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Completed Research Paper

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Abstract

This article examines how institutional pressures affect the adoption of green IS&IT across organizations. From the natural-resource-based perspective, it examines green IS&IT practices with strategic foci on pollution prevention, product stewardship, and sustainable development. Each category incorporates the separate roles played by IT (as a problem) and IS (as a solution). The partial least square method was employed to analyze the survey replies from 75 organizations. The results show that mimetic and coercive pressures significantly drive green IS&IT adoption. In particular, outcome-based imitation and imposition-based coercion represent major institutional processes. The results also suggest the complementary relationship between mimetic and coercive pressures. Such interaction significantly motivates the green IS&IT adoption focusing on product stewardship. These findings contribute to existing knowledge on the pro-environmental behaviors of organizations, demonstrate the interaction between institutional forces, and further current understanding of green IS&IT adoption. The study concludes with implications for research and practice.

Keywords: Institutional isomorphism, mimetic pressure, coercive pressure, natural-resource-based view, adoption, green information systems (IS), green information technology (IT).

Introduction

Managing their environmental footprint is a challenging task faced by many organizations. The current status of ecological deterioration and the severity of its potential consequences explain the overwhelming popularity of environmental initiatives across the world. Although there is a wealth of literature investigating technology use in the IS literature and environmentally friendly behaviors of organizations in the management literature, less attention has been devoted to the adoption and diffusion of green IS & IT (Chen et al. 2008). Much remains to be explored about the role played by IS & IT in the worldwide pursuit of ecological sustainability. The emergence of green practices within organizations is of significant theoretical and practical interest. This study aims to examine the adoption of green IS & IT[1] across organizations. To develop a finely grained understanding of the phenomenon, we differentiate between IS and IT, which contribute to the environmental issues differently. IT contributes to the problem (e.g., e-waste) and IS to the solution (e.g., routing optimization) (Boudreau et al. 2008; Watson et al. 2009). Boudreau and her colleagues argue that IT, which stores, transmits, or processes information, is too narrow a focus and attention should be extended to IS, which is defined as an integrated and cooperating set of people, processes, software, and information technologies to support individual, organizational, or social goals.

The worldwide agitation to achieve ecological sustainability is starting to redraw the industrial landscape. A single bottom line measure of success, in sheer economic terms, used to be the dominant paradigm in the market. Given the increasing magnitude of environmental issues, however, the moral aspect of such issues has rendered single value thinking inadequate as a criterion to evaluate an organization's losses and gains. The increased momentum of environmental issues signals the importance of social factors to organizations. An organization's decision to adopt green IS & IT is often based on a complicated mix of both pragmatic and moral factors. On the one hand, green IS & IT create financial concerns, as they may lead to reduced cost or incur additional expenses. Being green is not necessarily cost-efficient, though in many cases it is. On the other hand, the "green" orientation highlights the moral implications of these technologies, as an organization's adoption may generate positive or negative consequences for others (Velasquez et al. 1985). Given the public-goods nature of the natural environment, an organization's decision or action in response to an environmental problem becomes a moral issue because of the potential to harm or benefit others. The moral aspect of adopting green IS & IT does not preclude its pragmatic side. In other words, adoption of green IS & IT has consequences for both the organization (e.g., impact on cost and productivity) and others (e.g., impact on the natural environment and future generations).

One of the first studies examining the role played by IS & IT in ecological sustainability, this research takes the institutional approach (DiMaggio et al. 1983) to organizational adoption of green IS & IT. The institutional perspective provides a useful theoretical lens to study the organizational response to environmental issues, because it understands that institutional forces beyond the market play a critical role in making organizations responsive to the interests of others (Scott 2003). In institutionalized organizations, legitimacy and efficiency do not necessarily co-vary (Zucker 1987). This is often true in the case of adopting green IS & IT. Institutional theory explains how organizations adapt to institutional change through three different mechanisms – mimetic, normative, and coercive isomorphism.[2] The main effects of the three pressures are firmly defined. However, there are few studies investigating the interaction among them, which this study does.

The other major contribution is to inform the research and practice of green IS & IT by reviewing the level of environmental friendliness of organizations in a wide range of practices. Understanding the adoption and diffusion of green IS & IT across organizations informs the design of technological applications and institutional interventions to support ecological sustainability. The literature on green behaviors within organizations largely focuses on a single practice, such as recycling (Cheung et al. 1999). However, we believe that the level of an organization's environmental friendliness is better evaluated against a variety of relevant practices rather than a single one. Therefore, we adopt the natural-resource-based view of the firm (Hart 1995) to categorize organizational green IS &

[1] By "adoption of green IS & IT", we refer to the adoption of both green IS & IT products (e.g., software that manages the overall emissions) and green practices involving IS & IT (e.g., disposal of IT equipment in an environmentally friendly way).

[2] Mimetic isomorphism happens when organizations model other organizations' behaviors in pursuit of legitimacy or taken-for-granted practices. Normative isomorphism occurs when organizations feel compelled to honor certain cultural expectations from professional circles or the larger society. Coercive isomorphism is often driven by powerful stakeholders upon whom a focal organization depends.

IT practices into three groups based on their different strategic orientations, i.e., pollution prevention, product stewardship, and sustainable development. The three categories differ in terms of their resource requirements and contributions to ecological sustainability.

Based on the survey replies from 75 organizations, this research examines how institutional forces motivate organizational adoption of green IS & IT. The results of the study provide an overview of the status quo of organizational green behaviors involving a variety of IS & IT. The paper begins with a review of the theoretical background, i.e., institutional theory and the natural-resource-based view of the firm. Next, we present the research model along with the propositions, move to the identification of the indicators of the central constructs, and then progress to a discussion of empirical results. The paper concludes with implications for both research and practice.

Theoretical Background

We draw upon institutional theory and the natural-resource-based view of the firm. Institutional theory explains how institutional isomorphism occurs through three different mechanisms – mimetic, coercive, and normative pressures. The natural-resource-based view of the firm differentiates among strategies that underlie different categories of green IS & IT practices. We believe that the synergy of both theoretical perspectives yields a finely grained understanding of the effects of institutional pressures on organizational adoption of green IS & IT.

Institutional Theory

Institutional theory provides a rich, complex view of how organizations become homogeneous under social (as opposed to competitive) pressures, sometimes due to external sources, other times from within the organization. These pressures can direct an organization's attention away from economic performance to various widely practiced elements, such as professional certification, and prevalent activities across other organizations. Institutional theory has been used to explore an organization's environmental behaviors (Campbell 2007; Chen et al. 2008; Jennings et al. 1995).

