Green IT/IS Adoption and Environmental Performance: The Synergistic Roles of IT–Business Strategic Alignment and Environmental Motivation

Abstract

Drawing on the resource-based view, this study investigates the interactive effects of green information technologies/systems (IT/IS) adoption, environmental motivation, and IT–business strategic alignment on organizations' perceived relative environmental performance. We use data from a field study of 587 firms in China to test our hypotheses. The results confirm that green IT/IS positively affects the perceived relative environmental performance of organizations and that the interaction of IT–business strategic alignment and environmental motivation positively moderates the relationship between green IT/IS adoption and organizations' perceived relative environmental performance. The theoretical and managerial implications of these findings are also discussed.

Keywords: Green IT; Green IS; Environmental Performance; IT–Business Strategic Alignment; Environmental Motivation

1 Introduction

As a result of numerous environmental incidents caused by business activities in recent decades [26, 30], the public is increasingly aware of and questioning organizations' environmental impacts [150]. Therefore, organizations' survival and profitability depend heavily on their environmental performance [22, 29, 71, 119]. In response, organizations are starting to focus on environmental preservation by integrating pro-environmental innovations and strategies into their daily operations [57]. These innovations and strategies, such as green supply chain management, energy informatics, and end-of-pipe control technologies [78, 79, 91, 99, 135], usually rely on information technology (IT) and information systems (IS) and thus are labeled "green IT/IS" [23, 96, 135]. Green IT/IS refers to organizational initiatives that reduce the environmental impact of IT-related activities and IT-enabled initiatives to improve the eco-sustainability of businesses and society [33, 51, 64][1].

Green IT/IS is peculiar among organizations' pro-environmental innovations and practices because of the paradoxical nexus of IT and environmental preservation [133]. Indeed,

[1]Green IT refers to an organization's initiatives to reduce the environmental impact of its IT-related activities [64], whereas green IS refers to an organization's IT-enabled initiatives to improve the overall eco-sustainability of businesses and society [33, 51]. Although green IT and green IS are different concepts, they are typically co-investigated in the literature [e.g., 45, 89]. Following this tradition, this study investigates both green IT and IS and labels them collectively "green IT/IS."

the IT industry is a notorious polluter [107], and IT-related activities have various environmental impacts. For example, a study in China found that a one-unit increase in IT use substantially increases soot and dust pollution and results in a several-unit increase in sulfur dioxide and wastewater pollution [37]. However, IT can also be harnessed for environmental preservation [17]. It can provide timely and high-quality information for energy preservation [56]. For example, United Parcel Service implemented an IS that optimizes truck dispatches and limits the environmental impact of its operations by reducing fuel consumption and the disposal of used vehicle parts in landfills [136].

The research community has also provided empirical proof that green IT/IS is an effective organizational tool for environmental preservation. Numerous studies have empirically demonstrated the positive relationship between green IT/IS adoption and organizations' environmental performance [e.g., 64, 92, 141]. However, most have ignored the potential impacts of the contingencies in the relationship between green IT/IS adoption and environmental performance. That is, empirical studies on the impact of green IT/IS have implicitly assumed that green IT/IS exerts its effects in a vacuum. However, that could not be further from the truth. No policy or IT innovation operates in a vacuum. For example, the effectiveness of an organization's green logistics management in enhancing its environmental performance depends on the environmental regulatory pressure experienced by the organization [82]. Green IT/IS is no exception. Not all organizations are equally capable of reaping the potential benefits of green IT/IS [140]. Therefore, it is important to identify the contingencies that affect an organization's ability to utilize green IT/IS to achieve competitive environmental performance. This motivates this study's first research question: *What are the contingencies in the relationship between green IT/IS adoption and environmental performance?*

The contingencies that affect an organization's ability to use green IT/IS to achieve competitive environmental performance might originate from the interactions between green IT/IS and contextual factors, for example, the external environment or the organization's internal context [32, 115, 131]. Moreover, how these contingencies might affect the relationship between green IT/IS adoption and an organization's environmental performance beyond directly moderating the relationship is unknown. The literature has shown that an organization's contextual factors interact with each other and affect the outcomes of its pro-environmental initiatives [e.g., 127, 148]. This effect may also hold in the green IT/IS context. Therefore, three-way interactions between green IT/IS adoption and the contingencies related to an organization's contextual factors may affect the organization's environmental performance. This motivates this study's second research question: *How do these contingencies intervene in the relationship between green IT/IS adoption and environmental performance?*

For parsimony, we focus on organizations' internal contexts rather than environmental

factors. As organizational contexts are more manipulable than environmental factors, understanding the effects of organizational contexts leads to practical insights that managers can use to prepare their organizations to effectively use green IT/IS. Therefore, we use the resource-based view (RBV), which investigates an organization's internal sources of competitive advantages [73], to examine our two research questions. Specifically, we adopt the complementary resource view proposed by Ennen and Richter [58] in the later development of the RBV. It proposes that two types of complementary organizational resources—IT and non-IT—interact with IT resources to harness their value [17, 130]. Drawing on the literature [75, 76, 100, 111, 126], we examine IT–business strategic alignment and environmental motivation as complementary IT and non-IT resources, respectively.

The remainder of this paper is organized as follows. Section 2 reviews the relevant green IT/IS literature and discusses the theoretical background. Section 3 presents the research model and corresponding hypotheses. Section 4 describes the research design, data collection, and survey instruments. Section 5 presents the results of the data analysis. Section 6 discusses the results and their theoretical and managerial implications. Section 7 presents our conclusions, the study's limitations, and future research directions.

2 Literature Review and Theoretical Background

2.1 Literature on the Relationship Between Green IT/IS and Environmental Performance

To provide background for our study, we reviewed the empirical studies on how green IT/IS contributes to the environmental performance of organizations. This review is by no means exhaustive but serves as a representative summary of the relevant literature.

Among the reviewed studies, the RBV is the most frequently used theoretical framework, followed by the belief–action–outcome framework and task–technology fit model. Most of the studies that have adopted the RBV as their theoretical framework have treated green IT/IS as a unidimensional construct [92, 97, 98, 116, 133]. For example, Meacham, Toms, Green and Bhadauria [92] found that as a critical organizational resource, information sharing between the supply chain partners of US manufacturing organizations improves their environmental performance through the mediation of green IT/IS adoption. Ryoo and Koo [116] used the construct named green practices–IS alignment as a proxy of green IT/IS and found that it improves environmental performance via the mediation of two critical organizational resources: green manufacturing practices and marketing coordination. Wang, Chen and Benitez-Amado [133] used IT–environmental management integration as a proxy of green IT/IS and found that IT–environmental management integration is co-determined by two key organizational resources, i.e., IT competence and environmental orientation, and that it helps improve environmental performance. Nanath and Pillai [97] found that beyond improving an organization's environmental performance, green IT/IS adoption also improves an organization's competitive advantages. Specifically, they found that as an organizational resource, green IT/IS adoption improves organizational performance by reducing the environmental impacts of its products and business processes, which, in turn, provides competitive advantages. Finally, Ojo, Tan and Alias [98] found that as an organizational resource, green human resources practices lead to employees' green IT/IS use, improving the organization's environmental performance.

Some studies that have adopted the RBV treat green IT/IS as an umbrella term covering multiple constructs. For example, Chuang and Huang [40] used three independent constructs, i.e., green IT human, structural, and relational capital, to represent the concept of green IT/IS. They found that as organizational resources, green IT human, structural, and relational capital improve an organization's environmental performance and business competitiveness. Anthony Jr [3] used pollution prevention, product stewardship, and clean development enabled by green IS as proxies of green IT/IS and found that these practices can help organizations improve their environmental performance. However, these studies have not investigated contingencies that might contribute to the effect of green IT/IS, as an organizational resource, on an organization's

environmental performance.

As mentioned, many of the reviewed studies adopted the belief–action–outcome framework as their theoretical framework. Two of these studies operationalized green IT/IS as three distinct constructs enabled by green IT/IS: pollution prevention, product stewardship, and sustainable development. These constructs represent the types of environmental preservation actions taken by organizations. In particular, sustainable development enabled by green IT/IS was operationalized as the virtualization of business processes to reduce environmental impacts in these studies. For example, Gholami, Sulaiman, Ramayah and Molla [64] found that such environmental preservation actions are triggered by beliefs about environmental preservation, i.e., attitudes and consequences, and lead to improved environmental performance. However, although sustainable development enabled by green IT/IS led to improved environmental performance, product stewardship and pollution prevention enabled by green IT/IS did not have the same impact. Baggia, Maletič, Žnidaršič and Brezavšček [9] found that pollution prevention, product stewardship, and sustainable development are triggered by an organization's environmental strategy and attitude toward green IT/IS. They also found that among these environmental preservation actions, only pollution prevention and sustainable development enabled by green IT/IS lead to improved environmental performance, whereas product stewardship enabled by green IT/IS does not. Instead of operationalizing pollution prevention, product stewardship, and sustainable development enabled by green IT/IS as separate constructs, Yang, Sun, Zhang, Wang and Cao [141] operationalized them into a multidimensional construct that represents green IT/IS adoption. They found that as an environmental preservation action, green IT/IS contributes positively to organizations' environmental performance and green image. Finally, Loeser, Recker, Brocke, Molla and Zarnekow [89] separated green IT from green IS and found that both are triggered by an organization's environmental orientation and green IS strategy. They also found that green IT leads to cost reductions, whereas green IS improves an organization's reputation and green innovation capabilities.

One study used the task–technology fit model as its underlying theoretical framework. Yang, Sun, Zhang and Wang [140] found that the fit between green IT/IS and green supply chain management (SCM) efforts helps an organization improve its economic, environmental, and social performance. Another study that did not adopt any theoretical framework, Singh and Sharma [121], found that green IT/IS adoption leads to improved green brand image, competitive advantage, and sustainable development.

In sum, these studies have provided important evidence of the contributions of green IT/IS to improve the environmental performance of organizations. However, except for the study by Yang, Sun, Zhang and Wang [140], none has examined potential contingencies of

organizational context that might influence the effect of green IT/IS on environmental performance. That is, the literature on the effects of green IT/IS on organizations' environmental performance does not sufficiently answer this study's research questions. Thus, this study contributes to the literature by incorporating complementary organizational resources into its investigation of the effects of green IT/IS on environmental performance. Table 1 presents exemplary studies from the IS literature from 2013 to 2022.

