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RESEARCH NOTE

HOW GREEN INFORMATION TECHNOLOGY STANDARDS AND STRATEGIES INFLUENCE PERFORMANCE: ROLE OF ENVIRONMENT, COST AND DUAL FOCUS[1]

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How do green information technology (IT) standards and organizational strategies jointly influence firms' environmental sustainability and financial performance? This is an important question, as many firms adopt green IT standards without considering the fit with their organizational strategies and therefore face uncertain or mixed outcomes. We address this question by developing a theory-driven conceptual framework and collecting archival data on green IT standards and green IT organizational strategies from more than 230 firms in India. Our analysis yields two main findings. First, an environment-focused green IT organizational strategy has a stronger positive moderating effect than a cost-focused green IT organizational strategy on the association between green IT standards and sustainability-monitoring capability. Similarly, an environment-focused green IT organizational strategy has a stronger positive moderating effect than a cost-focused green IT organizational strategy on the association between green IT standards and financial profit. Second, a dual-focused green IT organizational strategy positively moderates the association between green IT standards and profit. This study provides a theoretical explanation and empirical evidence to support the salience of green IT standards and complementary organizational strategies in advancing environmental sustainability and financial performance objectives. It also informs managerial decision-making about how firms can choose the appropriate green IT organizational strategy to enhance sustainability-monitoring capability and the financial benefits of green IT standards.

Keywords: Green IT, sustainability, cost, profit, standards, strategy

[1] Jonathan Wareham was the accepting senior editor for this paper. Nirup Menon served as the associate editor.

Introduction

Climate change is a significant threat to global population health and economic stability (Melville, 2010), prompting many firms to take actions to curb climate change and its harmful effects. One approach is the voluntary adoption of green IT standards,[2] such as Energy Star for equipment energy use, ISO 14001 for environmental management practices, and the Green Electronics Council for green computing and rating systems (Gilbert et al., 2011). Firms adopt such green IT standards to enhance their sustainability capabilities and achieve economic benefits, although actual outcomes are often mixed (Delmas & Keller, 2005; Simpson et al., 2012). Prior research suggests that adopting green IT standards alone is unlikely to achieve the desired benefits, and that green IT standards must be coupled with a complementary organizational strategy (Delmas & Pekovic, 2013). The mixed performance outcomes associated with green IT standards point to the need for empirical research to enrich our theoretical understanding of when green IT standards yield favorable outcomes.

We draw on prior research (Aragón-Correa & Sharma, 2003; Watson et al., 2011) to argue that a cost focus versus an environmental focus in green IT organizational strategy is an important factor in explaining why some firms benefit from green IT standards, whereas other firms do not. A cost focus and an environmental focus can have competing effects regarding the influence of green IT standards on organizational outcomes. Whereas a cost-focused strategy may help firms achieve financial savings, it can hinder firms' investment in operational modifications to benefit from green IT standards. Conversely, whereas an environment-focused strategy encourages firms to undertake investments that complement green IT standards, it may increase the costs incurred by firms to benefit from green IT standards. Moreover, an environment-focused strategy may divert managers from their fiscal responsibility to improve the firm's financial outcomes (Ambec & Lanoie, 2008). Although a dual focus on cost and the environment may seem beneficial in theory, a dual-focused strategy may be counterproductive because it could distract the firm's attention from leveraging green IT standards by creating tensions and trade-offs associated with multiple strategic emphases (Porter, 1980).[3]

Motivated by mixed empirical evidence regarding the impacts of sustainability standards[4] and the tension between environment-focused, cost-focused, and dual-focused organizational strategies, we study how an element of green IT (standards) interacts with an element of green IS (organizational strategy) to impact firm sustainability capability and financial outcomes. For sustainability capability, we focus on *sustainability-monitoring capability*, defined as a firm's ability to monitor (or sense) its sustainability goals (Wu et al., 2013), consistent with prior research that invokes the dynamic capability perspective in the environmental context (Aragón-Correa & Sharma, 2003; Benitez-Amado & Walczuch, 2012). For financial outcomes, we focus on financial profit, which aligns with prior conceptual frameworks linking environmental practices to financial performance (DesAutels & Berthon, 2011).

We pose the research question: *How do environment-focused, cost-focused, and dual-focused green IT organizational strategies influence the effect of voluntary green IT standards on a firm's sustainability-monitoring capability and financial performance*?[5] Our analyses of archival data from more than 230 firms in India yield two main findings. First, an environment-focused green IT organizational strategy positively moderates the association between green IT standards and sustainability-monitoring capability and the association between green IT standards and financial performance. Second, a dual-focused green IT organizational strategy positively moderates the association between green IT standards and financial performance. Beyond these important empirical results, an additional contribution of the study is the derivation and testing of a conceptual framework that informs a theoretical understanding and offers a solid foundation for future research. Our study also offers practical implications for synchronizing green IT standards with a green IT organizational strategy to enhance sustainability-monitoring capability and financial performance.

[2] *Green IT* is the practice of designing, manufacturing, using and disposing of computers, servers and associated subsystems … efficiently and effectively with minimal or no impact on the environment" (Dedrick, 2010, p. 174). *Green information systems* (green IS) refers to the "integrated and cooperating set of people, processes, software, and information technologies to support individual, organizational, or societal goals" (Watson et al., 2010, p. 24). Building on prior research (Lambin & Thorlakson, 2018), we define *green IT standards* as a set of legitimized green IT practices, guidelines, or rules developed by an actor or actors (e.g., a recognized authority, stakeholders, experts) and used by other actors (e.g., manufacturers, businesses, service providers).

[3] This potential for a "dual focus" to distract a firm's attention from leveraging green IT standards was manifested in the firm *ElectronicsCo*, where an executive we interviewed indicated that the cost-driven aspect of the firm's dual focus was often a source of tension and hindrance to achieving the firm's sustainability motives (See Results section).

[4] We use the term "sustainability standards" to refer to voluntary environmental standards more generally, and the term "green IT standards" to refer to sustainability standards in the context of IT. As we discuss in the Moderating Role of Environmental Focus and Cost Focus in Green IT Organizational Strategy section, although there has been research on sustainability standards in the sustainability literature, there is scant research on green IT standards.

[5] Our use of strategy as a moderator is similar to research in information systems (e.g., Mithas & Rust, 2016), marketing (e.g., Olson et al., 2005), and management (e.g., Tang et al., 2012). In these studies, a strategy-related variable moderates the effect of an independent variable on firm performance. These studies thus use a moderation logic to explain "an unexpectedly weak or inconsistent relation between a predictor and a criterion variable" (Baron & Kenny, 1986, p. 1178). We thank the associate editor for motivating this explanation.

Theory and Hypotheses

Background and Conceptual Framework

Before developing our hypotheses, we motivate the three constructs in our conceptual framework (green IT standards, green IT organizational strategies, and environmental and economic impacts) and provide relevant background information. Figure 1 shows our conceptual framework.

