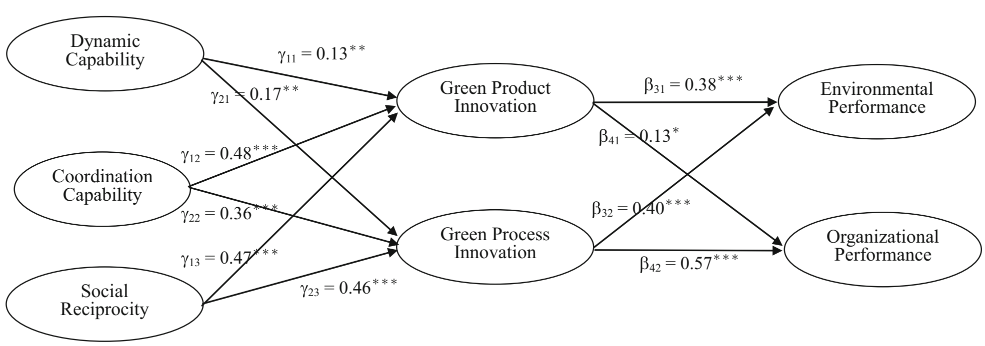

Fig. 1 The resulting model of this study *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$

relates positively to green product innovation ($\gamma_{13} = 0.47$, $t = 13.81$) and green process innovation ($\gamma_{23} = 0.46$, $t = 11.04$). Hence, the results are in support of H3a and H3b. As to the influence on performance, green product innovation is positively related to environmental performance ($\beta_{31} = 0.38$, $t = 7.13$) and organizational performance ($\beta_{41} = 0.13$, $t = 2.42$). Thus, H4a and H4b are supported. The hypothesized paths of green process innovation and environmental performance ($\beta_{32} = 0.40$, $t = 7.44$) and organizational performance ($\beta_{42} = 0.57$, $t = 10.65$) are also supported. Thus, H5a and H5b are supported. The findings add to the understanding that green product innovation and green process innovation are indeed necessary for firms to respond to environmental concerns and achieve favorable environmental and organizational performance.

Discussion and Conclusions

This study develops a conceptual model to examine the relationships between organizational capability, social reciprocity, green innovation, and performance. The growing trend of ecological modernization facilitates the ability of firms to conduct their business in an environmentally friendly manner (Banerjee 2002; Janicke 2008; Zhu et al. 2012). Ecological modernization theory encourages companies to apply new scientific and technological breakthroughs in ways that strengthen green products or green processes (Mol et al. 2009; Zhu et al. 2012). The results of this study revealed that the development of green product innovation and green process innovation positively explains a firm's environmental and organizational performance. This finding provides empirical support of the ecological modernization theory of green management as an explanation of competitive advantage (Janicke 2008; Mol et al. 2009; Zhu et al. 2012). The core theoretical underpinning of ecological modernization theory is that green management serves as an innovation mechanism for firms to gain some benefits, such as corporate reputation, financial performance, and new product success (Peng and Lin 2008; Huang and Wu 2010; Chiou et al. 2011; Przychodzen and Przychodzen 2015). Green innovation can prepare enterprises for superior performance through management of environmental risks and the development of capabilities leading to continuous environmental improvement (Zhu and Sarkis 2004; Peng and Lin 2008; Pane Haden et al. 2009). Green innovation in products and processes not only increases competitive advantage and supports compliance with environmental regulations, but also reduces negative impacts on the environment (Zhu et al. 2012; Bocken et al. 2014; Cai and Zhou 2014).