By developing structures or taking actions that are isomorphic with institutional pressures, organizations gain legitimacy, resources, and survival capabilities (DiMaggio et al. 1983; Meyer et al. 1977). Institutional isomorphism is diffused through three mechanisms – normative, mimetic, and coercive isomorphism. The three mechanisms are not necessarily empirically distinguishable (DiMaggio et al. 1983; Mizruchi et al. 1999).

Compliance under normative pressures occurs when organizations feel compelled to honor certain cultural expectations from professional circles or the larger society. Normative pressures can diffuse through dyadic and multilateral relational channels. Mimetic isomorphism happens when organizations model other organizations' behaviors in pursuit of legitimacy or taken-for-granted practices (DiMaggio et al. 1983; Tolbert et al. 1983). When a clear course of action is not available to an organization, it might decide to mimic others. Coercive pressures are often associated with powerful actors upon whom a focal organization depends. The power of key stakeholders is often rooted in their resource-dominant role in exchange relationships.

There has been significant recognition of institutional forces as important predictors of the adoption and diffusion of IS products and practices (e.g., Liang et al. 2007; Orlikowski et al. 2001; Teo et al. 2003; Tingling et al. 2002). While many IS studies with an institutional perspective focus on a specific technology (such as electronic data interchange) with a direct bearing on adopters, we apply institutional theory to the adoption of a variety of IS & IT practices with both pragmatic and moral implications.

Natural-Resource-Based View of the Firm

Organizational studies previously took little interest in the environment and focused on economic, social, political, and technological factors, with the natural environment being an absence of the performance puzzle (Shrivastava et al. 1992; Shrivastava et al. 1995). Recognizing the natural environment as an important emerging source of competitive advantage, Hart (1995) proposes a natural-resource-based view of the firm by integrating the natural environment into the resource-based view. An organization's competitive advantage is built upon its capabilities to engage in green economic activities.

From the natural-resource-based view, Hart (1995) distinguishes between three inter-connected green strategies with different orientations: pollution prevention, product stewardship, and sustainable development. Emphasizing the development of new capabilities in production and operations, pollution prevention can generate significant savings, especially during early stages, resulting in cost and productivity advantages over other organizations (Hart et al. 1996). Pollution prevention offers the potential to reduce the cost of installing and operating emission-control equipments (Smart 1992), shorten cycle times (Hammer et al. 1993), and reducing the organization's compliance and liability costs (Rooney 1993). Product stewardship focuses on the environmental footprint of activities at each step of the value chain. It aims to reduce the overall life-cycle environmental costs of a product by disciplining the design and development process with the objective of achieving system transformation from cradle-to-grave to cradle-to-cradle (Shrivastava et al. 1995). Sustainable development entails reducing the environmental impact of an organization's economic activities across the world. This is rooted in the focus on establishing long-term solutions rather than short-term profits by envisioning and developing sustainable technologies (e.g., replacing synthetic chemicals with biological substitutes).

Green IS & IT

Green IS & IT refers to IS & IT products (e.g., software that manages an organization's overall emissions) and practices (e.g., disposal of IT equipment in an environmentally friendly way) that aims to achieve pollution prevention, product stewardship, or sustainable development (Boudreau et al. 2008; Molla et al. 2009a). Green IS & IT can play a critical role in driving the shift to a sustainable society (Watson et al. 2009). There is a growing awareness among professionals that IS & IT can contribute to both the problem and the solution of environmental issues (Molla et al. 2009a). However, organizational investment in green IS & IT is still at the early stage of maturity (Molla et al. 2009b), and such investment may take longer to yield a return (Olson 2008). Adoption and diffusion of green IS & IT can be driven by a multitude of internal and external factors, such as financial, technological, organizational, regulatory, and ethical factors (González 2005; Molla 2008). This study represents one of the first that conceptualizes and empirically assesses the impact of institutional factors on the adoption of green IS & IT from both perspectives (i.e., IT as a problem and IS as a solution).

Research Model and Propositions

This study focuses on the mimetic and coercive mechanisms of isomorphism. With the fervent concern for environmental issues in both academic and popular media, there is hardly any doubt about the existence of widespread consensus among members of organizational fields with respect to the necessity and urgency of green practices. Therefore, we propose that the foremost consideration in diffusing green practices is not how such diffusion is influenced by normative pressures but how it is motivated through mimetic and coercive pressures when normative pressures are already established to some extent. By drawing upon institutional theory and the natural-resource-based view, we propose a research model including the main and the interaction effects of mimetic and coercive pressures on organizational adoption of green IS & IT (see Figure 1).

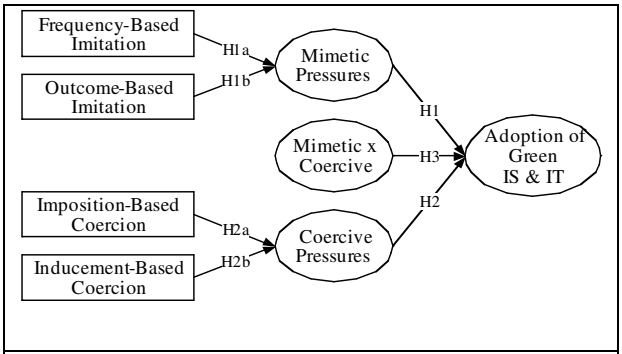

Figure 1. Research Model

Exclusion of Normative Pressure

Excluding normative pressure from this study allows us to eliminate a great amount of potential confounding, making the effects of mimetic and coercive pressures more likely to be detected. This decision is based on both theoretical and empirical considerations.

Theoretically, normative pressure may confound with mimetic and coercive pressures. Normative pressure stems from social expectations, which can be instilled through dyadic and multilateral relational channels. First, in the context of generic green behaviors, organizations connected via dyadic relational channels can become referent organization for each other to imitate. Thus, dyadic relational channels serve as a source of normative and mimetic pressures simultaneously. Dyadic relational channels, such as suppliers and customers, represent an important conduit through which norms and values are spread among organizations. For example, organizations have been found to gather information from inter-organizational communication channels to understand the implications of adopting a certain innovation (Huff et al. 1985). Mimetic pressure, however, arises from referent organizations, such as competitors, whose behaviors are the target of mimicry by the focal organization to reduce uncertainty. In the literature, normative and mimetic pressures are often generated by different organizations with which the focal organization is associated. Supply chain partners are an important source of normative pressures, while mimetic pressures often come from competitors. However, given that this study examines green practices as general organizational processes, competitors and supply chain partners do not necessarily differ in that respect. Adoption by others, regardless of whether "others" are competitors or supply chain partners, adds to the frequency of the adoption of a given practice. Likewise, both the successes of competitors and supply chain partners enhance the desirability of a certain practice. As a result, when it comes to the adoption and its success as perceived by an organization, we do not make a distinction between competitors and supply chain partners.