Green IT Standards

Green IT standards are an important type of sustainability standard and environmental management lever for firms (DesAutels & Berthon, 2011; Gilbert et al., 2011), especially considering the advanced functionality of such developments as embedded artificial intelligence, smart buildings, and Internet of Things. Although there is scant research on green IT standards, we draw on the broader environmental sustainability literature that reports mixed empirical findings on whether voluntary sustainability standards improve the performance of adopting firms and suggest at least five reasons for such mixed results.[6]

First, sustainability standards require complementary investments (Delmas & Pekovic, 2013). Second, sustainability standards *on their own* may not confer better environmental performance due to variation across facilities, such as infrastructure and capacity to support sustainability standards (Barla, 2007). Third, a firm may become certified but not actually adopt internal processes that improve environmental performance (King et al., 2005). Such a lack of commitment to standards may lead to a symbolic rather than substantive implementation of these standards (Vigneau et al., 2015). Fourth, the motivations manifested in strategic or managerial practices related to implementation may inhibit the integration of sustainability standards in firms (Boiral, 2007). Fifth, variations in environmental strategies may create differences in complementary assets that support sustainability standards (Christmann, 2000).

Many of these reasons for the mixed evidence of broader sustainability standards identified in the sustainability literature may also apply to green IT standards and therefore point to the importance of considering organizational strategy related to green IT standards. Another reason for the lack of effectiveness of green IT standards may be that these green IT standards may be incomplete. For instance, data centers may measure power usage effectiveness without considering whether computing power is being put to good use or what type of energy source is used to power the data center.

Green IT Organizational Strategies

Prior research suggests that firms can have one of two broad emphases for their green IT organizational strategy—a cost focus or an environmental focus. Concerning environmental strategy, some practices are "linked to cost advantage, such as process-focused practices that increase efficiency and productivity and reduce inputs and wastes." In contrast, other practices involve a "redesign for the environment and highlighting the environmental attributes of products and services" (Aragón-Correa & Sharma, 2003, p. 74).[7] A cost focus involves reducing the environmental impact through an increase in efficiency and a corresponding reduction in costs (Watson et al., 2011). A cost-focused green IT organizational strategy includes actions such as data center cooling and reducing server power consumption for improved efficiency, whereas an environmental focus prioritizes solutions to ecological problems rather than cost (Watson et al., 2011). An environment-focused green IT organizational strategy includes actions such as a preference for more costly green product suppliers over less costly and more power-consuming product suppliers and hiring green IT consultants to revamp systems and processes. Such environment-focused actions may increase the overall cost of operations compared to a cost focus. Because firms can have an environment-focused and a cost-focused green IT organizational strategy to varying degrees, we also study the implications of a dual green IT organizational strategy that is simultaneously focused on both cost and the environment.[8]

[6] See Appendix Table A1 (Appendices are available at https://osf.io/hcw79/?view_only=f69368d2267f4e6cbbcec3a29347e57e). Some studies even suggest that sustainability standards may be a mere marketing device to improve a firm's corporate image without impacting financial or environmental outcomes (Szymanski & Tiwari, 2004; Wagner, 2010). Thus, there is no empirical consensus on the impacts of sustainability standards on firm performance (Dowell et al., 2000). Regarding green IT standards (i.e., sustainability standards in the context of IT), although scholars have studied the association between IT sustainability practices and environmental or financial performance (e.g., Nishant et al., 2017; Watson et al., 2012; see Table A2 and Figure A1), how green IT standards intertwine with organizational strategy to help firms achieve sustainability capability and financial performance is unexplored.

[7] Watson et al. (2011) point to a dichotomy between eco-efficiency and eco-effectiveness. Eco-efficiency focuses on the "delivery of competitively-priced goods and services that satisfy human needs and bring quality of life, while progressively reducing ecological impacts and resource intensity, .. [whereas] environmentalists see a goal beyond eco-efficiency; they advocate eco-effectiveness." For example, "pursuing eco-efficiency, a firm may reduce consumption of coal-generated electricity. An eco-effective organization would instead switch to renewable resources" (p. 60). Our focus on the cost and environmental dimensions builds on prior research and centers our inquiry on two significant areas in which firms seek to leverage environmental sustainability initiatives (e.g., Tang et al., 2012).

[8] Our approach of studying dual-focused strategy is similar to IT business value research that considers a dual focus (Mithas & Rust, 2016).

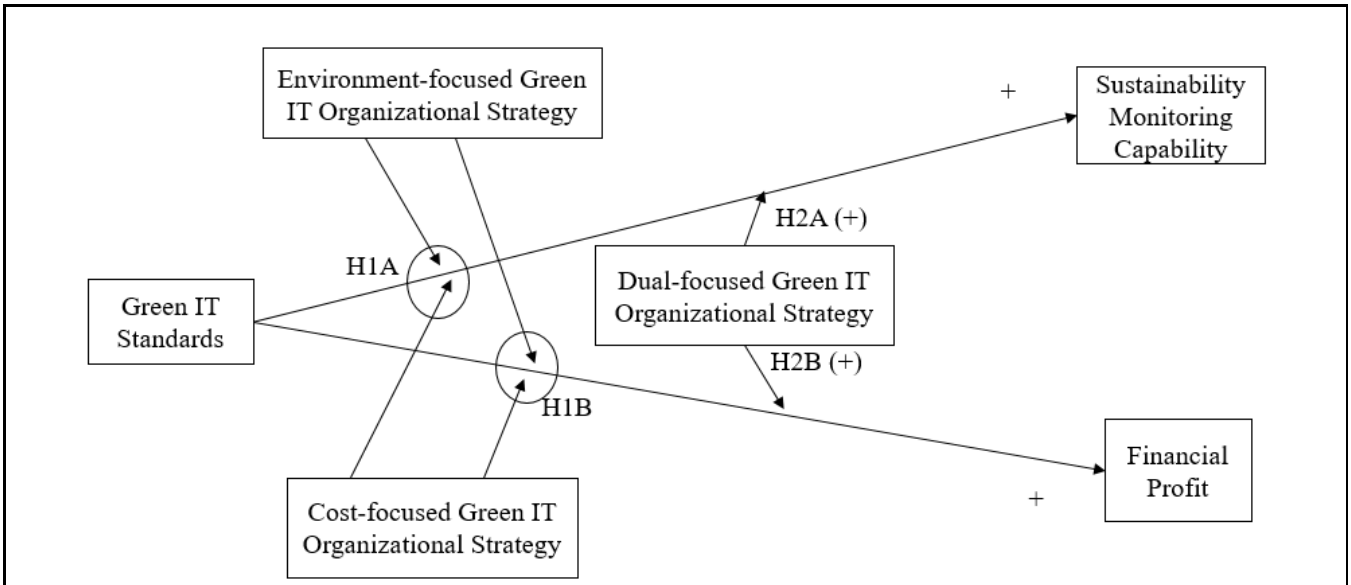

Figure 1. Conceptual Framework

Environmental and Economic Impacts

We assess the environmental and economic dimensions of impacts in our conceptual model. As discussed and defined earlier, we focus on sustainability-monitoring capability for the environmental dimension. Such monitoring includes a firm's scanning of emerging sustainability requirements and relates to the sensing component of dynamic capabilities. Of the three dynamic capability components (sensing, seizing, and reconfiguring), sensing makes the largest contribution to sustainability (Mousavi et al., 2018). Sensing involves organizational routines that monitor internal and external market sources to collect information about customer needs, suppliers, and opportunities. Monitoring internal data sources is important in enabling firms to gather information and reconfigure internal resources (Mousavi et al., 2018); moreover, monitoring external market information enables firms to integrate that information into their business operations (Amui et al., 2017). We focus on financial profit for the economic dimension, consistent with prior conceptual frameworks linking environmental practices to financial performance (DesAutels & Berthon, 2011).