Table 1. Review of the literature on the relationship between green IT/IS and environmental performance

Theorical Framework	Study	Conceptualization of Green IT/IS	Methodology	Contingencies in the Relationship Between Green IT/IS and Environmental Performance	Key Findings
Belief–action–outcome framework	Yang, Sun, Zhang, Wang and Cao [141]	Unidimensional construct	Online and onsite surveys of managers from 208 and 76 organizations in China and the United States, respectively	Not investigated	Green IT/IS adoption and employees' motivation to adopt green IT/IS contribute positively to organizations' environmental performance and green image. The effects are similar for the samples from China and the United States.
	Loeser, Recker, Brocke, Molla and Zarnekow [89]	1) Green IT 2) Green IS	Online survey of IT executives from 118 large organizations in the United States, Canada, Germany, Australia, and New Zealand		Green IS strategy is the antecedent of both green IT and green IS. However, green IT only leads to cost reduction, but green IS leads to improved corporate reputation and green innovation capabilities.
	Gholami, Sulaiman, Ramayah and Molla [64]	1) Pollution prevention enabled by green IT/IS 2) Product stewardship enabled by green IT/IS 3) Sustainable development enabled by green IT/IS	Survey of senior managers from 405 organizations in Malaysia		Sustainable development enabled by green IT/IS leads to high environmental performance. However, product stewardship and pollution prevention enabled by green IT/IS negatively or insignificantly affect the environmental performance of organizations.
	Baggia, Maletič, Žnidaršič and Brezavšček [9]		Survey of IT executives from 156 SMEs in Slovenia		Pollution prevention and sustainable development enabled by green IT/IS lead to better environmental performance, but product stewardship does not. Pollution prevention, product stewardship, and sustainable development enabled by green IT/IS are determined by an organization's environmental strategy and attitude toward green IT/IS.
Resource-based view	Ryoo and Koo [116]	Unidimensional construct	Survey of senior managers from 77 manufacturing organizations in South Korea	Not investigated	Green IT/IS indirectly affects environmental performance through the mediation of green practices–manufacturing coordination and green practices–marketing coordination. Moreover, an organization's environmental performance contributes to its economic performance.
	Meacham, Toms, Green and Bhadauria [92]		Online survey of plant-level managers from 159 manufacturing organizations in the United		Information sharing affects green IT/IS adoption, and information sharing and green IT/IS positively affect environmental performance.

			States		
	Wang, Chen and Benitez-Amado [133]		Matched survey of senior managers and IT executives from 151 manufacturing organizations in Northern China		IT competence determines the green IT/IS adoption of organizations, and environmental orientation moderates this relationship. Moreover, green IT/IS leads to improved environmental performance by organizations.
	Nanath and Pillai [97]		Survey of managers from 144 IT services and manufacturing organizations in India		Green IT/IS adoption leads to improved organizational performance in reducing the environmental impacts of products and business processes, which, in turn, leads to competitive advantages.
	Ojo, Tan and Alias [98]		Survey of managers from 333 ISO 14001-certified organizations in Malaysia		Green recruitment and selection, green training and development, green performance management, green rewards and compensation, green empowerment, and participation determine the green IT/IS adoption of organizations. Moreover, green IT/IS leads to improved environmental performance.
	Chuang and Huang [40]	1) Green IT human capital 2) Green IT structural capital 3) Green IT relational capital	Online survey of IT managers from 358 manufacturing organizations in Taiwan		Organizations' environmental corporate social responsibility determines their green IT human, structural, and relational capital. However, only green IT structural and relational capital improve environmental performance and business competitiveness. Moreover, environmental performance contributes to organizations' business competitiveness.
	Anthony Jr [3]	1) Pollution prevention enabled by green IT/IS 2) Product stewardship enabled by green IT/IS 3) Sustainable development enabled by green IT/IS	Survey of IT personnel from 133 organizations in Malaysia		Pollution prevention, product stewardship, and sustainable development enabled by green IT/IS lead to improved environmental performance by organizations. Moreover, institutional pressure, organizational strategy, and IT infrastructure also contribute to improved environmental performance.
Task-technology fit model	Yang, Sun, Zhang and Wang [140]	Unidimensional construct	Survey of supply chain managers from 311 and 105 organizations in China and the United States, respectively	Fit with green SCM	The fit between green IT/IS and green SCM efforts helps an organization achieve superior economic, environmental, and social performance through both mediating and moderating effects. The effects hold for the samples from both China and the United States.
Not available	Singh and Sharma [121]	Unidimensional construct	Survey of employees from 600 IT organizations in India	Not investigated	Green IT/IS leads to improved competitive advantage, green brand image, and sustainable development.

2.2 RBV and Information Systems

This section briefly reviews the RBV, on which our research model is based. As mentioned, investigating how an organization's internal context contributes to its environmental performance can generate more actionable managerial insights than investigating the external environment because internal contexts are more manipulable than the external environment [11]. Therefore, the RBV is a suitable theoretical framework for an exploration of how contingencies originating from an organization's internal context affect its environmental performance [80] because it posits that an organization's performance and competitive advantages are determined by its key strategic resources [14, 115, 137]. Strategic resources are tangible or intangible assets and capabilities that organizations use to generate value, such as making sense of and reacting to opportunities and threats in the operating environment [17]. Organizations acquire sustainable competitive advantages when their strategic resources have all of the VRIO framework characteristics: valuable, rare, inimitable, and organized to exploit [12, 77].

Taking IT and IS as key strategic resources, IS researchers have often used the RBV as a theoretical lens through which to examine the business value of IT [93, 139, 145]. However, as IT and IS are commercially available and competitors can easily acquire them from the market, they are unlikely to generate sustainable competitive advantages by themselves even though they add value to an organization [11, 67]. In other words, IT and IS alone lack rarity and inimitability and are not organized to exploit. Clemons and Kimbrough [42] and Clemons and Row [43] have supported this claim. They found that IT and IS supported by complementary organizational resources can be valuable, rare, inimitable, and organized to exploit and lead to sustained performance improvement [44, 105]. In addition, Grover, Chiang, Liang and Zhang [67] found that an organization's IT maturity, business orientation, and decision-making culture can make big data analytics valuable, rare, inimitable, and organized to exploit and thus generate sustainable competitive advantages. Beard and Sumner [16] obtained similar findings. Complementary organizational resources for IS can be tangible or intangible [58, 93]. Two types of complementary organizational resources have been suggested in the literature: non-IT and IT [17]. Investigating how these two types of complementary organizational resources interact with green IT/IS will help answer our research questions by identifying the contingencies that affect the relationship between green IT/IS adoption and environmental performance and how those contingencies exert their effects.

As noted in the literature review, the RBV is the most widely used theory in the green IT/IS literature [6, 59]. However, resources that complement green IT/IS and how they support it in improving environmental performance have seldom been empirically investigated because the VRIO concept has received little attention in the green IT/IS literature. Nevertheless, the

unexpected findings of Gholami, Sulaiman, Ramayah and Molla [64] indirectly supported the importance of VRIO in the impact of green IT/IS on environmental performance. As mentioned previously, they found that of the three categories of green IT/IS adoption studied, only the virtualization of business processes via green IT/IS, or in the authors' words, green IS adoption for sustainable development, positively affects environmental performance. The other categories of green IT/IS initiatives that mainly involve installing software for various pro-environmental purposes do not. As such software is available in the market and can easily be acquired by competitors, these green IT/IS initiatives lack rarity and inimitability. Thus, the nonsignificant or negative relationship between these two green IT/IS categories and competitive environmental performance was not surprising.

In contrast, the virtualization of business processes via green IT/IS depends less on software than on an organization's complementary resources, such as its culture and the behavior and experience of its members. Consequently, these green IT/IS initiatives are more likely to be rare and inimitable and thus to lead to competitive environmental performance. Therefore, it is necessary to incorporate VRIO into the study of green IT/IS and empirically investigate how complementary resources enable the incorporation of VRIO characteristics into green IT/IS and lead to competitive environmental performance.

We selected environmental motivation and IT–business strategic alignment as complementary non-IT and IT resources, respectively, and investigated their moderating effects on the influence of green IT/IS on environmental performance. For parsimony, we considered only one of each type of complementary resource, although other complementary resources may enable the incorporation of VRIO attributes into green IT/IS [2, 45]. Moreover, we chose these two resources because they match the two unique characteristics of green IT/IS: pro-environmental practices and IS initiatives.

Environmental motivation refers to an organization's utilitarian motive to adopt pro-environmental practices [111, 126]. We selected this as the complementary non-IT resource because it has been found to be critical to the integration of environmental management practices into daily operations [86, 126]. Therefore, we believe that environmental motivation can also facilitate the integration of green IT/IS, as a type of environmental management practice, into an organization's business processes and enable the integration of VRIO attributes into green IT/IS.

IT–business strategic alignment refers to the extent to which an organization's IT plan aligns with its business strategy [76]. We selected this as the complementary IT resource because IT–business strategic alignment has been found to be critical in using IT or IS to generate competitive advantages [62, 75]. It can facilitate the planning and implementation of IT projects and lead to sustained competitive performance [76, 110]. Moreover, IT–business

strategic alignment is crucial for small and medium-sized enterprises (SMEs) that normally lack capital and natural resources, as it allows them to substitute other resources by harnessing the potential of IS [108, 109]. As SMEs account for over 90% of enterprises in China [149], IT–business strategic alignment is particularly important in this study's context.

3 Hypothesis Development

3.1 Relationship Between Green IT/IS and Environmental Performance

The RBV posits that valuable organizational resources can help organizations generate competitive advantages because they can be used to neutralize threats and exploit opportunities [11, 65]. Following this rationale, green IT/IS can help organizations improve their environmental performance because it can be used to neutralize environmental threats and exploit opportunities to protect the environment.

Organizations can use green IT/IS to neutralize threats by limiting the environmental impact of their IT or IT-related activities [83]. For example, organizations can use server virtualization and thin clients to reduce the energy consumption of their servers and workstations [25]. Moreover, green IT/IS can add value by minimizing the environmental impact of other organizational activities [81]. For example, telecommuting, document sharing, and collaboration technologies can reduce paperwork and commuting time [46].

Moreover, organizations can use green IT/IS to implement pro-environmental policies and practices [64]. For example, organizations can install systems that make upstream and downstream supply chain management more environmentally friendly, improving the effectiveness of their product stewardship policies [140]. However, without green IT/IS, organizations cannot exploit opportunities to implement product stewardship. Therefore, we posit the following hypothesis:

H1: *Green IT/IS adoption positively affects the perceived relative environmental performance of organizations.*

As discussed, green IT/IS is a valuable organizational resource that increases the likelihood that an organization will generate competitive advantages through its environmental performance. However, these competitive advantages may not last long if the other essential elements proposed in the RBV—rarity, inimitability, and being organized to exploit—are lacking in the green IT/IS adopted [16]. These essential elements might not be present in every organization that adopts green IT/IS. First, green IT/IS is not inherently rare and inimitable. Although the adoption rate of green IT/IS across organizations is quite low [36], most such initiatives, such as software for supply chain management and telecommunications, energy-efficient IT hardware, and online collaboration tools, are commercially available and can be purchased easily. That is, competitors can easily acquire the same green IT/IS adopted by the focal organization. Second, organizations may not be organized in a way that allows them to fully exploit the competitive potential of green IT/IS. As green IT/IS includes a range of IS-enabled pro-environmental practices and tools, not all of which are inter-related [84], it is inherently not organized to exploit.