Second, social expectations and values can be spread through multilateral organizations such as professional affiliation and trade associations. This suggests external coercion to some degree (Perrow 1986). Cultural expectations from social actors play an important role in elevating concern about environmental issues to a level at which there are formal institutional pressures in the form of legal threats or regulatory rulings (Greening et al. 1994). The criticality of environmental destruction has already catapulted into the public spotlight. Environmental values can be diffused through key institutions, which set standards, evaluate organizational practices in professional and trade publications, and serve as a platform for education and knowledge sharing.

Empirically, the effects of each institutional pressure are not always clearly identifiable (DiMaggio and Powell, 1983). Each derives from a different process, but two or more tend to operate simultaneously and intermingle in empirical setting (DiMaggio et al. 1983; Mizruchi et al. 1999). First, the distinction between normative and mimetic pressures is not empirically clear (Burns et al. 1993), although they are theoretically different from each other. Whereas the perceived value of a behavior in generating competitive advantage drives mimicry, the need to comply with social expectations motivates normative isomorphism. For an organization affiliated with a professional association, both institutional pressures tend to be at work, making it difficult to determine where one ends and the other starts (Jennings et al. 1995). Furthermore, the same measure (e.g., the cumulative extent of adoption) has been used to capture the two sets of effects (Knoke 1982; Rowan 1982). For example, in an adoption study on electronic data interchange (Teo et al. 2003), the measure of normative pressure is based on adoption by suppliers and customers, and the measure of mimetic pressure is based on adoption by competitors. Sometimes, however, it is more difficult for an organization to accurately gauge the extent to which its competitors have adopted an innovation and benefited from it than in the case of suppliers and customers (Liang et al. 2007). Therefore, potential adopters are more likely to mimic the actions of their successful suppliers and customers when their competitors' adoptions are not readily assessable. Moreover, behavioral models such as the theory of planned behavior can also account for the connection between normative and mimetic pressures. As one's attitudinal belief is a well-tested determinant of adoption intention and actual adoption, the norms and understanding of other organizations (as captured by normative pressure) could be an important precursor to their adoption (as captured by frequency- and outcome-based mimetic pressures). Given the two reasons discussed previously, we might expect normative and mimetic pressures to be theoretically and empirically intertwined. Second, the effects of the normative and coercive pressures may not be empirically distinguishable (Ginsberg et al. 1990). The accumulation of certain normative factors can result in coercive pressures, suggesting a temporal sequence of the occurrence of both pressures. Whereas a longitudinal study can detect the precedence of normative pressure in this case, a cross-sectional study can mask the temporal sequence of the correlation between the two pressures. The current study focuses on the effects of institutional forces on the adoption of green IS & IT by organizations, rather than how different institutional forces develop over

time. Therefore, we choose a cross-sectional research design, although it cannot efficiently capture the temporal sequence between normative and coercive pressures. In sum, given both the theoretical and empirical difficulty of distinguishing the mimetic from the normative and coercive processes of institutional isomorphism (Table 1), we focus on mimetic and coercive pressures in this study.

Table 1. Potential Confounding of Normative Pressure with Mimetic and Coercive Pressures

Sources of Normative Pressure	Theoretical Consideration	Empirical Consideration
Suppliers and Customers (Dyadic relational channel)	Given the generic nature of green behaviors of interest to this study, suppliers and customers become a source of mimetic pressure at the same time.	The same scale, namely, the extent of adoption, measures both pressures in the literature.
Professional Affiliation (Multilateral relational channel)	Accumulation of normative pressure from professional affiliation can heighten environmental issues, resulting in coercion such as public policies.	The temporal sequence will be masked by correlation in a cross-sectional study.

Mimetic Pressures

The three fundamental modes of selective imitation are frequency-based, outcome-based, and trait-based imitations (Haunschild et al. 1997). Frequency-based mimetic pressure arises from the number of other organizations that have adopted a certain practice. With outcome-based imitation, organizations are motivated to adopt a given practice because of the favorable results achieved by other adopters. With trait-based imitation, organizations mimic the behaviors of other organizations with whom they share important attributes.

Mimetic isomorphism is considered a standard organizational response to uncertainty when the course of action is unclear (DiMaggio et al. 1983). The adoption of green IS & IT often involves considerable uncertainty. Given the public goods nature of the natural environment, the entrenched criterion of economic sustainability alone cannot adequately assess an organization's gains and losses from adopting a green practice. Deviation from the single bottom line of profitability requires a mindset shift among managers and induces uncertainty. Addressing the moral component of environmental issues while maximizing profitability represents a new challenge for practitioners.

The moral component of an environmental issue can be converted into one that incurs instrumental consideration through the enforcement of regulations or industrial standards. Relentless punishment such as steep fines or suspension of operation licenses for dumping industrial waste and toxic carries an immediate monetary implication for organizations that violate the mandate. In the absence of such coercive forces, other organizations' behaviors and the corresponding outcomes play a critical role in determining an organization's decision with respect to a moral issue.

P1: Mimetic pressures will be positively related to the adoption of green IS & IT.

Frequency-Based Imitation

When driven by frequency-based mimetic pressures, organizations make adoption decisions based on the prevalence of a practice. On the one hand, such prevalence is strong evidence of the legitimacy of the practice. When a practice has been adopted by a growing number of organizations, it becomes increasingly taken-for-granted so that some organizations may adopt such practice without thinking (March 1981; Zucker 1977).

P1a: Frequency-based imitation will be positively related to the adoption of green IS & IT.

Outcome-Based Imitation

When outcome-based pressures are at play, organizations tend to imitate others when the observed consequences of implementing these practices are considered favorable. The lack of immediate economic gains represents a barrier to organizational adoption of green IS & IT. Therefore, it is difficult for such practices to be immediately accepted by organizations, especially the myopic profit-focused ones. When this is the case, the adoption outcomes of other organizations will greatly reduce the uncertainty faced by a potential adopter, leading to adoption (or non-adoption) decisions.

