Information Systems Journal

Special Issue on: Information Systems addressing the Challenges of Environmental Sustainability

Title of paper:
How IT Executives Create Organizational Benefits by Translating Environmental Strategies into Green IS Initiatives

Suggested running headline:
Organizational Benefits of Green IS Strategies and Practices

Authors:
Fabian Loeser (corresponding author), Institute of Information Systems Management, Technische Universitaet Berlin, Strasse des 17. Juni 135, 10623 Berlin, Germany, email: Fabian.Loeser@gmail.com

Jan Recker, QUT Business School, Brisbane, Queensland University of Technology, Queensland, Australia, email: j.recker@qut.edu.au

Jan vom Brocke, Hilti Chair of Business Process Management, Institute of Information Systems, Universitaet Liechtenstein, Fürst-Franz-Josef-Strasse, 9490 Vaduz, Liechtenstein, email: jan.vom.brocke@uni.li

Alemayehu Molla, PhD School of Business Information Technology & Logistics, RMIT University, 400 Swanston Street, Melbourne VIC 3000, Australia, email: alemayehu.molla@rmit.edu.au

Ruediger Zarnekow, Institute of Information Systems Management, Technische Universitaet Berlin, Strasse des 17. Juni 135, 10623 Berlin, Germany, email: Ruediger.Zarnekow@tu-berlin.de

How IT Executives Create Organizational Benefits by Translating Environmental Strategies into Green IS Initiatives

ABSTRACT

Organizations increasingly recognize that environmental sustainability is an urgent problem. Green Information Systems (Green IS) initiatives can assist organizations in reaching their environmental goals by providing the ability to reduce the environmental impacts of Information Technology (IT) manufacturing, operations, and disposal; facilitate transparency and enhance the efficiency of organizational resources and business processes; and foster eco-products through technological innovation. However, the nature and type of benefits such initiatives can accrue remain poorly understood, and accordingly IT executives struggle to integrate environmental aspects in the corporate strategy and to launch Green IS initiatives. This paper clarifies the mechanisms that link organizational beliefs about environmental sustainability to Green IT and Green IS actions undertaken, and the organizational benefits that accrue from these actions. Using data from a global survey of 118 senior-level IT executives, we find that Green IS strategies mediate the relationship between environmental orientation and the implementation of Green IT practices and Green IS practices, which in turn lead to organizational benefits in the form of cost reductions, corporate reputation enhancement, and Green innovation capabilities. Our findings have implications for the potential of IS to enable organizations' environmental sustainability and also for the differentiation of Green IT and Green IS practices.

KEYWORDS

Environmental Sustainability, Environmental Orientation, Green IT, Green IS, Strategy, Practices, Belief-Action-Outcome, Organizational Benefits, Survey, PLS-SEM

INTRODUCTION

The information systems (IS) discipline has been challenged to determine how IS can contribute to environmentally responsible human activity (Watson *et al.*, 2010; Elliot, 2011). Researchers claim that IS can be a key enabler, assisting individuals, organizations, governments, and society to transform towards environmentally sustainable practices. In this context, the IS discipline has started to systematically explore the role that IS might play (e.g., Melville, 2010; Elliot, 2011; Seidel *et al.*, 2013; Hedman & Henningsson, 2016; Hasan *et al.*, in press).

An increasing number of studies that examine the role of IS for environmental sustainability have appeared in response to this global challenge. These studies broadly fall into two categories: abstract and substantive. Abstract-level studies, for instance, investigate factors that influence the adoption of *any type of* Green IS (e.g., Chen *et al.*, 2011; Molla *et al.*, 2011; Thongmak, 2013), while substantive-level studies conceptualize requirements *for some type of* Green IS, such as energy systems (Watson *et al.*, 2010) or examine particular *systems* for specific environmental challenges, such as energy consumption (Loock *et al.*, 2013), greenhouse gas emissions (Hilpert *et al.*, 2013), or organizational initiatives (e.g., Bengtsson & Ågerfalk, 2011; Butler, 2011; Seidel *et al.*, 2013).

Both types of studies are important, but it appears that most Green IS research to date is substantive-level in nature. The limitation of substantive-level studies is that they develop models that pertain only to specific cases (e.g., Seidel *et al.*, 2013), so they are limited in providing insights about the benefit of Green IS *in general*. The second key limitation of the research to date is the absence of empirical studies that evaluate consequences. Malhotra et al.'s (2013) review shows that the majority of research articles published in the domain of Green IS are *conceptual* or *analytical* studies, as opposed to *impact* studies that analyze organization-level outcomes empirically.

Our objective is to clarify both the antecedents and benefits of Green IS initiatives. Specifically, we ask a) how environmental orientation and strategy influence Green IS initiatives and (b) whether Green IS initiatives yield organizational benefits *in general*. The scope of our study to address this objective is to understand the organizational *beliefs* about environmental sustainability, the *actions* that organizations undertake by formulating Green IS strategies and translating these into Green IT practices and Green IS practices, and the organizational benefits they generate as *outcomes*. Based on a literature review, we show that no empirical study has yet contributed this knowledge, even though it is an important problem to address: CIOs are cautious about investments in Green IS when the investments' business value is unclear (Corbett, 2010; Dedrick, 2010; Bengtsson & Ågerfalk, 2011). Moreover, while a wide range of Green IT practices helps to reduce IT energy consumption in data centers and office environments, thus decreasing operational costs, the business case for enterprise-level Green IS initiatives that enhance the resource efficiency of business and production processes is more difficult to determine (Molla & Abareshi, 2012). This is because the long-term payoffs of Green innovations at the product level are often even less tangible because of ambiguous customer preferences and the uncertain development of future markets (Michaud & Llerena, 2010).

Our research provides three unique contributions: *Theoretically*, we establish a new model of organizational benefits accruing from Green IS investments. The model, based on Melville's (2010) Belief-Action-Outcome framework, postulates how environmental orientation shapes the formulation of Green IS strategies and the implementation of Green IT practices and Green IS practices that reduce costs and generate reputational and innovation benefits. The model also demonstrates the types of Green IT and Green IS practices and the specific organizational benefits being associated with them. *Empirically*, we provide the first (to the best of our knowledge) general-level study of the organization-level benefits of Green IS initiatives that builds on data from senior-level IT executives. We also provide new and validated measurement instruments for novel Green IS concepts such as Green IS strategy, Green IT practices and Green IS practices. In doing so, we add useful and original knowledge to the emergent field of Green IS research. *Practically*, our research provides senior-level IT executives with content, scope and measures for the design of Green IS strategies. We show that companies that execute Green IS initiatives must make substantial changes to their orientation to climate change, such as by revisiting their internal values and standards of ethical behavior. We also present the first empirical insights on the expected outcomes of such initiatives, which are important because of the prevailing uncertainty concerning the business benefits of Green IS (Elliot, 2013), particularly regarding their strategic long-term benefits (Shrivastava *et al.*, 2013).

The rest of the paper is organized as follows. First, we review the literature on Green IS research, focusing on the contributions to empirical knowledge to date. Then we provide a brief review of Melville's (2010) Belief-Action-Outcome framework, which is the starting point for our theorizing. Next, we develop our research model and discuss the research method. Then we describe our empirical results and the analyses we conducted on the data. Finally, we discuss our findings and their implications before reviewing our research's limitations and contributions.

BACKGROUND

To provide a background to our study, we review the literature on the theoretical relationships between IS and environmental sustainability, the empirical findings generated to date, and the potential benefits that might accrue from Green IS initiatives.

Information Systems and Environmental Sustainability

Environmental sustainability issues have come to the societal and governmental forefront because it is widely believed that the future of our ecosystem and society depends on our collective ability to limit or, ideally, reverse human-initiated environmental degradation and the effects of global climate change (Bansal, 2005). A survey of chief executive officers (CEOs) in 2013 indicates that 70 percent see environmental sustainability as a significant business issue (Kiron *et al.*, 2013). While the management literature typically sees institutional and resource-based perspectives as triggers for environmental innovation (Berrone *et al.*, 2013) and mechanisms for improving environmental outcomes (Bansal, 2005), DeGarmo et al. (2011) argue that corporate sustainability is primarily an information challenge. New dimensions of environmental performance must be integrated into measurement systems to facilitate transparency and allow for responsible decision-making as well as accountability to internal and external stakeholders.

Watson *et al.* (2010) argue that IS have been the greatest force for productivity improvement in the last half century, and it is expected that such systems can also help with the global environmental challenge (vom Brocke *et al.*, 2013) – more than 60 percent of CEOs (Gadatsch, 2011) expect IS to enable organizations to become more environmentally sustainable. To respond to the increased social, cultural, and legislative pressures, business firms increase their attention to environmental concerns (Mintzberg *et al.*, 2002). The problem is that IS, as technological artifacts, contribute to the environmental sustainability challenge themselves by consuming vast amounts of electricity, thereby placing heavy burdens on power grids and contributing to greenhouse gas emissions and other environmental problems during their production, use, and disposal (Murugesan, 2008).

To investigate these challenges, two sub-fields of research—Green IT and Green IS—have emerged as areas of IS research that address environmental sustainability issues regarding technology-based systems. *Green IT* is “the study and practice of designing, manufacturing, using, and disposing of computers, servers, and associated subsystems efficiently and effectively with minimal or no impact on the environment” (Murugesan, 2008, p. 25), while the concept of *Green IS* captures “IS-enabled organizational practices and processes that improve environmental and economic performance” (Melville, 2010, p. 2).

Some scholars argue that the concept of Green IT has a restricted view of technological issues (e.g., Dao *et al.*, 2011), whereas the concept of Green IS is more comprehensive and includes people, processes, and capabilities that address environmental sustainability in a holistic way. Watson *et al.* (2010, p. 24), suggest that Green IT is part of the more far-reaching concept of Green IS, which examines the possible ability of IT-based systems to make significant contributions to reducing greenhouse gas emissions and mitigating the effects of global climate change and other environmental problems. The key assumption is that, while IT creates negative environmental impacts because of the electricity required for its operation and the problem of disposing of obsolete hardware, innovative IS can be used to reduce environmental problems by changing processes and practices (Loos *et al.*, 2011). The key allure of IS in this regard is their potential to assist individuals and organizations to make better—that is, more environmentally sustainable—decisions and to facilitate environmentally sustainable (rather than environmentally unsustainable) work practices.

We contend that the environmental sustainability initiatives of organizations that are attempting to decrease their environmental footprint invariably involve some Green IT and some Green IS practices because the isolated implementation of Green IT practices, such as energy-efficient server farms and cloud solutions, are limited to the boundaries of the IT function and do not leverage IS' potential to decrease enterprise-wide environmental impacts. Accordingly, we understand Green IS initiatives as a wide range of IS-related environmental actions, such as the formulation of Green IS strategies and the translation of these strategies into concrete environmental practices that affect IT infrastructure resources, organizational processes, and even end-users' products and services. Therefore, we define *Green IS initiatives* as investments in IS and its deployment, use, and management in order to minimize the negative environmental impacts of IT, business operations, and end-users' products and services.

Empirical Research on Green IS

To position the contribution that we make in this study, we considered the state of knowledge in Green IS research and Green IT research, particularly empirical studies. Malhotra *et al.*'s (2013) review showed that twenty-nine of thirty Green IS research articles describe conceptual or analytical case studies, rather than being quantitative empirical studies that evaluate Green IS initiatives' environmental and economic impacts on performance.

To determine whether this body of knowledge has changed substantially since that review, we reviewed all issues of the AIS basket of eight journals (*EJIS*, *ISJ*, *ISR*, *JAIS*, *JIT*, *JMIS*, *JSIS*, and *MISQ*) published in 2013, 2014, and 2015, as these journals are widely acknowledged to represent leading IS research. This review identified five relevant articles (Table 1). Then we searched on Google Scholar using the keywords "Green IS" and "Green IT" from 2013 to 2015 to identify additional empirical studies that focus on organizations and that were published in journals ranked A*/A by the Australian Business Deans Council (ABDC). This process resulted in ten additional articles. Table 1, which summarizes our selective review, classifies the contributions in the literature as substantive or abstract, lists whether the studies operated on an individual (micro) or organizational (macro) level, and provides details about the basis of the empirical evidence reported.

Table 1. Summary of main recent empirical contributions to Green IS research.

Reference	Element of study	Focus of study	Level of study	Empirical Evidence
Henfridsson & Lind (2014)	Green IS	Micro: Sustainability strategizing	Substantive: Communities, processes, and activities to develop sustainability strategy	Single case study
Corbett (2013a)	Green IS	Micro: Design and use of carbon-	Substantive: How to develop a Green IS to persuade	Three case studies

		management system	employees to develop eco-friendly behavior.	
Loock *et al.* (2013)	Green IS	Micro: Decisions by consumers	Substantive: Goal-setting and energy-efficient behavior in private households.	1791 electricity consumers
Marett *et al.* (2013)	Green IS	Micro: System use	Substantive: Antecedents of drivers' continuous use of a bypass system	Survey of 212 drivers
Seidel *et al.* (2013)	Green IS	Macro and micro: Organizational and individual sensemaking and practices	Substantive: Duration of one transformation initiative	Single case study
Chuang & Huang (2015)	Green IT	Macro: Green IT capital	Abstract: How Green IT's human, structural. and relational capital contribute to business competitiveness	A survey of 148 Companies in Taiwan
Cooper & Molla (2014)	Green IT	Macro: Green IT assimilation	Abstract: Absorptive capacity and contextual influences of Green IT assimilation	International survey of 148 large organizations
Stiel & Teuteberg (2014)	Green IT	Macro: Modeling IT's environmental impact	Substantive: IT lifecycle analysis	Simulation
Bai & Sarkis (2013)	Green IT	Micro: Modeling tools	Substantive: Green IT strategic decision-making	Simulation
Cai *et al.* (2013)	Green IT	Macro: Adoption of Green IT	Abstract: Drivers of public concern, regulation, cost reduction, and differentiation related to adoption	A survey of 70 respondents in China
Corbett (2013b)	Green IS	Micro: Smart meters	Substantive: The energy-efficiency value of demand-side management through smart metering	Secondary data from the US Energy Information Administration
Gholami *et al.* (2013)	Green IS	Micro: Individual decision-makers' beliefs and actions	Abstract: Antecedents and consequences of a firm's adoption of Green IS	405 senior managers from Malaysian businesses
Hertel & Wiesent (2013)	Green IS	Micro: Modeling tools	Substantive: Optimal IS investment for energy efficiency	Simulation
Molla (2013)	Green IT	Macro: IT firms' environmental innovation	Abstract: An instrument to measure environmentally sustainable IT performance	A survey of 133 Australian IT firms
Ryoo & Koo (2013)	Green IS	Micro: Alignment of Green practices and IS	Abstract: The environmental and economic value of aligning IS with Green manufacturing and marketing practices	A survey of 77 manufacturing employees from South Korea
This research	*Both Green IT and Green IS*	*Macro: Organization-level beliefs, actions, and outcomes related to Green IS initiatives*	*Abstract: Orientation, strategy, practices, and benefits of Green IS initiatives in general*	*Cross-sectional, global, senior: 118 senior-level IT executives*

Our interpretation of this literature review is that substantive studies (9 out of 15) dominate general-level studies (6; Table 1). There are also more micro-level studies (9) than macro-level studies (5, with one study addressing both levels). Among studies like ours that are macro and general-level in nature, the four related studies (Cai *et al.*, 2013; Molla, 2013; Chuang & Huang, 2014; Cooper & Molla, 2014) all examine Green IT but not Green IS practices. Three of these four studies examine cross-sectional organization-level data from organizations in one country (Australia, China, Taiwan), with only Cooper and Molla (2014) collecting data from multiple countries (viz., Australia, New Zealand, the US). The present study adds a study that examines elements associated with both Green IT and Green IS on an abstract, macro level using data from a global survey of IT executives.

Benefits of Green IS Initiatives

Many outcomes, both positive and negative, might accrue from Green IS initiatives. Consistent with our objective and scope, we focus on organizational benefits alone. Scholars argue that Green IS initiatives can transform a firm's sustainability, leading to a variety of organizational benefits and advantages (Dao *et al.*, 2011; Seidel *et al.*, 2013; vom Brocke *et al.*, 2013) but without being clear as to the nature of these benefits and their origin in specific actions undertaken. We take this step. To identify the possible organizational benefits of Green IS initiatives, we broadly searched for Green IS literature that discusses the potential benefits of Green IS, independent from how benefits were interpreted specifically (e.g., as positive impact, value or advantage).

Chuang and Huang (2015) suggest that the development of Green IT-related human, structural, and relational capital can contribute to *business competitiveness*. Harmon and Demirkan (2011) explain that IT-related environmental measures can *reduce costs*, whereas innovative IS services can create *customer and societal benefit*, thus changing the competitive landscape, although they do not provide empirical data in support of this assertion. In a study of sixty-three firms, Benitez-Amado and Walczuch (2011) find that IT-management capabilities facilitate proactive environmental strategies, thus leading to organization-level *cost savings* and improved *corporate reputation*. In this context, Ziegler *et al.* (2011) suggest that environmental technologies can have a positive effect on corporate reputation, an intangible resource that positively influences financial performance (Orlitzky *et al.*, 2003). Bengtsson and Ågerfalk's case study (2011) indicates that IT can be a change agent in *sustainability innovations*, changing the behavior of employees through sustainability initiatives. Thambusamy and Salam (2010) present a preliminary case study that brings these organizational benefits together and demonstrate that organizations can *reduce costs*, build *reputation*, and *innovate* to create new growth trajectories using IT-enabled environmental sustainability strategies.

We conclude from this literature review that Green IS initiatives can generate at least three types of benefits: 1) Green IS initiatives can *reduce costs* by increasing the resource efficiency of IT infrastructure resources (Murugesan, 2008; Corbett, 2010) and organization-wide business processes (Watson *et al.*, 2008). 2) Green IS initiatives can also enhance *corporate reputation* by decreasing the organization's environmental footprint while providing tools for environmental performance tracking and reporting (El-Gayar & Fritz, 2006; Thambusamy & Salam, 2010). 3) Green IS initiatives can facilitate and improve organizational capabilities for *Green product and process innovations*, which can result in long-term organizational advantages (Albino *et al.*, 2009; Bengtsson & Ågerfalk, 2011; Besson & Rowe, 2012; vom Brocke *et al.*, 2012).

THEORETICAL FOUNDATION

To pursue our objective of identifying the antecedents and benefits of Green IS initiatives in organizations, we require a framework that draws attention to organization-level intentions and behaviors, establishes relevant links from intentions to concrete actions in the context of environmental sustainability, and mechanisms that lead to organizational-level benefits as outcomes. Melville's (2010) Belief-Action-Outcome framework provides such a basis. It differs from other theories that provide a framework for the factors and forces that influence organizational Green IS initiatives, such as motivational theory (Molla & Abareshi, 2012), institutional theory (Butler, 2011), and the technology-organization-environment framework (Dao *et al.*, 2011), because these theories are useful in clarifying the antecedents to Green IS initiatives but not their outcomes (Gholami *et al.*, 2013).

Melville's (2010) framework suggests that organizational behaviors are the result of beliefs and actions on the macro and micro levels. It covers three areas: *Beliefs* capture how psychic states (beliefs, desires, orientations, etc.) related to the natural environment are formed. On the macro level, these states include how an organization coordinates and divides labor and defines its agents' environment-related expectations. These expectations could include the managerial interpretation of environmental issues in light of corporate identity (Sharma, 2000). On the micro level, beliefs capture environment-related attitudes in the form of norms and beliefs. For instance, individual environmentalism depends on ecological worldviews, awareness of consequences, and ascription of responsibility (Steg, 2000; Steg *et al.*, 2005).