In contrast, although green IT/IS alone is not rare, inimitable, or organized to exploit, green IT/IS supported by complementary resources is. That is, if specific resources complement green IT/IS, their combination is valuable, rare, inimitable, and organized to exploit [11, 67, 93], which helps the focal organization achieve sustainable environmental performance.

As a complementary non-IT resource, environmental motivation can be combined with green IT/IS to create a rare and inimitable resource. Environmental motivation can help cultivate a supportive climate for the implementation of green IT/IS. First, environmental motivation can provide the resources needed to support the implementation of green IT/IS. Environmental motivation reflects an organization's financial and other reasons for pursuing pro-environmental practices [31]. Therefore, a high level of environmental motivation implies that environmental sustainability is at the core of an organization's business strategy [138]. Organizational resources are allocated according to an organization's strategic emphasis [61]. Therefore, when environmental sustainability is included in an organization's business strategy, organizational leaders are likely to allocate substantial resources to practices and activities related to environmental protection [129], and such resources can support the implementation of green IT/IS.

Second, environmental motivation stimulates organization members' support for green IT/IS. Beyond a strategic emphasis on environmental sustainability, environmental motivation indicates organization leaders' support of and devotion to environmental preservation [87]. Moreover, organization members' behaviors are guided by the attitudes of their leaders [7, 74]. Therefore, environmental motivation should align organization members' actions with the principles of environmental preservation [15]. Hence, organization members are more likely to support and engage with the implementation of green IT/IS. Environmental motivation also provides a pragmatic and utilitarian perspective on green IT/IS adoption [48, 68], as it refers to an organization's utilitarian motive to adopt pro-environmental practices [111, 126]. Therefore, environmental motivation provides the legitimacy required for implementing green IT/IS, generating the necessary support and engagement of organization members [28].

Although competitors can easily copy an organization's green IT/IS initiatives, green IT/IS complemented by a supportive climate is rare, inimitable, valuable, and unlikely to be acquired by competitors. In particular, green IT/IS implementation usually requires employees and organization members to change their work routines, which creates tremendous resistance in most organizations [128]. However, environmental motivation can help overcome such resistance by ensuring sustained effort by organization members and resources for green IT/IS adoption [106]. Hence, we posit the following hypothesis.

H2: *Environmental motivation positively moderates the effects of green IT/IS adoption on the perceived relative environmental performance of organizations.*

IT–business strategic alignment, as a complementary IT resource, can make green IT/IS adoption rare and inimitable, helping the focal organization to stand out from its competitors on environmental performance. First, although an organization's competitors can easily acquire green IT/IS initiatives, the combination of green IT/IS with an appropriate IT governance mechanism is rare. IT–business strategic alignment enables organizations to design appropriate IT governance mechanisms through the combined efforts of IT and business executives, ensuring excellent IT–business fit and generating value from IT [75, 113]. Therefore, IT–business strategic alignment ensures that green IT/IS initiatives are integrated into business processes and create value for the business [49].

Second, expertise and experience effectively using green IT/IS can be rare and inimitable because not all organizations can develop that expertise and experience [45]. IT–business strategic alignment ensures frequent interactions between IT personnel and top managers, creating greater awareness among organization members of the green IT/IS adopted, which in turn promotes the development of expertise and experience with green IT/IS [75, 76].

Third, IT–business strategic alignment enables the coevolution of green IT/IS and business strategies and green IT/IS and business processes [34, 63]. Consequently, IT strategies related to green IT/IS are more likely to be integrated into an organization's goals, activities, requirements, and business strategies [47]. Such integration is rare and somewhat difficult for competitors to imitate. In summary, IT–business strategic alignment can help organizations extend, improve, and effectuate the adoption of green IT/IS, making it rare and inimitable [133]. Thus, we posit the following hypothesis.

H3: *IT–business strategic alignment positively moderates the effects of green IT/IS adoption on the perceived relative environmental performance of organizations.*

The last element in the VRIO framework of the RBV, organized to exploit, refers to whether an organization can effectively and efficiently exploit the full potential of green IT/IS [16]. Although either environmental motivation or IT–business strategic alignment can make green IT/IS rare and inimitable, making an organization organized to exploit the potential of green IT/IS adopted requires a combination of environmental motivation and IT–business strategic alignment.

First, green IT/IS is a hybrid of pro-environmental practices and IT initiatives [95]. Therefore, an organization needs complementary resources for both pro-environmental practices and IT initiatives to fully exploit the potential of green IT/IS. As a pro-environmental practice, embedding green IT/IS into an organization may require strictly following sustainable environmental strategies (Banerjee, 2001). In contrast, embedding green IT/IS as an IT initiative requires high-level IT capabilities [4]. A lack of complementary resources for pro-environmental practices or IT initiatives would render an organization unable to fully exploit

the potential of green IT/IS with respect to the characteristics of pro-environmental practices and IT initiatives. Therefore, synergy between IT–business strategic alignment and environmental motivation is important.

Second, as hypothesized, IT–business strategic alignment ensures that the implemented green IT/IS fits an organization's business strategy. However, the effect of such fit may be limited to the strategic or top management level [49]. Hence, to embed green IT/IS into an organization and harness its full potential, it should be assimilated at the operational level and broadly supported by the organization's members as an organizational resource [139]. Environmental motivation can fill this gap by stimulating support for the adopted green IT/IS [28] and promoting its assimilation at every level, fully embedding it in the organization. Therefore, we propose the following hypothesis.

H4: *Environmental motivation positively moderates the moderating effects of IT–business strategic alignment on the relationship between green IT/IS adoption and perceived relative environmental performance of organizations such that the effect is stronger when both environmental motivation and IT–business strategic alignment are high.*

Following the literature, we controlled for the following variables linked to organizations' environmental performance: export orientation, financial status, size, age, environmental management practices, ownership, location, and industry. We controlled for export orientation because international environmental standards are higher than those in China [142]; therefore, the environmental standards of importing countries may influence the environmental management practices of exporting organizations and thus affect their environmental performance [120]. We controlled for financial status because organizations with good financial performance have resources to invest in pro-environmental practices [24, 142]. We specify size as a control variable because the literature has shown that size determines an organization's environmental performance [e.g., 123, 124, 146]. We also specify age as a control variable because studies have found that the older an organization is, the more likely it is to possess the necessary infrastructure for efficient environmental management [50, 94]. In addition, we controlled for environmental management practices because studies have shown that an organization's environmental management practices affect its environmental performance [8, 144]. We also controlled for ownership because the interests of the dominant shareholder may affect an organization's environmental management practices and performance [55, 132]. Location was also controlled because government monitoring may vary by region [142]. Last, we controlled for industry because industry-specific characteristics may have different effects on environmental performance [70]. Figure 1 shows the research model.

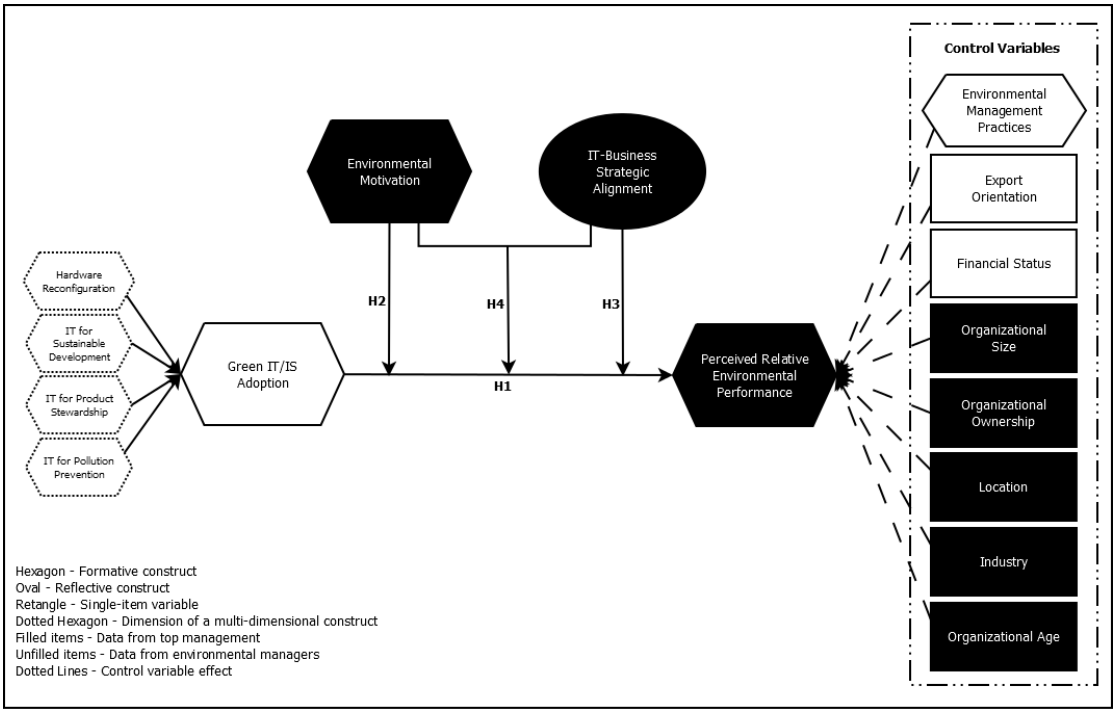

Figure 1. The research model

4 Research Methodology

4.1 Survey Instrument

4.1.1 Research Constructs

Table A2 provides the formal definitions of the constructs. Wherever possible, we adopted their measurement scales from the literature. All of the constructs were measured using multiple items and a 7-point Likert scale unless otherwise specified (1 = *strongly disagree* to 7 = *strongly agree*). IT–business strategic alignment was measured using a 3-item scale adopted from Kearns and Sabherwal [76]. A sample item is "IT managers regularly attend business meetings." Green IT/IS adoption was measured using a 13-item scale adapted from the literature with slight modifications [141]. It was operationalized as a multidimensional construct, and the details are shown in Table A1 of the Appendix. Perceived relative environmental performance was measured using an 8-item scale adopted from Lo, Egri and Ralston [88]. A sample item is "Relative to most other enterprises in China, my company uses relatively little energy." Environmental motivation was measured using a 6-item scale adopted from Tang, Li, Fryxell and Lo [126]. A sample item is "My company can improve its reputation by adopting better environmental protection measures." All of the research constructs were formative except IT–business strategic alignment, which was a reflective construct [27].