P1b: Outcome-based imitation will be positively related to the adoption of green IS & IT.

Coercive Pressures

An organization's adoption of green practices arises from both imposition and inducement. First, the adoption of green practices may be imposed upon organizations, as when regulatory authorities such as governments or agencies mandate such behaviors by law or industrial standards. Second, the adoption of green practices may be induced, when supply chain partners make the fulfillment of certain criteria an eligibility requirement for collaboration.

P2: Coercive pressures will be positively related to the adoption of green IS & IT.

Imposition-Based Coercion

Regulatory institutions utilize coercive power to create institutional elements when they perceive that organizational practices are in conflict with the societal good. With regulatory authority, these institutional elements, such as industrial regulations and threat of legal sanctions, are powerful tools to govern organizational behaviors. The consequences for noncompliance may include suspension of an operating license or a steep monetary penalty. Coercion in the form of public policy plays an important role in effective environmental management (Kilbourne et al. 2002). In the US, regulatory institutions have enacted ordinances, regulations and laws in response to the growing awareness of environmental issues (Clemens et al. 2006). Imposition-based coercion has been the most prevalent approach in the US (Delmas et al. 2001). The constraints imposed on organizations also reflect the interpretation of a given institutional situation by regulatory institutions, reducing the uncertainty faced by organizations. For example, building a cap-and-trade market for carbon emissions would provide organizations with more certainty about energy costs in the future, guiding their investment decisions (Carey 2009). The law-like nature of imposition-based coercive elements forces compliance among organizations in order to ward off undesired consequences.

P2a: Imposition-based coercion will be positively related to the adoption of green IS & IT.

Inducement-Based Coercion

The second manner in which coercive isomorphism may happen is that of inducements. Important supply chain partners do not have the authority or power to impose regulations or laws, but they often possess the power to create strong inducements for a focal organization to comply with their demands (Meyer et al. 1992). Supply chain partners generate forces for conformity to certain standards, which translate into coercive pressure by providing incentives (or disincentives). For example, important customer or supply chain partners, as "dominant" or "definitive" stakeholders (Mitchell et al. 1997), may exert pressures over organizations to be ISO 14000[3] certified.

P2b: Inducement-based coercion will be positively related to the adoption of green IS & IT.

Interaction between Mimetic and Coercive Pressures

The three institutional pressures do not necessarily operate in isolation, especially in a dynamic environment (Roy et al. 2000). The normative pressure from environmental associations may induce regulatory institutions to enact public policies, which, in turn, can force organizations to adopt green behaviors (Delmas et al. 2004).

Both mimetic and coercive pressures aim at motivating institutional isomorphism. However, they trigger different reasoning mechanisms behind an organization's decisions to adopt green practices. Under coercive pressures, the threat of sanction by powerful organizations such as regulatory authorities and critical supply chain partners drives an organization's adoption choices. Coercive isomorphism is an organization's conforming response to mandated standards. With mimetic pressure, organizations use the frequency and outcome of others' adoption as a proxy indicator of the legitimacy of a given practice, when there is lack of adequate information to validate the feasibility and profitability of such a practice through a cost-and-benefit calculation. Mimetic isomorphism represents an organization's response to uncertainty as a barrier to adoption of green practices. In organizational fields where coercive pressure is not directly involved, mimetic forces represent a significant factor in an organization's green decision-making (Jennings et al. 1995). Between coercive and mimetic pressures, the presence of one is very likely to add to the institutional legitimacy suggested by the other. The prevalence of a green practice among organizations may reflect the urgency and validity of existing or anticipated coercive forces. Legal enforcement of a regulation or pressures from supply chain partners may suggest the legitimacy and criticality of a green practice, easing the

[3] The ISO 14000 family entails guidelines for different aspects of environmental management.

uncertain conditions faced by potential adopters. Moreover, when evidence of the value of a given practice comes from multiple sources rather than a single one, it is very likely to be perceived as more convincing by an organization. Therefore, the presence of one pressure reinforces the effect of the other. Accordingly, we expect mimetic and coercive pressures to synergistically combine, lowering the uncertainty faced by potential adopters of green IS & IT and demonstrating the regulatory validity.

P3: Interaction between coercive and mimetic pressures will have a positive effect on the adoption of green IS & IT.

Controls

Organizations are subject to different regulatory sanctions across industries. For example, the food and drug industries are more tightly regulated than textile manufacturing because of the public health consequences. Therefore, we include industry as a control variable. Financial resources are an important precursor to innovation adoption (Iacovou et al. 1995; Riggins et al. 1994). Organizations with sufficient financial resources are able to experiment with new practices and cope with adoption failures. As a result, revenue is also included as a control.

Methodology

A questionnaire-based, cross-sectional field study was conducted to test the research model, as the objective of this research is to understand the effects of institutional pressures on the adoption of green IS & IT by organizations. Data were collected through the Cutter Consortium in 2008. Participating organizations are from 18 industries, including both manufacturing and service industries, and from 22 countries, with about one third of the sample in the U.S. The majority of the organizational representatives who filled out the questionnaires are in a position of IS management (26.7%), consulting (21.3%), or senior management/policymaking (14.7%). We aim to examine general rather than industry-specific green IS & IT adopted by organizations. Therefore, our target population consists of organizations across industries and with diverse attributes (see Table 2).

Table 2. Annual Revenue of Organizations/Divisions

Annual Revenues of Organizations/Divisions (U.S. $)	Response Percentage	Annual Revenues of Organizations/Divisions (U.S. $)	Response Percentage
Less than 1 million	25.3%	More than 100 million to 1 billion	18.7%
1 million to 10 million	12%	More than 1 billion to 10 billion	13.3%
More than 10 million to 50 million	12%	More than 10 billion to 50 billion	5.3%
More than 50 million to 100 million	10.7%	More than 50 billion	2.7%

Operationalization

All the dependent and independent variables are operationalized formatively according to the Jarvis et al. (2003) criteria. The measures are summarized in Table 3.

Dependent Variables

Based on empirical studies of green IT practices (such as telecommuting), on interviews with professional and managerial employees, and on discussions with colleagues interested in green IS & IT, we generated the items tapping each of the categories discussed in the preceding theoretical background: green IS & IT practices focusing on pollution prevention, product stewardship and sustainable development. Thus, we operationalized organizational adoption of green IS & IT through three dependent variables.