Actions describe how psychic states related to the natural environment translate into actions. On the macro level, these actions include those an organization undertakes to affect its agents' actions. For instance, organizations deploy IS to allow for sensemaking of environmental issues and use the enterprise's social networks to democratize sustainability information and its employees' critical environmental decisions (Seidel *et al.*, 2013). On the micro level, actions describe what individuals do to improve behavioral environmentalism. For instance, individuals may choose to use web portals that minimize energy consumption by setting individual goals (Loock *et al.*, 2013) or to delocalize work practices by relying on file-sharing and conferencing systems rather than physical travel (Seidel *et al.*, 2013).

Outcomes describe the consequences of the actions on the macro and/or micro levels, as a measure of the organizations' (or other social systems') environmental functioning. Outcomes in this framework can be as both positive and negative for both business and the environment. For example, they could include environmental impacts on the behavior of organizations (or other social systems) or such systems' environmental performance. Outcomes may also be environmentally negative, e.g., IT investments in server farms that increase electricity demand and, thus, greenhouse gas emissions (Cho *et al.*, 2007).

Melville's (2010) framework provides a sound conceptual basis on which to differentiate organizational from individual actions and to classify behavior in terms of beliefs, actions, and outcomes. While previous research examined micro-level beliefs, actions, and outcomes (Table 1), we examine these elements on the macro—that is, organizational—level. Our literature review in Table 1 shows that this focus is unique in the literature.

RESEARCH MODEL

In developing a research model based on Melville's (2010) framework, we start by describing how we instantiated the core categories of belief formation, sustainability actions, and organizational outcomes. The BAO framework describes both positive and negative outcomes for businesses and the environment. In line with our study's scope, our instantiation of outcomes is limited to the reported positive environmental and economic benefits at an organizational level. However, the context of these benefits is the environmental context within which organizations seek benefits by improving the environment (Porter & van der Linde, 1995).

In developing constructs for each category, we followed the extant literature on construct development (Lewis *et al.*, 2005; Urbach & Ahlemann, 2010; MacKenzie *et al.*, 2011). We reviewed the literature on our major constructs of *environmental orientation*, *Green IS strategy*, *Green IT practices*, *Green IS practices*, and *organizational benefits*. Next, we identified candidate measurements and conducted suggested tests to focus and improve our measures. More information on this process is provided in the research method section. We discuss each category of constructs in turn.

Organizational Belief Formation: Environmental Orientation

Environmental belief formation on the organization level relates to the attention an organization pays to environmental issues. Because environmentalism is increasingly important for a firm's competitiveness, corporate environmentalism has evolved from being a complementary management task to an integral part of strategic management activities (Schaltegger *et al.*, 2013). The creation of competitive advantage is highly context-dependent, and uncoordinated environmental sustainability initiatives without strategic coherence are ineffective (Orsato, 2006).

Some studies examine how an organization's environmentalism is formed. For example, Chen *et al.* (2010a), Butler (2011) and Molla and Abareshi (2012) analyze the organizational motivations for adopting Green IS or Green IT. External pressures shape executives' personal beliefs and result in sustainability actions (Melville, 2010; Gholami *et al.*, 2013). The phenomenon of corporate environmentalism has been studied through the concept of *environmental orientation*, which is defined as managers' recognition of the importance of the environmental issues that their firms are confronted with (Banerjee *et al*., 2003). A firm's historical development, organizational culture, top management commitment, and executives' personal experiences influence its environmental orientation (Barney, 1986; Banerjee *et al*., 2003). This environmental orientation of the firm, in turn, shapes executives' beliefs about the environment, decision-making processes, and the initiation of environmental actions (Gholami *et al*., 2013). Hence, we conceptualize *environmental orientation* (Table 2) as an antecedent of Green IS strategies, Green IT practices, and Green IS practices.

Table 2: Conceptualization of *environmental orientation*.

Construct	Definition	Description
Environmental Orientation	**Executives' recognition** of the importance of the environmental issues that face their firm (Banerjee *et al.*, 2003, p. 106).	A company's environmental orientation reflects its internal values, standards of ethical behavior, commitment to environmental protection, and relationships with external stakeholders (Banerjee *et al.*, 2003, p. 106). This concept is closely linked to organizational culture, which refers to the complex set of values, beliefs, and assumptions that define how a firm conducts its business (Barney, 1986). Environmental orientation guides executives' beliefs and actions and influences how a firm interacts with key stakeholders on issues related to the environment (Rugman & Verbeke, 1998).

Organizational Sustainability Actions: Green IS Initiatives

We use three constructs to describe and measure the IS-related sustainability actions an organization undertakes: *Green IS strategy* delineates environmental IS strategies from an organization level and a function level; *Green IT practices* refer to environmental actions implemented in the domain of the IT department while focusing on reducing IT-based environmental impacts; and *Green IS practices*, which cover environmental actions, such as process innovations that use IS to decrease the organization's environmental footprint, or environmental technologies, which facilitate Green product innovations that decrease the environmental impacts of end-user products and services. We discuss each construct in turn.

Green IS strategy

Banerjee (2002, p. 182) emphasizes that "environmental concerns need to be translated into strategy if corporate greening is to occur" and explains that environmental strategies at a function level are limited to the reduction of waste and emissions. Organizational strategies, on the other hand, can enhance business performance by facilitating low-cost or differentiation advantages (Porter, 1980; Orsato, 2006).

Typically, corporate, business, and functional strategies are differentiated (Andrews, 1971), a distinction that corporate sustainability research also applies (Stead *et al*., 2004). For environmentally sustainable management practices to be strategically significant, sustainability must be integrated into strategies on each of these levels (Aragón-Correa, 1998). Chen *et al.* (2010b, p. 237) suggest that "while IS strategy is part of a corporate strategy, conceptually it should not be examined as part of a business strategy. Rather, it is a separate perspective from the business strategy that addresses the scope of the entire organization to improve firm performance." Therefore, the consistent and holistic translation of an organization's environmental orientation into IS-related sustainability actions requires that Green IS strategies are not being restricted to the functional management level of the IT domain but also being considered in organizational IS strategies (Loeser *et al.*, 2012). Accordingly, we conceptualize *Green IS strategy* by means of two sub-constructs, *organizational Green IS strategy* and *functional Green IS strategy* (Table 3).

Organizational Green IS strategy is characterized by business and IT executives' mutual understanding concerning future opportunities and challenges and by collaborative, cross-functional strategic planning processes. Organizational Green IS strategy articulates a shared vision by top management and IT executives and describes the fundamental role of Green IS in achieving organization-wide, long-term environmental objectives. This conception relates to corporate environmental sustainability strategies, defined as the long-term vision formulated by top management that outlines the organization's attitude toward stakeholders and the natural environment (Klassen & McLaughlin, 1996; Stead *et al.*, 2004).

A *functional Green IS strategy* facilitates effective and efficient IT operations and IS-based processes through a resource-efficient IT infrastructure that supports environmental goals. Concrete policies defined at the function level result in the effective implementation of Green IT practices and Green IS practices. Functional strategies are important in creating internal Green-IS-related resources and capabilities over time. These firm-specific assets, both tangible and intangible, lay the foundation for a company's productivity and innovation capacities (Barney, 1991), so the development of IS-based environmental management systems and the establishment of environmental management practices are key factors at this level (Klassen & McLaughlin, 1996). Green IS strategies at the function level determine concrete action plans and affect business and production processes, and since they can increase the resource efficiency of internal operations, they enhance the firm's competitiveness (Grant, 1991).

For the conceptualization of these two domains of Green IS strategy, we refer to Chen *et al.* (2010b), who review and consolidate the literature on IS strategy from leading IS journals to identify fundamental IS strategy concepts. Our research uses two of these concepts: "IS strategy as the master plan of the IS function" and "IS strategy as the shared view of the role of IS within the organization" (see Chen *et al.*, 2010b, p. 239). These conceptualizations refer to strategy as a plan and as a perspective (Mintzberg, 1987) and represent two specific facets of a Green IS strategy (Table 3).

Table 3: Conceptualization of *Green IS strategy* (with reference to Chen *et al.*, 2010b, p. 239).

Second-order	First-order	Conceptual domain	Definition	Description

construct	constructs			
Green IS strategy	*Organizational Green IS strategy*	Organization-wide role of Green IS; organization-centric	Shared view of the role of Green IS in the organization	An organizational Green IS strategy describes a *perspective*: What is our view toward Green IS in the organization? *Desired strategic impact:* Provide a shared understanding of the potential of Green IS throughout the organization and guide fundamental Green IS investment decisions.
	Functional Green IS strategy	Intended course of action; IS-centric	Master plan of the Green IS function	A functional Green IS strategy describes a *plan*: What assets (staff, processes, infrastructure, applications, budget, etc.) are required for Green IS implementation, and how should existing assets be allocated efficiently? *Desired strategic impact:* Give direction for the effective and efficient management of IS resources and capabilities.

Green IT practices

Green IT practices decrease the negative environmental effects of the manufacturing, operation, and disposal of IT equipment and infrastructure (Murugesan, 2008; Dao *et al.*, 2011). Green IT practices, such as considering eco-labels when purchasing IT hardware, the consolidation and virtualization of servers and storage devices, the deployment of free cooling, the use of thin clients, and the refurbishing of computers to extend their lifecycle, are directly related to IT components, devices, and infrastructure. Building on this definition, the *Green IT practices* construct covers three kinds of IT environmental impacts: the resource requirements of manufacturing IT equipment like desktop computers, notebooks, servers, printers, and network devices; the power consumption by all of the organization's IT devices, particularly the servers running in data centers and the desktop computers and peripheral IT equipment in office environments; and electronic waste generated by disposing of outdated IT equipment.

To capture these three kinds of environmental impacts, we conceptualize *Green IT practices* by means of the sub-constructs *IT sourcing*, *IT operations*, and *IT disposal* (Park *et al.*, 2012) (Table 4). The basis for our conceptualization was a comprehensive catalogue of seventy exemplary measures developed by Loeser (2013) to give guidance to practitioners on how to decrease IT-related environmental impacts using Green IT practices.

Table 4: Conceptualization of *Green IT practices.*

Second-order constructs	First-order constructs	Definition	Description
Green IT practices	*IT sourcing*	Environmentally-friendly sourcing practices for IT hardware and services	Green IT initiatives that focus on the environmental assessment and auditing of suppliers and the selection of IT hardware and services according to predefined environmental criteria.
	IT operations	Green IT practices to decrease IT operations' energy consumption	Implementation of Green IT measures in data centers (e.g., server consolidation and virtualization, energy monitoring, air-flow optimization) and office environments (e.g., installing energy management software, raising users' awareness of environmental issues, deploying energy-efficient desktop computers) to decrease IT operations' energy consumption.
	IT disposal	End-of-IT-life management	Green IT practices that reduce e-waste by repairing, re-deploying, or disposing of outdated IT hardware in an environmentally friendly

			manner.

Green IS practices

In contrast to Green IT practices, which are restricted to the domain of IT departments and so are limited to IT's environmental impacts, organization-wide *Green IS practices* refer to the positive environmental impacts that can be achieved by decreasing the negative environmental effects of business operations and advancing corporate sustainability (Butler, 2011). Green IS practices relate to organizational processes that can be enhanced using IS solutions, including those that facilitate the tracking and improvement of energy and resource flows, industry 4.0 technologies that support smart factories through cyber-physical processes and the Internet of Things, and environmental technologies that contribute to eco-products (e.g., building automation, smart grids, traffic-management systems). Business and production processes' resource efficiency can be enhanced through IS-enabled process re-engineering (Seidel *et al.*, 2013), and environmental management systems can quantify emissions and track resource flows (Corbett, 2010; Malhotra *et al.*, 2013), thereby uncovering opportunities to reduce business and production processes' consumption of resources (Benitez-Amado *et al.*, 2010). Green IS initiatives can also foster innovations that decrease resource consumption, waste, and emissions during the use phase of end users' products and services (Albino *et al.*, 2009), thereby reducing their environmental footprint. The integration of IS functionalities into a company's processes can generate innovative end products and infrastructure solutions, such as building automation, smart-grid technologies, engine-control units, intelligent traffic management systems, and dematerialization initiatives that substitute physical products with digital services (e.g., books, music) (GeSI, 2008; Dangelico & Pujari, 2010; Butler, 2011). To capture these kinds of Green IS practices, we conceptualize *Green IS practices* by means of the sub-constructs *process reengineering, environmental management systems*, and *environmental technologies* (Table 5).

Table 5: Conceptualization of *Green IS practices*.

Second-order construct	First-order constructs	Definition	Description
Green IS practices	*Process re-engineering*	IS-enabled reengineering of business and production processes	Green IS practices that enhance the resource efficiency of business and production processes through IS-enabled process re-engineering and business transformation.
	Environmental management systems	Use of IS-based environmental management systems to control resource flows, waste, and emissions	Use of IS-based environmental management systems that track resource flows, waste, and emissions (to provide information for environmental control and sustainability-oriented decision-making); enhance transparency; and provide aggregated information for external stakeholders through environmental reports.
	Environmental technologies	IS-enabled environmental technologies that reduce the footprints of products and services	Improvement of the environmental characteristics of end products and services with the help of Green IS, such as smart buildings, traffic management systems, smart grids, engine control units, and dematerialization through digital services.

Outcomes: Perceived Organizational Benefits

In keeping with the BAO framework, we conceptualize the outcome construct of the present research as *perceived organizational benefits*. Building on previous studies, we discussed possible outcomes of Green IS initiatives: Central benefits can be cost reductions from enhanced resource efficiency of internal operations, increased revenues from a positive corporate reputation, and technological innovations that result in eco-products that support competitive differentiation and/or the creation of new markets (Klassen & McLaughlin, 1996; Chen *et al.*, 2010a; Thambusamy & Salam, 2010; Ziegler *et al.*, 2011). A company's ability to differentiate itself from its competitors through innovative eco-products can increase profit margins if customers perceive and value the products' superior environmental characteristics (Aragón-Correa & Sharma, 2003; Albino *et al.*, 2009; Dangelico & Pujari, 2010). Accordingly, we define *organizational benefits* as consisting of three dimensions: *cost reductions*, *corporate reputation*, and *Green innovation capabilities* (Table 6).

Table 6: Conceptualization of *organizational benefits*.

Second-order construct	First-order constructs	Definition	Description
Organi-zational benefits	*Cost reductions*	Reduction of operational costs through superior resource efficiency	Firms' competitiveness depends on their operational costs. Effective environmental management systems can track and analyze the flow of organizational material and resource consumption in order to help executives identify the optimization opportunities that can be realized with the aid of environmental process technologies (Klassen & Whybark, 1999). As a consequence, the raw material requirements and energy consumptions of business and production processes can be reduced (Porter & van der Linde, 1995). Internal operations' enhanced resource efficiency reduces costs (Ambec & Lanoie, 2008).
	Corporate reputation	Positive corporate image resulting from effective environmental management	Environmental management systems and environmental technologies enhance the efficiency of internal resources, decreasing resource requirements, corporate waste, and emissions. Firms that act in an ethical and environmentally responsible manner (corporate citizenship) can improve their reputations with internal and external stakeholders. A positive corporate image increases existing customers' loyalty and attracts new ones, increasing sales volumes and profits. A good reputation can also improve employee retention rates and the firm's attractiveness to talented workers, which can also enhance competitiveness (Sharma & Vredenburg, 1998; Bansal & Roth, 2000; Bansal, 2005; Ziegler *et al.*, 2011).
	Green innovation capabilities	Superior R&D leads to Green product and process innovations that differentiate the firm from competitors	If managers fundamentally rethink the internal processes that are in place, they can innovate to enhance company-wide operations' resource efficiency (Klassen & Whybark, 1999). Environmental research and development (R&D) can give rise to Green product innovations that influence a product's entire lifecycle, from design to manufacturing to use and disposal. Customers' appreciation of products and services with small environmental footprints is increasing, and they are willing to pay a price premium for them. The environmental characteristics of these products, such as lower fuel consumption during the use phase, can differentiate them from competitors, increasing the firm's competitiveness, profit margins, and sales volumes (Klassen & McLaughlin, 1996; Albino *et al.*, 2009; Chang, 2011).

Proposition Development

Having specified the research constructs that compose our research model, we offer seven propositions describing the links between *environmental orientation*, *Green IS strategy*, *Green IT practices*, *Green*

IS practices, and *organizational benefits*. Figure 1 visualizes the propositions, which we discuss in turn.

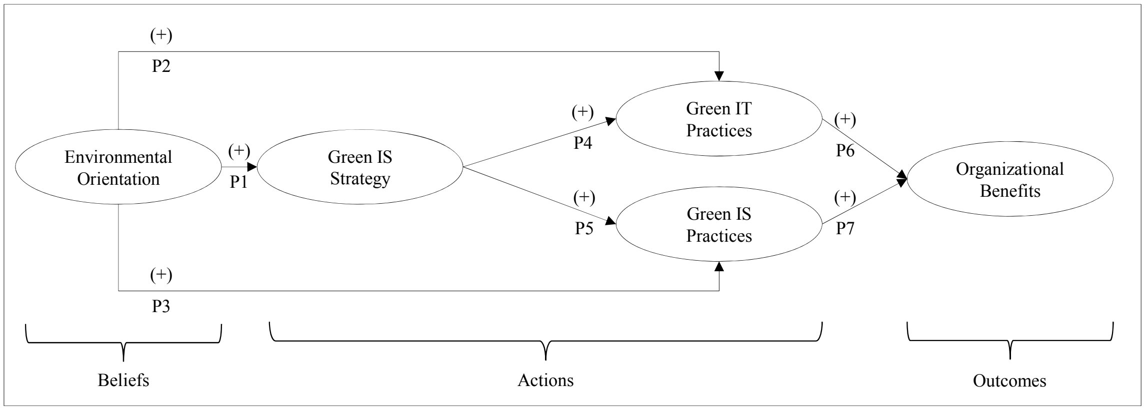

Figure 1: Research model.

Congruent with Melville's (2010) BAO framework, we first suggest that environmental actions on an organization level (viz., the implementation of Green IS strategy, Green IT practices, and Green IS practices) are driven by the formation of organizational sustainability beliefs. Specifically, in line with Banerjee *et al.* (2003), we argue that IT executives' environmental orientation drives their sustainability-related actions, such as the formulation of environmental strategies and the implementation of concrete environmental practices. Organizations develop responses to environmental issues when executives identify economic opportunities, legislation, and eco-responsibility as salient issues (Bansal & Roth, 2000), at which time the formation of a Green IS strategy translates its executives' beliefs about environmental issues (i.e., their orientation) into both an organizational perspective and a master plan. If executives recognize the importance of the environmental issues that face their firm, it is more likely that a corresponding strategy will be formulated in response (Sharma, 2000). Therefore:

P1: Environmental orientation is positively associated with the formulation of a Green IS strategy.

Similarly, the implementation of Green IT practices and Green IS practices depends on executives' recognition of the need to respond to environmental issues because action occurs only when the actor recognizes that an event requires response. For example, the adoption of a social networking site that encourages energy conservation depends on the presence of a belief that reducing greenhouse gas emissions is critical to sustainability (Bottrill, 2007) and that sustainability is a desirable outcome. Seidel *et al.* (2013) show that sustainability-related action in an organization is supported when environmental beliefs are shared through systems that facilitate the democratization of information and reflective disclosure. Therefore, we contend that similar influences motivate the implementation of both Green IT practices and Green IS practices in an organizational initiative:

P2: Environmental orientation is positively associated with the implementation of Green IT practices.