4.1.2 Control Variables

Environmental management practices were measured using a formative 16-item scale adopted from Yee, Lo and Tang [142]. The scale assessed the environmental management practices of organizations by asking the respondents whether their organization's business model included 16 pro-environmental practices. A sample item is "Setting environmental performance objectives is a part of our annual business plan."

The remaining control variables were operationalized as single-item variables. The measurement scales for export orientation and financial status were adopted from Yee, Lo and Tang [142]. Export orientation was measured using the respondents' answers about the proportion of their organizations' exports, and financial status was measured using the respondents' answers about their organizations' current yearly profit. Following Zhu, Kraemer and Xu [151], we measured organizational size as the number of employees. Organizational age was measured as the number of years since the organization was founded [117]. Last, organizational ownership, location, and industry were measured as single factual items [41]. Ownership indicates whether the organization is state-owned, non-state-owned, wholly foreign-owned, a joint venture, or privately owned. Location indicates the location of the focal organization's manufacturing facilities. Last, industry indicates the sector to which the focal organization belongs.

4.2 Data Collection

We tested the research hypotheses using survey data from manufacturing companies in Beijing and Shanghai, China. The data were collected in China because it is the world's manufacturing hub and one of the most polluting and energy-consuming countries [122]. How China tackles its current environmental pollution issues could significantly affect the world's future environmental sustainability [133]. Moreover, manufacturers in China are likely to use green IT/IS for environmental preservation [141]. Therefore, we considered China a suitable context for this study. We chose Beijing and Shanghai as the focal manufacturing cities because among China's 30 provincial regions, Beijing and Shanghai are two of the five provincial regions in which over half of the manufacturers are heavily polluting [147]. Shanghai is also a major manufacturing hub in China [85].

As the data were cross-sectional and self-reported, we collected data from two sources, environmental managers and top management, to avoid common method bias (CMB) [102, 103, 134]. The data on green IT/IS adoption, export orientation, financial status, and environmental management practices were collected from the environmental managers. The data on environmental performance, IT–business strategic alignment, and environmental motivation were collected from top management. We designed and developed a questionnaire in English that was reviewed for content and face validity by a panel of four researchers/academics. As the questionnaire was to be administered in Chinese, we first translated it to Chinese and then back translated it to English to ensure translational equivalence. A few minor changes were made to the questionnaire's wording following the panel's suggestions.

The Beijing Municipal Research Institute of Environmental Protection assisted in distributing the questionnaires to key informants in the targeted organizations (i.e., environmental and top managers with the following job titles: Environmental Affairs Manager, Environmental Department Manager, HR Manager, IT Manager, CEO, Chief Information Officer, Chief Operating Officer, Vice President, and General Manager) in 2015 (see Table A3). After three rounds of follow-up, 587 matched responses were received, representing a response rate of 49.7%, which is comparable to that of previous surveys conducted in enterprises in China [41, 90, 143]. Most of the surveyed organizations were non-state-owned (82.6%). State-owned, wholly foreign-owned, joint ventures, and private enterprises accounted for 5.6%, 5.5%, 3.9%, and 2.4%, respectively. Moreover, most of the surveyed organizations were young, with 38.5% of them in operation for 5–10 years. In addition, 14.5%, 27.6%, 10.1%, 2.2%, and 7.2% of the organizations had been in operation for less than 5 years, 11–15 years, 16–20 years, 21–25 years, and more than 25 years, respectively. The distribution of organizational age was unsurprising because the average organization in China is relatively young, 2.5 and 7.5 years for SMEs and large corporations, respectively [10, 125]. Almost all of the surveyed

organizations were manufacturers, and 74.6% and 14.0% were located in industrial and commercial–industrial mixed areas, respectively. The remaining organizations were located in commercial areas, residential–industrial mixed areas, residential–commercial mixed areas, and residential–commercial–industrial mixed areas. In terms of organization size, 42.6% of the surveyed organizations had fewer than 100 employees, 45.0% had 100–499 employees, 9.4% had 500−999 employees, and 3.1% had 1,000 or more employees. The distribution of organizational size was also unsurprising because SMEs with less than 500 employees account for over 90% of Chinese enterprises [149].

We followed Armstrong and Overton [5] and compared the first and last thirds of the respondents' data to evaluate nonresponse bias. As no significant differences were found, we concluded that nonresponse bias was not a serious concern.

4.3 Common Method Bias

We performed the following procedures to mitigate CMB [102, 104]: improving the scale items, protecting the respondents' identities and reducing their evaluation apprehension, and acquiring the variable measures from different sources.

We improved the scale items by reducing their ambiguity to avoid double-barreled questions, define unfamiliar or ambiguous terms, and avoid complex syntax. The respondents were assured of their anonymity in the questionnaire cover letter. We also informed the respondents that there were no right or wrong answers to reduce any evaluation apprehension. Last, the data were collected from two sources: environmental managers and top management.

A formative measurement model is unlikely to suffer from CMB [114], and as most of the research constructs are formative, we concluded that CMB was not a serious concern.

5 Analysis and Results

Following recent IS studies that adopted partial least squares (PLS) [19, 72, 118], we used ADANCO 2.3.1 for the PLS path modeling in our data analysis. PLS path modeling has several advantages as a structural equation modeling (SEM) approach over the alternative approach of covariance-based SEM (CB-SEM). First, PLS-SEM can handle both formative and reflective measurement models, whereas CB-SEM can only handle reflective measurement models [72, 114]. As our research model included multiple formative constructs, PLS-SEM was the appropriate choice. Second, relative to CB-SEM, PLS-SEM yields better estimates of relatively complex models, such as those with multidimensional constructs [69, 72]. As our primary research construct, green IT/IS adoption, was multidimensional, PLS-SEM could better estimate our research model than its counterpart. Third, PLS-SEM is preferred when newly developed measurement scales are used [114]. As the measurement scale of green IT/IS adoption is quite new, PLS-SEM was thus preferable. Fourth, unlike CB-SEM, PLS-SEM does not restrict the use of single-item measures [112]. As our research model contains several control variables measured by single factual items, PLS-SEM was more appropriate for this study than CB-SEM.

5.1 Measurement Model Validity

Environmental motivation and environmental performance are formative first-order constructs, whereas green IT/IS adoption is a composite second-order construct. We assessed multicollinearity, weights, loadings, and the corresponding significance to evaluate the composite constructs at the first- and second-order levels [18, 19].

Multicollinearity among our indicators/dimensions was evaluated by estimating their variance inflation factors, which ranged from 1.000 to 2.114. As they were all below 3.3, which is the cutoff for assessing multicollinearity [52], multicollinearity was not a serious concern. We used regression weights (mode B) to estimate all of the model's constructs [20].

A bootstrap analysis with 2,000 subsamples was conducted to test the loadings and weights of the constructs (see Table A4 of the Appendix). Although some indicators had nonsignificant weights and loadings, we retained these composite indicators to maintain our conceptualization and understanding of the concept (i.e., to preserve content validity) [19].

Green IT/IS adoption is a multidimensional construct estimated using a two-step approach [39]. In the first step, all of the first-order constructs were freely correlated to obtain the latent variable scores of the dimensions. In the second step, we used the latent variable scores to measure the multidimensional construct (i.e., green IT/IS adoption) [18].

Last, the external validity of all of the constructs was tested via confirmatory composite analysis of the saturated model [18, 19]. Confirmatory composite analysis tests whether a composite model is adequate by estimating the differences between the empirical correlation

matrix and the model-implied correlation matrix of the saturated model. The smaller the difference, the better the fit [19]. Table 2 shows the results for the first- and second-order models. Both models were supported on the basis of an alpha of 0.05 because all of the discrepancies were below the 95% quantile of the bootstrap discrepancies. Therefore, the results empirically supported the composite structures at the first- and second-order levels. In summary, the proposed model had satisfactory measurement properties, which enabled us to proceed with the structural model assessment.

Table 2. Results of the confirmatory composite analysis (saturated model)

Discrepancy	First-order Constructs				Second-order Constructs			
	Value	HI_{95}	HI_{99}	Conclusion	Value	HI_{95}	HI_{99}	Conclusion
SRMR	0.041	0.040	0.043	Supported	0.018	0.025	0.027	Supported
d_{ULS}	3.738	3.720	4.151	Supported	0.037	0.073	0.090	Supported
d_G	0.760	109.530	125.300	Supported	0.007	0.015	0.018	Supported

Note. SRMR = standardized root-mean-squared residual; d_{ULS} = discrepancy; d_G = geodesic discrepancy

All of the constructs were formative except IT–business strategic alignment. Cronbach's α and the average variance extracted (AVE) of IT–business strategic alignment were 0.750 and 0.799, which were above the commonly used cutoffs of 0.7 and 0.5 [60], respectively. However, no other Cronbach's α or AVE could be generated because the other research constructs were formative. The validity of the research constructs was assessed by examining multicollinearity among the constructs [52] and the significance of the item weights [38, 53]. Table 3 presents the correlation matrix.