For item clarity, we retained the distinction between the separate roles played by IS & IT, as both a problem and a solution. The items themselves did not combine both aspects, each with a single focus either on practices to curb the environmental impact of IT or on practices enabled by IS to enhance the environmental friendliness of other business operations. This distinction is important because it allows an explicit empirical investigation of the seemingly contradictory roles in environmental issues. Thus, the three dependent variables are measured formatively, each with two dimensions capturing the roles played by IS & IT.

This study examines a wide variety of green IS & IT practices, which may differ from each other along multiple dimensions. For example, they range from low-frequency practices such as investing in energy-efficient IT hardware and software to high-frequency ones such as using green IS to manage overall emissions. Moreover, they include both intra-organizational practices such as using renewable energy to support IT infrastructure to inter-organizational practices such as enhancing the environmental friendliness of supply chain activities through green IS. Given the diversified nature of the green IS & IT practices, we used the level of institutionalization (i.e., the existence of policies/regulations/incentives) of such practices as a proxy of adoption. This measure, as opposed to the traditional adoption measures (e.g., frequency and scope), captures the stabilized organizational behaviors. Each item asked respondents to indicate the adoption status of their organizations on a 3-point Likert scale, with 1 representing no adoption, 2 representing adoption plan, and 3 representing existing adoption.

Adoption of green IS & IT with a focus on pollution prevention. Adoption of green IS & IT focusing on pollution prevention consists of two formative indicators: adoption of practices that reduce pollution generated by IT, and adoption of green IS to reduce pollution generated by other business operations. To measure the first dimension, we used the sum of two formative indicators capturing the practices that improve the energy efficiency of IT infrastructure and hardware. To measure the second dimension, we used the sum of three formative indicators capturing the use of IS to reduce overall emissions, waste and hazardous materials. This operationalization reflects the first dimension addressing IT as a cause of the environmental issues and the second dimension presenting IS as a solution of environmental issues.

Adoption of green IS & IT with a focus on product stewardship. Adoption of green IS & IT focusing on product stewardship consists of two formative indicators: adoption of practices that emphasize the lifecycle of IT equipment, and adoption of practices that use IS to enhance the lifecycle management on the supply chain. To measure the first dimension, we used the sum of two formative indicators capturing the practices of recycling and disposing of IT equipment in an environmental friendly way. To measure the second dimension, we used the sum of two formative indicators capturing the use of IS to enhance the environmental friendliness of upstream and downstream supply chain activities.

Adoption of green IS & IT with a focus on sustainable development. Adoption of green IS & IT focusing on sustainable development consists of two formative indicators: adoption of practices that seek renewable energy to support IT infrastructure and adoption of practices that transform business operations with IS. We used the adoption of renewable energy to support IT infrastructure to gauge the first dimension. To measure the second dimension, we used the sum of three formative indicators capturing the use of IS to transform business operations.

Independent and Control Variables

Mimetic and coercive pressures were both measured formatively with scales adapted from Teo, Wei and Benbasat's study (2003). Each scale asked respondents to indicate the degree to which they agreed with the statements regarding the institutional pressures on a 5-point Likert format, with 1 representing strongly disagree and 5 representing strongly agree.

Mimetic Pressure. We measured mimetic pressure through two formative indicators: frequency- and outcome-based mimetic forces. To measure frequency-based mimetic pressure, we used the mean of two reflective indicators capturing the extent of adoptions by an organization's competitors and supply chain partners. To measure outcome-based mimetic pressure, we used the mean of four reflective indicators that capture the perceived success of adoptions by other organizations.

Coercive Pressure. We measured coercive pressure through two formative indicators: imposition- and inducement-based coercive pressures. We measured the imposition-based coercive pressure by asking respondents to indicate whether their organizations are pressured to adopt green IS & IT by current and foreseeable regulations. Two reflective indicators on whether the organizations are pressured to adopt green IS & IT by major customers and suppliers were used to gauge the inducement-based coercive pressure.

Control Variables. For the control variables (i.e., industry and revenue), we used two ordinal variables that indicate the industry and revenue range of an organization respectively.

Table 3. Operationalization of Constructs

Constructs	Measure (Reliability)	Items
Mimetic Pressure	Frequency-based imitation: Extent of adoption by competitors, suppliers and customers (0.820)	What is the current extent of the adoption of sustainable IS business practices by your organization's *competitors* (Adp_Comp)? *supply chain ecosystem* (Adp_SuCu)?

	Outcome-based imitation: Perceived success of competitors, suppliers and customers that have adopted green IS & IT (0.852)	• Our main competitors who have adopted sustainable IS business practices
		  o have benefited greatly financially. (Suc_C1)
		  o are perceived favorably by customers. (Suc_C2)
		• Within my organization's supply chain management ecosystem, those who have adopted sustainable IS business practices
		  o have benefited greatly financially. (Suc_SuCu1)
		  o are perceived favorably by customers. (Suc_SuCu2)

Coercive Pressure	Imposition-based coercion: Pressure from regulatory bodies	Current and foreseeable regulations are pressuring us to adopt sustainable IS business practices. (Policy)
	Inducement-based coercion: Pressure from major customers and suppliers (0.801)	• Our suppliers are pressuring us to adopt sustainable IS business practices. (Press_Sup) • Our major customers are pressuring us to adopt sustainable IS business practices. (Press_Cus)
Pollution prevention	PolPre_prob: Organizational action on reducing energy consumed by IT infrastructure and hardware (IT as a problem)	To what extent does your organization have policies • to reduce the energy consumed by its IT infrastructure (through virtualization, thin clients, etc.)? (PolPre1) • to purchase energy-efficient IT hardware (e.g., Energy Star, 80 PLUS power supply, Electronic Product Environmental assessment Tool, etc.)? (PolPre2)
	PolPre_solu: Organizational adoption of IS to reduce overall emissions, waste and hazardous materials (IS as a solution)	To what extent does your organization have policies that encourage installation of software for which the main goal is to reduce your organization's overall *emissions* (PolPre5)? *waste* (PolPre6)? *use of hazardous and toxic materials* (PolPre7)?
Product Stewardship	ProSte_prob: Organizational action on disposing of IT equipment in an environmentally friendly way (IT as a problem)	To what extent does your organization have policies that encourage • purchasing products based on an IT vendor's end-of-life/recycling program? (ProSte2) • disposing of its IT equipment in an environmentally friendly manner? (ProSte3)
	ProSte_solu: Organizational adoption of IS to enhance the environmental friendliness of upstream and downstream supply chain management (IS as a solution)	To what extent does your organization have policies that encourage installing software for which the main goal is • to make its upstream supply chain management (material sourcing and acquisition) more environmentally friendly? (ProSte4) • to make its downstream supply chain management (product distribution and delivery) more environmentally friendly? (ProSte5)
Sustainable development	SusDev_prob: Organizational action on seeking renewable energy to support IT infrastructure (IT as a problem)	To what extent does your organization have policies that encourage use of renewable energy (solar, wind, hydro, etc.) to support its IT infrastructure? (SusTec4)
	SusDev_solu: Organizational adoption of IS to transform business operations (IS as a solution)	To what extent does your organization have policies that encourage • online collaboration tools (beyond email) to substitute for travel (e.g., video conferencing, etc.)? (SusDev1) • employee telecommuting? (SusDev2) • transforming its business processes to be paperless? (SusDev3)