P3: Environmental orientation is positively associated with the implementation of Green IS practices.

Uncoordinated environmental sustainability initiatives that involve the implementation of new practices that have no strategic coherence are ineffective (Orsato, 2006) because such implementations rely on managerial interpretation, strategy, and policy definition (Bansal & Roth, 2000). The formulation of environmental strategy has been shown to positively influence the execution of an organization's eco-friendly initiatives (Ramus & Steger, 2000). In the same manner, Green IT practices and Green IS practices effectively describe change resources in the form of dynamic capabilities that help a company to become more environmentally sustainable, so they describe capabilities that facilitate the effective and efficient use of IS and the firm's assets (Watson *et al.*, 2008). A Green IS strategy features and defines the characteristics of such capabilities and facilitates the effective deployment, combination, and efficient management of the firm's technological infrastructure (Green IT practices), as well as IS-based new environmental practices that change processes, management, and/or the environmental characteristics of technology use. Therefore, we expect that:

P4: Green IS strategy is positively associated with the implementation of Green IT practices.

P5: Green IS strategy is positively associated with the implementation of Green IS practices.

Finally, we explore the links between organizational actions and outcomes. Green IT practices can decrease the electricity costs of IT operations, whereas Green IS practices can reduce business and production processes' consumption of resources through efficiency enhancements facilitated by process re-engineering. Moreover, Green IS practices can lower compliance costs by delivering necessary information through environmental management systems. Green IS can also deliver tools that help a firm to implement environmental management that improves the firm's image and reputation. Finally Green IS practices can lead to environmental technology innovations that alter the firm's products and services (Corbett, 2010). Therefore, we expect the implementation of Green IT practices and Green IS practices to have organizational benefits as perceived by the IT executives. Accordingly, we suggest that:

P6: The implementation of Green IT practices is positively associated with organizational benefits.

P7: The implementation of Green IS practices is positively associated with organizational benefits.

Like our research model, these seven propositions remain on an abstract level of theorizing and encapsulate our general expectations of links. However, our construct definitions, most of which involve multiple dimensions, allow us to evaluate the propositions empirically, which is important in our effort to ascertain *which* Green IT or Green IS practices *in particular* depend most and least on a Green IS strategy and *which practices* lead to *which types* of organizational benefits. We report on the detailed evaluations of our propositions in the results section below.

RESEARCH METHOD

Design

To evaluate the propositions in our research model, we designed a global, cross-sectional survey targeting senior-level IT executives as respondents. This choice was motivated by three main conclusions from our literature review: The need in research and practice for abstract rather than substantive-level contributions, a lack of global Green IS studies in IS research that rely on quantitative data, and the need for an organization-level research model that builds on practice-oriented concepts and delivers meaningful insights. In addition, we recognize that senior-level IT executives have sophisticated knowledge regarding the formulation of Green IS strategies, the implementation of Green IT practices and Green IS practices, and outcomes at an organization level, so these respondents are a suitable target population for our research model.

The survey method is appropriate when there are clearly identified independent and dependent variables and a model that theorizes the relationships between the variables (Pinsonneault *et al.*, 1993). Such is the case in our study. We collected data using a web-based instrument because of the advantages of low cost, no geographical restrictions, and fast responses (Klassen & Jacobs, 2001). However, web-based surveys also have disadvantages, such as low response rates, as was an issue in our study.

In designing the survey, we followed Fowler’s (2009) recommendations in using Dillman’s (2007) Tailored Design Method. In particular, we sought to create valuable rewards for the respondents by assembling an executive-oriented management summary and an extensive catalogue of implementation measures and keeping the efforts required to participate at a minimum by developing a user-friendly online survey with a clear structure, graphic elements, and completion time of less than ten minutes. We also emphasized the study’s importance in advancing Green IS research and practice, pointing out the benefits that organizations could achieve by implementing Green IS following a strategic approach.

Measurement

Because measurements for our thirteen theoretical constructs were not always available or suitable, we created new measurement instruments, where needed, using Lewis *et al.*'s (2005) and MacKenzie et al.'s (2011) guidelines. Because of methodological considerations (Gefen *et al.*, 2000; Diamantopoulos & Siguaw, 2006) and the availability of some empirically validated measures from prior research, all thirteen first-order constructs where measured reflectively using a common 7-point Likert scale, anchored between "strongly disagree" and "strongly agree."

In developing the measures, we first identified potential items for the instrument by reviewing empirical studies that included similar research constructs, as recommended by Urbach and Ahlemann (2010). Although we could not adapt complete measurement scales to our constructs, 248 fragments and single items suited the research model. Next, we analyzed the initial list of 248 items and found that they did not cover all sub-dimensions of the constructs' domains. In particular, several aspects of the *Green IS strategy*, *Green IT practices*, and *Green IS practices* constructs were missing. Therefore, we developed 22 new items based on our construct definitions and descriptions (Lewis *et al.*, 2005; MacKenzie *et al.*, 2011). Then we analyzed the quality and appropriateness of the 270 selected items; three researchers from non-IS disciplines, each with a profound knowledge of quantitative studies and significant experience with SEM research, provided critical feedback, in response to which we revised several items. Next, a panel of five IS researchers, all of whom were familiar with the key subject areas, participated in a rating procedure (MacKenzie *et al.*, 2011) to reduce the number of items to 89. Then we pretested the measurement instrument with eleven researchers and practitioners who were familiar with the research topic to evaluate its appropriateness (Lewis *et al.*, 2005). The pretest and subsequent feedback helped to improve the structure and the design of the survey. Because the participants in the pretest criticized the length of the survey, we undertook another round of item screening in which the five IS research panelists once again evaluated the items' relevance using the content-validity-ratio method Lewis *et al.* (2005) propose. Based on this assessment, the final instrument contained 50 items (Appendix A, Table 10). Next, we discuss how we measured each construct.

We operationalized *environmental orientation* as a reflective first-order construct that we measured reflectively (Mode A, according to Becker *et al.*, 2012) with four items (Table 10 in Appendix A). These items capture, in particular, organizational (executives' and employees') positions, goals, values, and identities regarding environmental protection.

Our definition of the concepts *Green IS strategy* (Table 3), *Green IT practices* (Table 4), *Green IS practices* (Table 5), and *organizational benefits* (Table 6) featured sub-dimensions. Operationalizing each concept as a multidimensional, hierarchical construct allowed us to retain a relatively parsimonious research model while maintaining a high level of detail for supplementary analysis. In modeling our four higher-order constructs, we followed the guidelines Becker *et al.* (2012) propose. We applied the recommended repeated-indicator approach, using measurement Mode B, for our four reflective-formative second-order constructs. We evaluated our construct models with PLS-SEM, using the inner-path weighting scheme, as Wetzels et al. (2009) recommended.

We modeled *Green IS strategy* as a reflective-formative second-order construct with the underlying dimensions *organizational Green IS strategy* and *functional Green IS strategy* (Table 3). Each dimension describes one defining characteristic of the overarching *Green IS strategy* construct but they represent two distinct facets of strategy (i.e., as an organization-wide perspective and as a functional plan). Both dimensions, which we measured with five reflective items each, influence the second-order construct and were modeled through formative relationships accordingly (Petter *et al.*, 2007; Urbach & Ahlemann, 2010).

We also modeled *Green IT practices* as a reflective-formative second-order construct (Becker *et al.*, 2012). It consists of practices that address four different IT management areas and thus facets of the construct (viz., IT sourcing, data center operations, IT operations in the office environment, IT disposal). We measured each of the four first-order constructs using three reflective items.

In the same way, we modeled the construct *Green IS practices* as a reflective-formative second-order construct that is influenced through the three reflectively measured first-order constructs of *process reengineering* (5 items), *environmental management systems* (4 items), and *environmental technologies* (3 items). For this construct, we used the repeated indicator approach with an inner path weighting scheme and Mode B measurement because it is robust in models that have an unequal number of items (Becker *et al.*, 2012).

Finally, we modeled *organizational benefits* also as a reflective-formative second-order construct. We defined it through the three sub-dimensions *cost reductions*, *corporate reputation*, and *Green innovation capabilities*. We measured the underlying first-order constructs empirically with three reflective items each (Petter *et al.*, 2007; Becker *et al.*, 2012).

Procedures

We conducted the online survey using the open-source software LimeSurvey. We defined our target population as large companies from highly developed countries, so we invited CIOs and similar senior-level IT executives from companies with more than 250 employees in the US, Canada, Germany, Australia, and New Zealand to participate in the survey. This range of countries ensured that we had data from North America, Europe, and the Asia-Pacific region.

We used a database of 6,546 contact records for CIOs and senior-level IT executives that we acquired from the Top IT Executives Database (5,899 records) (Applied Computer Research, Inc.), OneSource

Australia (384 records), and our own research on CIOs of large German enterprises (263 records). This sample features a distribution of companies in terms of size that is similar to the target population (Table 11 in Appendix B). After sending the initial invitation, we followed up with four rounds of reminders, each with different formulations of the invitation text, to improve the response rate (Sivo *et al.*, 2006). Our emails were undeliverable to 29.3 percent of the email addresses. Of the 4,628 invitations that were delivered, we received 169 responses for a response rate of 3.65 percent. Although this response rate is low, the number of responses is comparable to the number of responses used in previous Green IS and Green IT research published in top-tier IS journals (Table 1). To put our sample size in context, we performed a ten-year analysis of the sample sizes of IS studies that focus on organizational benefits and were published in the basket of eight IS journals. We identified twenty-five articles with numbers of responses ranging from 59 to 372 (median 144 and mean 162; Table 13 in Appendix B), suggesting that the number of observations in our study is within the norm of similar IS studies. We also performed analyses of statistical power to ensure our sample size was sufficient to run the analyses required.

To show that our study is comparable to other organizational performance-related IS studies in spite of the limitations and future enhancements that we discuss in the Limitations section, we reviewed the empirical base of the twenty-five articles we identified (Table 13) and found four primary features: First, some studies include a wide variety of industries in their sample frames (Ravichandran & Lertwongsatien, 2005); only a few studies focus on a specific industry segment (Pavlou & El Sawy, 2006; Ray *et al.*, 2005). Second, most of the firms investigated were medium-sized or large. Third, nearly all studies are conducted in North America, especially in the US. Fourth, previous researchers follow both single- and multiple-respondent designs. By contrast, in our study we examine the concepts of Green IS strategies and practices and their potential to deliver organizational benefits *in general*. Because these concepts are recognized as being important to all industries (Melville *et al.*, 2010), we included all industries in the sample selection. However, similar to previous studies, we focused on medium-sized to large organizations.

One of the advantages of the sampling frame used in the current study was that, unlike some previous studies that mix single-informant IT and non-IT respondents, we exclusively address IT executives. We focus on senior IT executives like CIOs because they tend to be knowledgeable about the issues with which we are concerned. In addition, they tend to be well-versed not only in the organizational capabilities and benefits that pertain to IT but also in managing customer and enterprise processes to improve business performance, including environmental initiatives and corporate responsibility (Weill & Woerner, 2013). Most CIOs are also involved in processes related to formulating organizational and business strategy. Many of them report directly to CEOs, and most interact with business managers while maintaining a focus on the overall business (Kappelman *et al.*, 2014). These commonalities indicate that CIOs are knowledgeable about questions of organizational benefits and business performance. Our focus on IT executives also helps us avoid conflicts caused by multiple responses from the same company and alleviates complexity during data analysis. Because our study design might raise questions about common method bias, we sought to determine whether common method bias is a major problem in interpreting our results.

RESULTS

In reporting our results, we proceed in three steps. First, we report on measures taken to screen and purify the data and to assess potential sources of bias. Second, we report on measurement and structural model estimation using structural equation modeling (SEM) (Hair *et al.*, 2011). Third, we report on selected supplementary analyses in order to examine parts of our results in more detail.

We opted for partial least squares structural equation modeling (PLS-SEM), which is an established technique in IS and strategic management research (Hair *et al.*, 2013a). PLS-SEM is particularly useful in exploratory research settings, where the identification of relationships is the central purpose (Goodhue *et al.*, 2012; Ringle *et al.*, 2012). This focus was particularly relevant to our goals of evaluating our propositions *in general* and exploring important links between core concepts *in detail*. In addition, as a component-based approach, PLS-SEM is appropriate and often used to test higher-order constructs and complex research models (Urbach & Ahlemann, 2010; Ringle *et al.*, 2012).

PLS-SEM is comprised of two levels of analysis: the measurement model, which evaluates the latent constructs' measurement scales, and the structural model, which assesses the direction and strength of the relationships between the constructs (Gefen *et al.*, 2000). Our PLS-SEM evaluation and our detailed report of the analysis' statistics and quality criteria follow Gefen *et al.*'s (2011) and Hair *et al.*'s (2013a) established guidelines.

Data Screening

We received 169 survey responses, of which 48 were incomplete. Analysis of the standard deviation of the responses revealed 3 more data sets that included numerous arbitrary answers and so were invalid. We searched for multivariate outliers by calculating the Mahalanobis d-squared values with SPSS and found that the remaining datasets were all within an acceptable range, resulting in a final sample of 118 valid datasets. Table 7 summarizes the descriptive statistics of the organizations whose employees participated in the survey.

Table 7: Characteristics of respondents' organizations [n = 118].

Annual company revenues [million USD]		Annual IT budget [million USD]		Number of employees		Number of IT staff	
< 50	22%	< 1	13%	251 – 1,000	40%	< 10	13%
50 – 250	32%	1 – 5	36%	1,001 – 5,000	25%	11 – 50	42%
251 – 1,000	17%	5.1 – 25	20%	5,001 – 25,000	27%	51 – 250	20%
1,001 – 5,000	17%	25.1 – 100	21%	25,001 – 100,000	5%	251 – 1,000	20%
5,001 – 25,000	8%	100.1 – 500	8%	> 100,000	3%	> 1,000	5%
> 25,000	4%	> 500	2%				

Our response rate of 3.65 percent is low, although we followed Sivo *et al.*'s (2006) suggestions to increase response rates by considering feedback from colleagues and practitioners, continually improving invitation mails, sending several rounds of reminders, guaranteeing confidentiality, and providing an incentive for survey participants in the form of a management summary and an extensive catalogue of Green IT/IS measures. As Abareshi and Martin (2008) explain, it is often difficult to get top managers to respond to survey requests. One reason for the low response rate is likely to have been our sending the invitations and follow-ups via email. Ranchhod and Zhou (2001) emphasize that online surveys tend to have lower response rates than mail surveys do. Senior-level executives are unlikely to respond to outside emails from unknown addresses and response rates to reminder emails are likely to decrease (Baruch & Holtom, 2008). In short, low response rates are not unusual for surveys that address senior executives (Anseel *et al.*, 2010; Messerschmidt & Hinz, 2013).

To ensure that our dataset still demonstrated external validity, we examined our data for nonresponse bias using three established post-hoc techniques to assess the possibility of a nonresponse bias (Sivo *et al.*, 2006). First, we compared the responses from the first wave of participants to those from the last wave of respondents using a two-tailed test (Armstrong & Overton, 1977; Rogelberg & Stanton, 2007; Gefen *et al.*, 2011) and found that the test was not significant at the 0.05 level. Second, we compared the demographic characteristics of the respondents' organizations to those of the overall sample from our contact record database (Sivo *et al.*, 2006) using a chi-squared test of homogeneity, which did not indicate a significant difference in company-size distributions between the expected observations and the observed responses at the 0.05 level (Table 11 in Appendix B). Third, we contacted 100 randomly selected non-respondents to learn their reasons for not participating in the survey, which is an established method for determining whether relevant patterns of nonresponse reasons emerge (Ravichandran & Rai, 2000; Rogelberg & Stanton, 2007). If dominant reasons for nonresponse are related to the topic of the survey (e.g., systematic disregard of environmental sustainability issues), participants' responses would differ from non-respondents, indicating a biased sample. Table 12 in Appendix B shows that 96 percent of the reasons for nonresponse were unrelated to the topic of the survey. Based on the results of these tests, there is no indication of a nonresponse bias, and we assumed that the dataset has external validity, despite a low response rate.

Next, we determined whether our sample of 118 datasets is large enough to test our structural model. Leading researchers and statisticians (Marcoulides & Saunders, 2006; Goodhue *et al.*, 2012; Hair *et al.*, 2013b) recommend conducting an assessment to ensure that the statistical power of the sample is sufficient to ensure statistical validity of the conclusions reached, which "concerns the power to detect relationships that exist and determine with precision the magnitude of these relationships" (Sivo *et al.*, 2006, p. 354). Wetzels *et al.* (2009) explain that the convention for behavioral research is to use a value of 0.80 for power. Marcoulides *et al*. (2009) advise using Cohen's (1988) power tables to evaluate the number of predictors and the effect size of each of the structural model's multiple regression analyses to calculate the statistical power. Following this method, we calculated that, with n = 118 and a maximum of seven predictors, we achieve the required statistical power of 80 percent for effect sizes larger than or equal to 0.18, with an error probability of less than 1 percent (GPower calculator, as suggested by Hair *et al.*, 2013b). Therefore, our sample has sufficient statistical power for our conclusions to be valid for all effect sizes that are larger than or equal to 0.18. We also conducted a more rigorous test that takes additional parameters of the entire model into account (http://www.danielsoper.com, as proposed by Gefen *et al.*, 2011). This test is based on the work of Westland (2010, p. 476), who proposes "two lower bounds on sample size in SEM, the first as a function of the ratio of indicator variables to latent variables, and the second as a function of minimum effect, power and significance." According to this sophisticated SEM evaluation of sample size, we achieve statistical power of 80 percent for effect sizes larger than or equal to 0.25 in our model with fifty observed and thirteen latent variables. Therefore, we can conclude that the sample has adequate power to detect medium to large effects, which is acceptable for exploratory research that seeks to identify the relationships between theoretically derived constructs (Pinsonneault & Kraemer, 1993; Gefen *et al.*, 2011; Goodhue *et al.*, 2012). Our post-hoc power analysis simulation, reported in the structural model estimation section, supports this assertion.

To assess the potential for common method bias, which would indicate a systematic error of measurement, we conducted Harman's single-factor test, which involves performing an exploratory factor analysis in SPSS with all independent and dependent variables and analyzing the unrotated solution (Podsakoff *et al.*, 2003). The first factor that emerged explained 21.98 percent of the total variance. Since the first factor does not explain the majority of the variance, a common method bias is unlikely (Gefen *et al.*, 2011). Because Harman's single factor test has several methodological shortcomings (Podsakoff *et al.*, 2003), we also conducted a second test by including a common method factor in the PLS model, as Liang *et al.* (2007) describe. This test revealed that the average substantively explained variance of the indicators is 0.72, whereas the method-based variance is only 0.014, making the ratio of substantive variance to method variance 51:1. This high value suggests the absence of significant common method bias.

Measurement Model Estimation

We used PLS-SEM, as implemented in SmartPLS 2.0 (Ringle *et al.*, 2005), to assess both the measurement model and the structural model. We first evaluated the properties of the first-order constructs, followed by the properties of the second-order constructs (Jarvis *et al.*, 2003).