Hypotheses

Before we develop our hypotheses of the moderating effects as a baseline, we first discuss three mechanisms through which we expect green IT standards to influence sustainability-monitoring capability and financial performance: by serving as a guide for process improvement, creating a learning platform, and enhancing organizational legitimacy.[9] First, green IT standards help quantify sustainability metrics and set boundaries and targets (Melville & Whisnant, 2014); they also facilitate the creation and documentation of policies and procedures to enhance sustainability monitoring (Green et al., 2012). Green IT standards help firms formalize their metrics for auditing and compliance, thus supporting the development of their sustainability-monitoring capability (El-Gayar & Fritz, 2006). Green IT standards support process improvements in terms of low energy consumption, low IT operating expenditures, and high resource efficiency, all of which contribute to reduced costs and higher profits (Khuntia et al., 2018; Nishant et al., 2017).

[9] Although one could argue that sustainability-monitoring capability may lead to the adoption of green IT standards, prior empirical and conceptual research suggests that this is highly unlikely. Empirical research on the voluntary adoption of green standards indicates that environmental and economic benefits are key outcomes of the adoption of voluntary standards: "actual economic and/or environmental benefits that are a direct result of the standard" (Corbett & Muthulingam, 2007, p. 2), strongly suggesting a temporal flow of standard adoption leading to achieving or not achieving the performance outcome. In our extensive review of related literature, we did not find any article that suggested the reverse direction. Thus, the direction of the relationship is from *green IT standards* to *sustainability-monitoring capability*.

Second, green IT standards create a learning platform to improve sustainability-monitoring (sensing) capability. By codifying repeatable and sustainable business processes, green IT standards provide a structure for firms to engage in learning that fosters the capability to monitor sustainability objectives (Melville & Whisnant, 2014). Green IT standards facilitate the reporting and tracking of sustainability requirements, helping to reduce the overhead associated with green IT standards such as ISO 14001 through documentation management and control (El-Gayar & Fritz, 2006). Standards audits induce firms to uphold their commitment to standards and increase their sustainability-monitoring capability (Potoski & Prakash, 2005). As green IT standards promote environmental cognition among employees (Jenkin et al., 2011), the learning attained from these standards enhances efficiency and profit via lower cycle times and higher productivity (Isaac et al., 2003).

Finally, green IT standards enhance firms' organizational legitimacy with customers and business partners (El-Gayar & Fritz, 2006), given that these standards signal that these firms have specific capabilities and serve as guidelines to improve their capabilities (Delmas & Pekovic, 2013). Green IT standards also attract environmentally conscious customers, resulting in improved sales and market share (Nishant et al., 2017).

Moderating Role of Environmental Focus and Cost Focus in Green IT Organizational Strategy

Why are green IT standards more effective when a firm has an environmental focus versus a cost focus in its green IT organizational strategy? We build on prior research to formulate four reasons. First, firms with an environment-focused green IT organizational strategy are more likely to make complementary investments in human resource, social, financial, and environmental-related areas, resulting in benefits from standards compared to firms with a cost focus (Jenkin et al., 2011). In contrast, firms with a cost focus may resist investing in complementary resources and may do little to advance performance when adopting green IT standards. Because the adoption of green IT standards requires complementary investments in operational modifications and resources (Dao et al., 2011), due to a lack of complementary investments by cost-focused firms, standards may improve performance only marginally for simple "low-hanging fruit" problems faced by cost-focused firms (Simpson et al., 2012, p. 90). Conversely, compared with cost-focused firms, environment-focused firms make more investments that complement green IT standards to improve their sustainability-monitoring capability.

Second, an environment-focused green IT organizational strategy fuels the development of dynamic capabilities and helps green IT standards serve as a learning platform. Benefiting from green IT standards calls for engaging the workforce, which requires a cultural shift that embeds sustainable IT into work routines (Curry et al., 2012). Firms with a cost focus may not invest in operational capabilities or changes that would provide a fit with their adopted green IT standards (Chuang & Huang, 2015; Simpson et al., 2012). Cost-focused firms may seek to reduce the risk and cost associated with green IT standards and are unlikely to fully leverage green IT standards to develop related dynamic capabilities (Melnyk et al., 2003). In contrast, environment-focused firms make investments to reconfigure resources in ways consistent with green IT standards, in turn developing the dynamic capability of sustainability monitoring.

Third, an environment-focused green IT organizational strategy reflects efforts by top management to initiate and prioritize sustainability activities that strengthen green IT standards' contributions to sustainability-monitoring capability and financial performance (Hart, 1995). The environmental focus involves managerial systems that integrate environmental metrics with other process-related metrics in the firm (Hendricks & Singhal, 2001). An environmental focus is likely to be accompanied by complementary capabilities and accountability structures such as functional and technical expertise and reliable measurements of energy consumption (Melville & Whisnant, 2014). Thus, compared to a cost-focused strategy, an environment-focused green IT organizational strategy reflects a higher commitment to sustainable management practices that effectively leverage green IT standards (Molla et al., 2011).

Fourth, an environment-focused green IT organizational strategy has a broader impact than a cost-focused strategy due to its integration with operational and supply chain business processes (Lee & Klassen, 2008). Given the salience of external stakeholders, working closely with green partners embeds a green focus and culture in a firm, leading to new insights, revenue, and profit. Although an environment-focused green IT strategy may lead to higher costs (e.g., higher costs of choosing green suppliers and paying green IT consultants), such a strategy could also lead to higher profits if such increased costs are more than offset by increased revenues arising from increased legitimacy with customers and business partners (El-Gayar & Fritz, 2006). This principle in the relatively newer context of green IT strategy is consistent with the more established marketing literature, which indicates that customer willingness to pay and customer satisfaction increase when customers perceive that the product quality has increased relative to the product

price, even if the product price (and inputs such as green costs) has also increased (Fornell et al., 1996).[10]