Environmental management involves consideration of how it affects the competitiveness and profitability of a firm (Banerjee 2002; Pane Haden et al. 2009). Previous literature on corporate environmental ethics posits that the motivation of firms toward green innovation is not always tied to profit and performance (Hillestad et al. 2010; Chang 2011). Corporate environmental ethics formalize business values and expectations of ethical behavior (Peng and Lin 2008; Chang 2011). Green businesses perceive green innovation as an opportunity to assert their social roles and social responsibilities (Hillestad et al. 2010; López-Gamero et al. 2008; Chang 2011). The functionalist perspective of green business could emerge in the instance of greening for the purpose of morality, raw economics, and customer perception, etc. The functionalist perspective assumes that all parts of society work together to create a functioning ecosystem. Although industrial development and related technologies have improved productivity, companies have to deal with the negative consequences of waste, pollution, and the destruction of ecosystem. Functionalists emphasize that companies must become more sensitive to their actions on the environment (Ogunbameru 2004). Environmental protection should be a crucial ethical aspect of the companies. To avoid damage to the ecosystem, companies need to safeguard the interests of their stakeholders, society, and the environment. Such precaution will lead to a state of balance or equilibrium (Ogunbameru 2004).

Proactive green innovation can prepare companies for the management of environmental risks and capabilities leading to continuous environmental improvement (Hillestad et al. 2010; Chang 2011; Zhu et al. 2012). Companies can take into account the interests of their multiple stakeholders to formulate their green innovation strategies in order to integrate the goals of economic performance and ethical practice (López-Gamero et al., 2008; Hillestad et al. 2010; Chang 2011). Green management highlights the concept of sustainable development, which places top priority on environmental protection in an industrial system that emphasizes economic, social, and environmental benefits (Pane Haden et al. 2009; Bocken et al. 2014; Cai and Zhou 2014). The conduct of green enterprises reflects ethical concerns related to social welfare and ecological protection. Green enterprises can become aware of their corporate social responsibilities and gain sustainable development based on distinctive ethical values (López-Gamero et al. 2008; Peng and Lin 2008; Hillestad et al. 2010; Chang 2011).

Our results indicate that organizational capabilities, including dynamic capability and coordination capability, are positively related to green product innovation and green process innovation. Our study contributes to the literature by filling the gap in the relationship between organizational capability, green innovation, and performance. The consideration of dynamic capability and coordination capability created a related understanding of the dynamic capability perspective (Teece et al. 1997; Teece 2007; Wu 2010). Dynamic capability represents a strategic routine by which firms achieve new resource configurations in order to adapt to rapidly changing environments (Teece 2007; Wu 2010; Li and Liu 2014). Dynamic capability enables firms to renew their competences to sense and shape opportunities during a trend toward ecological modernization (Teece 2007; Ellonen et al. 2009; Li and Liu 2014). Firms can generate and modify their operating routines to adapt to the challenges of green innovation. Furthermore, the development of new green products and processes involves members from different backgrounds and managerial positions. Our results emphasize the importance of coordination capability in the green innovation procedure.

Coordination capability can facilitate joint involvement across functions related to specific new product tasks. The findings agree with the research of Huang and Wu (2010), who argued that coordination enables environmental commitment across different functions leading to success with new green products.

This study offers contributions through the synthesis of the dynamic capability perspective and social network theory. The dynamic capability perspective suggests that knowledge from partners helps firms avoid duplication of efforts or provides them with complementary competences (Eisenhardt and Martin 2000; Teece 2007; Li and Liu 2014). Social network theory emphasizes the importance of network relationships and ties (Dyer and Singh 1998; Tsai and Ghoshal 1998; Adler and Kwon 2002; Vachon and Klassen 2008). This study applies the concept of social network theory to the reciprocity between partners in green supply chain networks. This study provides an empirical support in social network analysis and demonstrates that social reciprocity plays an important role by which firms can develop green innovation. Firms are more willing to share their knowledge if they expect to receive other knowledge in return or receive future help from firms in the network (Wasko and Faraj 2005; Wincent et al. 2010). Frequent learning or regular interaction is more likely to happen when a reciprocal relationship exists (Shi et al. 2014). Increases in social reciprocity help a firm obtain more resources from other partner firms to reinforce its responsiveness to environmental issues. The finding is congruent with prior research suggesting that strong ties and social reciprocity are key sources of resources and learning (Wasko and Faraj 2005; Lin et al. 2009; Chen and Hung 2010).