Data Analysis

We used the partial least squares (PLS), a structural equation modeling (SEM) tool, to test the research model in view of PLS's ability to operationalize a latent construct either formatively or reflectively. We adopted SmartPLS with a 500 sample bootstrapping technique for model assessment. All statistical tests were assessed with one-tailed t-tests because of the unidirectional nature of our hypotheses and corollaries.

An important concern for formative indicators is multicollinearity (Diamantopoulos et al. 2001; Petter et al. 2007). Since Mimetic Pressure and Coercive Pressure are formatively measured, we examined Variance Inflation Factors (VIF). With the maximum VIF being 1.495, neither exceeds 3.3 as recommended by Diamantopoulos and Siguaw (2006). This indicates that multicollinearity is not a concern. The inter-construct correlations for the second-order constructs are presented in Table 4 and the correlations[4] between the first-order dimensions (as well as control variables) are shown in Appendix A. Prior to assessing the structural model, we assessed the psychometric properties of our first-order dimensions. Factor analysis (see Table 5), comparison of the average variance extracted (AVE) to inter-construct correlations (see Appendix A), and reliabilities (see Table 3) show that our scales exhibit good psychometric properties.

Table 4. Intercorrelations Among Latent Variables

	Coercive Pressures	Mimetic Pressures	Pollution prevention
Coercive Pressures	1.000		
Mimetic Pressures	0.488	1.000	
Pollution prevention	0.502	0.527	1.000
	Coercive Pressures	Mimetic Pressures	Product Stewardship
Coercive Pressures	1.000		
Mimetic Pressures	0.455	1.000	
Product Stewardship	0.476	0.450	1.000
	Coercive Pressures	Mimetic Pressures	Sustainable development
Coercive Pressures	1.000		
Mimetic Pressures	0.487	1.000	
Sustainable development	0.422	0.462	1.000

Table 5. PLS Confirmatory Factor Analysis Results

	Pollution Prevention				Product Stewardship				Sustainable Development			
	Frequency	Imposition	Inducement	Outcome	Frequency	Imposition	Inducement	Outcome	Frequency	Imposition	Inducement	Outcome
Adp_Comp	0.87	-0.086	0.038	0.161	0.884	-0.086	0.04	0.178	0.813	-0.086	0.037	0.181
Adp_SuCu	0.959	0.054	0.175	0.216	0.95	0.054	0.171	0.222	0.984	0.054	0.177	0.216
Policy	0.003	1	0.585	0.45	-0.002	1	0.575	0.448	0.022	1	0.59	0.432
Press_Cus	0.136	0.598	0.935	0.502	0.131	0.598	0.913	0.508	0.155	0.598	0.95	0.505
Press_Sup	0.106	0.454	0.889	0.32	0.103	0.454	0.914	0.332	0.116	0.454	0.868	0.33

[4] We assessed the correlations among the formative dimensions of the institutional pressures. The extent of adoption by supply chain partners, as one dimension of the normative pressure in the literature, is significantly and highly correlated (>=0.6) with the extent of adoption by competitors, as one dimension of the mimetic pressure. Professional affiliation, as the other dimension of the normative pressure in the literature, is significantly and highly correlated (>=0.6) with both imposition- and inducement-based coercive pressures. The results support our rationale for excluding the normative pressure from this study.

Suc_C1	0.119	0.335	0.411	0.853	0.122	0.335	0.404	0.873	0.106	0.335	0.416	0.897
Suc_C2	0.105	0.299	0.287	0.834	0.099	0.299	0.271	0.8	0.123	0.299	0.298	0.79
Suc_SuCu1	0.307	0.388	0.461	0.859	0.306	0.388	0.451	0.889	0.307	0.388	0.467	0.9
Suc_SuCu2	0.174	0.486	0.384	0.781	0.172	0.486	0.377	0.756	0.179	0.486	0.389	0.708

As shown in Figure 2, Figure 3, and Figure 4, PLS results provide strong support for H1 and H2. The bolded lines represent the paths that are significant at 0.05. The corollary H1b is consistently supported across the models, indicating strong evidence for the role of outcome-based pressure in organizational adoption of green IS & IT. The corollary H1a is not supported in all models. Hypotheses H2a, H2b and H3 are partially supported. Mimetic and coercive pressures, but not the control variables[5] (i.e., industry and revenue), are significant determinants of organizational adoption of green IS & IT, explaining 35.6%, 29.7%, and 27.6% of the variances in practices focusing on pollution prevention, product stewardship and sustainable development, respectively. Furthermore, all formative indicators of the dependent variables, except for the "IT as a problem" dimension of sustainable development, have significant weights on their corresponding constructs. Table 6 and Figure 5 show the results of our tests of the interaction hypotheses. The hypothesized complementary effect (i.e., positive interaction) between mimetic and coercive pressures is significant only in the product stewardship model. The interaction effects, which are presented in Figure 6, explain an additional 6.8% of variance in the adoption of green IS & IT focusing on product stewardship.