Table 3. Correlation matrix

	1	1.1	1.2	1.3	1.4	2	3	4	5	6	7	8	9	10	11	12
1. Green IT adoption	1															
1.1. Hardware reduction	0.038	1														
1.2. Green practices enabled by IT	0.637	-0.027	1													
1.3. Pro-environmental IT policy	-0.540	0.115	-0.059	1												
1.4. Pollution control software	0.608	-0.040	0.027	-0.046	1											
2. Environmental motivation	0.013	-0.073	0.017	-0.008	0.015	1										
3. IT–business strategic alignment	-0.022	-0.033	-0.055	0.007	0.031	-0.011	1									
4. Perceived relative environmental performance	0.253	0.010	0.161	-0.137	0.154	-0.115	0.024	1								
5. Environmental management practices	0.006	0.035	-0.036	-0.012	0.030	-0.044	0.015	0.175	1							
6. Export orientation	-0.024	-0.054	-0.09	0.079	0.048	0.064	0.032	-0.016	-0.017	1						
7. Financial status	-0.026	0.004	0.001	0.030	-0.023	0.002	0.072	0.074	-0.060	0.083	1					
8. Size	0.023	-0.020	0.034	0.008	0.015	0.015	0.042	0.086	0.023	0.217	0.187	1				
9. Ownership	0.087	0.006	0.074	-0.035	0.043	-0.085	-0.046	0.159	0.015	0.105	0.053	0.022	1			
10. Location	0.007	-0.063	-0.030	-0.017	0.044	0.046	0.023	-0.117	0.019	0.049	0.060	0.015	-0.045	1		
11. Industry	-0.043	0.008	-0.061	0.002	-0.012	0.032	-0.006	-0.146	0.034	0.015	-0.050	-0.048	-0.067	0.033	1	
12. Age	0.037	-0.028	0.042	-0.010	0.020	-0.058	-0.060	0.101	-0.002	0.059	0.020	0.149	0.258	0.91	-0.024	1

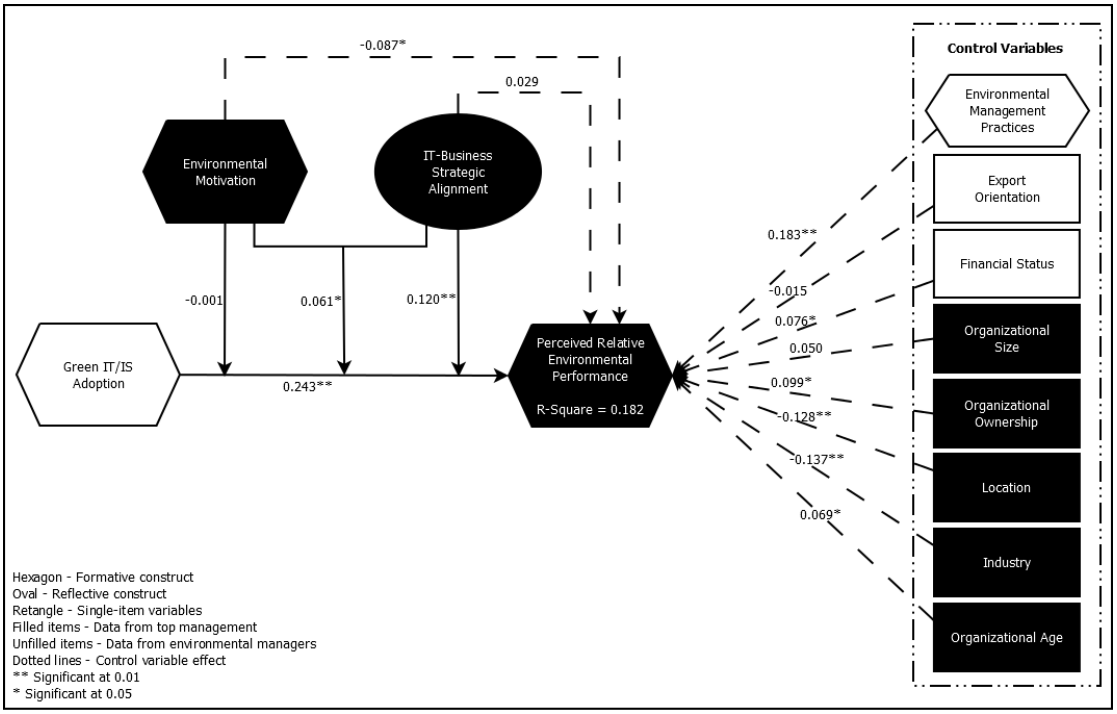

Figure 2. The structural model with path coefficients

Figure 2 shows the structural model and associated path coefficients. Table 2 shows the goodness of fit of the saturated model indices. All of the discrepancies were below the 95% or 99% quantiles of the bootstrap discrepancies and supported the fit of the research model [21].

5.2 Structural Model Assessment

The beta coefficients and significance of the proposed relationships were evaluated by running a bootstrap analysis with 2,000 subsamples to test the hypothesized relationships. The research model explained 18.16% of the variance in environmental performance. The overall R^2 was low, which is not unusual in business and social science research. There are three reasons why a low R^2 is acceptable in this study [54, 66, 101]. First, models with low R^2 can still yield excellent goodness of fit (Chin, 1998b). Second, the aim of this study was to explain and understand whether and how green IT/IS adoption, environmental motivation, and IT–business strategic alignment affect an organization's environmental performance, not to achieve predictive efficiency. The low R^2 is partially driven by the survey's broad industrial coverage and the omission of other variables that affect environmental performance. Third, this is a novel study that combines the constructs of green IT/IS adoption and environmental motivation. We believe that such a low R^2 is not uncommon for novel research models such as ours.

Table 4 summarizes the results of the hypothesis tests. First, we assessed the goodness

of fit of the structural model using the confirmatory composite analysis previously described. The indices evaluated were standardized root-mean-squared residual, unweighted least squares, discrepancy, and geodesic discrepancy. The standardized root-mean-squared residual was 0.018, which was below 0.080, and the discrepancy and geodesic discrepancy were 0.037 and 0.007, respectively. These values were below the 95% quantiles of the bootstrap discrepancies, which were 0.025, 0.073, and 0.015, respectively. Thus, these results indicated good structural model fit [18].

Table 4. Structural model assessment

Hypothesis	Result
H1: Green IT/IS adoption positively affects the perceived relative environmental performance of organizations.	Supported
H2: Environmental motivation positively moderates the effects of green IT/IS adoption on the perceived relative environmental performance of organizations.	Rejected
H3: IT–business strategic alignment positively moderates the effects of green IT/IS adoption on the perceived relative environmental performance of organizations.	Supported
H4: Environmental motivation positively moderates the moderating effects of IT–business strategic alignment on the relationship between green IT/IS adoption and perceived relative environmental performance of organizations such that the effect is stronger when both environmental motivation and IT–business strategic alignment are high.	Supported

We included all of the research constructs and control variables in Model 1 to test H1, which hypothesizes that green IT/IS adoption affects perceived relative environmental performance. Green IT/IS adoption demonstrated a statistically significant and positive relationship with perceived relative environmental performance ($\beta = 0.243$; $p_{\text{one-tailed}} < 0.01$). Thus, H1 was supported.

Interaction terms were added to Model 1 to form Model 2, which was used to test the three hypotheses about moderating effects [18]. Environmental motivation did not exhibit a statistically significant moderating effect on the relationship between green IT/IS adoption and perceived relative environmental performance ($\beta = -0.001$; $p_{\text{one-tailed}} > 0.05$). Thus, H2 was rejected. IT–business strategic alignment demonstrated a statistically significant moderating effect on the relationship between green IT/IS adoption and perceived relative environmental performance ($\beta = 0.120$; $p_{\text{one-tailed}} < 0.01$). Hence, H3 was supported. The three-way interaction between IT–business strategic alignment, environmental motivation, and green IT/IS adoption demonstrated a statistically significant and positive effect on perceived relative environmental performance ($\beta = 0.061$; $p_{\text{one-tailed}} < 0.05$). Hence, H4 was supported.

6 Discussion and Practical and Theoretical Implications

Using the RBV as a theoretical lens, we demonstrate that complementary organizational factors and the implementation of green IT/IS have a synergistic effect on the environmental performance of organizations. Our empirical study yields several important findings. By identifying the contingencies in the relationship between green IT/IS adoption and environmental performance and how these contingencies influence the relationship between

green IT/IS adoption and environmental performance, we answer our research questions: (1) What are the contingencies in the relationship between green IT/IS adoption and environmental performance? and (2) How do these contingencies intervene in the relationship between green IT/IS adoption and environmental performance? This study fills a gap in the green IT/IS literature. Most of the studies on the relationship between green IT/IS and environmental performance have investigated the effects of green IT/IS as though it operates in a vacuum [92, 116]. These studies have disregarded how organizational contingencies interact with green IT/IS and contribute to organizations' environmental performance. For example, among the studies on the relationship between green IT/IS and environmental performance, only Yang, Sun, Zhang, and Wang [12] investigated how organizational contingencies, i.e., fit with green SCM, influence the effects of green IT/IS on environmental performance.

In addition to filling a gap in the literature, this study yields a surprising and interesting finding that is worthy of further investigation. Our results show that environmental motivation does not moderate the positive effect of green IT/IS on environmental performance. However, this does not imply that environmental motivation does not play a role in improving an organization's environmental performance because we also found that environmental motivation positively moderates the effects of IT–business strategic alignment in the relationship between green IT/IS and environmental performance. This may indicate that complementary IT resources support the integration of green IT/IS into business strategies and processes during the implementation of green IT/IS. In addition, complementary non-IT business resources may also help with the assimilation of green IT/IS business strategies and processes. Future studies could examine the roles of other complementary IT and non-IT business resources.

This study's findings have several important theoretical implications. First, the study provides a framework for investigating the effects of green IT/IS on perceived relative environmental performance under the effects of complementary resources. Compared with studies that implicitly assume that green IT/IS creates value in a vacuum [e.g., 64, 92, 141], this study proves the existence of boundary conditions that influence the effectiveness of green IT/IS. Notably, green IT/IS interacts with other complementary organizational resources to influence the perceived relative environmental performance of organizations. This allows for a deeper understanding of how green IT/IS interacts with other organizational resources to achieve competitive environmental performance.

Second, we identify the synergistic roles of complementary IT and non-IT resources related to environmental protection that support green IT/IS and its effect on the perceived relative environmental performance of organizations. Although the literature suggests that an organization's contextual factors interact and affect the outcomes of its pro-environmental

initiatives [127, 148], the moderating effects of such interactions on the effect of green IT/IS adoption on environmental performance have not been empirically studied. Our findings suggest that a research model for investigating green IT/IS should consider resources related to both environmental protection and IT because green IT/IS has characteristics of both. Therefore, our findings contribute to the green IT/IS literature by establishing the importance of complementary IT and pro-environmental resources in studies that adopt the RBV.

Third, this study contributes to the RBV by responding to the call of Barney, Ketchen and Wright [13] to expand the concept of strategic resources. This study does so by suggesting that the combination of green IT/IS, IT–business strategic alignment, and environmental motivation creates a valuable, rare, and inimitable resource that is organized to exploit instead of considering green IT/IS a strategic resource for achieving sustained competitive advantages. Although the RBV is often used in green IT/IS studies [92, 97, 133], such studies have not empirically investigated the conditions that allow green IT/IS to become valuable, rare, and inimitable. This study adds to the RBV knowledge base by identifying complementary resources specific to green IT/IS, which has received little research attention.

Our findings also have three important practical implications. First, this study shows that after adopting green IT/IS, managers should focus on establishing its value, rarity, and inimitability and organizing it to exploit because green IT/IS can easily be imitated or acquired by competitors. Consequently, the competitive environmental performance achieved solely by green IT/IS may not be sustainable. For example, managers could help their organization develop routines and policies unique to its business context that use green IT/IS to incorporate the VRIO attributes.

Second, our study highlights that organizational factors influence the potential effects of green IT/IS. Therefore, managers should seek the support of internal stakeholders, such as general employees and IT personnel, for the implementation of green IT/IS to ensure its success. Internal stakeholders play a crucial role in the change processes involved in organizational innovation [35], including green IT/IS adoption.