Further, compared to firms with a cost-focused green IT strategy, firms with an environment-focused green IT strategy would be more cognizant of implementing process improvements that result in resource efficiencies and higher profit (Nishant et al., 2017).[11] Whereas a cost-focused strategy may produce one-off cost savings, such initiatives are narrower than initiatives based on an environment-focused strategy. In contrast, an environment-focused green IT strategy extends beyond the firm to stakeholders and reflects a stronger commitment by top managers to invest in activities that reinforce the effect of green IT standards on sustainability-monitoring capability and profit. This principle in the relatively newer context of green IT strategy is consistent with the information systems software literature, which posits that a focus on quality eventually reduces costs and improves performance (Krishnan et al., 2000). Compared to a cost-focused strategy, the investment and commitment required to execute an environment-focused strategy more strongly complement the investment and commitment to green IT standards. Hence, we hypothesize:

H1a: *An environment-focused green IT organizational strategy has a stronger positive moderating effect than a cost-focused green IT organizational strategy on the association between green IT standards and sustainability-monitoring capability.*

H1b: *An environment-focused green IT organizational strategy has a stronger positive moderating effect than a cost-focused green IT organizational strategy on the association between green IT standards and financial profit.*

Moderating Role of Dual Green IT Organizational Strategy

Our second set of hypotheses concerns the moderating effect of a dual-focused green IT organizational strategy—a strategy simultaneously focused on both cost and the environment. The idea of firms pursuing a dual strategy has emerged in environmental management research, consistent with strategy, information systems and management literature that consider dual strategies to be an increasingly viable option.[12]

The efficacy of a dual-focused green IT strategy may depend on the organizational or competitive context. On one hand, pursuing both cost-focused and environment-focused strategies improves outcomes from green IT standards due to economies of scope and opportunities to apply learning from one focus to another. A firm with a dual-focused strategy can benefit from its cost focus by realizing its revenue and cost targets (e.g., via lower cycle times in product development), and benefit from its environmental focus in the form of improved sustainability monitoring by making complementary investments to reconfigure resources based on green IT standards. This is consistent with the notion of ambidexterity and resonates with the dynamic capabilities perspective (Eisenhardt & Martin, 2000), clarifying the benefits of a balanced strategic orientation. For example, firms may orient their environmental strategies to dual environmental and financial outcomes per Porter's "green hypothesis" (Porter & Linde, 1995), where "success must involve innovation-based solutions that promote both environmentalism and industrial competitiveness" (Porter & Linde, 1995, p. 116). On the other hand, pursuing cost-focused and environment-focused strategies simultaneously may diminish the effectiveness of green IT standards due to a lack of focus and spreading resources too thinly across different strategic initiatives. For example, due to its emphasis on the environment and cost, a dual-focused strategy may constrain a firm from investing in costly practices (e.g., training) that could more fully leverage green IT standards for sustainability monitoring.

We argue that a dual emphasis may be less challenging to pursue in the green IT context, due to more rigorous decision-making resulting from leadership commitment to an environment-focused strategy, leading to better sustainability monitoring, and reduced costs leading to

[10] *AutoCo*, a company we interviewed (see Appendix Table C8), provides an illustration of this principle. Although *AutoCo* incurred additional costs by including environmental management as a criterion for supplier selection, and also incurred additional costs by conducting regular detailed audits of its suppliers, *AutoCo* believes that its sustainability focus and "environmental gearing" helped the firm deliver higher-quality products. *BankCo*, another firm we interviewed, provides another illustration of this principle. *BankCo* has a "social impact return on investment" as a significant priority for its senior managers. While the *BankCo* executive we interviewed acknowledged that sustainability actions can increase employee workloads, *BankCo* believes that its priority on the "social impact return" and sustainability actions portray *BankCo* as a responsible bank and help *BankCo* acquire and retain customers.

[11] For example, *AutoCo* (see Appendix Table C8) implemented green IT standards with an environmental focus, which helped the firm increase its level of rigor by analyzing processes at a more granular level, thereby leading to lower costs and higher profits. In addition to delivering higher-quality products, *AutoCo* believes that it reduced the cost and waste of its vehicles through green principles.

[12] The notion of a dual strategy is consistent with the strategic ambidexterity thesis, which argues that firms can pursue efficiency for the current business environment (exploitation) while being adaptable to changing environments (exploration). Some empirical research supports the ambidexterity thesis (He & Wong, 2004), whereas others find mixed or no support (Atuahene-Gima, 2005).

higher profitability. Hence, notwithstanding competing views and a general lack of empirical evidence, we posit a baseline hypothesis that a dual-focused strategy positively shapes the relationship between green IT standards and performance. Thus, we hypothesize:

H2a: *A dual-focused green IT organizational strategy positively moderates the association between green IT standards and sustainability-monitoring capability.*

H2b: *A dual-focused green IT organizational strategy positively moderates the association between green IT standards and financial profit.*

Method

Empirical Context and Data

We use data from organizations in India, a country that is a global leader in IT and IT-related services and one of the world's largest economies. India has made significant strides in IT since the late 1980s, fueled by the 1990s dot-com era and the 2000s e-commerce era, during which many e-commerce vendors set up operations in India (Jalote & Natarajan, 2019). Such IT-related services need data centers, IT equipment, and offices with air conditioning systems to withstand the hot Indian climate, which has added to environmental pollution in India (Magazzino et al., 2021). Such developments have led to local pressures and steps to curb environmental damage through the use of sustainability standards and environmental approaches during the time frame of our study.[13]

We combined data from two sources. The first data source is an archival survey conducted by a leading market research firm in India in 2009. The research firm collected data following a structured protocol of face-to-face interviews with the senior employees of each respondent firm, including chief information officers, IT leaders, and other senior IT executives. The seniority of the respondents ensures that they are well-versed in their firm's sustainability practices.[14] To avoid response bias, the respondents were assured anonymity. Of the 293 firms that responded to the survey, 243 firms gave complete responses for our variables of interest, and we discarded the 50 firms that gave incomplete responses (some estimation models have fewer than 243 observations due to missing data points for some variables). Second, we collected data on firm characteristics and profits from a secondary database maintained by the Centre for Monitoring the Indian Economy (CMIE) for the firms in our data set for which data were available.[15] By combining the archival survey data with the CMIE data, we triangulated our results across the two data sources to enhance our study's richness and robustness.

We operationalized the variables following prior research. Table 1 summarizes the key variable definitions, descriptive statistics, and correlations, with details in Appendix C and Appendix Table C1. Appendix Table C2 provides the distribution of industries in our sample.[16]

Empirical Models and Econometric Considerations

For the *sustainability-monitoring capability* models, we use the probit estimator because the dependent variable is binary. For the *profit* models, we use the ordinary least squares (OLS) estimator because the dependent variable is continuous. To test H1a and H1b, we estimate Equation (1):

$$Y = \text{f}\ (\textit{Green IT standards}, \textit{Cost-focused green IT organizational strategy}, \textit{Environment-focused green IT organizational strategy}, \textit{Green IT standards} \times \textit{Cost-focused green IT organizational strategy}, \textit{Green IT standards} \times \textit{Environment-focused green IT organizational strategy}, \text{Control variables}) \quad (1)$$

where Y is the dependent variable. We tested H1a and H1b by conducting chi-square tests (or F-tests) of the difference in the coefficients of the interactions *Green IT standards* × *Environment-focused green IT organizational strategy* and *Green IT standards* × *Cost-focused green IT organizational strategy*.[17]

[13] For example, the Indian government articulated several measures to curb environmental damage, culminating in the important *National Green Tribunal Act* of 2010 (Government of India Ministry of Law and Justice, 2010), which recommended several environmental actions.