We discarded four measurement items because their loadings were lower than 0.707 (Chin, 1998) (ITC1: 0.683; ISR5: 0.596; IST1: 0.666; OBR5: 0.560; Table 10 in Appendix A). It was possible to do so without significantly affecting our results because all constructs but one (*organizational benefits – corporate reputation*) retained three or more items, and all constructs showed improved reliability and validity after we deleted the items. Next, we analyzed the cross-loadings of the remaining forty-six measurement items and found that all items exhibited higher loadings on the constructs they were intended to measure than they did on any other constructs (Table 14 in Appendix C). The AVEs are higher than 0.6 for all constructs, pointing to a high convergent validity. With a minimum of composite reliability of 0.84, all constructs' composite reliability was well above the 0.7 threshold, which indicates internal consistency reliability (Table 15). To determine discriminant validity, we checked whether each construct shared more variance with its assigned measurement items than did any other construct (Table 16). The Fornell-Larcker criterion, which requires the average variance explained (AVE) of each latent construct to be greater than the construct's highest squared correlation with any other construct, was met for all constructs (Table 16).

Next, we evaluated the higher-order constructs (Hair *et al.*, 2013a). As Becker *et al.* (2012) recommend, we used the repeated-indicator PLS-SEM approach to model the second-order reflective-formative constructs in SmartPLS 2.0. To evaluate the constructs, we assessed the path coefficients between the lower-order latent variables and the higher-order constructs (PLS algorithm, path weighting scheme, bootstrapping with 118 cases and 1,000 re-samples). All paths from the first- and second-order sub-constructs to the higher-order constructs showed weights considerably above the 0.2 threshold (Chin, 1998; Urbach & Ahlemann, 2010), and the positive relationships were significant at the 0.001 level (Table 17). To identify possible multicollinearity between the formative indicators, we evaluated the Variance Inflation Factor (VIF) statistics with SPSS (Table 17). All VIFs were 2.3 or smaller, well below recommended cut-off of 3.3 (Diamantopoulos & Siguaw, 2006; Petter *et al.*, 2007; Hair *et al.*, 2011). The significance of the paths from lower-order to higher-order constructs and the low multicollinearity between the indicators demonstrate that the chosen lower-order constructs represent distinct facets of the higher-order constructs (Becker *et al.*, 2012).

Structural Model Estimation

Next, we evaluated the structural model using a PLS algorithm (SmartPLS 2.0, path weighting scheme) to estimate the predictive power of the model and analyzed the significance of the path coefficients with a bootstrapping procedure (118 cases and 1,000 re-samples). The results are shown in Figure 2.

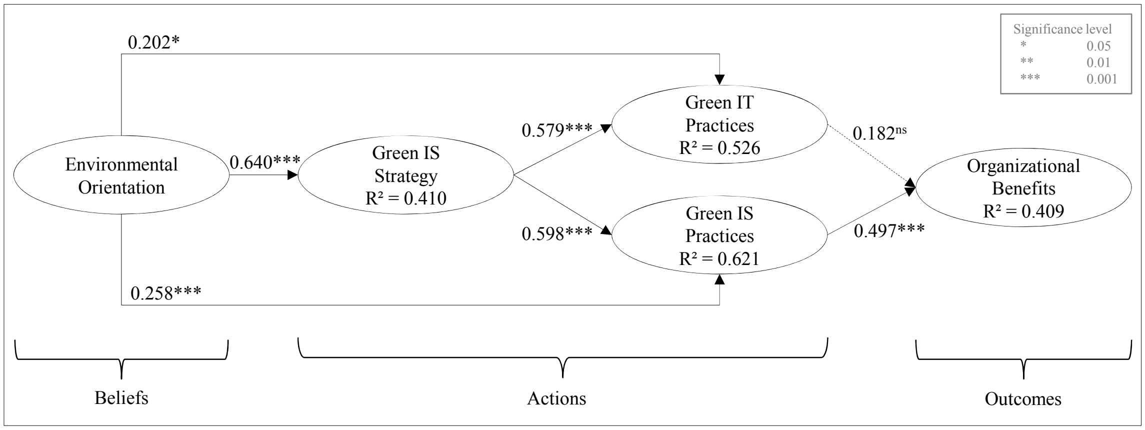

Figure 2: Assessment of the structural model with PLS-SEM (n = 118).

The model explains 40.9 percent of the variance of the dependent outcome variable *organizational benefits* through the endogenous latent variables *Green IT practices* and *Green IS practices*. 41 percent of the variance in *Green IS strategy* is explained by *environmental orientation.* More than 52 percent of the variance of *Green IT practices* and more than 62 percent of the variance of *Green IS practices* are explained through *Green IS strategy* and the exogenous latent variable *environmental orientation*. These R^2 values fall within the range of moderate to substantial power to explain the endogenous variables.

Using one-tailed tests based on a bootstrapping procedure, we evaluated our propositions by examining the significance and weights of the paths in the structural model. P1, P3, P4, P5, and P7 receive significant support from the data at the $p < 0.001$ level. The path proposed in P2 is significant at the $p < 0.05$ level. We rejected only P6 because the path from *Green IT practices* to *organizational benefits* is not significant ($p > 0.05$).

We estimated the effect sizes (f^2) to determine the relative contributions of each path (Liang *et al.*, 2007). According to Cohen (1988), f^2 values from 0.02 to 0.13 are small effect sizes, those from 0.13 to 0.26 are moderate effect sizes, and values greater than 0.26 are large effect sizes (Wetzels *et al.*, 2009). The results show that *environmental orientation* has a large effect on *Green IS strategy* ($f^2 = 0.69$) but only a small effect on *Green IT practices* ($f^2 = 0.04$) and *Green IS practices* ($f^2 = 0.10$). According to the PLS model, *Green IS strategy* has a large effect on *Green IT practices* ($f^2 = 0.41$) and on *Green IS practices* ($f^2 = 0.55$). *Green IS practices* have a large effect on the creation of *organizational benefits* ($f^2 = 0.19$), but *Green IT practices* have a minor effect ($f^2 = 0.04$).

In order to establish the adequacy of our sample size (n = 118) to detect the effect sizes obtained in the PLS analysis with acceptable power (0.80), we conducted a post-hoc power-analysis simulation following Aguirre-Urreta and Rönkkö's (2015) simulation procedure using R. We obtained the factor loadings for the items measuring each of the constructs, the path coefficients, and residual values from the PLS run in Figure 2. We used a sample size of 118, 1000 converged replications, and 500 bootstrapping resamples for the simulation. The simulation analysis assumed a normal distribution to generate the sample data. The results are summarized in Table 8.

Table 8: Power analysis results based on Aguirre-Urreta and Rönkkö's (2015) methodology.

Path	Parameter	R Simulation	Statistical power greater than 0.8 (n = 118)?
P1: Environmental Orientation → Green IS Strategy	0.640	1.000	Yes
P2: Environmental Orientation → Green IT Practices	0.202	0.678	No
P3: Environmental Orientation → Green IS Practices	0.258	0.929	Yes
P4: Green IS Strategy → Green IT Practices	0.579	1.00	Yes
P5: Green IS Strategy→ Green IS Practices	0.598	1.00	Yes
P6: Green IT Practices → Organizational Benefits	0.182	0.536	No
P7: Green IS Practices → Organizational Benefits	0.497	1.000	Yes

The result of the simulation shows that our sample size is adequate to detect all but two paths with adequate power. For P2 and P6, the powers were only 0.678 and 0.536, respectively. The non-significant finding about P6 should be interpreted with caution since our sample lacks sufficient power to identify a true relationship if it existed.

Supplementary Analyses

We carried out four additional analyses to examine our results in greater detail.

First, we examined the suggested mediations in our model by assessing the type of mediation between *environmental orientation* and *Green IT/IS practices* using Zhao *et al.*'s (2010, p. 201) decision tree for establishing and understanding mediation and non-mediation. Our original empirical results indicated a minor effect between *environmental orientation* and *Green IT practices*, although the path between the two is significant ($\beta = 0.202$; $p < 0.05$; $f^2 = 0.04$). By comparison, the influence of *environmental orientation* on *Green IS strategy* is much more pronounced ($\beta = 0.640$; $p < 0.001$; $f^2 = 0.69$), so environmental orientation, which influences executives' beliefs, has a strong effect on the formulation of Green IS strategies. The impact of *Green IS strategy* on the implementation of *Green IT practices* is large ($\beta = 0.579$; $p < 0.001$; $f^2 = 0.41$).

Equally, our data suggest only a minor effect of *environmental orientation* on *Green IS practices* ($\beta = 0.258$; $p < 0.001$; $f^2 = 0.10$) while *Green IS strategy* has a large effect on the implementation of *Green IS practices* ($\beta = 0.598$; $p < 0.001$; $f^2 = 0.55$).

These results suggest a linkage from *environmental orientation* to *Green IS strategy* through to *Green IT practices* and *Green IS practices* respectively. We used Zhao *et al.*'s (2010) procedure, which is based on Preacher and Hayes' (2004) syntax, to examine the proposed mediation effects. Results are summarized in Table 9.

Table 9: Mediation tests based on Zhao et al. (2010).

Mediation test	Unstandardized coefficient a	Unstandardized coefficient b	Unstandardized coefficient c	Mean value a × b	95% CI
Environmental Orientation → Green IS Strategy → Green IT Practices	0.640	0.579	0.573	0.370	Lower Bound: 0.255 Upper Bound: 0.499
Environmental Orientation → Green IS Strategy → Green IS Practices	0.640	0.598	0.641	0.383	Lower Bound: 0.275 Upper Bound: 0.514

For the mediation path *environmental orientation* → *Green IS strategy* → *Green IT practices*, the results show that, before *Green IS strategy* is introduced as a mediator, *environmental orientation* has a significant total effect on *Green IT practices* (coefficient = 0.573; t = 7.52; $p < 0.001$). When *Green IS strategy* is introduced as the mediator, *environmental orientation* does not have a significant direct impact on *Green IT practices* (coefficient = 0.202; t = 2.42). At the same time, the indirect effect of *environmental orientation* on *Green IT practices* through *Green IS strategy* is 0.370 with 95 percent bootstrap confidence intervals (CI) of 0.255 and 0.499. Since this CI does not contain zero, the indirect effect is significantly different from zero. In addition, because the original direct path between *environmental orientation* and *Green IT practices* is significant and the product a × b × c is positive, the type of mediation can be classified as complementary (Zhao *et al.*, 2010).

For the mediation path *environmental orientation* → *Green IS strategy* → *Green IS practices*, the results show that the direct effect of *environmental orientation* on *Green IS practices* is significant (coefficient = 0.641; t = 8.988; $p < 0.001$). When the mediator is included, *environmental orientation* retains a significant direct impact on *Green IS practices* (coefficient = 0.258; t = 3.457; $p < 0.001$). The indirect effect of *environmental orientation* on *Green IS practices* through *Green IS strategy* is 0.383. Because the CI does not contain zero and the product a × b × c is positive, the type of mediation can also be classified as complementary (Zhao *et al.*, 2010). Both types of mediation are consistent with the proposed research model. These results suggest that executives' environmental orientation is more likely to lead to environmental actions in the form of Green IT practices and Green IS practices when Green IS strategies have been formulated than when they have not.

The second of the four additional analyses we carried out was an examination of a deconstructed first-order structural model. While hierarchical construct models are established in quantitative IS research (Ringle *et al.*, 2012), they are also criticized because detailed information may be lost when constructs are aggregated to a higher level (Wright *et al.*, 2012), so we also examined the deconstructed first-order structural model. Table 20 and Table 21 in Appendix D summarize these results, which are consistent with our main results (Figure 2).

Third, given the notable scarcity of empirical research on Green IS initiatives and outcomes, we relaxed the assumption that there is only one model that fits the data and tested meaningful variants of our structural model (Evermann & Tate, 2011). In comparing our proposed model to alternative models, we evaluated the predictive relevance of the structural model by comparing the cross-validated redundancies of the latent variables (Ringle *et al.*, 2012) through the Q-square statistic (Sharma & Kim, 2012). In the original model, the Q-square values of all endogenous latent variables are considerably larger than zero (*Green IS strategy*: $Q^2 = 0.2681$; *Green IT practices*: $Q^2 = 0.2098$; *Green IS practices*: $Q^2 = 0.3373$; *organizational benefits*: $Q^2 = 0.1943$). That the values in the alternatively tested models are considerably lower indicates that the proposed research model is preferable.

Fourth, we compared the variations in our model results to organization-level variations. In particular, we sought to determine whether responses about environmental orientation, Green IS strategy, Green IT practices, Green IS practices, and reported organizational outcomes varied between organizations of differing sizes. To that end, we compared the variance in the latent variable scores for all first- and second-order constructs between respondents, grouped by reported number of employees and reported annual IT budget, two indicators of an organization's size. Results from this test are summarized in Table 23. No significant variances were detected for either grouping, suggesting that the results obtained are robust against variations in number of employees and IT budget size.

Detailed Exploration of Propositions

Having formulated our propositions on a general level between our higher-order constructs, we now explore the links in our structural model in more detail.

First, we examine the paths between the first-order sub-constructs of Green IS strategy (*organizational Green IS strategy* and *functional Green IS strategy*) and the implementation of *Green IT practices* and *Green IS practices*. Figure 3 shows a detailed view of the links in this part of the structural model (overview in Figure 2). We omitted the insignificant paths in the interest of clarity.

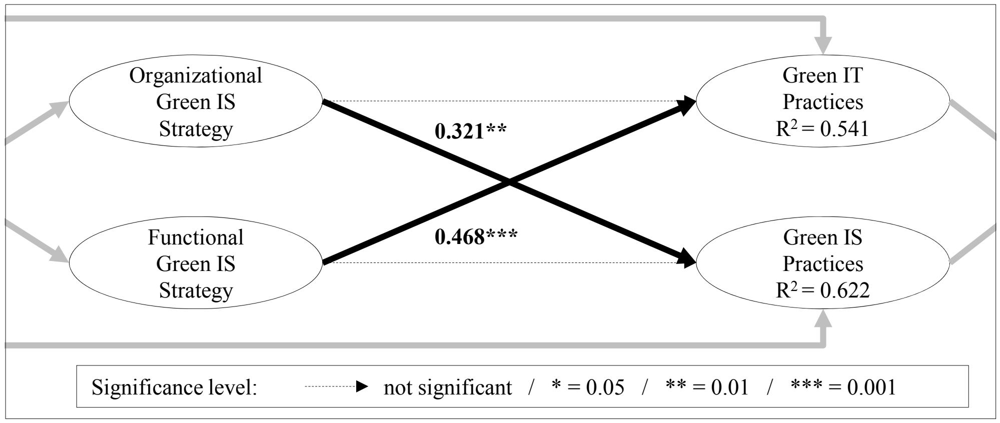

Figure 3: Detailed view of the links between *Green IS strategy* and *Green IT/IS practices*.

As Figure 3 illustrates, *organizational Green IS strategy* has a significant effect on the implementation of *Green IS practices*, whereas *functional Green IS strategy* significantly impacts *Green IT practices*. Functional Green IS strategies address primarily issues that are bound to the IT domain, so these strategies articulate plans that seek to decrease the direct environmental impacts of IT manufacturing, IT operations, and IT disposal. The relevant implementation measures in this area refer to Green IT practices. On the other hand, organizational Green IS strategies refer to high-level understanding of the potential of IS to decrease organization-wide and product-related emissions through the use of Green IS. The empirical results confirm that organizational strategies promote the implementation of cross-functional Green IS practices; apparently, functional strategies are not appropriate for the consistent implementation of Green IS since these strategies are restricted to the boundaries of the IT domain. This conclusion underscores the importance of organizational strategies, which are a necessity if the enterprise-wide potential of Green IS is to be realized.

Next, we examine in detail the effects of *Green IT practices* and *Green IS practices* on the creation of *organizational benefits*. Figure 4 provides a more detailed view of the results in Figure 2. *Green IT practices* have a moderate positive effect on *cost reductions* ($\beta = 0.412$; $p < 0.001$; $f^2 = 0.11$), while their impact on *corporate reputation* and *Green innovation capabilities* is not significant. By contrast, *Green IS practices* do not have a significant relationship with *cost reductions* but have a large effect on *corporate reputation* ($\beta = 0.572$; $p < 0.001$; $f^2 = 0.25$) and a moderate effect on *Green innovation capabilities* ($\beta = 0.459$; $p < 0.001$; $f^2 = 0.14$).

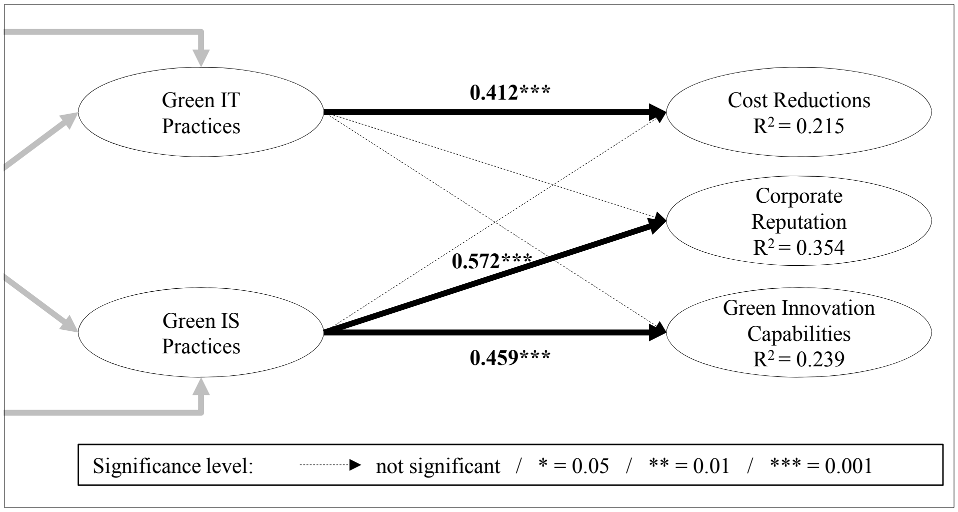

Figure 4: Detailed view of the links between *Green IT/ IS practices* and *organizational benefits*.

For both detailed views, we ran additional R simulations (Aguirre-Urreta & Rönkkö, 2015) to determine the power of the sample size to detect each path shown. The sample was adequate to detect nine of the paths (Table 22 in Appendix D) including the two significant paths illustrated in Figure 3 and the three in Figure 4

Overall, our empirical analysis supports the proposition that Green IS initiatives can have organizational benefits (e.g., Brooks *et al.*, 2010; Benitez-Amado & Walczuch, 2011). We also find support for the proposition that certain practices result in cost reductions, improved corporate reputation, and/or Green innovation capabilities (Thambusamy & Salam, 2010; Corbett, 2010; Dao *et al.*, 2011). Specifically, our empirical results reveal a significantly positive relationship between Green IT practices (IT sourcing, operations, and disposal) and cost reductions. Our results also demonstrate a significant impact of Green IS practices (process re-engineering, environmental management systems, and IS-enabled environmental technologies) on corporate reputation and environmental innovation capabilities. These empirical insights offer meaningful contributions to research and executives, which we discuss below.

DISCUSSION

The four key contributions from our work are (1) a new conceptual model of organizational benefits accruing from Green IS initiatives; (2) a definition of the Green IS practices and Green IT practices constructs, together with the development of a measurement instrument for these constructs; (3) an empirical demonstration of the benefits that can be derived from Green IS initiatives as well as the mechanisms that achieve these benefits; and (4) exemplary content and scope for the design of Green IS strategies and the cultivation of environmentally sustainable organizational and technology practices. We elaborate on each of these key contributions and discuss their implications for researchers and practitioners.