Third, managers should consider the synergies between complementary IT and non-IT business resources (i.e., IT–business strategic alignment and environmental motivation) to improve their organization's environmental performance because the effect of green IT/IS on environmental performance depends heavily on IT–business strategic alignment and environmental motivation. Thus, green IT/IS can be fully embedded into organizations, and its full potential to enhance environmental performance can be realized.

7 Conclusions, Limitations, and Areas for Further Research

This study's primary limitation is that its findings may not be generalizable to other cultural settings or developing economies. However, the research model is for general contexts, and cross-country studies in the green IT/IS literature have found similar results from samples collected in different countries [140, 141], so the generalizability of this study may not be a serious concern. Future studies could investigate whether the findings can be applied to other cultural contexts and geographical locations.

Second, CMB may be a problem because the data were self-reported. However, the responses were collected from different sources, and most of the research constructs were formative. Thus, CMB should not be a serious concern. However, future studies could use objective data.

Third, our data are cross-sectional and may be too specific to a certain type of location as most of the organizations studied were located in industrial–commercial areas. Longitudinal investigations of organizations in different locations should be conducted in the future.

This study also highlights several opportunities for future studies. First, future research could investigate interactions between the external environment and complementary organizational resources and the interactions between different types of complementary organizational resources. Additionally, future studies could further explore the complementarity of organizational resources that influence the impacts of green IT/IS.

Second, the effects of pro-environmental innovations on the economic performance of organizations should be investigated. Improving environmental performance is the primary goal of pro-environmental innovations [1]. However, such innovations cannot compromise the goal of improving economic performance. Therefore, how pro-environmental innovations, such as green IT, contribute to environmental and economic performance should be established before they are implemented.

Third, we found that environmental motivation (a complementary non-IT business resource) does not positively moderate the positive effect of green IT/IS on perceived relative environmental performance but does positively moderate the effect of IT–business strategic alignment on the positive relationship between green IT/IS and perceived relative environmental performance. This suggests that complementary IT and non-IT business resources may play different roles in supporting green IT/IS. Future studies could empirically investigate how complementary IT and non-IT business resources support the effects of green IT/IS.

Although green IT/IS, an important pro-environmental innovation for environmental sustainability, has been extensively studied, there remains a critical research gap. The interaction between green IT/IS and other organizational factors had remained unexplored.

Therefore, we use the RBV as a theoretical lens to develop a research model that investigates the effects of the interactions between green IT/IS adoption, IT–business strategic alignment, and environmental motivation on the perceived relative environmental performance of organizations. This study paves the way for future studies by investigating the interaction between green IT/IS and other organizational factors. Thus, this study promotes further research on the interaction between green IT/IS and other organizational complementary resources and its role in the effect of green IT/IS on environmental performance.

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References:

[1] A. Ajamieh, J. Benitez, J. Braojos, C. Gelhard, IT infrastructure and competitive aggressiveness in explaining and predicting performance, Journal of Business Research, 69(10) (2016) 4667-4674.

[2] A.M. Aladwani, An empirical examination of the role of social integration in system development projects, Information Systems Journal, 12(4) (2002) 339-353.

[3] B. Anthony Jr, Green information system integration for environmental performance in organizations, Benchmarking: An International Journal, 26(3) (2019) 1033-1062.

[4] C.P. Armstrong, V. Sambamurthy, Information technology assimilation in firms: The influence of senior leadership and IT infrastructures, Information Systems Research, 10(4) (1999) 304-327.

[5] J.S. Armstrong, T.S. Overton, Estimating nonresponse bias in mail surveys, Journal of Marketing Research, 14(3) (1977) 396-402.

[6] S. Asadi, A.R.C. Hussin, H.M. Dahlan, Organizational research in the field of Green IT: A systematic literature review from 2007 to 2016, Telematics and Informatics, 34(7) (2017) 1191-1249.

[7] S.J. Ashford, N.P. Rothbard, S.K. Piderit, J.E. Dutton, Out on a limb: The role of context and impression management in selling gender-equity issues, Administrative Science Quarterly, 43(1) (1998) 23-57.

[8] S. Aslam, M.H. Elmagrhi, R.U. Rehman, C.G. Ntim, Environmental management practices and financial performance using data envelopment analysis in Japan: The mediating role of environmental performance, Business Strategy and the Environment, 30(4) (2020) 1655-1673.

[9] A. Baggia, M. Maletič, A. Žnidaršič, A. Brezavšček, Drivers and outcomes of green IS adoption in small and medium-sized enterprises, Sustainability, 11(6) (2019) Article 1575.

[10] Z. Bao, Innovative behavior and the Chinese enterprise survival risk: an empirical research, China Finance and Economic Review, 4(2016) Article 18.

[11] J. Barney, Firm resources and sustained competitive advantage, Journal of Management, 17(1) (1991) 99-120.

[12] J.B. Barney, W. Hesterly, Strategic Management and Competitive Advantage: Concepts and Cases (Pearson Education, 2014).

[13] J.B. Barney, D.J. Ketchen, M. Wright, Bold voices and new opportunities: An expanded research agenda for the resource-based view, Journal of Management, 47(7) (2021) 1677-1683.

[14] J.B. Barney, D.J. Ketchen, M. Wright, Resource-based theory and the value creation framework, Journal of Management, 47(7) (2021) 1936-1955.

[15] M.R. Barrick, G.R. Thurgood, T.A. Smith, S.H. Courtright, Collective organizational engagement: Linking motivational antecedents, strategic implementation, and firm performance, Academy of Management Journal, 58(1) (2015) 111-135.
[16] J.W. Beard, M. Sumner, Seeking strategic advantage in the post-net era: viewing ERP systems from the resource-based perspective, The Journal of Strategic Information Systems, 13(2) (2004) 129-150.
[17] J. Benitez-Amado, R.M. Walczuch, Information technology, the organizational capability of proactive corporate environmental strategy and firm performance: A resource-based analysis, European Journal of Information Systems, 21(6) (2012) 664-679.
[18] J. Benitez, A. Castillo, J. Llorens, J. Braojos, IT-enabled knowledge ambidexterity and innovation performance in small US firms: The moderator role of social media capability, Information & Management, 55(1) (2018) 131-143.
[19] J. Benitez, J. Henseler, A. Castillo, Development and update of guidelines to perform and report partial least squares path modeling in information systems research, in: the 21st Pacific Asia Conference on Information Systems, (Langkawi, Malaysia, 2017), pp. 1-15.
[20] J. Benitez, J. Henseler, A. Castillo, F. Schuberth, How to perform and report an impactful analysis using partial least squares: Guidelines for confirmatory and explanatory IS research, Information & Management, 57(2) (2020) Article 103168.
[21] J. Benitez, J. Llorens, J. Braojos, How information technology influences opportunity exploration and exploitation firm's capabilities, Information & Management, 55(4) (2018) 508-523.
[22] J. Benitez, L. Ruiz, A. Castillo, J. Llorens, How corporate social responsibility activities influence employer reputation: The role of social media capability, Decision Support Systems, 129(2020).
[23] A. Bohas, N. Poussing, An empirical exploration of the role of strategic and responsive corporate social responsibility in the adoption of different Green IT strategies, Journal of Cleaner Production, 122(2016) 240-251.
[24] O. Boiral, J.-F. Henri, D. Talbot, Modeling the Impacts of Corporate Commitment on Climate Change, Business Strategy and the Environment, 21(8) (2012) 495-516.
[25] R. Bose, X. Luo, Integrative framework for assessing firms' potential to undertake Green IT initiatives via virtualization – A theoretical perspective, The Journal of Strategic Information Systems, 20(1) (2011) 38-54.
[26] Y.D. Bouzzine, R. Lueg, The contagion effect of environmental violations: The case of Dieselgate in Germany, Business Strategy and the Environment, 29(8) (2020) 3187-3202.
[27] J. Braojos, J. Benitez, J. Llorens, How do social commerce-IT capabilities influence firm performance? Theory and empirical evidence, Information & Management, 56(2) (2019) 155-

171.
[28] A.D. Brown, Managing understandings: Politics, symbolism, niche marketing and the quest for legitimacy in IT implementation, Organization Studies, 16(6) (1995) 951-969.
[29] T. Butler, R. Hackney, The role of informational mechanisms in the adoption of Green IS to achieve eco-sustainability in municipalities, Information & Management, 58(3) (2021) Article 103320.
[30] G. Cao, L. Yang, L. Liu, Z. Ma, J. Wang, J. Bi, Environmental incidents in China: Lessons from 2006 to 2015, Science of the Total Environment, 633(2018) 1165-1172.
[31] A.B. Carroll, K.M. Shabana, The business case for corporate social responsibility: A review of concepts, research and practice, International Journal of Management Reviews, 12(1) (2010) 85-105.
[32] A. Castillo, J. Benitez, J. Llorens, J. Braojos, Impact of social media on the firm's knowledge exploration and knowledge exploitation: The role of business analytics talent, Journal of the Association for Information Systems, 22(5) (2021) 1472-1508.
[33] R.Y.K. Chan, K.H.Y. Ma, Impact of executive compensation on the execution of IT-based environmental strategies under competition, European Journal of Information Systems, 26(5) (2017) 489-508.
[34] Y.E. Chan, B.H. Reich, IT alignment: What have we learned?, Journal of Information Technology, 22(4) (2007) 297-315.
[35] H. Chebbi, D. Yahiaoui, M. Sellami, I. Papasolomou, Y. Melanthiou, Focusing on internal stakeholders to enable the implementation of organizational change towards corporate entrepreneurship: A case study from France, Journal of Business Research, 119(2020) 209-217.
[36] E.T. Chen, Green IT and the struggle for a widespread adoption, in: D.B.A.M. Khosrow-Pour Ed. Advanced Methodologies and Technologies in Engineering and Environmental Science, (IGI Global, Hershey, PA, USA, 2019), pp. 157-166.
[37] Z. Cheng, L. Li, J. Liu, The effect of information technology on environmental pollution in China, Environmental Science Pollution Research, 26(32) (2019) 33109-33124.
[38] W.W. Chin, The partial least squares approach to structural equation modeling, in: G.A. Marcoulides Ed. Modern Methods for Business Research, (Lawrence Erlbaum, Mahwah, N.J., 1998), pp. 295-336.
[39] W.W. Chin, How to write up and report PLS analyses, in: V.E. Vinzi, W.W. Chin, J. Henseler, H. Wang Eds. Handbook of Partial Least Squares: Concepts, Methods and Applications, (Springer, Berlin Heidelberg, 2010), pp. 655-690.
[40] S.-P. Chuang, S.-J. Huang, The effect of environmental corporate social responsibility on environmental performance and business competitiveness: The mediation of green