[14] Many studies recognize that IT executives are well aware of IT implementations and practices (Ravichandran & Rai, 2000).

[15] Of the 243 firms, 182 firms were present in the CMIE database that provided the data on *profit*. Some of the 182 firms are dropped from the *profit* analysis due to missing data. We also dropped outliers based on Cook's distance and studentized residuals, leaving a final sample of 239 firms for the *sustainability-monitoring capability* models and 114 firms for the *profit* models.

[16] Appendices are available at https://osf.io/hcw79/?view_only=f69368d2267f4e6cbbcec3a29347e57e

[17] It would not be appropriate to compare the "environment-focused green IT strategy" with "the best of a cost-focused strategy" because it is better to compare strategies in the average form rather than compare the average level of one strategy with the "best of" another strategy. Also, we do not have data on the "best of" either the environment-focused or cost-focused strategy.

Table 1. Descriptive Statistics and Correlations, and Measurements of Key Variables

		Mean	*SD*	Min	Max	1	2	3	4	5	6
1	*Profit*	0.20	0.11	-0.11	0.36	1					
2	*Sustainability-monitoring capability*	0.17	0.37	0	1	0.28*	1				
3	*Green IT standards*	3.24	1.73	0	6	-0.14	0.24*	1			
4	*Cost-focused green IT organizational strategy*	0.25	1.37	-1.05	2.45	0.32*	0.21*	0.04	1		
5	*Environment-focused green IT organizational strategy*	0.07	1.26	-0.43	2.21	0.08	0.24*	0.11	0.16*	1	
6	*Dual-focused green IT organizational strategy*	0.12	0.32	0	1	0.07	0.28*	0.06	0.46*	0.74*	1
7	*Leadership commitment*	0.79	0.41	0	1	0.27*	0.17*	0.16*	0.11	0.12	0.16*
8	*Multinational*	0.21	0.41	0	1	-0.09	0.12	0.14*	0.09	0.13*	0.18*
9	*Private*	0.55	0.50	0	1	-0.03	-0.17*	-0.17*	-0.13*	-0.21*	-0.15*
10	*Public sector*	0.09	0.28	0	1	0.19	-0.05	-0.04	0.11	0.09	-0.03
11	*Government*	0.13	0.33	0	1	0.01	0.13*	0.13*	-0.02	0.01	0.01
12	*Size*	3.90	2.16	1	7	0.31*	0.05	-0.06	0.17*	0.03	0.02
13	*Green IT budget*	1.84	0.63	1	3	0.29*	0.21*	0.06	0.22*	0.13*	0.09
14	*Sourcing challenges*	1.48	0.63	0	3	-0.02	-0.00	0.08	0.03	0.03	0.02
15	*Share information*	0.54	0.50	0	1	0.12	0.06	0.25*	-0.03	0.09	0.13*
16	*Awareness*	0.45	0.49	0	1	0.09	0.02	0.24*	0.03	0.12	0.13*
17	*Industry green IT standards*	3.08	1.60	0.20	4.40	0.08	0.03	0.20*	-0.02	-0.03	-0.06

		7	8	9	10	11	12	13	14	15	16
7	*Leadership commitment*	1									
8	*Multinational*	0.02	1								
9	*Private*	-0.04	-0.57*	1							
10	*Public sector*	0.09	-0.16*	-0.34*	1						
11	*Government*	-0.05	-0.19*	-0.42*	-0.11	1					
12	*Size*	0.04	-0.11	-0.04	0.25*	0.02	1				
13	*Green IT budget*	0.08	0.07	-0.11	0.17*	-0.04	0.27*	1			
14	*Sourcing challenges*	0.13*	0.01	0.08	0.02	-0.14*	-0.13*	-0.01	1		
15	*Share information*	0.28*	0.21*	-0.19*	0.14*	-0.06	0.04	0.18*	0.11	1	
16	*Awareness*	0.14*	0.13	-0.22*	0.07	0.14*	-0.03	0.11	0.04	0.33*	1
17	*Industry green IT standards*	-0.03	0.01	0.02	-0.11	0.06	-0.15*	-0.01	0.03	-0.05	0.01

Note: * indicates significance at $\alpha = 0.05$. Measurement of key variables (See Appendix Table C1 for details and other variables): *Profit:* Profit after tax for the subsequent year from the Centre for Monitoring Indian Economy (CMIE), computed as a ratio to sales. *Sustainability-monitoring capability*: Ability of the organization to monitor environmental sustainability goals. 1= Yes, 0 = No. *Green IT standards:* Number of green IT standards implemented/followed in the organization. *Cost-focused green IT organizational strategy:* This variable comprises three formative binary measures that indicate the cost-focused green IT processes implemented by the firm. *Environment-focused green IT organizational strategy:* This variable comprises three formative binary measures that indicate the environment-focused green IT processes implemented by the firm. *Dual-focused green IT organizational strategy:* Binary variable defined as 1 if both *cost-focused green IT organizational strategy* and *environment-focused green IT organizational strategy* are above their median values, and 0 otherwise.

To test H2a and H2b, we estimate Equation (2):

$$Y = f(\textit{Green IT standards}, \textit{Dual-focused green IT organizational strategy}, \textit{Green IT standards} \times \textit{Dual-focused green IT organizational strategy}, \text{Control variables}) \quad (2)$$

To account for the possibility that firms may self-select into using more green IT standards based on observable or unobservable factors, we used two approaches. First, we used the two-stage estimation approach with a control function approach, as suggested by Garen (1984), which has also been used in other firm-level research (Saldanha et al., 2017).[18] Second, we used two-stage least squares for the *profit* models, and bivariate probit for the *sustainability-monitoring capability* models.[19] As an instrument variable in the two-stage models, we used the average of green IT standards at the industry level (excluding the focal firm).[20]

[18] Appendix B provides further technical details and models pertaining to Garen's (1984) approach.

[19] We also use seemingly unrelated regression equation models to account for the potential correlation of error terms in the *sustainability-monitoring capability* and *profit* models.

[20] Because the industry average use of green IT standards is likely to drive the use of standards in the focal firm, but is unlikely on its own to improve firm sustainability-monitoring capability or profit, the industry average use of green IT standards is an appropriate instrument and aids in model identification. Our approach and reasoning for using the industry average of

In the first stage, we also included additional variables that may influence the firm's use of green IT standards. These include the extent to which the firm's chief information officer (CIO) shares green IT information with the CIOs of other firms (*ShareInfo*), and a variable that proxies for a firm's awareness of government sustainability energy policy (*Awareness*).[21] As detailed in Appendix B, we conducted several tests to assess instrument validity. These tests include: (1) examining the significance of the coefficient of the instrument in the first stage, (2) the *F*-tests of excluded instruments, (3) Lagrange multiplier tests for underidentification, (4) Sargan test and Basmann test for overidentifying restrictions; and (5) Craig-Donald Wald tests for weak identification.