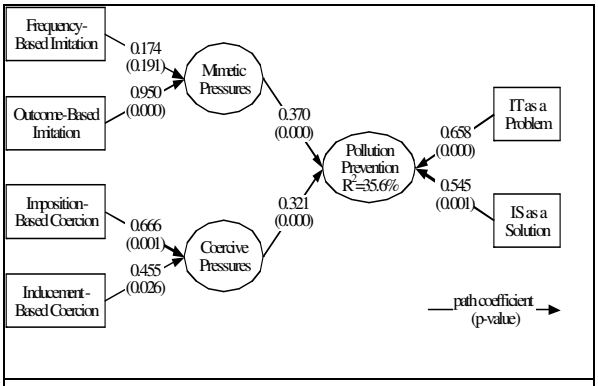

Figure 2. Results of PLS Analyses (pollution prevention)

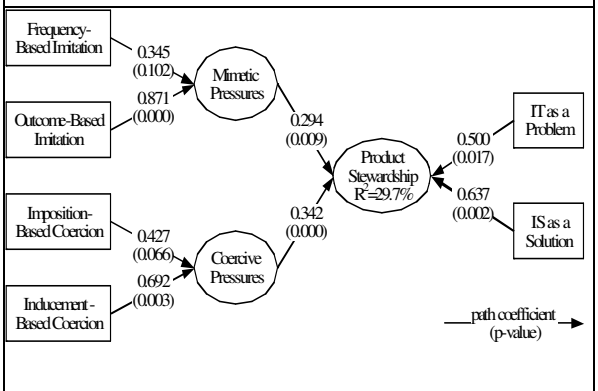

Figure 3. Results of PLS Analyses (product stewardship)

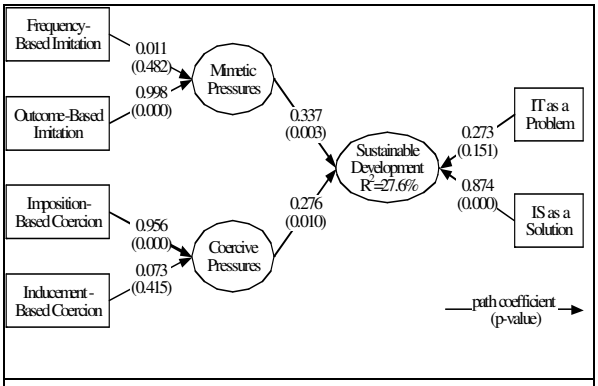

Figure 4. Results of PLS Analyses (sustainable development)

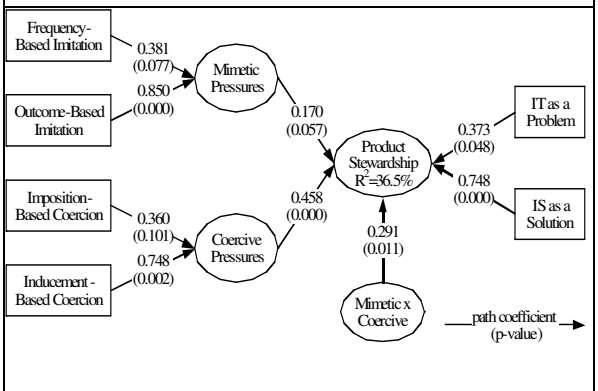

Figure 5. Results of PLS Analyses (product stewardship with interaction effect)

[5] We first ran the three models including the control variables one at a time. Because neither of them is significant at 0.05, we exclude the control variables from the models presented in this paper.

Table 6. Interaction Effects for Product Stewardship		
Independent Variable	**Model 1**	**Model 2**
Mimetic Pressures ➔ Product Stewardship	0.294* (0.009)	0.170 (0.057)
Coercive Pressures ➔ Product Stewardship	0.342** (0.000)	0.458** (0.000)
Mimetic Pressures x Coercive Pressures ➔ Product Stewardship		0.291* (0.011)
Adjusted R^2	29.70%	36.50%
ΔR^2		6.80%
F		7.603*

path coefficient (p-value)

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

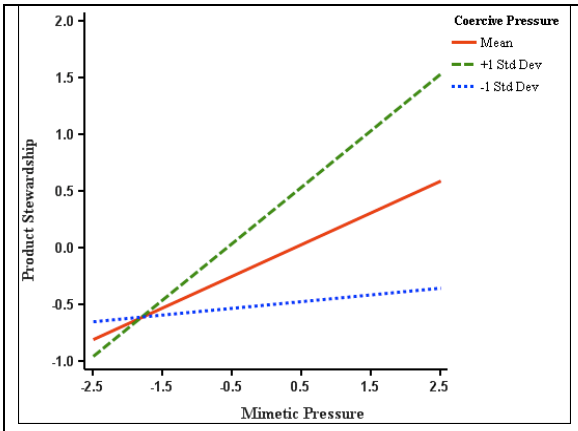

Figure 6. Interaction of Mimetic and Coercive Pressures (product stewardship)

Discussion

This study examines institutional pressures that can motivate the adoption of green practices across organizations. Given the theoretical and empirical difficulty of differentiating the effects of mimetic and normative pressures, we focus on mimetic and coercive pressures and propose that both pressures are important factors that drive green IS & IT practices. Adoption of general rather than industry-specific IS & IT is of interest. We control for the effects of certain organizational attributes such as industry and revenue. We consider frequency- and outcome-based imitations as two important mechanisms of mimetic isomorphism. The extent to which other organizations have adopted green IS & IT and the perceived success of their adoptions serve as valid proxy indicators of the mimetic pressure. Regulatory authorities and supply chain partners represent two important sources of coercive pressures.

The analysis of green IS & IT adoption across 75 organizations provides strong support for the main effects of mimetic and coercive pressures. The hypothesized complementary relationship between the two receives partial support, being significant only in the product stewardship model. One explanation for partial support for the complementary relationship between mimetic and coercive pressures may be that the reliance on supply chain partners and the lack of regulatory guidance in product stewardship practices present high levels of uncertainty so that organizations take extra precaution in making adoption decisions.

According to the analysis, outcome-based imitation consistently represents a significant source of mimetic pressures across the three models, while frequency-based imitation is consistently insignificant. This suggests organizations cautiously adopt green IS & IT: the sheer number of adopters is not strong enough to reduce the uncertainty associated with green practices. Rather, favorable outcomes perceived by the potential adopters provide a more convincing rationale for adoption.

In contrast to the consistent pattern of mimetic pressures, different indicators of coercive pressures turn out to be significant in different models. Regulations are a significant source of coercive pressures only in models predicting pollution prevention and sustainable development practices. This reflects the effectiveness of regulatory efforts in guiding green behaviors across organizations, especially when such behaviors have an organization-wide, as opposed to supply-chain-wide, impact.