Social network theory suggests that close and frequent interactions between partners can build strong ties leading to knowledge integration and sharing across organizational boundaries (Wasko and Faraj 2005; Lin et al. 2009; Wincent et al. 2010). However, some scholars provide a different argument about tie strength. The theory of the strength of weak ties advanced by Granovetter (1973) suggests that weak ties are efficient for knowledge sharing because they provide access to novel information by bridging otherwise disconnected groups (Granovetter 1973; Ruef 2002). The reduction of information redundancy and conformity in weak ties creates a milieu to spur innovation (Ruef 2002; Salman and Saives 2005; Shi et al. 2014). Thus, the strength of social ties between partners becomes a key point when firms seek to develop green innovation. Tie strength can greatly affect the partners' willingness to forward knowledge and resource (Shi et al. 2014). Strong ties with partners can reinforce reciprocity and bind firms tightly, and weak ties knit firms into a larger dynamic community of knowledge sharing.

From a practical point of view, this study offers some managerial implications. Green management involves a consideration of how green innovation affects the competitiveness and profitability of a firm (Banerjee 2002; Pane Haden et al. 2009; Przychodzen and Przychodzen 2015). Firms can develop green innovation to integrate environmental management into their operation. Managers need to recognize ecological issues and advance green innovation to respond to environmental concerns of stakeholders and to mitigate environmental problems. Managers can learn how to execute environmental incentive programs to promote sustainable development of new green product and green process innovation. Green product and process innovation help firms to achieve waste reduction and elimination, stimulate resource recovery and reuse, and promote dematerialization. Such improvements can further have positive impacts on both environmental and organizational performance.

Green innovation encompasses the generation and implementation of new ideas, products, or processes. Managers can cultivate dynamic capability and coordination capability in an organization to facilitate green product and process innovation. The results show that dynamic capability focuses more on green process innovation, while coordination capability places a larger emphasis on green product innovation. Managers could potentially maintain a dynamic pool of complementary capabilities to transform the existing resource base and to internalize external resources in competitively intensive environments (Teece 2007; Wu 2010). Firms with strong dynamic capability appear to be more inclined to renew their competences in order to sense and seize opportunities. They can combine and reconfigure their intangible and tangible assets to shape the ecosystems they occupy. Dynamic capability facilitates the utilization of current knowledge among organizational members and further generates new combinations of prior knowledge leading to the development of green products. In addition, managers could develop the coordination capability necessary to incorporate environmental issues in the strategic planning process. Organizational members also need coordination capability to facilitate communication and collaboration among different functional roles. Both dynamic capability and coordination capability can stimulate creative and innovative thoughts that lead to the development of new knowledge and experimentation with new alternatives that are required in green product and process innovation.

The findings of this study have some limitations. Firstly, this study uses a cross-sectional research design. Although the results are consistent with theoretical reasoning, the cross-sectional design prevents us from ruling out causality concerning the hypothesized relationships. Future research might address this issue by using a longitudinal design when drawing causal inferences. Secondly, this study refers to previous research to measure dynamic capability (Teece et al. 1997; Wu 2010). The measures of dynamic capability are limited to four questions. Given the importance of dynamic capability to this study, the assessment of whether a firm has dynamic capabilities seems quite thin. Future researchers might wish to collect evidence from different corroborative data, as a proxy, to establish the characteristics of dynamic capability. Thirdly, this study is based on self-reported data to measure degree of agreement. Future research could be strengthened with provision of correlating empirical data, such as information derived from corporate annual reports. Future research might use objective measures for green innovation and performance that can be independently verified. Finally, this study empirically investigates ICT firms in Taiwan, which causes potential cultural and industrial limitations. ICT firms are specific sort of high-tech firms. High-tech firms have particular propensity toward green innovation that make them not similar to other organizations. Future researchers might gain additional insights by conducting a study in different cultural contexts and assessing the generalization across different industries.