A New Conceptual Model for Analyzing Organizational Benefits of Green IS

We set out to investigate the antecedents of Green IS initiatives and the benefits these initiatives might provide to organizations. Although some frameworks, such as Melville's (2010) BAO, are useful, they don't provide a specific or focused conceptual lens with which to explain both the antecedents and the outcomes of Green IS investments. Our study provides a new conceptual model that builds a nomological net of environmental orientation, Green IS strategy, Green IT practices, Green IS practices, and organizational benefits. This model is important to the body of knowledge in IS research, particularly to the relatively new area of Green IS research, as it provides the conceptual foundation that defines the relationship between environmental actions in the form of Green IS initiatives and the creation of organizational benefits as outcomes. Prior research has focused primarily on the environmental benefits dimension of Green IS initiatives (e.g., Chen *et al.*, 2008; Melville, 2010; Watson *et al.*, 2010; Butler, 2011) but has devoted little study to t economic benefits. We add to this a focus on economic dimensions of benefits, such as cost reductions and corporate reputation). Thereby, our study offers a unique, logical chain from environmental orientation, which affects executives' beliefs and decision-making processes, to the formulation of Green IS strategies and the implementation of Green IT/IS practices, through to both environmental and economic benefits. The organizational-level environmental benefits, particularly those related to Green innovations, demonstrate how organizational actions could lead to potential positive effects on the environment. It also helps to address business concerns in achieving improved environmental sustainability through product and process innovations that reduce negative environmental footprint. The addressed economic benefit dimensions (cost reduction and corporate reputation) help clarify the relationship of these benefit dimensions and how each is anchored in Green IS initatives. These findings are thus one step further towards supporting organizational efforts to address environmental problems without trading off cost reduction and brand reputation concerns of businesses.

Definition of the Green IT Practices and Green IS Practices Constructs and their Measurement

We reviewed the definitions of Green IT and Green IS prior to conceptualizing *Green IS strategy*, *Green IT practices*, and *Green IS practices*. We also developed a measurement instrument that operationalizes them. We conceptualized Green IS strategy through two sub-domains—organizational-level and functional-level Green IS strategies—thus providing an important insight because each type of strategy fosters the implementation of a unique set of Green IS practices and Green IT practices, respectively. Such differences must be taken into consideration before making any empirical generalization or abstraction. Further, we re-defined Green IT practices into the three-sub domains of IT sourcing, operations, and disposal and divided Green IS practices into re-engineering of business processes, environmental management systems, and environmental technologies. Thus, this study developed and validated a measurement instrument for thirteen novel latent constructs that can be applied in future research contexts, an important contribution to empirical research in Green IS, which is dominated by conceptual work. Our work provides tools that can spur more systematic empirical research in this field.

Mechanisms for Harvesting Benefit from Green IS

Our study demonstrates to researchers and executives who may be suspicious about the benefit of Green IS initiatives that coherent Green IS investments not only contribute to environmental goals but can also reduce costs, improve corporate reputations, and enhance Green innovation capabilities. This evidence decreases the uncertainty about the economic impacts of Green IS initiatives and motivates both business and IT executives to advance their environmental sustainability efforts.

In order to harvest the benefit of Green IS Investments, IT executives must make substantial changes to their environmental orientation. The development of pro-environmental beliefs, values, and standards of behavior are important precursors to the formulation of both organizational and/or functional Green IS strategies, which can then be translated into Green IT practices and Green IS practices, respectively. The successful implementation of Green IT practices can reduce costs, whereas enterprise-wide Green IS practices enhance corporate reputations and strengthen Green innovation capabilities. We demonstrate that an organization's environmental orientation, which is formed by executives' beliefs concerning the importance of the environmental issues with which their firms are confronted, has a substantial influence on the formulation of Green IS strategies. The firm's environmental orientation also has a substantial impact on the implementation of Green IT practices and Green IS practices, although this effect is not pronounced because Green IS strategies mediate the relationship. Our empirical insights illustrate a distinct path from environmental orientation through Green IS strategy to the implementation of Green IT practices and Green IS practices. These findings underscore the significance of formulating a Green IS strategy to translate executives' environmental beliefs into firm-specific implementations of Green IT practices and Green IS practices.

Although we proposed that the cultivation of both Green IS practices and Green IT practices could result in similar organization-level benefits, the empirical data suggests that different value classes are associated with different types of green practices. For example, Green IT practices, which target the sourcing, operations, and disposal of IT equipment, not only decrease the need for hardware-specific raw materials, electrical power, and e-waste, but also have economic benefits in the form of cost reductions. However, because of their restricted focus on IT-related issues, these practices might not contribute directly to enhancing the corporate reputation or encourage Green innovations in all industries.

However, Green IS practices have a pronounced effect on corporate reputation since these practices can reduce waste and emissions throughout the organization. IS-based environmental management systems can facilitate the monitoring of and reporting about the corporate environmental footprint to internal and external stakeholders, elevating the firm's reputation. Green IS practices can also improve the firm's reputation by supporting the development of environmentally friendly products, thereby adding to brand image and positive customer perceptions. The use of Green IS practices to transform the company's systems and processes can also strengthen the firm's Green innovation capabilities, probably because of the expertise that emerges from using IS to employ resources efficiently and to quantify environmental impacts throughout the product lifecycle.

Exemplary Scope for Formulating Green IS Strategies and Cultivating Green IT/IS Practices

Our study suggests to IT executives that the scope of Green IS strategy can be formulated as an organizational perspective and/or as a functional plan, each of which has its own effects. Functional strategies foster the implementation of Green IT practices, whereas organizational strategies promote the realization of cross-functional Green IS practices. For their part, CIOs should see the role of IS in a broader business and corporate sustainability context than is currently typical. Because of their cross-functional perspective, which results from delivering technical solutions to a wide range of business units, CIOs are in a unique position to identify cross-functional synergies that can advance corporate sustainability initiatives (Clark, 2010).

On the other hand, a strategy without implementation of supporting practices is as useless as the uncoordinated implementation of activities without a unifying strategic focus. Our work suggests that managers can choose from various Green practices, cultivating either Green IT practices or Green IS practices, based on the goal they want to achieve. Many companies have implemented first Green IT practices in their data centers and office environments (Park *et al.*, 2012), but Green IS practices have a more far-reaching potential that most companies have not fully exploited (Dao *et al.*, 2011). Green IS practices can facilitate sound corporate-sustainability management throughout the organization and foster eco-innovations in products and services.

In order to assist in the scoping and cultivation exercises, existing literature can be used to identify implementable Green IT practices and Green IS practices. Loeser (2013), for example, provides two catalogues. One categorizes Green IT practices according to functional areas like IT sourcing, IT operations in data centers and office environments, and IT disposal. The other describes Green IS practices in areas such as governance, process optimization, innovative end projects and infrastructure. Because the potential of Green IS initiatives to improve corporate environmentalism differs substantially among companies and industries (Gartner Research, 2007), we recommend close collaboration between IT and other business executives in order to identify the areas where Green IS initiatives offer the greatest potential to contribute to the organization's environmental goals.

LIMITATIONS

Our work has several limitations, conceptually, empirically and analytically. Conceptually, we analyzed only the macro level of our research model in the context of Melville's (2010) BAO framework. We suggested several new concepts and examined them empirically with novel latent constructs. However, micro-level concepts and constructs might also be important in clarifying the relationships among environmental beliefs, actions, and outcomes. For example, environmental orientation constitutes not only executives' beliefs and experiences but also processes and culture, which we did not examine. There is a potential for tension, "… due to conflicts between organizational values (e.g., short-term profit motive) and personal values which are shaped by society (e.g., going green to save the planet)" (Melville 2010, p.5). This potential tension might be relevant in instigating action but was not covered in this study.

Moreover, for reasons of scope we operationalized Melville's (2010) concept of outcomes as reported organizational benefits only. The original framework describes outcomes as (a) both positive and negative for (b) both business and the environment (Melville 2010). We did not examine negative outcomes, nor did we examine the exact location of the benefits within an environmental context. However, our operationalization of benefits as outcomes was grounded in the literature, and our operationalization focused on both economic dimensions (e.g., cost reductions) and environmental dimensions (e.g., green product innovations). Still, whether and how the creation of benefits across these dimensions was shared or not (Porter and Kramer 2011) was not the focus of our study. This limits our contribution because a business focus on achieving organizational benefits in isolation is part of the broader sustainability problem (Shrivastava 1995).

We also note several empirical limitations. Although low response rates are not unusual in top-level executive studies, the generalizability of our results might be limited because of the low response rate to our survey. In hindsight, we could have chosen another strategy, such as contacting internal survey champions (e.g., personal assistants), telephone calls, or other incentives. Still, our ambition was to maximize the *absolute* rather than the *relative* size of the sample because senior-level IT executive data on Green IS initiatives is notably scarce in the literature, and we wanted sufficient data to maximize the validity of our statistical conclusions, possibly at the expense of external validity.

To assess the limitations to external validity, we performed three independent tests, none of which indicated the presence of non-response bias. We also estimated the effect sizes that were discernible with our dataset, which indicated that we could draw statistically valid conclusions for large and medium effect sizes. Still, a larger sample would have made it possible to detect small effect sizes and would have allowed us to test differences between companies of certain sizes, industries, or regions.

Another empirical limitation is that we examined large organizations in the US, Canada, Australia, New Zealand, and Germany. The results might differ for small or medium-sized companies and/or companies in other countries.

Another empirical limitation is the use of single informants. A multiple-informant approach that included both business and IT executives would have offered findings related to specific functional areas and a more objective assessment of organizational benefits. Our key motivation was to construct and analyze a data set that was global, cross-sectional, and from the senior executive level. However, it is difficult to obtain multi-source data about every organization in a cross-sectional sample. Our sample is comparable to other IT executive studies, which we determined by means of a ten-year review of twenty-five articles published in the top-tier IS journals (Table 13).

A final empirical limitation is our choice to operationalize the outcome variable (*organizational benefits*) through perceptual measures. Other ways of measuring organizational benefits could have involved comparative data on organizations in relation to competitors, which could have delivered more objective results, although this kind of data is also challenging to obtain.

Analytically, limitations may accrue from our application of PLS-SEM. We based this choice on available guidelines, primarily the advantages that have been ascribed to PLS-SEM for complex, hierarchical models (Wetzels *et al.*, 2009; Gefen *et al.*, 2011; Becker *et al.*, 2012; Hair *et al.*, 2013). We are aware that a debate has ensued regarding the potential limitations and threats to validity concerning PLS-SEM (Marcoulides *et al.*, 2009; Goodhue *et al.*, 2012), and our ambition is not to contribute to this discussion or to make contributions to the methodological debate. We considered the available methodological literature at that time, noting that our results meet the recommended criteria for robustness, validity, and reliability (Ringle *et al.*, 2012; Hair *et al.*, 2013). Under the caveat that we are not in a position to comment on or resolve methodological quarrels over our choice of data analysis strategy, we posit that our results and interpretations are robust. We hope that we can leave the methodological debate to colleagues more adept in resolving these issues than we are.

A second analytical limitation lies in the limited availability of control variables like organizational culture, firm size, and institutional pressures. We had data only on firm size (number of employees, annual IT budget), and our post-hoc analysis confirmed the robustness of our measures against variations in firm size. Still, an organization’s culture may impact its environmental orientation (Molla & Abareshi, 2012), and organizational Green IS initiatives are often triggered in response to institutional pressures (Butler, 2011), so the impact of these variables on the theoretical model advanced in this paper certainly deserves further empirical examination.

CONCLUSION

We examined how an organization's environmental orientation and strategy influence Green IS initiatives, and which organizational benefits accrue from these inititatives. We found that Green IS strategies mediate the relationship between environmental orientation and the implementation of Green IT/IS practices, which in turn lead to organizational benefits in the form of cost reductions, corporate reputation enhancement, and Green innovation capabilities. . Through this research, we reduced the economic uncertainty that is associated with far-reaching Green IS investments by providing detailed empirical insights into the relationships between Green IT practices and Green IS practices and organizational benefits. We make the case that Green IS practices, beyond IT-focused Green IT measures that many organizations have already implemented, can add substantial corporate benefits beyond cost reductions.

While our study provides unique theoretical and actionable contributions, we still regard its findings – much like Green IS itself – as nascent. In moving forward, we hope that the pathways that flow from our work will lead to extensions, challenges, and revisions of the knowledge on and around Green IS. We have provided some pieces to the puzzle of environmental sustainability, but the puzzle is far from solved.

REFERENCES

Abareshi, A. & Martin, B. (2008) A Meta-Analysis of Survey-Based Research in MIS Field from 1992-2006. In: *Proceedings of the 19th Australasian Conference on Information Systems (ACIS)*, Christchurch, New Zealand.

Aguirre-Urreta, M. & Rönkkö, M. (2015) Sample Size Determination and Statistical Power Analysis in PLS Using R: An Annotated Tutorial. *Communications of the AIS*, **36** (3), 33–51.

Albino, V., Balice, A. & Dangelico, R. M. (2009) Environmental Strategies and Green Product Development: An Overview on Sustainability-Driven Companies. *Business Strategy and the Environment*, **18** (2), 83–96.

Ambec, S. & Lanoie, P. (2008) Does It Pay to Be Green? A Systematic Overview. *Academy of Management Perspectives*, **22** (4), 45–62.

Andrews, K. R. (1971) *The Concept of Corporate Strategy*. R.D. Irwin, Homewood.

Anseel, F., Lievens, F., Schollaert, E. & Choragwicka, B. (2010) Response Rates in Organizational Science, 1995–2008: A Meta-analytic Review and Guidelines for Survey Researchers. *Journal of Business and Psychology*, **25** (3), 335–349.

Aragón-Correa, J. A. & Sharma, S. (2003) A Contingent Resource-Based View of Proactive Corporate Environmental Strategy. *Academy of Management Review*, **28** (1), 71–88.

Armstrong, J. S. & Overton, T. S. (1977) Estimating Nonresponse Bias in Mail Surveys. *Journal of Marketing Research*, **14** (3), 396–402.

Bai, C. & Sarkis, J. (2013) Green Information Technology Strategic Justification and Evaluation. *Information Systems Frontiers*, **15** (5), 831–847.

Banerjee, S. B. (2002) Corporate Environmentalism: The Construct and its Measurement. *Journal of Business Research*, **55** (3), 177–191.

Banerjee, S. B., Iyer, E. S. & Kashyap, R. K. (2003) Corporate Environmentalism: Antecedents and Influence of Industry Type. *Journal of Marketing*, **67** (2), 106–122.

Bansal, P. (2005) Evolving Sustainably: A Longitudinal Study of Corporate Sustainable Development. *Strategic Management Journal*, **26** (3), 197–218.

Bansal, P. & Roth, K. (2000) Why Companies Go Green - A Model of Ecological Responsiveness. *Academy of Management Journal*, **43** (4), 717–736.

Barney, J. B. (1986) Organizational Culture: Can It Be a Source of Sustained Competitive Advantage? *Academy of Management Review*, **11** (3), 656–667.

Barney, J. (1991) Firm Resources and Sustained Competitive Advantage. *Journal of Management*, **17** (1), 99–120.

Baruch, Y. & Holtom, B. C. (2008) Survey Response Rate Levels and Trends in Organizational Research. *Human Relations*, **61** (8), 1139–1160.

Becker, J. M., Klein, K. & Wetzels, M. (2012) Hierarchical Latent Variable Models in PLS-SEM: Guidelines for Using Reflective-Formative Type Models. *Long Range Planning*, **45** (5), 359–394.

Bengtsson, F. & Ågerfalk, P. J. (2011) Information Technology as a Change Actant in Sustainability Innovation: Insights from Uppsala. *The Journal of Strategic Information Systems*, **20** (1), 96–112.

Benitez-Amado, J., Perez-Arostegui, M. N. & Tamayo-Torres, J. (2010) Information Technology-Enabled Innovativeness and Green Capabilities. *Journal of Computer Information Systems*, **51** (2), 87–96.

Benitez-Amado, J. & Walczuch, R. (2011) IT, Proactive Environmental Strategy and Firm Performance: A Resource-based Analysis. In: *Proceedings of the 17th Americas Conference on Information Systems (AMCIS)*, Detroit, USA.

Berrone, P., Fosfuri, A., Gelabert, L. & Gomez-Mejia, L. R. (2013) Necessity as the Mother of 'Green' Inventions: Institutional Pressures and Environmental Innovations. *Strategic Management Journal*, **34** (8), 891–909.

Besson, P. & Rowe, F. (2012) Strategizing Information Systems-enabled Organizational Transformation: A Transdisciplinary Review and New Directions. *The Journal of Strategic Information Systems*, **21** (2), 103–124.

Bottrill, C. (2007) *Internet-Based Carbon Tools for Behavior Change*. Environmental Change Institute, Oxford University Centre for the Environment, Oxford, England.

Brooks, S., Wang, X. & Sarker, S. (2010) Unpacking Green IT: A Review of the Existing Literature. In: *Proceedings of the 16th Americas Conference on Information Systems (AMCIS)*, Lima, Peru.

Butler, T. (2011) Compliance with Institutional Imperatives on Environmental Sustainability: Building Theory on the Role of Green IS. *The Journal of Strategic Information Systems*, **20** (1), 6–26.

Cai, S., Chen, X. & Bose, I. (2013) Exploring the Role of IT for Environmental Sustainability in China: An Empirical Analysis. *International journal of production economics*, **146** (2), 491–500.

Chang, C.-H. (2011) The Influence of Corporate Environmental Ethics on Competitive Advantage: The Mediation Role of Green Innovation. *Journal of Business Ethics*, **104** (3), 361–370.

Chen, A. J., Boudreau, M.-C. & Watson, R. T. (2008) Information Systems and Ecological Sustainability. *Journal of Systems and Information Technology*, **10** (3), 186–201.

Chen, A. J., Watson, R. T., Boudreau, M. C. & Karahanna, E. (2010a) An Institutional Perspective on the Adoption of Green IS & Green IT. *Australasian Journal of Information Systems*, **17** (1), 23–45.

Chen, D. Q., Mocker, M., Preston, D. S. & Teubner, A. (2010b) Information Systems Strategy: Reconceptualization, Measurement, and Implications. *MIS Quarterly*, **34** (2), 233–259.

Chen, A. J., Watson, R. T., Boudreau, M. C. & Karahanna, E. (2011) An Institutional Perspective on the Adoption of Green IS & IT. *Australasian Journal of Information Systems*, **17** (1), 5–27.

Chin, W. W. (1998) The Partial Least Squares Approach for Structural Equation Modeling. In: *Modern Methods for Business Research*. Marcoulides, G. A. (ed.), pp. 295–336. Lawrence Erlbaum, Mahwah, NJ.

Cho, Y., Lee, J. & Kim, T. Y. (2007) The Impact of ICT Investment and Energy Price on Industrial Electricity Demand: Dynamic Growth Model Approach. *Energy Policy*, **35** (9), 4730–4738.

Chuang, S.-P. & Huang, S.-J. (2015) Effects of Business Greening and Green IT Capital on Business Competitiveness. *Journal of Business Ethics*, **128** (1), 221–231.

Clark, T. (2010) Unlocking Sustainability: Why the CIO Should Hold the Key. *World Economic Forum - The Global Information Technology Report*, **29** (1), 71–79.

Cohen, J. (1988) *Statistical Power Analysis for Behavioral Sciences*. Lawrence Erlbaum, Hillsdale, NJ.

Cooper, V. & Molla, A. (2014) Absorptive Capacity and Contextual Factors that Influence Green IT Assimilation. *Australasian Journal of Information Systems*, **18** (3).

Corbett, J. (2010) Unearthing the Value of Green IT. In: *Proceedings of the 31st International Conference on Information Systems (ICIS)*, Saint Louis, USA.

Corbett, J. (2013a) Designing and Using Carbon Management Systems to Promote Ecologically Responsible Behaviors. *Journal of the Association for Information Systems*, **14** (7), 339–378.