information technology capital, Journal of Business Ethics, 150(4) (2016) 991-1009.
[41] L. Chung, C.W.-H. Lo, P.H.Y. Li, The interaction effects of institutional constraints on managerial intentions and sustainable performance, International Journal of Production Economics, 181(2016) 374-383.
[42] E.K. Clemons, S.O. Kimbrough, Information systems, telecommunications, and their effects on industrial organization, in: the Seventh International Conference on Information Systems, (San Diego, CA, 1986), pp. 25-35.
[43] E.K. Clemons, M. Row, McKesson Drug Company: A case study of economost–A strategic information system, Journal of Management Information Systems, 5(1) (1988) 36-50.
[44] E.K. Clemons, M.C. Row, Sustaining IT advantage: The role of structural differences, MIS Quarterly, 15(3) (1991) 275-292.
[45] V. Cooper, A. Molla, Information systems absorptive capacity for environmentally driven IS-enabled transformation, Information Systems Journal, 27(4) (2017) 379-425.
[46] J. Corbett, Unearthing the value of Green IT, in: Proceedings of the 31th International Conference on Information Systems, (St. Louis, 2010).
[47] P. Cragg, M. King, H. Hussin, IT alignment and firm performance in small manufacturing firms, The Journal of Strategic Information Systems, 11(2) (2002) 109-132.
[48] J. Cramer, A. van der Heijden, J. Jonker, Corporate social responsibility: Making sense through thinking and acting, Business Ethics: A European Review, 15(4) (2006) 380-389.
[49] S. De Haes, W. Van Grembergen, An exploratory study into IT governance implementations and its impact on business/IT alignment, Information Systems Management, 26(2) (2009) 123-137.
[50] C. de Villiers, V. Naiker, C.J. van Staden, The effect of board characteristics on firm environmental performance, Journal of Management, 37(6) (2011) 1636-1663.
[51] J. Dedrick, Green IS: Concepts and issues for information systems research, Communications of the Association for Information Systems, 27(11) (2010) 173-184.
[52] A. Diamantopoulos, P. Riefler, K.P. Roth, Advancing formative measurement models, Journal of Business Research, 61(12) (2008) 1203-1218.
[53] A. Diamantopoulos, H.M. Winklhofer, Index construction with formative indicators: An alternative to scale development, Journal of Marketing Research, 38(2) (2001) 269-277.
[54] B.R. Dineen, D.G. Allen, Third Party Employment Branding: Human Capital Inflows and Outflows Following “Best Places to Work” Certifications, Academy of Management Journal, 59(1) (2016) 90-112.
[55] D. Earnhart, L. Lizal, Effects of ownership and financial performance on corporate environmental performance, Journal of Comparative Economics, 34(1) (2006) 111-129.

[56] O. El-Gayar, B.D. Fritz, Environmental management information systems (EMIS) for sustainable development: A conceptual overview, Communications of the Association for Information Systems, 17(2006) Article 34.
[57] S.C. El Idrissi, J. Corbett, Green IS research: A modernity perspective, Communications of the Association for Information Systems, 38(2016) 596-623.
[58] E. Ennen, A. Richter, The whole is more than the sum of its parts—Or is it? A review of the empirical literature on complementarities in organizations, Journal of Management, 36(1) (2010) 207-233.
[59] X. Fan, X. Shan, S. Day, Y. Shou, Toward green innovation ecosystems: Past research on green innovation and future opportunities from an ecosystem perspective, Industrial Management & Data Systems, 122(9) (2022) 2012-2044.
[60] C. Fornell, D.F. Larcker, Evaluating structural equation models with unobservable variables and measurement error, Journal of Marketing Research, 18(1) (1981) 39-50.
[61] C.B. Gabler, R.G. Richey, A. Rapp, Developing an eco-capability through environmental orientation and organizational innovativeness, Industrial Marketing Management, 45(2015) 151-161.
[62] J.E. Gerow, V. Grover, J. Thatcher, P.L. Roth, Looking toward the future of IT-business strategic alignment through the past: A meta-analysis, MIS Quarterly, 38(4) (2014) 1159-1185.
[63] J.E. Gerow, J.B. Thatcher, V. Grover, Six types of IT-business strategic alignment: An investigation of the constructs and their measurement, European Journal of Information Systems, 24(5) (2014) 465-491.
[64] R. Gholami, A.B. Sulaiman, T. Ramayah, A. Molla, Senior managers' perception on green information systems (IS) adoption and environmental performance: Results from a field survey, Information & Management, 50(7) (2013) 431-438.
[65] C.B. Gibson, S.C. Gibson, Q. Webster, Expanding our resources: Including community in the resource-based view of the firm, Journal of Management, 47(7) (2021) 1878-1898.
[66] J.V. Gray, A.V. Roth, B. Tomlin, The Influence of Cost and Quality Priorities on the Propensity to Outsource Production, Decision Sciences, 40(4) (2009) 697-726.
[67] V. Grover, R.H.L. Chiang, T.-P. Liang, D. Zhang, Creating strategic business value from big data analytics: A research framework, Journal of Management Information Systems, 35(2) (2018) 388-423.
[68] T. Hahn, L. Preuss, J. Pinkse, F. Figge, Cognitive frames in corporate sustainability: Managerial sensemaking with paradoxical and business case frames, Academy of Management Review, 39(4) (2014) 463-487.
[69] J.F. Hair, M. Sarstedt, C.M. Ringle, J.A. Mena, An assessment of the use of partial least

squares structural equation modeling in marketing research, Journal of the Academy of Marketing Science, 40(3) (2012) 414-433.
[70] J. Hartmann, S. Vachon, Linking environmental management to environmental performance: The interactive role of industry context, Business Strategy and the Environment, 27(3) (2018) 359-374.
[71] J. Hedman, S. Henningsson, Developing ecological sustainability: a green IS response model, Information Systems Journal, 26(3) (2016) 259-287.
[72] J. Henseler, G. Hubona, P.A. Ray, Using PLS path modeling in new technology research: Updated guidelines, Industrial Management & Data Systems, 116(1) (2016) 2-20.
[73] R.E. Hoskisson, M.A. Hitt, W.P. Wan, D. Yiu, Theory and research in strategic management: Swings of a pendulum, Journal of Management, 25(3) (1999) 417-456.
[74] J.M. Howell, C.A. Higgins, Champions of technological innovation, Administrative Science Quarterly, 35(2) (1990) 317-341.
[75] G.S. Kearns, A.L. Lederer, A resource-based view of strategic IT alignment: How knowledge sharing creates competitive advantage, Decision Sciences, 34(1) (2003) 1-29.
[76] G.S. Kearns, R. Sabherwal, Strategic alignment between business and information technology: A knowledge-based view of behaviors, outcome, and consequences, Journal of Management Information Systems, 23(3) (2007) 129-162.
[77] J. Kim, R. Makadok, Unpacking the "O" in VRIO: The role of workflow interdependence in the loss and replacement of strategic human capital, Strategic Management Journal, 44(6) (2021) 1453-1487.
[78] R.D. Klassen, C.P. McLaughlin, The impact of environmental management on firm performance, Management Science, 42(8) (1996) 1199-1214.
[79] P.R. Kleindorfer, K. Singhal, L.N. Wassenhove, Sustainable operations management, Production and Operations Management, 14(4) (2009) 482-492.
[80] J. Kraaijenbrink, J.C. Spender, A.J. Groen, The Resource-Based View: A Review and Assessment of Its Critiques, Journal of Management, 36(1) (2009) 349-372.
[81] B.N. Kuo, G.N. Dick, Organizational Green IT: It seems the bottom line rules, in: 16th Americas Conference on Information Systems, (Association for Information Systems, Lima, Peru, 2010).
[82] K.-h. Lai, C.W.Y. Wong, Green logistics management and performance: Some empirical evidence from Chinese manufacturing exporters, Omega, 40(3) (2012) 267-282.
[83] C.F. Lei, E.W.T. Ngai, Green information technologies adoption: A managerial perspective, in: In Proceeding of the Pacific Asia Conference on Information Systems, (Jeju Island, South Korea, 2013).
[84] C.F. Lei, E.W.T. Ngai, Green IT adoption: An academic review of literature, in:

Association for Information Systems: Proceedings of the 2013 Pacific Asia Conference on Information Systems, (Jeju Island, Korea, 2013).
[85] W. Li, J. Wen, B. Xu, X. Li, S. Du, Integrated assessment of economic losses in manufacturing industry in Shanghai metropolitan area under an extreme storm flood scenario, Sustainability, 11(1) (2018) Article 126.
[86] I.E. Lisi, Translating environmental motivations into performance: The role of environmental performance measurement systems, Management Accounting Research, 29(2015) 27-44.
[87] C.W.-H. Lo, G.E. Fryxell, S.-Y. Tang, Stakeholder pressures from perceived environmental impacts and the effect on corporate environmental management programmes in China, Environmental Politics, 19(6) (2010) 888-909.
[88] C.W.H. Lo, C.P. Egri, D.A. Ralston, Commitment to corporate, social, and environmental responsibilities: an insight into contrasting perspectives in China and the US, Organization Management Journal, 5(2) (2008) 83-98.
[89] F. Loeser, J. Recker, J.v. Brocke, A. Molla, R. Zarnekow, How IT executives create organizational benefits by translating environmental strategies into Green IS initiatives, Information Systems Journal, 27(4) (2017) 503-553.
[90] Y.D. Luo, M.W. Peng, Learning to compete in a transition economy: Experience, environment, and performance, Journal of International Business Studies, 30(2) (1999) 269-295.
[91] A. Malhotra, N.P. Melville, R.T. Watson, Spurring impactful research on information systems for environmental sustainability, MIS Quarterly, 37(4) (2013) 1265-1274.
[92] J. Meacham, L. Toms, K.W. Green, Jr., V.S. Bhadauria, Impact of information sharing and green information systems, Management Research Review, 36(5) (2013) 478-494.
[93] N. Melville, K. Kraemer, V. Gurbaxani, Review: Information technology and organizational performance: An integrative model of IT business value, MIS Quarterly, 28(2) (2004) 283-322.
[94] S.I. Mohan-Neill, The influence of firm's age and size on its environmental scanning activities, Journal of Small Business Management, 33(4) (1995) 10-21.
[95] A. Molla, A. Abareshi, Organizational green motivations for information technology: Empirical study, Journal of Computer Information Systems, 52(3) (2012) 92-102.
[96] A. Molla, S. Pittayachawan, B. Corbitt, H. Deng, An international comparison of Green IT diffusion, International Journal of e-Business Management, 3(2) (2009) 3-23.
[97] K. Nanath, R.R. Pillai, The influence of green IS practices on competitive advantage: Mediation role of green innovation performance, Information Systems Management, 34(1) (2017) 3-19.