Results

Table 2 shows the results for H1a and H1b. In the *sustainability-monitoring capability* model, the coefficient of *green IT standards* is positive and significant (Column 1, $\beta = 0.267$, $p < 0.05$). The interaction between *green IT standards* and *cost-focused green IT organizational strategy* is not significant (Column 2, β = ns), and the interaction between *green IT standards* and *environment-focused IT organizational strategy* is positive and significant (Column 2, $\beta = 0.802$, $p < 0.01$). In the *profit* model, the coefficient of *green IT standards* is not significant (Column 3, β = ns); the interaction between *green IT standards* and *cost-focused green IT organizational strategy* is positive and marginally significant (Column 4, $\beta = 0.005$, $p < 0.10$), and the interaction between *green IT standards* and *environment-focused green IT organizational strategy* is positive and significant (Column 4, $\beta = 0.037$, $p < 0.01$). We find support for H1a because a chi-square test comparing the coefficients of the interactions is significant (Column 2, chi-square = 11.902, $p < 0.01$). We find support for H1b because an *F*-test comparing the interaction coefficients is significant (Column 4, $F = 9.217$, $p < 0.01$).

Table 3 shows the results for H2a and H2b. In the *sustainability-monitoring capability* model, the interaction between *dual-focused green IT organizational strategy* and *green IT standards* is not significant (Column 2, $p > 0.10$), providing no support for H2a. In the *profit* model, the interaction between *dual-focused green IT organizational strategy* and *green IT standards* is positive and significant (Column 4, $\beta = 0.085$, $p < 0.01$), supporting H2b.

Although not the main focus of this study, the coefficients of the organizational strategy variables merit discussion. In the *sustainability-monitoring capability* model shown in Table 2, the coefficient of *cost-focused green IT organizational strategy* is positive and significant in Column 1 ($\beta = 0.601$, $p < 0.01$), indicating a positive effect at the mean value of green IT standards, while it is also positive and significant at the zero value of green IT standards in Column 2 ($\beta = 0.805$, $p < 0.01$). Without overinterpreting the result (particularly for Column 2, which also has interaction effects rendering the interpretation conditional), one plausible explanation for this finding may be that a cost-focused green IT organizational strategy could be associated with a culture of discipline that leads to sustainability-monitoring capability, even in the absence of green IT standards. A plausible explanation for the positive and significant coefficient of the *cost-focused green IT organization strategy* in the *profit* model ($\beta = 0.029$, $p < 0.05$, Column 3 of Table 2) is that a cost focus encourages a broad emphasis on increasing the efficiency of the firm's operations.

The positive and marginally significant coefficient of *environment-focused green IT organizational strategy* in the *sustainability-monitoring capability* model ($\beta = 0.164$, $p < 0.1$, Column 1 of Table 2) suggests that, at the mean value of green IT standards, the environment-focused strategy has a positive effect on *sustainability-monitoring capability*, as expected.[22] In contrast, for the *profit* model in Table 2, the coefficient of the *environment-focused green IT organizational strategy* is nonsignificant in Column 3 ($p > 0.10$), and negative and significant in Column 4 ($\beta = -0.022$, $p < 0.05$) at the zero value of *green IT standards*. A plausible explanation may be that the environment-focused green IT organizational strategy *on its own* may entail a higher cost for the firm (e.g., choosing green product suppliers over less costly more power-consuming product suppliers).

green IT standards as an instrument for firm-level green IT standards are consistent with prior studies in the sustainability literature that apply the industry use of standards as an instrument for the firm's use of standards (Barla, 2007), and other studies that use industry IT intensity as an instrument for firm IT intensity (e.g., Kleis et al., 2012; Saldanha et al., 2020). Similar to prior studies (Barla, 2007), the average of green IT standards at the industry level is computed using the sample firms.

[21] *ShareInfo* and *Awareness* likely influence green IT standards use, as they imply a firm's high exposure to information on standards. The results are retained with or without these variables.

[22] As Column 2 of Table 2 shows, the *environment-focused green organizational IT strategy* term is not statistically significant once the interaction with *green IT standards* is included in the model. Although we are cautious not to overinterpret the main effect coefficient in the presence of an interaction term, this suggests that at the zero value of *green IT standards*, *environment-focused green organizational IT strategy* has no significant effect on *sustainability-monitoring capability*. This is intuitive because it implies that an environment-focused strategy may be less impactful unless accompanied by green IT standards.

Table 2. How Cost-Focused and Environment-Focused Green IT Organizational Strategy Moderate the Relationship between Green IT Standards and Sustainability-Monitoring Capability and Profit

Variables	Tests for H1a and H1b			
	(1)	(2)	(3)	(4)
	Sustainability monitoring capability	Sustainability monitoring capability	Profit	Profit
Green IT standards	0.267** (0.124)	0.121 (0.220)	0.005 (0.013)	-0.018 (0.012)
Cost-focused green IT organizational strategy	0.601*** (0.121)	0.805*** (0.205)	0.029** (0.012)	0.008 (0.013)
Environment-focused green IT organizational strategy	0.164* (0.097)	-0.109 (0.148)	-0.004 (0.011)	-0.022** (0.011)
Green IT standards × Cost-focused green IT organizational strategy		**-0.056 (0.043)**		**0.005* (0.003)**
Green IT standards × Environment-focused green IT organizational strategy		**0.802*** (0.244)**		**0.037*** (0.010)**
Leadership commitment	0.616 (0.545)	0.880 (0.652)	0.059 (0.036)	0.064* (0.033)
Multinational	0.013 (1.009)	0.100 (1.092)	0.085 (0.153)	-0.035 (0.138)
Private	-0.185 (0.982)	-0.715 (1.077)	0.099 (0.150)	-0.031 (0.136)
Public sector	-1.165 (1.095)	-2.200* (1.324)	0.142 (0.148)	0.029 (0.133)
Government	-0.018 (1.052)	-0.037 (1.106)	0.115 (0.154)	0.004 (0.139)
Firm size	-0.075 (0.072)	-0.099 (0.081)	0.009 (0.008)	0.008 (0.007)
Green IT budget	0.675*** (0.237)	0.208 (0.312)	0.079*** (0.025)	0.061*** (0.022)
Sourcing challenges	-0.284 (0.247)	-0.215 (0.298)		
Industry dummy variables	Included	Included	Included	Included
Number of firms	239	239	114	114
R-squared (or pseudo *R*-squared)	0.442	0.589	0.525	0.637
Log likelihood	-60.226	-44.350		
Chi-square (or *F*-statistic)	95.451***	127.205***	2.802***	4.077***
Chi-square (or *F*) test of difference in interaction terms		**11.902*** **		**9.217*** **
Area under the receiver operating characteristics (ROC) curve	0.918	0.961		
Pearson goodness-of-fit test *p*-value	0.994	1.000		
Percent correctly classified by the model	87.87%	91.63%		

Note: (1) Robust standard errors are in parentheses. (2) *10%, **5%, and ***1% levels. (3) The intercept is included in the equations but is omitted from this table for brevity. (4) We also tested models by introducing the interaction terms one at a time and found substantively similar results.