Corbett, J. (2013b) Using Information Systems to Improve Energy Efficiency: Do Smart Meters Make a Difference? *Information Systems Frontiers*, **15** (5), 747–760.

Dangelico, R. M. & Pujari, D. (2010) Mainstreaming Green Product Innovation: Why and How Companies Integrate Environmental Sustainability. *Journal of Business Ethics*, **95** (3), 471–486.

Dao, V., Langella, I. & Carbo, J. (2011) From Green to Sustainability: Information Technology and an Integrated Sustainability Framework. *The Journal of Strategic Information Systems*, **20** (1), 63–79.

Dedrick, J. (2010) Green IS: Concepts and Issues for Information Systems Research. *Communications of the AIS*, **27** (1), 173–184.

DeGarmo, T., Parker, B., Scott, R., Nieland, K. & Delaye, N. (2011) Building Sustainable Companies. *PwC Technology Forecast*, **4** (4), 1–80.

Diamantopoulos, A. & Siguaw, J. A. (2006) Formative Versus Reflective Indicators in Organizational Measure Development: A Comparison and Empirical Illustration. *British Journal of Management*, **17** (4), 263–282.

Dillman, D. A. (2007) *Mail and Internet Surveys: The Tailored Design Method,* 2nd ed., 2007 update with new internet, visual, and mixed-mode guide. Wiley, Hoboken.

El-Gayar, O. & Fritz, B. D. (2006) Environmental Management Information Systems (EMIS) for Sustainable Development: A Conceptual Overview. *Communications of the AIS*, **17** (1), 756–784.

Elliot, S. (2011) Transdisciplinary Perspectives on Environmental Sustainability: A Resource Base and Framework for IT-Enabled Business Transformation. *MIS Quarterly*, **35** (1), 197–236.

Elliot, S. (2013) A Transdisciplinary Exploratory Model of Corporate Responses to the Challenges of Environmental Sustainability. *Business Strategy and the Environment*, **22** (4), 269–282.

Evermann, J. & Tate, M. (2011) Fitting Covariance Models for Theory Generation. *Journal of the Association for Information Systems*, **12** (9), 632–661.

Fowler, F. J. (2009) *Survey Research Methods,* 4th edition. Sage Publications, Los Angeles, California.

Gadatsch, A. (2011) Comments on "Green IT: A Matter of Business and Information Systems Engineering?". *Business & Information Systems Engineering*, **3** (6), 297.

Gartner Research (2007) *Defining the Environmental Value of IT*. ID Number G00151471, Gartner, Inc., Stamford, CT.

Gefen, D., Straub, D. & Boudreau, M.-C. (2000) Structural Equation Modeling and Regression: Guidelines for Research Practice. *Communications of the Association for Information Systems*, **4** (7), 1–77.

Gefen, D., Rigdon, E. E. & Straub, D. (2011) An Update and Extension to SEM Guidelines for Administrative and Social Science Research. *MIS Quarterly*, **35** (2), iii–xiv.

GeSI (2008) *SMART 2020: Enabling the Low Carbon Economy in the Information Age*. The Climate Group, Global E-Sustainability Initiative.

Gholami, R., Sulaiman, A. B., Ramayah, T. & Molla, A. (2013) Senior Managers' Perception on Green Information Systems Adoption and Environmental Performance: Results from a Field Study. *Information & Management*, **50** (7), 431–438.

Goodhue, D. L., Lewis, W. & Thompson, R. (2012) Does PLS Have Advantages for Small Sample Size or Non-Normal Data? *MIS Quarterly*, **36** (3), 981–1001.

Grant, R. M. (1991) The Resource-Based Theory of Competitive Advantage: Implications for Strategy Formulation. *California Management Review*, **33** (3), 114–135.

Hair, J. F., Ringle, C. M. & Sarstedt, M. (2011) PLS-SEM: Indeed a Silver Bullet. *Journal of Marketing Theory and Practice*, **19** (2), 139–151.

Hair, J. F., Ringle, C. M. & Sarstedt, M. (2013a) Partial Least Squares Structural Equation Modeling: Rigorous Applications, Better Results and Higher Acceptance. *Long Range Planning*, **46** (1), 1–12.

Hair, J. F., Hult, G. T., Ringle, C. M. & Sarstedt, M. (2013b) *A Primer on Partial Least Squares Structural Equation Modeling (PLS-SEM)*. Sage Publications, Thousand Oaks, California.

Harmon, R. & Demirkan, H. (2011) The Next Wave of Sustainable IT. *IT Professional*, **13** (1), 19–25.

Hasan, H., Smith, S. & Finnegan, P. (In Press) An Activity Theoretic Analysis of the Mediating Role of Information Systems in Tackling Climate Change Adaptation. *Information Systems Journal*, forthcoming.

Hedman, J. & Henningsson, S. (2016) Developing Ecological Sustainability: A Green IS Response Model. *Information Systems Journal*, **26** (3), 259–287.

Henfridsson, O. & Lind, M. (2014) Information systems strategizing, organizational sub-communities, and the emergence of a sustainability strategy. *The Journal of Strategic Information Systems*, **23** (1), 11–28.

Hertel, M. & Wiesent, A. (2013) Investments in Information Systems: A Contribution Towards Sustainability. *Information Systems Frontiers*, **15** (5), 815–829.

Hilpert, H., Kranz, J. & Schumann, M. (2013) Leveraging Green IS in Logistics. *Business & Information Systems Engineering*, **5** (5), 315–325.

Jarvis, C. B., MacKenzie, S. B. & Podsakoff, P. M. (2003) A Critical Review of Construct Indicators and Measurement Model Misspecification in Marketing and Consumer Research. *Journal of Consumer Research*, **30** (2), 199–218.

Kappelman, L., McLean, E., Johnson, V. & Gerhart, N. (2014) The 2014 SIM IT Key Issues and Trends Study. *MIS Quarterly Executive*, **13** (4), 237–263.

Kiron, D., Kruschwitz, N., Rubel, H., Reeves, M. & Fuisz-Kehrbach, S.-K. (2013) Sustainability's Next Frontier: Walking the Talk on the Sustainability Issues that Matter Most. *Sloan Management Review*, **55** (1), 75–76.

Klassen, R. D. & McLaughlin, C. P. (1996) The Impact of Environmental Management on Firm Performance. *Management Science*, **42** (8), 1199-1214.

Klassen, R. D. & Whybark, D. C. (1999) The Impact of Environmental Technologies on Manufacturing Performance. *Academy of Management Journal*, **42** (6), 599-615.

Klassen, R. D. & Jacobs, J. (2001) Experimental Comparison of Web, Electronic, and Mail Survey Technologies in Operations Management. *Journal of Operations Management*, **19** (6), 713–728.

Lewis, B. R., Templeton, G. F. & Byrd, T. A. (2005) A Methodology for Construct Development in MIS Research. *European Journal of Information Systems*, **14** (4), 388–400.

Liang, H., Saraf, N., Hu, Q. & Xue, Y. (2007) Assimilation of Enterprise Systems: The Effect of Institutional Pressures and the Mediating Role of Top Management. *MIS Quarterly*, **31** (1), 59–87.

Loeser, F., Erek, K. & Zarnekow, R. (2012) Towards a Typology of Green IS Strategies: Insights from Case Study Research. In: *Proceedings of the 33rd International Conference on Information Systems (ICIS)*, Orlando, USA.

Loeser, F. (2013) Green IT and Green IS: Definition of Constructs and Overview of Current Practices. In: *Proceedings of the 19th Americas Conference on Information Systems (AMCIS)*, Chicago, USA.

Loock, C.-M., Staake, T. & Thiesse, F. (2013) Motivating Energy-Efficient Behavior With Green IS: An Investigation of Goal Setting and the Role of Defaults. *MIS Quarterly*, **37** (4), 1313–1332.

Loos, P., Nebel, W., Gómez, J. M., Hasan, H., Watson, R. T., vom Brocke, J., Seidel, S. & Recker, J. (2011) Green IT: A Matter of Business and Information Systems Engineering? *Business & Information Systems Engineering*, **3** (4), 245–252.

MacKenzie, S. B., Podsakoff, P. M. & Podsakoff, N. P. (2011) Construct Measurement and Validation Procedures in MIS Behavioral Research: Integrating New and Existing Techniques. *MIS Quarterly*, **35** (2), 293–334.

Malhotra, A., Melville, N. & Watson, R. T. (2013) Spurring Impactful Research on Information Systems for Environmental Sustainability. *MIS Quarterly*, **37** (4), 1265-1274.

Marcoulides, G. A. & Saunders, C. (2006) PLS: A Silver Bullet? *MIS Quarterly*, **30** (2), III–IX.

Marcoulides, G. A., Chin, W. W. & Saunders, C. (2009) A Critical Look at Partial Least Squares Modeling. *MIS Quarterly*, **33** (1), 171–175.

Marett, K., Otondo, R. F. & Taylor, S. G. (2013) Assessing the Effects of Benefits and Institutional Influences on the Continued Use of Environmentally Munificent Bypass Systems in Long-Haul Trucking. *MIS Quarterly*, **37** (4), 1301–1312.

Melville, N., Kraemer, K. & Gurbaxani, V. (2004) Review: Information Technology and Organizational Performance: An Integrative Model of IT Business Value. *MIS Quarterly*, **28** (2), 283–322.

Melville, N. (2010) Information Systems Innovation for Environmental Sustainability. *MIS Quarterly*, **34** (1), 1–21.

Messerschmidt, C. M. & Hinz, O. (2013) Explaining the Adoption of Grid Computing: An Integrated Institutional Theory and Organizational Capability Approach. *Journal of Strategic Information Systems*, **22** (2), 137–156.

Michaud, C. & Llerena, D. (2010) Green Consumer Behaviour: An Experimental Analysis of Willingness to Pay for Remanufactured Products. *Business Strategy and the Environment*, **20** (6), 408–420.

Mintzberg, H. (1987) The Strategy Concept I: Five Ps For Strategy. *California Management Review*, **30** (1), 11–24.

Mintzberg, H., Simons, R. & Basu, K. (2002) Beyond Selfishness. *MIT Sloan Management Review*, **44** (1), 67–74.

Molla, A. (2013) Identifying IT Sustainability Performance Drivers: Instrument Development and Validation. *Information Systems Frontiers*, **15** (5), 705–723.

Molla, A. & Abareshi, A. (2012) Organizational Green Motivations for Information Technology: Empirical Study. *Journal of Computer Information Systems*, **52** (3), 92–102.

Molla, A., Cooper, V. & Pittayachawan, S. (2011) The Green IT Readiness (G-Readiness) of Organizations: An Exploratory Analysis of a Construct and Instrument. *Communications of the AIS*, **29** (1), 67–96.

Murugesan, S. (2008) Harnessing Green IT: Principles and Practices. *IT Professional*, **10** (1), 24–33.

Orlitzky, M., Schmidt, F. L. & Rynes, S. L. (2003) Corporate Social and Financial Performance: A Meta-Analysis. *Organization Studies*, **24** (3), 403–441.

Orsato, R. J. (2006) Competitive Environmental Strategies: When Does It Pay to be Green? *California Management Review*, **48** (2), 127–143.

Park, S.-H., Eo, J. & Lee, J. J. (2012) Assessing and Managing an Organization's Green IT Maturity. *MIS Quarterly Executive*, **11** (3), 127–140.

Pavlou, P. A. & El Sawy, O. A. (2006) From IT Leveraging Competence to Competitive Advantage in Turbulent Environments: The Case of New Product Development. *Information Systems Research*, **17** (3), 198–227.

Petter, S., Straub, D. W. & Rai, A. (2007) Specifying Formative Constructs in Information Systems Research. *MIS Quarterly*, **31** (4), 623–656.

Pinsonneault, A. & Kraemer, K. L. (1993) Survey Research Methodology in Management Information Systems: An Assessment. *Journal of Management Information Systems*, **10** (2), 75–105.

Podsakoff, P. M., MacKenzie, S. B., Lee, J. Y. & Podsakoff, N. P. (2003) Common Method Biases in Behavioral Research: A Critical Review of the Literature and Recommended Remedies. *Journal of Applied Psychology*, **88** (5), 879–903.

Porter, M. E. (1980) *Competitive Strategy: Techniques for Analyzing Industries and Competitors*. Free Press, New York.

Porter, M. E. & Kramer, M. R. (2004) Creating Shared Value: How to Reinvent Capitalism-and Unleash a Wave of Innovation and Growth. *Harvard Business Review*, **89** (1-2), 62-77.

Porter, M. E. & van der Linde, C. (1995) Green and Competitive - Ending the Stalemate. *Harvard Business Review*, **73** (5), 120–134.

Preacher, K. J. & Hayes, A. F. (2004) SPSS and SAS Procedures for Estimating Indirect Effects in Simple Mediation Models. *Behavior Research Methods, Instruments, and Computers*, **36** (4), 717–731.

Ramus, C. A. & Steger, U. (2000) The Roles of Supervisory Support Behaviors and Environmental Policy in Employee "Ecoinitiatives" at Leading-Edge European Companies. *Academy of Management Journal*, **43** (4), 605–626.

Ranchhod, A. & Zhou, F. (2001) Comparing Respondents of E-Mail and Mail Surveys: Understanding the Implications of Technology. *Market Intelligence & Planning*, **19** (4), 254–262.

Ravichandran, T. & Rai, A. (2000) Quality Management in Systems Development: An Organizational System Perspective. *MIS Quarterly*, **24** (3), 381–415.

Ravichandran, T. & Lertwongsatien, C. (2005) Effect of Information Systems Resources and Capabilities on Firm Performance: A Resource-Based Perspective. *Journal of Management Information Systems*, **21** (4), 237–276.

Ray, G., Muhanna, W. A. & Barney, J. B. (2005) Information Technology and the Performance of the Customer Service Process: A Resource-Based Analysis. *MIS Quarterly*, **29** (4), 625–652.

Ringle, C., Sarstedt, M. & Straub, D. W. (2012) A Critical Look at the Use of PLS-SEM in MIS Quarterly. *MIS Quarterly*, **36** (1), I–XIV.

Rogelberg, S. G. & Stanton, J. M. (2007) Understanding and Dealing With Organizational Survey Nonresponse. *Organizational Research Methods*, **10** (2), 195–209.

Rugman, A. M. & Verbeke, A. (1998) Corporate Strategies and Environmental Regulations: An Organizing Framework. *Strategic Management Journal*, **19** (4), 363–375.

Ryoo, S. Y. & Koo, C. (2013) Green Practices-IS Alignment and Environmental Performance: The Mediating Effects of Coordination. *Information Systems Frontiers*, **15** (5), 799–814.

Schaltegger, S., Beckmann, M. & Hansen, E. G. (2013) Transdisciplinarity in Corporate Sustainability: Mapping the Field. *Business Strategy and the Environment*, **22** (4), 219–229.

Schryen, G. (2013) Revisiting IS Business Value Research: What We Already Know, What We Still Need to Know, and How We Can Get There. *European Journal of Information Systems*, **22** (2), 139–169.

Seidel, S., Recker, J. & Vom Brocke, J. (2013) Sensemaking and Sustainable Practicing Functional Affordances of Information Systems in Green Transformations. *MIS Quarterly*, **37** (4), 1275–1299.

Sharma, S. & Vredenburg, H. (1998) Proactive Corporate Environmental Strategy and the Development of Competitively Valuable Organizational Capabilities. *Strategic Management Journal*, **19** (2), 729–753.

Sharma, S. (2000) Managerial Interpretations and Organizational Context as Predictors of Corporate Choice of Environmental Strategy. *Academy of Management Journal*, **43** (4), 681–697.

Sharma, P. N. & Kim, K. H. (2012) Model Selection in Information Systems Research Using Partial Least Squares Based Structural Equation Modeling. In: *Proceedings of the 33rd International Conference on Information Systems* (ICIS), Orlando, USA.

Shrivastava, P. (1995) The Role of Corporations in Achieving Ecological Sustainability. *Academy of Management Review*, **20** (4), 936-960.

Shrivastava, P., Ivanaj, S. & Persson, S. (2013) Transdisciplinary Study of Sustainable Enterprise. *Business Strategy and the Environment*, **22** (4), 230–244.

Sivo, S. A., Saunders, C., Chang, Q. & Jiang, J. J. (2006) How Low Should You Go? Low Response Rates and the Validity of Inference in IS Questionnaire Research. *Journal of the Association for Information Systems*, **7** (6), 351–414.

Stead, W. E., Stead, J. G. & Starik, M. (2004) *Sustainable Strategic Management*. M.E. Sharpe, New York.

Steg, L. (2000) Toward a Coherent Theory of Environmentally Significant Behavior. *Journal of Social Issues*, **50** (3), 65–84.

Steg, L., Dreijerink, L. & Abrahamse, W. (2005) Factors Influencing the Acceptability of Energy Policies: A Test of VBN Theory. *Journal of Environmental Psychology*, **25** (4), 415–425.

Stiel, F. & Teuteberg, F. (2014) Measuring the Environmental Impact of IT/IS Solutions: A Life Cycle Impact Modelling Approach. *Environmental Modelling & Software*, **56** (1), 94–104.

Thambusamy, R. & Salam, A. F. (2010) Corporate Ecological Responsiveness, Environmental Ambidexterity and IT-Enabled Environmental Sustainability Strategy. In: *Proceedings of the 31st International Conference on Information Systems (ICIS)*, Saint Louis, USA.

Thongmak, M. (2013) A Systematic Framework for Sustainable ICTs in Developing Countries. *International Journal of Information Technologies and Systems Approach*, **6** (1), 1–19.

Urbach, N. & Ahlemann, F. (2010) Structural Equation Modeling in Information Systems Research Using Partial Least Squares. *Journal of Information Technology Theory and Application*, **11** (2), 5–40.

vom Brocke, J., Seidel, S. & Recker, J. (2012) *Green Business Process Management: Towards the Sustainable Enterprise*. Springer, Heidelberg.

vom Brocke, J., Watson, R. T., Dwyer, C., Elliot, S. & Melville, N. (2013) Green Information Systems: Directives for the IS Discipline. *Communications of the Association for Information Systems*, **33**, 509–520.

Watson, R. T., Boudreau, M. C., Chen, A. & Huber, M. (2008) *Green IS: Building Sustainable Business Practices*. Global Text Project, Athens, GA.

Watson, R. T., Boudreau, M. C. & Chen, A. J. (2010) Information Systems and Environmentally Sustainable Development: Energy Informatics and New Directions for the IS Community. *MIS Quarterly*, **34** (1), 23–38.

Weill, P. & Woerner, S. L. (2013) The Future of the CIO in a Digital Economy. *MIS Quarterly Executive*, **12** (2), 65–75.

Westland, C. J. (2010) Lower Bounds on Sample Size in Structural Equation Modeling. *Electronic Commerce Research and Applications*, **9** (6), 476–487.

Wetzels, M., Odekerken-Schroeder, G. & van Oppen, C. (2009) Using PLS Path Modeling for Assessing Hierarchical Construct Models: Guidelines and Empirical Illustration. *MIS Quarterly*, **33** (1), 177–195.

Zhao, X., Lynch, J. G. & Chen, Q. (2010) Reconsidering Baron and Kenny: Myths and Truths about Mediation Analysis. *Journal of Consumer Research*, **37** (2), 197–206.

Ziegler, A., Busch, T. & Hoffmann, V. H. (2011) Disclosed Corporate Responses to Climate Change and Stock Performance: An International Empirical Analysis. *Energy Economics*, **33** (1), 1283–1294.

APPENDIX A: MEASUREMENT ITEMS

Table 10: Measurement items; (*) = item excluded from the analysis due to a low factor loading [λ<0.7].