[98] A.O. Ojo, C.N.-L. Tan, M. Alias, Linking green HRM practices to environmental performance through pro-environment behaviour in the information technology sector, Social Responsibility Journal, 18(1) (2020) 1-18.
[99] M. Pagell, D. Gobeli, How plant managers' experiences and attitudes toward sustainability relate to operational performance, Production and Operations Management, 18(3) (2009) 278-299.
[100] L.D. Parker, Corporate social accountability through action: Contemporary insights from British industrial pioneers, Accounting, Organizations and Society, 39(8) (2014) 632-659.
[101] A. Paulraj, A.A. Lado, I.J. Chen, Inter-organizational communication as a relational competency: Antecedents and performance outcomes in collaborative buyer–supplier relationships, Journal of Operations Management, 26(1) (2008) 45-64.
[102] P.M. Podsakoff, S.B. MacKenzie, J.Y. Lee, N.P. Podsakoff, Common method biases in behavioral research: A critical review of the literature and recommended remedies, Journal of Applied Psychology, 88(5) (2003) 879-903.
[103] P.M. Podsakoff, S.B. MacKenzie, N.P. Podsakoff, Sources of method bias in social science research and recommendations on how to control it, Annual Review of Psychology, 63(2012) 539-569.
[104] P.M. Podsakoff, D.W. Organ, Self-reports in organizational research - Problems and prospects, Journal of Management, 12(4) (1986) 531-544.
[105] T.C. Powell, A. Dent-Micallef, Information technology as competitive advantage: The role of human, business, and technology resources, Strategic Management Journal, 18(5) (1997) 375-405.
[106] M. Randall, Building a business case for cross-border trading, Journal of Securities Operations & Custody, 3(1) (2010) 7-13.
[107] P. Ranganathan, Recipe for efficiency, Communications of the ACM, 53(4) (2010) 60-67.
[108] L. Raymond, F. Bergeron, Enabling the business strategy of SMEs through e-business capabilities, Industrial Management & Data Systems, 108(5) (2008) 577-595.
[109] L. Raymond, A.M. Croteau, Enabling the strategic development of SMEs through advanced manufacturing systems, Industrial Management & Data Systems, 106(7) (2006) 1012-1032.
[110] P. Reynolds, P. Yetton, Aligning business and IT strategies in multi-business organizations, Journal of Information Technology, 30(2) (2015) 101-118.
[111] B.J. Richardson, Keeping ethical investment ethical: Regulatory issues for investing for sustainability, Journal of Business Ethics, 87(4) (2008) 555-572.

[112] Ringle, Sarstedt, Straub, Editor's comments: A critical look at the use of PLS-SEM in "MIS Quarterly", MIS Quarterly, 36(1) (2012).
[113] J.W. Ross, P. Weill, Six IT decisions your IT people shouldn't make, Harvard Business Review, 80(11) (2002) 84-92.
[114] L. Rueda, J. Benitez, J. Braojos, From traditional education technologies to student satisfaction in management education: A theory of the role of social media applications, Information & Management, 54(8) (2017) 1059-1071.
[115] M.V. Russo, P.A. Fouts, A resource-based perspective on corporate environmental performance and profitability, Acadamy of Management Journal, 40(3) (1997) 534-559.
[116] S.Y. Ryoo, C. Koo, Green practices-IS alignment and environmental performance: The mediating effects of coordination, Information Systems Frontiers, 15(5) (2013) 799-814.
[117] H.-S. Ryu, J.-N. Lee, Understanding the role of technology in service innovation: Comparison of three theoretical perspectives, Information & Management, 55(3) (2018) 294-307.
[118] S. Sarker, M. Ahuja, S. Sarker, Work–life conflict of globally distributed software development personnel: An empirical investigation using border theory, Information Systems Research, 29(1) (2018) 103-126.
[119] A. Schaefer, Contrasting institutional and performance accounts of environmental management systems: Three case studies in the UK water & sewerage industry, Journal of Management Studies, 44(4) (2007) 506-535.
[120] K.U. Shah, J.E. Rivera, Export processing zones and corporate environmental performance in emerging economies: The case of the oil, gas, and chemical sectors of Trinidad and Tobago, Policy Sciences, 40(4) (2007) 265-285.
[121] A. Singh, M. Sharma, Development of a ‘green IT brand image sustainability model for competitive advantage’, Environment, Development and Sustainability, 25(2022) 40-60.
[122] D.V. Spracklen, Global warming: China's contribution to climate change, Nature, 531(7594) (2016) 310-312.
[123] P.A. Stanwick, S.D. Stanwick, The relationship between corporate social performance, and organizational size, financial performance, and environmental performance: An empirical examination, Journal of Business Ethics, 17(2) (1998) 195-204.
[124] S.D. Stanwick, P.A. Stanwick, Corporate social responsiveness: An empirical examination using the environmental disclosure index, International Journal of Commerce and Management, 8(3/4) (1998) 26-40.
[125] G.X. Tang, K. Park, A. Agarwal, F. Liu, Impact of innovation culture, organization size and technological capability on the performance of SMEs: The case of China, Sustainability, 12(4) (2020) Article 1355.

[126] S.Y. Tang, P.H. Li, G.E. Fryxell, C.W. Lo, Enterprise-Level Motivations, Regulatory Pressures, and Corporate Environmental Management in Guangzhou, China, Environmental Management, 56(3) (2015) 777-790.
[127] Z. Tang, J. Tang, Stakeholder Corporate Social Responsibility Orientation Congruence, Entrepreneurial Orientation and Environmental Performance of Chinese Small and Medium-sized Enterprises, British Journal of Management, 29(4) (2017) 634-651.
[128] J. vom Brocke, R.T. Watson, C. Dwyer, S. Elliot, N. Melville, Green Information Systems: Directives for the IS Discipline, Communications of the Association for Information Systems, 33(2013).
[129] G.B. Voss, D. Sirdeshmukh, Z.G. Voss, The Effects of Slack Resources and Environmental Threat on Product Exploration and Exploitation, The Academy of Management Journal, 51(1) (2008) 147-164.
[130] M. Wade, J. Hulland, Review: The resource-based view and information systems research: Review, extension, and suggestions for future research, MIS Quarterly, 28(1) (2004) 107-142.
[131] J.L. Walls, P. Berrone, P.H. Phan, Corporate governance and environmental performance: is there really a link?, Strategic Management Journal, 33(8) (2012) 885-913.
[132] H. Wang, Y. Jin, Industrial Ownership and Environmental Performance: Evidence from China, Environmental and Resource Economics, 36(3) (2006) 255-273.
[133] Y. Wang, Y. Chen, J. Benitez-Amado, How information technology influences environmental performance: Empirical evidence from China, International Journal of Information Management, 35(2) (2015) 160-170.
[134] Y. Wang, S. Shi, S. Nevo, S. Li, Y. Chen, The interaction effect of IT assets and IT management on firm performance: A systems perspective, International Journal of Information Management, 35(5) (2015) 580-593.
[135] R.T. Watson, M.C. Boudreau, A.J. Chen, Information systems and environmentally sustainable development: Energy informatics and new directions for the IS community, MIS Quarterly, 34(1) (2010) 23-38.
[136] R.T. Watson, M.C. Boudreau, S. Li, J. Levis, Telematics at Ups: En Route to Energy Informatics, MIS Quarterly Executive, 9(1) (2010) 1-11.
[137] B. Wernerfelt, A resource-based view of the firm, Strategic Management Journal, 5(2) (1984) 171-180.
[138] T. Whelan, C. Fink, The Comprehensive Business Case for Sustainability, Harvard Business Review Digital Articles, (2016) 2-8.
[139] F. Wiengarten, P. Humphreys, G. Cao, M. McHugh, Exploring the Important Role of Organizational Factors in IT Business Value: Taking a Contingency Perspective on the

Resource-Based View, International Journal of Management Reviews, 15(1) (2013) 30-46.
[140] Z. Yang, J. Sun, Y. Zhang, Y. Wang, Perceived fit between green IS and green SCM: Does it matter?, Information & Management, 56(7) (2019) 1-13.
[141] Z. Yang, J. Sun, Y. Zhang, Y. Wang, L. Cao, Employees' collaborative use of green information systems for corporate sustainability: motivation, effort and performance, Information Technology for Development, 23(3) (2017) 486-506.
[142] W.-H. Yee, C.W.-H. Lo, S.-Y. Tang, Assessing Ecological Modernization in China: Stakeholder Demands and Corporate Environmental Management Practices in Guangdong Province, The China Quarterly, 213(213) (2013) 101-129.
[143] J. Yu, C.W.-H. Lo, P.H.Y. Li, Organizational visibility, stakeholder environmental pressure and corporate environmental responsiveness in China, Business Strategy and the Environment, 26(3) (2017) 371-384.
[144] W. Yu, R. Ramanathan, Environmental management practices and environmental performance, Industrial Management & Data Systems, 116(6) (2016) 1201-1222.
[145] F. Zand, S. Solaimani, C. van Beers, A Role-based Typology of Information Technology: Model Development and Assessment, Information Systems Management, 32(2) (2015) 119-135.
[146] B. Zhang, J. Bi, Z. Yuan, J. Ge, B. Liu, M. Bu, Why do firms engage in environmental management? An empirical study in China, Journal of Cleaner Production, 16(10) (2008) 1036-1045.
[147] D. Zhang, W. Du, L. Zhuge, Z. Tong, R.B. Freeman, Do financial constraints curb firms' efforts to control pollution? Evidence from Chinese manufacturing firms, Journal of Cleaner Production, 215(2019) 1052-1058.
[148] M. Zhang, Y.K. Tse, J. Dai, H.K. Chan, Examining Green Supply Chain Management and Financial Performance: Roles of Social Control and Environmental Dynamism, IEEE Transactions on Engineering Management, 66(1) (2019) 20-34.
[149] C. Zheng, X. Qin, B. Eynard, J. Bai, J. Li, Y. Zhang, SME-oriented flexible design approach for robotic manufacturing systems, Journal of Manufacturing Systems, 53(2019) 62-74.
[150] Y. Zhou, J. Cao, Y. Feng, Stock Market Reactions to Pollution Information Disclosure: New Evidence from the Pollution Blacklist Program in China, Sustainability, 13(4) (2021).
[151] K. Zhu, K. Kraemer, S. Xu, Electronic business adoption by European firms: a cross-country assessment of the facilitators and inhibitors, European Journal of Information Systems, 12(4) (2017) 251-268.