Table 3. How Dual-Focused Green IT Organizational Strategy Moderates the Relationship between Green IT Standards and Sustainability-Monitoring Capability and Profit

Variables	Tests for H2a and H2b			
	(1)	(2)	(3)	(4)
	Sustainability monitoring capability	Sustainability monitoring capability	Profit	Profit
Green IT standards	0.488*** (0.115)	0.463*** (0.124)	0.016 (0.014)	0.009 (0.013)
Dual-focused green IT organizational strategy	1.373*** (0.341)	1.243*** (0.399)	0.032 (0.059)	-0.079 (0.059)
Green IT standards × Dual-focused green IT organizational strategy		**0.128 (0.242)**		**0.085*** (0.017)**
Leadership commitment	0.620* (0.374)	0.618* (0.368)	0.053 (0.039)	0.081** (0.031)
Multinational	0.282 (0.616)	0.192 (0.629)	0.081 (0.088)	-0.074 (0.083)
Private	0.002 (0.572)	-0.112 (0.604)	0.083 (0.079)	-0.065 (0.075)
Public sector	-0.304 (0.646)	-0.434 (0.691)	0.138* (0.076)	0.014 (0.080)
Government	0.186 (0.657)	0.099 (0.672)	0.082 (0.087)	-0.052 (0.085)
Firm size	-0.016 (0.067)	-0.020 (0.066)	0.016** (0.008)	0.012* (0.007)
Green IT budget	0.685*** (0.241)	0.674*** (0.241)	0.067** (0.026)	0.041 (0.027)
Sourcing challenges	-0.247 (0.197)	-0.240 (0.197)		
Industry dummy variables	Included	Included	Included	Included
Number of firms	239	239	114	114
R-squared (or pseudo *R*-squared)	0.378	0.379	0.503	0.614
Log likelihood	-67.199	-67.073		
Chi-square (or *F*-statistic)	62.852***	61.715***	2.683***	4.031***
Area under the receiver operating characteristics (ROC) curve	0.894	0.896		
Pearson goodness-of-fit test *p*-value	0.961	0.962		
Percent correctly classified by the model	88.28%	88.28%		

Note: (1) Robust standard errors are in parentheses. (2) *10%, **5%, and ***1% levels. (3) The intercept is included in the equations but is omitted for brevity. (4) We also tested models by introducing the interaction terms one at a time and found substantively similar results.

Interpreting the coefficient of *environment-focused green IT organizational strategy* (Column 4 of Table 2, $\beta = -0.022$, $p < 0.05$) in combination with its interaction with *green IT standards* (Column 4, $\beta = 0.037$, $p < 0.01$) suggests that the marginal effect of *environment-focused green IT organizational strategy* on *profit* is negative for firms that adopt no green IT standards (i.e., *green IT standards* = 0), but is positive for firms that adopt at least one green IT standard. This makes sense and suggests that firms incur a higher financial cost (thus, reduced profit) from the green IT organizational strategy unless they implement some green IT standards. Considering the moderating effects in Columns 2 and 4 of Table 2, caution is needed in interpreting the effects of strategies at zero values of the interaction terms.

Appendix Table C7 shows the second-stage endogeneity-corrected models with the endogeneity-correction terms

computed from the first stage (Garen, 1984).[23] The results for all hypotheses are substantively retained, implying robustness to endogeneity. For further robustness, we used two-stage least squares models and limited information maximum likelihood models to test the profit hypotheses and obtained similar results (Appendix Table C4). Using a bivariate probit estimator for the *sustainability-monitoring capability* models provides similar results.[24] In sum, across various estimation approaches, hypotheses H1a, H1b, and H2b are supported, whereas hypothesis H2a is not supported.

We conducted further robustness checks (see Table 4), including tests for confounding variables, common method bias, selection bias, reverse causality, standards implementation dates, sample power, and other tests, which point to the robustness of the results and collectively address potential endogeneity concerns (Mithas, Y. Chen et al., in press). As discussed in Appendix B, the results of our tests for instrument validity suggest that our instrument strategy is valid.

For additional insights, we conducted semi-structured interviews with senior executives from four firms in India that implemented green IT standards. These executives had at least five years of experience in their firm and were intimately familiar with the implementation of green IT standards in their respective firms. The four firms represent a range of industries and green IT strategies. Consistent with our quantitative analysis, *AutoCo* and *BankCo* are examples of firms that implemented green IT standards with an environmental focus and achieved both sustainability benefits and cost benefits. *PharmaCo* and *ElectronicsCo* are examples of firms that implemented green IT standards with a cost or dual focus but could not achieve sustainability benefits. Overall, the four executives provided insights that complement our theorizing and quantitative analysis (see Appendix Table C8).

Our first finding that green IT standards have a stronger positive association with sustainability-monitoring capability and profit when accompanied by an environment-focused green IT organizational strategy versus a cost-focused green IT organizational strategy is supported by the contrasting examples of *BankCo* and *PharmaCo*, whose representatives we interviewed for this study. While *BankCo* believes that its environmental focus has been instrumental to benefiting from green IT standards and achieving improved financial performance across its elaborate branch network, *PharmaCo* believes that its cost focus distracted plant managers and factory workers from achieving its sustainability objectives. An executive we interviewed stated, "When the company is so hell-bent on saving cost, standards are pretty darn ineffective."

Our second finding that a dual-focused green IT organizational strategy positively moderates the association between green IT standards and profit, but not the association between green IT standards and sustainability-monitoring capability, is also validated. The senior IT executive we interviewed from *ElectronicsCo* indicated that the firm's attempt to use a dual focus was a source of tension and a hindrance to achieving its sustainability objectives. The executive stated, "We [*ElectronicsCo*] are neither here nor there when it comes to sustainability ... Our sustainability outcomes have suffered." The interviews suggest that the lack of impact of a dual focus on sustainability outcomes stems from the incompatibility between cost savings and investments needed for sustainability.

Discussion

Findings and Contributions

Our study contributes to a better understanding of how organizational strategy interacts with green IT standards to advance sustainability and profit. We respond to the call from prior research that emphasizes the need to "shift to the right end of the value chain" and study the "impact of green IS," noting that "very little research" has been conducted on the "impact dimensions [of green IS]" (Malhotra et al., 2013, pp. 1266-1267, 1270). Our study documents two key findings. First, green IT standards have a stronger positive association with sustainability-monitoring capability and profit when accompanied by an environment-focused green IT organizational strategy than when accompanied by a cost-focused green IT organizational strategy. Second, a dual-focused green IT organizational strategy positively moderates the association between green IT standards and profit, but not the association between green IT standards and sustainability-monitoring capability.