Code	Item	Adopted from...
Environmental Orientation (EO)		
EO1	Our company's executives and employee feel that the company has carved out a significant position with respect to environmental protection.	Chen (2011)
EO2	Our company's executives and employees feel that the company has a set of environmental goals worth striving for.	Chen (2011)
EO3	Our company's executives and employees feel that environmental preservation is a central value of the company.	Banerjee (2002)
EO5	Our company's executives and employees identify strongly with the company's actions with respect to environmental matters.	Chen (2011)
Green IS Strategy (S) – Organizational (1) / Functional (2)		
S11	Our company's top management recognizes the possibilities and strategic potential of Green IT/IS.	Kearns & Sabherwal (2007)
S12	Our company's top management emphasizes the role of Green IT/IS to drive environmental sustainability within our company.	Paulraj (2011)
S13	Our company's top management demonstrates a high degree of involvement concerning Green IT/IS initiatives.	Henriques & Sadorsky (1999)
S15	Our company's top management considers Green IT/IS to be an essential enabler of our corporate sustainability strategy.	Paulraj (2011)
S16	Our company's top management responds rapidly to early signals concerning areas of opportunity for Green IT/IS.	Chen *et al.* (2010a)
S21	In our IT/IS planning processes, we have integrated environmental aspects.	Banerjee (2002)
S23	In our IT/IS planning processes, we always give preference to IT projects and infrastructure investments that are favorable from an environmental point of view.	New
S24	In our IT/IS planning processes, we have established performance indicators for assessing the impact of Green IT/IS initiatives.	Molla *et al.* (2011)
S25	In our IT/IS planning processes, we have earmarked financial and other resources for Green IT/IS initiatives.	Molla *et al.* (2011)
S26	In our IT/IS planning processes, we define concrete environmental targets for each Green IT/IS initiative.	Molla *et al.* (2011)
Implementation of Green IT Practices (IT) – IT Sourcing (S) / Data Center Operations (C) / Office Environment IT Operations (O) / IT Disposal (D)		
ITS1	We monitor the environmental performance of our IT hardware and service suppliers.	Molla *et al.* (2011)
ITS2	We always give preference to IT hardware and service suppliers which have a green track record.	Molla *et al.* (2009)
ITS5	We exclusively purchase energy-efficient IT hardware.	Chen *et al.* (2010a)
ITC1*	In our data center, we have consolidated and virtualized our servers.	New
ITC3	In our data center, we have optimized the energy efficiency of our storage systems.	New
ITC4	In our data center, we have optimized airflows and the entire cooling system.	New
ITC6	In our data center, we thoroughly monitor IT energy consumption.	New
ITO2	In our company's offices, we inform and educate users regarding the energy consumption of IT.	New
ITO3	In our company's offices, we have installed power management software.	New
ITO4	In our company's offices, we exclusively deploy energy efficient computers, such as laptops and thin clients.	New
ITD1	To reduce e-waste, we dispose IT equipment in an environmentally friendly manner.	Chen *et al.* (2010a)
ITD2	To reduce e-waste, we repair IT systems whenever possible.	New
ITD3	To reduce e-waste, we always search for alternative uses of outdated IT systems.	New

Table 10 (continued): Measurement items; (*) = item excluded from the analysis due to a low factor loading [λ<0.7].

Code	Item	Adopted from...
Implementation of Green IS Practices (IS) – Process Reengineering (R) / Environmental Management Systems (E) / Environmental Technologies (T)		
ISR1	Our company makes use of Green IT/IS to improve the efficiency of its production facilities.	Karacaoglu & Özkanli (2011)
ISR2	Our company makes use of Green IT/IS to streamline existing business processes.	Tallon (2011)
ISR3	Our company makes use of Green IT/IS to develop new processes that are more environmentally-friendly.	Christmann (2000)
ISR4	Our company makes use of Green IT/IS to transform the entire business towards long-term sustainability.	Tallon & Pinsonneault (2011)
ISR5*	Our company makes use of Green IT/IS to reduce individual employee travel through teleconferences.	New
ISR6	Our company makes use of Green IT/IS to optimize its supply chain processes.	Wagner (2003)
ISE1	Our company makes use of information systems that provide important environmental information for decision-making.	Venkatraman & Grant (1986)
ISE2	Our company makes use of information systems to track resource and energy flows.	New
ISE3	Our company makes use of information systems to control the effectiveness of environmental programs.	Sharma (2000)
ISE4	Our company makes use of information systems to quantify company-wide carbon dioxide emissions.	Molla *et al.* (2009)
IST1*	Our company improves existing products with the help of information systems (e.g., tracking and analyzing the footprint of product lifecycles).	Christmann (2000)
IST2	Our company offers IT-enabled services with decreased environmental impact (e.g., dematerialization: e-commerce, online banking, digital music).	New
IST3	Our company enhances the environmental characteristics of its products or services by embedding IT/IS in them (e.g., smart logistics, smart buildings, smart engines).	Tallon (2011)
IST4	Our company views IT/IS as enabler for developing new products and services that reduce environmental impacts (e.g., traffic management systems, smart grids)	Banerjee (2002)
Organizational Benefits (OB) – Cost Reductions (C) / Corporate Reputation (R) / Green Innovation Capabilities (I)		
OBC1	Our company has incurred lower costs for complying with environmental regulations than our competitors.	Christmann (2000)
OBC2	Our company requires relatively less material and resources than our competitors.	Christmann (2000)
OBC4	Our company has lower operational costs than our competitors.	Kearns & Lederer (2000)
OBR1	Our company has a better corporate image than our competitors.	Chang (2011)
OBR3	Our company is perceived as being environmentally responsible by our customers.	Tallon & Pinsonneault (2011)
OBR5*	Our company is favored by shareholders due to our good reputation.	New
OBI2	Our company is more capable of environmental R&D than our major competitors.	Chen (2011)
OBI3	Our company is more capable of environmental management than our major competitors.	Chen (2011)
OBI4	Our company is more capable of green innovations than our major competitors.	Chen (2011)

APPENDIX B: ADDITIONAL SURVEY MATERIALS

Table 11: Comparison of expected and observed responses according to company size distributions.

Company size: Number of employees	Distribution in original population (US Census[1])	Distribution of contact records in database (random sample)	Expected observations (according to database)	Observations (distribution of empirical results)	Chi-Squared test of homogeneity
251 – 1,000	49%	45.6%	53.8	47	0.86
1,001 – 5,000	38%	31%	36.6	29	1.57
5,001 – 25,000	9%	18%	21.2	32	5.45
25,001 – 100,000	2%	3.5%	4.1	6	0.85
> 100,000	0.3%	1.9%	2.2	4	1.38
				χ^2 (critical value for f = 5: 11.07 for α = 0.05)	10.11

Table 12: Nonresponse reasons (n = 100) [* = topic-specific reasons].

Reason for not participating in the survey	#	Percentage
I was too busy.	27	27%
Our company does not participate in any surveys.	19	19%
Our company security policies prevent us from sharing this kind of information.	10	10%
I did not receive your invitation.	9	9%
I never participate in surveys.	7	7%
Other reasons.	7	7%
I have a new position in the organization and thus cannot answer your questions.	6	6%
My time is too valuable to participate in research projects.	5	5%
I did not trust the confidentiality protection of your institution.	4	4%
Personally, I am not interested in the topic.*	2*	2%*
Our company does not address these issues.*	2*	2%*
I could not access your survey.	1	1%
I do not participate in un-solicited surveys from outside my country.	1	1%

[1] https://www.census.gov/econ/esp/

Table 13: Summary of empirical IT executive studies on organizational benefits as reported in AIS-Top-8 journals.

Reference	Types of Informants	Respondent Role	# of observations
Bharadwaj *et al.* (2007)	Multiple	Production and inventory managers	169
Bulchand-Gidumal & Melián-González (2011)	Single	IT experts	59
Chakravarty *et al.* (2013)	Single	Senior business manager (CEO or Founder or Vice president)	109
Coltman *et al.* (2011)	Multiple	Two managers from the same business unit	86
Coltman *et al.* (2007)	Single	Senior business managers	293
Choi & Lee (2012)	Single	CIOs or management strategy executives	372
Keil *et al.* (2013)	Single	IT executives	63
Kettinger *et al.* (2013)	Single	Senior business manager (CEO or CFO or Vice president)	103
Kim *et al.* (2011)	Multiple	CIOs and Finance managers	243
Leidner *et al.* (2011)	Single	Highest rating executives, CEO	283
Pavlou & El Sawy (2010)	Single	New product development manager	180
Quaadgras *et al.* (2014)	Multiple	IT and Non-IT managers	210
Rai *et al.* (2006)	Single	Supply chain and logistics managers	110
Ravichandran & Lertwongsatien (2005)	Single	CIOs, VPs, Assistant VPs and Directors of Technology	119
Ray *et al.* (2005)	Multiple	IT and Customer Service managers	72
Rivard *et al.* (2006)	Single	CEO	96
Setia *et al.* (2013)		Brunch managers, IS managers and actual customers	170
Shah *et al.* (2007)	Single	Senior IT managers	114
Tanriverdi (2005)		Senior IT and Business Executives	280
Wang *et al.* (2013)	Single	Senior purchasing managers	144
Wu & Hu (2012)	Single	Senior IT executives or managers	144
Wu *et al.* (2015)	Single	Business and IT executives, senior IT managers	136
Yayla & Hu (2012)	Multiple	Executives, business managers	177
Zhang *et al.* (2008)	Single	Senior managers	180
Zhang *et al.* (2013)	Single	Senior managers	136

APPENDIX C: MEASUREMENT VALIDATION MATERIALS

Table 14: Item cross-loadings.

Second-order construct		Organizational Benefits			Green IT Practices				Green IS Practices			Green IS Strategy	
First-order construct	Environmental Orientation	Green Innovation Capabilities	Corporate Reputation	Cost Reductions	IT Disposal	IT Operations Data Center	IT Operations Office Environment	IT Sourcing	Environmental Management Systems	Process Reengineering	Environmental Technologies	Organizational Green IS Strategy	Functional Green IS Strategy
EO1	**0.927**	0.579	0.586	0.370	0.317	0.427	0.401	0.471	0.575	0.474	0.423	0.596	0.474
EO2	**0.946**	0.592	0.548	0.349	0.281	0.466	0.405	0.542	0.595	0.553	0.418	0.609	0.568
EO3	**0.916**	0.531	0.478	0.340	0.211	0.462	0.380	0.480	0.491	0.453	0.351	0.536	0.429
EO5	**0.945**	0.593	0.545	0.370	0.301	0.511	0.399	0.526	0.600	0.546	0.483	0.626	0.498
OBI2	0.585	**0.948**	0.369	0.290	0.188	0.263	0.210	0.396	0.424	0.389	0.352	0.349	0.442
OBI3	0.576	**0.970**	0.358	0.324	0.208	0.255	0.221	0.395	0.456	0.398	0.389	0.356	0.464
OBI4	0.605	**0.946**	0.403	0.351	0.201	0.254	0.230	0.390	0.429	0.359	0.346	0.358	0.473
OBR1	0.450	0.284	**0.910**	0.461	0.320	0.313	0.256	0.262	0.440	0.455	0.421	0.373	0.294
OBR3	0.605	0.432	**0.918**	0.342	0.303	0.380	0.345	0.369	0.528	0.492	0.399	0.473	0.353
OBC1	0.385	0.294	0.458	**0.853**	0.372	0.428	0.346	0.353	0.296	0.353	0.268	0.328	0.310
OBC2	0.324	0.332	0.350	**0.911**	0.212	0.325	0.305	0.358	0.149	0.284	0.311	0.329	0.282
OBC5	0.291	0.257	0.332	**0.876**	0.142	0.312	0.294	0.299	0.173	0.263	0.299	0.283	0.329
ITD1	0.276	0.126	0.330	0.299	**0.765**	0.361	0.236	0.290	0.233	0.234	0.216	0.157	0.228
ITD2	0.265	0.228	0.278	0.196	**0.843**	0.263	0.199	0.298	0.226	0.237	0.152	0.102	0.200
ITD3	0.139	0.138	0.169	0.157	**0.768**	0.213	0.183	0.253	0.246	0.260	0.207	0.107	0.247
ITC3	0.399	0.113	0.412	0.343	0.267	**0.817**	0.476	0.499	0.451	0.463	0.343	0.414	0.385
ITC4	0.374	0.279	0.210	0.278	0.396	**0.777**	0.277	0.431	0.243	0.253	0.289	0.284	0.189
ITC6	0.450	0.277	0.296	0.371	0.259	**0.859**	0.608	0.635	0.445	0.572	0.433	0.568	0.465
ITO2	0.396	0.241	0.291	0.248	0.149	0.436	**0.850**	0.578	0.523	0.489	0.419	0.493	0.632
ITO3	0.325	0.129	0.256	0.247	0.185	0.528	**0.812**	0.452	0.431	0.370	0.357	0.485	0.455
ITO4	0.301	0.179	0.249	0.388	0.318	0.442	**0.761**	0.590	0.282	0.452	0.299	0.358	0.425
ITS1	0.439	0.308	0.286	0.262	0.247	0.565	0.614	**0.827**	0.477	0.488	0.406	0.562	0.637
ITS2	0.476	0.405	0.326	0.347	0.322	0.528	0.548	**0.902**	0.518	0.616	0.363	0.519	0.682
ITS5	0.413	0.287	0.227	0.343	0.313	0.505	0.484	**0.710**	0.335	0.442	0.183	0.310	0.419
ISE1	0.457	0.319	0.368	0.159	0.231	0.317	0.422	0.464	**0.829**	0.515	0.387	0.498	0.552
ISE2	0.494	0.379	0.443	0.163	0.295	0.482	0.467	0.503	**0.897**	0.580	0.418	0.501	0.497
ISE3	0.561	0.458	0.539	0.289	0.293	0.440	0.482	0.503	**0.937**	0.648	0.546	0.565	0.576
ISE4	0.620	0.441	0.503	0.218	0.223	0.437	0.453	0.478	**0.870**	0.583	0.433	0.547	0.564
ISR1	0.370	0.298	0.428	0.338	0.224	0.541	0.497	0.575	0.538	**0.823**	0.404	0.492	0.470
ISR2	0.392	0.268	0.431	0.289	0.271	0.496	0.501	0.562	0.519	**0.901**	0.447	0.509	0.476
ISR3	0.500	0.336	0.439	0.291	0.276	0.475	0.477	0.531	0.572	**0.880**	0.442	0.557	0.590
ISR4	0.579	0.472	0.470	0.331	0.295	0.440	0.448	0.586	0.661	**0.899**	0.461	0.584	0.609
ISR6	0.480	0.325	0.466	0.231	0.241	0.410	0.431	0.490	0.543	**0.806**	0.425	0.511	0.393
IST2	0.300	0.292	0.259	0.157	0.182	0.269	0.164	0.220	0.356	0.322	**0.819**	0.378	0.378
IST3	0.406	0.331	0.443	0.349	0.247	0.444	0.445	0.355	0.454	0.434	**0.917**	0.581	0.469
IST4	0.457	0.371	0.441	0.327	0.199	0.418	0.497	0.433	0.508	0.543	**0.896**	0.585	0.488

Table 14 (continued): Confirmatory factor analysis with item-to-construct- and cross-loadings.

Second-order construct		Organizational Benefits			Green IT Practices				Green IS Practices			Green IS Strategy	
First-order construct	Environmental Orientation	Green Innovation Capabilities	Corporate Reputation	Cost Reductions	IT Disposal	IT Operations Data Center	IT Operations Office Environment	IT Sourcing	Environmental Management Systems	Process Reengineering	Environmental Technologies	Organizational Green IS Strategy	Functional Green IS Strategy
S11	0.618	0.346	0.438	0.365	0.154	0.458	0.496	0.511	0.525	0.511	0.545	**0.885**	0.609
S12	0.611	0.360	0.449	0.331	0.150	0.493	0.530	0.568	0.576	0.563	0.601	**0.946**	0.656
S13	0.589	0.290	0.435	0.302	0.107	0.467	0.521	0.522	0.545	0.557	0.535	**0.949**	0.621
S15	0.589	0.376	0.454	0.310	0.194	0.569	0.528	0.534	0.575	0.629	0.578	**0.921**	0.634
S16	0.516	0.330	0.356	0.343	0.113	0.460	0.466	0.521	0.535	0.580	0.504	**0.899**	0.648
S21	0.463	0.400	0.330	0.378	0.299	0.342	0.508	0.572	0.511	0.463	0.435	0.520	**0.810**
S23	0.523	0.535	0.337	0.413	0.264	0.395	0.529	0.634	0.526	0.527	0.431	0.557	**0.818**
S24	0.462	0.424	0.217	0.217	0.278	0.406	0.570	0.687	0.530	0.518	0.444	0.611	**0.888**
S25	0.359	0.337	0.283	0.255	0.195	0.374	0.526	0.534	0.500	0.499	0.453	0.631	**0.857**
S26	0.426	0.328	0.339	0.209	0.145	0.347	0.543	0.613	0.555	0.509	0.410	0.596	**0.859**

Table 15: Descriptive statistics for latent variable constructs.

Construct	Mean	Standard deviation	Composite reliability
Corporate Reputation	4.635	1.049	0.910
Cost Reductions	4.112	1.030	0.912
IT Disposal	5.590	1.128	0.835
Environmental Management Systems	3.925	1.511	0.935
Environmental Orientation	4.744	1.455	0.964
Environmental Technologies	4.541	1.335	0.910
Organizational Green IS Strategy	4.140	1.498	0.965
Functional Green IS Strategy	3.505	1.358	0.927
Green Innovation Capabilities	4.070	1.139	0.969
IT Operations Data Center	5.178	1.279	0.859
IT Operations Office Environment	4.359	1.414	0.850
IT Sourcing	3.954	1.350	0.856
Process Reengineering	4.287	1.350	0.936

Table 16: Average variance extracted and correlation matrix of principal components (diagonal elements, highlighted in bold, are the square root of AVE; off-diagonal elements are correlations between the constructs).

	Corporate Reputation	Cost Reductions	IT Disposal	Environmental Management Systems	Environmental Orientation	Environmental Technologies	Organizational Green IS Strategy	Functional Green IS Strategy	Green Innovation Capabilities	IT Operations Data Center	IT Operations Office Environment	IT Sourcing	Process Reengineering
Corporate Reputation	**0.914**												
Cost Reductions	0.438	**0.880**											
IT Disposal	0.341	0.285	**0.793**										
Environmental Management Systems	0.531	0.240	0.294	**0.884**									
Environmental Orientation	0.579	0.383	0.299	0.608	**0.933**								
Environmental Technologies	0.448	0.332	0.240	0.509	0.451	**0.878**							
Organizational Green IS Strategy	0.464	0.358	0.157	0.599	0.636	0.602	**0.921**						
Functional Green IS Strategy	0.354	0.348	0.280	0.620	0.530	0.513	0.688	**0.847**					
Green Innovation Capabilities	0.394	0.337	0.209	0.457	0.616	0.380	0.371	0.481	**0.955**				
IT Operations Data Center	0.380	0.409	0.363	0.477	0.501	0.442	0.533	0.441	0.269	**0.818**			
IT Operations Office Environment	0.329	0.360	0.264	0.516	0.425	0.447	0.553	0.633	0.231	0.576	**0.808**		
IT Sourcing	0.346	0.385	0.357	0.551	0.542	0.397	0.577	0.721	0.412	0.649	0.671	**0.817**	
Process Reengineering	0.518	0.345	0.305	0.661	0.545	0.506	0.618	0.595	0.401	0.545	0.544	0.637	**0.863**

Table 17: Evaluation of higher-order constructs (* = path between constructs significant at p<0.001).**

Construct	Sub-construct	# items	VIF	Weights
Green IS Strategy	Organizational Green IS Strategy	5	1.90	0.587***
	Functional Green IS	5	1.90	0.499***
Green IT Practices	IT Sourcing	3	2.30	0.369***
	IT Operations Data Center	3	1.90	0.343***
	IT Operations Office Environment	3	1.94	0.318***
	IT Disposal	3	1.19	0.221***
Green IS Practices	Process Reengineering	5	1.91	0.504***
	Environmental Management Systems	4	1.92	0.410***
	Environmental Technologies	3	1.45	0.258***
Organizational Benefits	Cost Reductions	3	1.29	0.437***
	Corporate Reputation	2	1.35	0.293***
	Green Innovation Capabilities	3	1.23	0.563***

APPENDIX D: SUPPLEMENTARY ANALYSES

Table 18: Path Coefficients and Standard Errors referring to Figure 2.