Pressures from supply chain partners, rather than regulations, turn out to be significant in the model of product stewardship. On the one hand, this suggests a lag in regulatory efforts to motivate a full-lifecycle eco-friendliness. On the other hand, the significance of coercive pressures from supply chain reflects the supply-chain-dependent nature of practices oriented towards product stewardship. Product stewardship emphasizes the full lifecycle of a product, striving to turn the traditional cradle-to-grave production into cradle-to-cradle eco-design that builds upon the collaborative agreements among supply chain partners. It calls for a mindset shift from a partial-lifecycle to a full-lifecycle perspective. Overall optimization does not necessarily mean local optimization. As stakeholders become salient at different stages of a product lifecycle, they tend to maximize financial gains during the part of

product lifecycle that matters to their financial performance rather than seeking a full-lifecycle optimization. For example, manufacturers are the dominant stakeholders during the production stage. Obtaining materials, manufacturing products, and distributing products through retail channels are of immediate concern to manufacturers. Therefore, they aim to optimize those activities to increase financial gains during the production stage. To manufacturers, how individual consumers deal with the products at the end of their lifecycle is of little interest, especially in financial terms. Likewise, consumers tend to care more about the price and performance of a product than about how it is produced and how raw materials are obtained. Creating regulations that effectively drive collective efforts across the supply chain seems to be a challenging task for regulatory authorities.

Contributions and Implications for Research and Practice

The study examines how mimetic and coercive pressures affect the adoption of green IS & IT by organizations, in the presence of established normative pressure. Based on institutional theory and the natural-resource-based view of the firm, we developed a research model with both the main effects and interaction of mimetic and coercive pressures. Based on the survey responses from 75 organizations, outcome-based mimetic pressure, imposition- and inducement-based coercive pressures are found to be strong institutional forces impelling organizations to initiate or elaborate behavioral responses to environmental issues. The interaction of mimetic and coercive pressures is found to be significant only in the model of product stewardship.

This study contributes to research and practice in several ways. The contribution to research is three-pronged. First, it represents one of the first studies focusing on the role played by IS & IT in green practices. The heightened importance of ecological sustainability has generated a body of research on green practices. However, IS & IT have been a missing piece of the eco-sustainability puzzle. By drawing upon the natural-resource-based view of the firm, we identify three types of IS & IT-based green practices. We also make an important distinction between IS and IT in driving ecological sustainability. Second, the research contributes to the literature of institutional theory by examining the interaction between institutional forces. Although such interaction has been theoretically recognized (Delmas et al. 2004), there is a paucity of empirical research on it. In particular, this study provides empirical support for the complementary effects between mimetic and coercive pressures in driving the adoption of IS & IT-based product stewardship by organizations. Third, this study also enriches the research on green practices by assessing organizational action on adopting a multitude of green practices. A wide variety of practices can better capture the eco-friendliness of an organization.

The research model and the hypotheses developed in this study provide avenues for future research. First, by examining a multitude of generic IS & IT-based green practices, we have embarked on a study across various industries. Future studies can take a finely grained approach by focusing on a particular industry. Thus, the findings based on industry-specific green IS & IT may provide more insights in industrial heterogeneity regarding the adoption of green practices. Alternatively, future research can also explore emerging green IS & IT practices, which may not exist or gain prevalence when this study was conducted. The advancement of IS and IT, coupled with the growth of institutional pressures, may further change the industrial landscape and give rise to new practices across organizations. Therefore, revisiting the list of green IS & IT practices identified in this study is important for keeping our understanding of the field current. Second, given the cross-sectional nature of research design, this study focuses on the synchronic effects of the institutional pressures. To complement the findings yielded in this study, future research can take a longitudinal approach to demonstrate the interactive operation of the institutional forces over time, and thereby account for the diachronic effects. Additionally, our understanding of green IS & IT in this study is built upon a small sample size (75 organizations). A future study based on an extended sample can be conducted to refine our understanding of this increasingly important phenomenon.

Our study has important implications for practitioners. First, the outcome-based mimetic isomorphism is an important determinant of organizational adoption of green IS & IT. Due to the inherent uncertainty of the outcomes of green practices, making successful adoptions known to potential adopters will motivate their mind-set shift and provide effective guidance in their decision-makings. Second, it highlights the importance of the complementary effects between mimetic and coercive pressures. The complementary effects between the two may inform regulatory authorities in developing effective interventions in driving the diffusion of green IS & IT across organizations. Finally, this study also brings to the attention of organizations and regulatory bodies the separate roles played by IS and IT in our pursuit of ecological sustainability. This careful differentiation helps organizations to find the right positions for IS and IT in their green business strategies.

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Appendix A: Correlation Matrix

	Mean	Frequency-Based	Outcome-Based	Imposition-Based	Inducement-Based	PolPre_prob	PolPre_solu	ProSte_prob	ProSte_solu	SusDev_prob	SusDev_solu	Industry	Revenue
Frequency-Based	1.30 (1.21)	**1.000**											
Outcome-Based	3.16 (0.77)	0.204	**1.000**										
Imposition-Based	3.32 (1.25)	-0.015	0.454**	**1.000**									
Inducement-Based	2.70 (1.05)	0.117	0.447**	0.575**	**1.000**								
PolPre_prob	3.84 (1.46)	0.108	0.485**	0.390**	0.320**	**1.000**							
PolPre_solu	4.35 (1.87)	0.225	0.367**	0.384**	0.386**	0.376**	**1.000**						
ProSte_prob	3.64 (1.40)	0.133	0.387**	0.405**	0.333**	0.579**	0.486**	**1.000**					
ProSte_solu	2.93 (1.38)	0.268*	0.365**	0.302**	0.442**	0.518**	0.690**	0.540**	**1.000**				
SusDev_prob	1.52 (0.76)	0.181	0.230*	0.291*	0.13	0.356**	0.584**	0.496**	0.408**	**1.000**			
SusDev_solu	6.41 (1.98)	0.058	0.460**	0.403**	0.268*	0.569**	0.439**	0.575**	0.584**	0.340**	**1.000**		
Industry	11.72 (6.18)	-0.146	0.088	0.127	0.109	-0.03	-0.086	0.033	-0.053	-0.107	-0.033	**1.000**	
Revenue	3.60 (2.10)	0.075	0.004	0.06	0.043	0.151	0.039	-0.004	0.084	0.047	0.05	0.156	**1.000**

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

The AVE values of frequency-based imitation are 0.839, 0.843, and 0.814 for the models of pollution prevention, product stewardship, and sustainable development, respectively; the AVE values of outcome-based imitation for the three models are 0.693, 0.691, and 0.685, respectively; and the AVE values of inducement-based coercion for the three models are 0.832, 0.834, and 0.828, respectively.