Appendix

See Table 4.

Table 4 Measures and items

Items					
Dynamic capability					
Please indicate your company's capability on the following competencies. (5-point Likert scale, 1: strongly disagree to 5: strongly agree)					
	1	2	3	4	5
Resource integration capability	☐	☐	☐	☐	☐
Resource reconfiguration capability	☐	☐	☐	☐	☐
Learning capability	☐	☐	☐	☐	☐
Ability to respond to the rapidly changing environment	☐	☐	☐	☐	☐
Coordination capability					
Please indicate your company's capability on the following competencies. (5-point Likert scale, 1: strongly disagree to 5: strongly agree)					
	1	2	3	4	5
Using liaison personnel to coordinate activities	☐	☐	☐	☐	☐
Using temporary task forces to coordinate activities	☐	☐	☐	☐	☐
Using permanent teams to coordinate activities	☐	☐	☐	☐	☐
Participation in decision making	☐	☐	☐	☐	☐
Rotation regularly between different functions	☐	☐	☐	☐	☐
Rotation regularly between different subunits	☐	☐	☐	☐	☐
Social reciprocity					
Please indicate your company's attitude toward your main suppliers or subcontractors. (5-point Likert scale, 1: strongly disagree to 5: strongly agree)					
	1	2	3	4	5
The attitude of the cooperating parties toward the mutual exchange of resources	☐	☐	☐	☐	☐
The attitude of fair distribution of benefits	☐	☐	☐	☐	☐
The attitude of mutual understanding and trust	☐	☐	☐	☐	☐
Green product innovation					
Has your company ever taken the following action when designing the product? (5-point Likert scale, 1: strongly disagree to 5: strongly agree)					
	1	2	3	4	5
Using environmentally friendly material (e.g. less or non-polluting/toxic materials)	☐	☐	☐	☐	☐
Improving and designing environmentally friendly packaging (e.g.: less paper and plastic material used) for existing and new products	☐	☐	☐	☐	☐
Recovery of company's end-of-life products and recycling	☐	☐	☐	☐	☐
Using eco-labeling	☐	☐	☐	☐	☐

Table 4 continued

Items					
Green process innovation					
Has your company ever taken the following action in the production process? (5-point Likert scale, 1: strongly disagree to 5: strongly agree)					
	1	2	3	4	5
Low energy consumption such as water, electricity, gas and petrol during production/use/disposal	☐	☐	☐	☐	☐
Use of cleaner technology to make savings and prevent pollution (such as energy, water and waste)	☐	☐	☐	☐	☐
Recycle, reuse and remanufacture material	☐	☐	☐	☐	☐
Less or no toxicity in manufacturing process	☐	☐	☐	☐	☐
Environmental performance					
Has your company performed better compared to your main competitors in the following areas? (5-point Likert scale, 1: strongly disagree to 5: strongly agree)					
	1	2	3	4	5
Reduction of air emission	☐	☐	☐	☐	☐
Reduction of waste water	☐	☐	☐	☐	☐
Reduction of solid wastes	☐	☐	☐	☐	☐
Decrease of consumption for hazardous/harmful/toxic materials	☐	☐	☐	☐	☐
Decrease of frequency for environmental accidents	☐	☐	☐	☐	☐
Improve a enterprise's environmental situation	☐	☐	☐	☐	☐
Organizational performance					
Has your company performed better compared to your main competitors in the following areas? (5-point Likert scale, 1: strongly disagree to 5: strongly agree)					
	1	2	3	4	5
Sales growth	☐	☐	☐	☐	☐
Profit growth	☐	☐	☐	☐	☐
Market share growth	☐	☐	☐	☐	☐
Operational efficiency	☐	☐	☐	☐	☐
Cash flow from market operations	☐	☐	☐	☐	☐
Market reputation	☐	☐	☐	☐	☐

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