Path	Path Coefficient	Standard Error
P1: Environmental Orientation → Green IS Strategy	0.6400	0.0538
P2: Environmental Orientation → Green IT Practices	0.2024	0.0605
P3: Environmental Orientation → Green IS Practices	0.2581	0.0474
P4: Green IS Strategy → Green IT Practices	0.5786	0.0846
P5: Green IS Strategy → Green IS Practices	0.5978	0.0627
P6: Green IT Practices → Organizational Benefits	0.1823	0.1294
P7: Green IS Practices → Organizational Benefits	0.4971	0.1113

Table 19: Path Coefficients and Standard Errors referring to the Detailed Analysis of Figure 3 and Figure 4.

Path	Path Coefficient	Standard Error
Environmental Orientation → Organizational Green IS Strategy	0.6359	0.0556
Environmental Orientation → Functional Green IS Strategy	0.5309	0.0624
Environmental Orientation → Green IT Practices	0.2369	0.0622
Environmental Orientation → Green IS Practices	0.2631	0.0505
Organizational Green IS Strategy → Green IT Practices	0.1370	0.1200
Organizational Green IS Strategy → Green IS Practices	0.3212	0.1023
Functional Green IS Strategy → Green IT Practices	0.4679	0.0928
Functional Green IS Strategy → Green IS Practices	0.3263	0.1005
Green IT Practices → Cost Reductions	0.4124	0.1125
Green IT Practices → Corporate Reputation	0.0320	0.1183
Green IT Practices → Green Innovation Capabilities	0.0412	0.1547
Green IS Practices → Cost Reductions	0.0684	0.1232
Green IS Practices → Corporate Reputation	0.5723	0.0909
Green IS Practices → Green Innovation Capabilities	0.4593	0.1315

Table 20: First-order Model Path Results (paths highlighted in bold are significant at the 0.05 level).

Relationship	Path Sample Mean	T Statistic
Beliefs – Actions		
Environmental Orientation → Organizational Green IS Strategy	0.63	**11.08**
Environmental Orientation → Functional Green IS Strategy	0.53	**8.58**
Environmental Orientation → IT Sourcing	0.54	**6.16**
Environmental Orientation → IT Operations Data Center	0.50	**7.89**
Environmental Orientation → IT Operations Office Environment	0.43	**5.18**
Environmental Orientation → IT Disposal	0.31	**3.28**
Environmental Orientation → Process Reengineering	0.55	**9.02**
Environmental Orientation → Environmental Management Systems	0.61	**9.76**
Environmental Orientation → Environmental Technologies	0.45	**5.59**

Table 22 (continued): First-order Model Path Results (paths highlighted in bold are significant at the 0.05 level).

Relationship	Path Sample Mean	T Statistic
Actions (Green IS Strategy) – Actions (Green IT Practices and Green IS Practices)		
Organizational Green IS Strategy → IT Sourcing	0.05	0.44
Organizational Green IS Strategy → IT Operations Data Center	0.30	**2.45**
Organizational Green IS Strategy → IT Operations Office Environment	0.20	1.37
Organizational Green IS Strategy → IT Disposal	-0.21	1.60
Organizational Green IS Strategy → Process Reengineering	0.28	**2.49**
Organizational Green IS Strategy → Environmental Management Systems	0.15	1.13
Organizational Green IS Strategy → Environmental Technologies	0.43	**3.61**
Functional Green IS Strategy → IT Sourcing	0.58	**7.03**
Functional Green IS Strategy → IT Operations Data Center	0.10	0.97
Functional Green IS Strategy → IT Operations Office Environment	0.47	**3.76**
Functional Green IS Strategy → IT Disposal	0.28	**2.74**
Functional Green IS Strategy → Process Reengineering	0.29	**2.49**
Functional Green IS Strategy → Environmental Management Systems	0.35	**2.76**
Functional Green IS Strategy → Environmental Technologies	0.17	1.55
Actions (Green IT Practices and Green IS Practices) – Outcomes		
IT Sourcing → Corporate Reputation	-0.11	0.85
IT Sourcing → Cost Reduction	0.12	0.78
IT Sourcing → Green Innovation Capabilities	0.33	**2.77**
IT Operations Data Center → Corporate Reputation	0.07	0.64
IT Operations Data Center → Cost Reductions	0.18	**1.74**
IT Operations Data Center → Green Innovation Capabilities	-0.09	0.76
IT Operations Office Environment → Corporate Reputation	-0.04	0.29
IT Operations Office Environment → Cost Reductions	0.10	0.91
IT Operations Office Environment → Green Innovation Capabilities	-0.21	1.56
IT Disposal → Corporate Reputation	0.16	**1.75**
IT Disposal → Cost Reductions	0.12	1.23
IT Disposal → Green Innovation Capabilities	0.03	0.27
Process Reengineering → Corporate Reputation	0.25	**2.45**
Process Reengineering → Cost Reductions	0.10	0.84
Process Reengineering → Green Innovation Capabilities	0.07	0.41
Environmental Management Systems → Corporate Reputation	0.27	**2.79**
Environmental Management Systems → Cost Reductions	-0.14	1.32
Environmental Management Systems → Green Innovation Capabilities	0.27	**2.41**
Environmental Technologies → Corporate Reputation	0.17	**1.85**
Environmental Technologies → Cost Reductions	0.16	1.62
Environmental Technologies → Green Innovation Capabilities	0.19	**1.72**

Table 21: First-order Model R^2 Results.

Green IS Strategy		Green IT/IS Practices		Organizational Benefits	
Organizational Green IS Strategy	0.40	IT Sourcing	0.56	Corporate Reputation	039
Functional Green IS Strategy	0.28	IT Operations Data Center	0.33	Cost Reductions	0.24
		IT Operations Office Environment	0.43	Green Innovation Capabilities	0.30
		IT Disposal	0.13		
		Process Reengineering	0.46		
		Environmental Management Systems	0.50		
		Environmental Technologies	0.39		

Table 22: Power analysis results according to the methodology of Aguirre-Urreta and Rönkkö (2015).

Path	Parameter	R Simulation	Statistical power greater than 0.8 (n = 118)?
Environmental Orientation → Organizational Green IS Strategy	0.636	1.000	Yes
Environmental Orientation → Functional Green IS Strategy	0.531	1.000	Yes
Environmental Orientation → Green IT Practices	0.237	0.700	No
Environmental Orientation → Green IS Practices	0.263	1.000	Yes
Organizational Green IS Strategy → Green IT Practices	0.137	0.300	No
Organizational Green IS Strategy → Green IS Practices	0.321	1.000	Yes
Functional Green IS Strategy → Green IT Practices	0.468	1.000	Yes
Functional Green IS Strategy → Green IS Practices	0.326	1.000	Yes
Green IT Practices →Cost Reductions	0.412	0.800	Yes
Green IT Practices → Corporate Reputation	0.032	0.090	No
Green IT Practices → Green Innovation Capabilities	0.041	0.300	No
Green IS Practices → Cost Reductions	0.068	0.100	No
Green IS Practices → Corporate Reputation	0.572	1.000	Yes
Green IS Practices → Green Innovation Capabilities	0.459	1.000	Yes

Table 23: MANOVA results: Latent variable scores by organizational size.

Latent variable	Factor	F (4, 118)	P-value
Environmental Orientation (Reflective first-order construct)	Number of employees[1]	0.91	0.46
	Annual IT budget[2]	0.72	0.58
Green IS Strategy (Reflective-formative second-order construct)	Number of employees[1]	1.37	0.25
	Annual IT budget[2]	0.30	0.87
Organizational Green IS Strategy (Reflective first-order construct)	Number of employees[1]	0.94	0.44
	Annual IT budget[2]	0.16	0.966
Functional Green IS Strategy (Reflective first-order construct)	Number of employees[1]	1.60	0.18
	Annual IT budget[2]	0.59	0.67
Green IT Practices (Reflective-formative second-order construct)	Number of employees[1]	1.23	0.30
	Annual IT budget[2]	1.24	0.30
IT Disposal (Reflective first-order construct)	Number of employees[1]	0.43	0.78
	Annual IT budget[2]	1.48	0.21
IT Operations Data Center (Reflective first-order construct)	Number of employees[1]	0.64	0.63
	Annual IT budget[2]	1.14	0.34
IT Operations Office Environment (Reflective first-order construct)	Number of employees[1]	1.67	0.16
	Annual IT budget[2]	1.67	0.16
IT Sourcing (Reflective first-order construct)	Number of employees[1]	1.75	0.15
	Annual IT budget[2]	1.30	0.27
Green IS Practices (Reflective-formative second-order construct)	Number of employees[1]	1.43	0.23
	Annual IT budget[2]	1.08	0.37
Process Reengineering (Reflective first-order construct)	Number of employees[1]	0.99	0.42
	Annual IT budget[2]	0.69	0.60
Environmental Management Systems (Reflective first-order construct)	Number of employees[1]	1.89	0.12
	Annual IT budget[2]	0.79	0.54
Environmental Technologies (Reflective first-order construct)	Number of employees[1]	1.25	0.29
	Annual IT budget[2]	2.11	0.08
Organizational Benefits (Reflective-formative second-order construct)	Number of employees[1]	0.13	0.97
	Annual IT budget[2]	0.98	0.42
Corporate Reputation (Reflective first-order construct)	Number of employees[1]	0.65	0.63
	Annual IT budget[2]	0.73	0.57
Cost Reductions (Reflective first-order construct)	Number of employees[1]	0.27	0.90
	Annual IT budget[2]	0.50	0.74
Green Innovation Capabilities (Reflective first-order construct)	Number of employees[1]	0.47	0.76
	Annual IT budget[2]	2.07	0.09

[1] Ranking of variable (n): 251 to 1000 employees (47), 1001 to 5000 employees (29), 5001 to 25.000 employees (32), 25.001 to 100.000 employees (6), more than 100.000 employees (4).

[2] Ranking of variable (n): less than USD 1 million (15), USD 1 million to USD 5 million (42), USD 5 million to USD 25 million (24), USD 25 million to USD 100 million (25), more than USD 100 million (12).

REFERENCES OF APPENDICES

Banerjee, S. B. (2002) Corporate Environmentalism: The Construct and its Measurement. *Journal of Business Research*, **55** (3), 177–191.

Bharadwaj, S., Bharadwaj, A. & Bendoly, E. (2007) The Performance Effects of Complementarities Between Information Systems, Marketing, Manufacturing, and Supply Chain Processes. *Information Systems Research*, **18** (4), 437–453.

Bulchand-Gidumal, J. & Melián-González, S. (2011) Maximizing the positive influence of IT for improving organizational performance. *The Journal of Strategic Information Systems*, **20** (4), 461–478.

Chakravarty, A., Grewal, R. & Sambamurthy, V. (2013) Information Technology Competencies, Organizational Agility, and Firm Performance. *Information Systems Research*, **24** (4), 976–997.

Chang, C.-H. (2011) The Influence of Corporate Environmental Ethics on Competitive Advantage: The Mediation Role of Green Innovation. *Journal of Business Ethics*, **104** (3), 361–370.

Chen, A. J., Watson, R. T., Boudreau, M. C. & Karahanna, E. (2010) An Institutional Perspective on the Adoption of Green IS & Green IT. *Australasian Journal of Information Systems*, **17** (1), 23–45.

Chen, Y.-S. (2011) Green Organizational Identity: Sources and Consequence. *Management Decision*, **49** (3), 384–404.

Choi, B. & Lee, J.-N. (2012) Complementarities and Substitutabilities among Knowledge Sourcing Strategies and their Impact on Firm Performance. *Journal of the Association for Information Systems*, **13** (7), 498–545.

Christmann, P. (2000) Effects of Best Practices of Environmental Management on Cost Advantage: The Role of Complementary Assets. *Academy of Management Journal*, **43** (4), 663–680.

Coltman, T., Devinney, T. M. & Midgley, D. F. (2007) E-Business Strategy and Firm Performance: A Latent Class Assessment of the Drivers and Impediments to Success. *Journal of Information Technology*, **22** (2), 87–101.

Coltman, T., Devinney, T. M. & Midgley, D. F. (2011) Customer Relationship Management and Firm Performance. *Journal of Information Technology*, **26** (3), 205–219.

Henriques, I. & Sadorsky, P. (1999) The Relationship between Environmental Commitment and Managerial Perceptions of Stakeholder Importance. *Academy of Management Journal*, **42** (1), 87–99.

Karacaoglu, K. & Özkanli, Ö. (2011) Competitive Strategies of Turkish Manufacturing Enterprises: The Case of Kayseri. *International Business and Management*, **2** (2), 66–76.

Kearns, G. & Lederer, A. (2000) The Effect of Strategic Alignment on the Use of IS-based Resources for Competitive Advantage. *The Journal of Strategic Information Systems*, **9** (4), 265–293.

Kearns, G. S. & Sabherwal, R. (2007) Strategic Alignment Between Business and Information Technology: A Knowledge-Based View of Behaviors, Outcome, and Consequences. *Journal of Management Information Systems*, **23** (3), 129–162.

Keil, M., Rai, A. & Liu, S. (2013) How User Risk and Requirements Risk Moderate the Effects of Formal and Informal Control on the Process Performance of IT Projects. *European Journal of Information Systems*, **22** (6), 650–672.

Kettinger, W. J., Zhang, C. & Chang, K.-C. (2013) Research Note - A View from the Top: Integrated Information Delivery and Effective Information Use from the Senior Executive's Perspective. *Information Systems Research*, **24** (3), 842–860.

Kim, G., Shin, B., Kim, K. K. & Lee, H. G. (2011) IT Capabilities, Process-oriented Dynamic Capabilities, and Firm Financial Performance. *Journal of the Association for Information Systems*, **12** (7), 487–517.

Leidner, D. E., Lo, J. & Preston, D. (2011) An Empirical Investigation of the Relationship of IS Strategy with Firm Performance. *The Journal of Strategic Information Systems*, **20** (4), 419–437.

Loeser, F. (2013) Green IT and Green IS: Definition of Constructs and Overview of Current Practices. In: *Proceedings of the 19th Americas Conference on Information Systems (AMCIS)*, Chicago, USA.

Molla, A., Cooper, V. & Pittayachawan, S. (2009) IT and Eco-sustainability: Developing and Validating a Green IT Readiness Model. In: *Proceedings of the 30th International Conference on Information Systems (ICIS)*, Phoenix, USA.

Molla, A., Cooper, V. & Pittayachawan, S. (2011) The Green IT Readiness (G-Readiness) of Organizations: An Exploratory Analysis of a Construct and Instrument. *Communications of the AIS*, **29** (1), 67–96.

Paulraj, A. (2011) Understanding the Relationships between Internal Resources and Capabilities, Sustainable Supply Management and Organizational Sustainability. *Journal of Supply Chain Management*, **47** (1), 19–37.

Pavlou, P. A. & El Sawy, O. A. (2010) The “Third Hand”: IT-enabled Competitive Advantage in Turbulence through Improvisational Capabilities. *Information Systems Research*, **21** (3), 443–471.

Quaadgras, A., Weill, P. & Ross, J. W. (2014) Management Commitments that Maximize Business Impact from IT. *Journal of Information Technology*, **29** (2), 114–127.

Rai, A., Patnayakuni, R. & Seth, N. (2006) Firm Performance Impacts of Digitally Enabled Supply Chain Integration Capabilities. *MIS Quarterly*, **30** (2), 225–246.

Rivard, S., Raymond, L. & Verreault, D. (2006) Resource-Based View and Competitive Strategy: An Integrated Model of the Contribution of Information Technology to Firm Performance. *The Journal of Strategic Information Systems*, **15** (1), 29–50.

Setia, P., Venkatesh, V. & Joglekar, S. (2013) Leveraging Digital Technologies: How Information Quality Leads to Localized Capabilities and Customer Service Performance. *MIS Quarterly*, **37** (2), 565–590.

Shah, M. H., Braganza, A. & Morabito, V. (2007) A Survey of Critical Success Factors in Online Banking: An Organizational Perspective. *European Journal of Information Systems*, **16** (4), 511–524.

Sharma, S. (2000) Managerial Interpretations and Organizational Context as Predictors of Corporate Choice of Environmental Strategy. *Academy of Management Journal*, **43** (4), 681–697.

Tallon, P. P. & Pinsonneault, A. (2011) Competing Perspectives on the Link Between Strategic Information Technology Alignment and Organizational Agility: Insights from a Mediation Model. *MIS Quarterly*, **35** (2), 463–486.

Tallon, P. P. (2011) Value Chain Linkages and the Spillover Effects of Strategic Information Technology Alignment: A Process-Level View. *Journal of Management Information Systems*, **28** (3), 9–44.

Tanriverdi, H. (2005) Information Technology Relatedness, Knowledge Management Capability, and Performance of Multibusiness Firms. *MIS Quarterly*, **29** (2), 311–334.

Venkatraman, N. & Grant, J. H. (1986) Construct Measurement in Organizational Strategy Research: A Critique and Proposal. *The Academy of Management Review*, **11** (1), 71–87.

Wagner, M. (2003) *How does it Pay to be Green? An Analysis of the Relationship between Environmental and Economic Performance at the Firm Level and the Influence of Corporate Environmental Strategy Choice*. Tectum, Marburg.

Wang, E. T., Tai, J. C. & Grover, V. (2013) Examining the Relational Benefits of Improved Interfirm Information Processing Capability in Buyer-Supplier Dyads. *MIS Quarterly*, **37** (1), 149–173.

Wu, I.-L. & Hu, Y.-P. (2012) Examining Knowledge Management Enabled Performance for Hospital Professionals: A Dynamic Capability View and the Mediating Role of Process Capability. *Journal of the Association for Information Systems*, **13** (12), 976–999.

Wu, S. P.-J., Straub, D. & Liang, T.-P. (2015) How Information Technology Governance Mechanisms and Strategic Alignment Influence Organizational Performance. *MIS Quarterly*, **39** (2), 497–518.

Yayla, A. A. & Hu, Q. (2012) The Impact of IT-Business Strategic Alignment on Firm Performance in a Developing Country Setting: Exploring Moderating Roles of Environmental Uncertainty and Strategic Orientation. *European Journal of Information Systems*, **21** (4), 373–387.

Zhang, M., Sarker, S. & Sarker, S. (2008) Unpacking the Effect of IT Capability on the Performance of Export-Focused SEMs: A Report from China. *Information Systems Journal*, **18** (4), 357–380.

Zhang, M., Sarker, S. & Sarker, S. (2013) Drivers and Export Performance Impacts of IT Capability in 'Born-Global' Firms: A Cross-National Study. *Information Systems Journal*, **23** (5), 419–443.