This study makes four contributions. First, we develop an integrative conceptual framework of green IT standards that incorporates green IT organizational strategy and environmental and financial outcomes to generate new insights using a moderation logic, which is distinct from a related study (Benitez-Amado & Walczuch, 2012) that used a mediation logic to examine how IT capabilities enable a proactive corporate environmental strategy that in turn influences firm performance.

[23] The first stage of the model (shown in Appendix Table C3) is significant, with many variables being statistically significant. As expected, large firms, firms in industries with a high mean adoption of green IT standards, firms with a high awareness of energy policies, and firms that share green IT information with the IT leaders of other firms adopt more green IT standards.

[24] We also used seemingly unrelated regression estimators, which estimate the models for *sustainability-monitoring capability* and *profit* jointly. The results remain substantively unchanged.

Table 4. Additional Robustness Checks

Brief description	Action(s) performed
Alternate model specifications	Use of logit and linear specification for the *sustainability-monitoring capability* models provided similar results.
Multicollinearity	Variance inflation factors are well below the suggested thresholds, suggesting that multicollinearity is not a problem in our data.
Heteroskedasticity	Breusch-Pagan tests gave non-significant test statistics. Hence, heteroscedasticity is not a concern.
Common method bias	Harman's one-factor test showed no single major factor, suggesting that common method bias is not a problem. Moreover, because our core theory pertains to interactions, common method variance is even less of a concern, given that such variance reduces the likelihood of detecting interaction effects (Siemsen et al., 2010).
Potential confounding variables	We followed Frank's (2000) method to calculate the thresholds at which a confounding variable would nullify the significance of our focal variables to mitigate concerns about unmeasured confounding variables (Huang et al., 2018; Kim et al., 2014; Larcker & Rusticus, 2010; Saldanha et al., 2020; Whitaker et al., 2019). Frank (2000) defined the *impact threshold of a confounding variable* (ITCV) as the minimum correlation required between the confounding variable and focal variable, *and* between the confounding variable and the dependent variable that is necessary to nullify the significance of the estimated coefficient, with a higher ITCV implying that the regression coefficient is more robust to omitted variable concerns (Frank, 2000). In the *profit* models, the ITCV for the *Green IT standards* × *Environment-focused green organizational strategy* coefficient is 0.26, with a threshold correlation of 0.59 between the confounding variable and interaction term, and a threshold correlation of 0.44 between the confounding variable and dependent variable, before conditioning on the covariates. For the *sustainability-monitoring capability* models, the threshold correlation is 0.33 between the confounding variable and *green IT standards*, and 0.38 between the confounding variable and the dependent variable (*sustainability-monitoring capability*) before conditioning on the covariates. The ITCV for the *Green IT standards* × *Environment-focused green organizational strategy* coefficient is 0.35 between the confounding variable and the interaction term, and 0.37 between the confounding variable and the dependent variable. These threshold correlation values are high. To put these correlation thresholds in perspective, among all variables in our regression, the largest correlation between any independent variable and *profit* is 0.32, the largest correlation between any independent variable and *sustainability-monitoring capability* is 0.28, and the largest correlation between any control variable with the focal interactions is 0.19. Hence, a confounding variable exceeding these high correlation thresholds is very unlikely. Also, the ITCV estimates are conservative because their computation assumes that the confounding variable is not correlated with the existing covariates (Frank, 2000). To the extent that a confounding variable also correlates with covariates other than the focal variables of interest, the ITCVs of the focal variables would be even higher (Frank, 2000). In sum, these ITCV computations mitigate concerns about omitted confounding variables that would falsify the effects of the coefficients of interest.
Reverse causality	To mitigate concerns due to reverse causality, and in the absence of information on the date of implementation of green IT standards in the firms, we repeated the analyses after limiting the g*reen IT standards* variable to capture only those green IT standards that were founded at around the same time. In particular, we reanalyzed all models by restricting the *green IT standards* variable to comprise three standards (Energy Star, ISO 14000/ISO 14001, Telecommunications Certification Organization) that were founded during a more distant past time. Doing so enhanced our confidence that the maturity level of the three standards is roughly the same, given that the founding time frames of the three standards are similar. All findings are substantively unchanged (See Appendix Table C5). We also conducted a robustness test where we restricted the *green IT standards* variable to comprise the three standards (Climate Savers Computing Initiative, Green Grid, and Green Electronics Council) that were founded in a more recent (2005-2007) time frame (Butler, 2012; Goth, 2008) that is relatively close to the year of the survey (2009), with qualitatively similar results. As an exploratory approach, we assessed whether prior profitability influences green IT standards adoption. This helps us assess the causal relationships underlying our model in a Granger causality sense (Granger, 1980), similar to prior research (Atasoy et al., 2016; Terence JV Saldanha et al., 2020). We regressed *green IT standards* on *prior profit* (*profit* in the prior year) and the control variables. The coefficient of *prior profit* is not statistically significant ($p > 0.10$), mitigating reverse-causality concerns. We also regressed *sustainability-monitoring capability* on *prior profit* and obtained a nonsignificant coefficient of *prior profit* ($p > 0.10$).

Selection bias tests	We performed selection bias tests to assess (1) whether the firms that were surveyed are significantly different from the firms that were not surveyed, and (2) whether the firms included in the final sample are significantly different from those that were surveyed but dropped from the final sample due to missing variables. We compare the respondent firms with firms in the CMIE database in the same year on the financial metrics of *total assets*, *total income*, *sales*, and *profit*, using two-tailed *t*-tests of difference of the means and Levene's test for differences of the variances (Levene, 1960). The tests showed that the respondent firms as a group do not differ significantly ($p > 0.40$) in the mean or variance of these variables from other firms in the CMIE database. We compared the sample firms with the respondent firms not included in the final sample (due to incomplete responses). There is no significant difference ($p > 0.40$) between the two groups of firms in the means and variances of *firm size*, *green IT standards*, *leadership commitment*, *awareness*, *sourcing challenges*, and *ShareInfo*. Thus, the means and variances of the variables are statistically equal between the included and excluded firms, suggesting the absence of selection bias. To the extent that these tests suggest that the sample firms and respondent firms are similar to other firms in India at the time of this study (based on the CMIE database), it boosts our confidence in the generalizability of our results.
Industry idiosyncrasies	We reestimated the models by clustering the standard errors by industry, and obtained qualitatively similar results
Power tests for sample size	We conducted power tests to assess the statistical power and minimum sample size needed to detect a change in the *R*-square at the 5% significance level. The statistical power of the *sustainability-monitoring capability* model is above 0.99. For the *profit* model, the power is 0.89. These high values suggest that our models have adequate statistical power. We conducted tests to assess the required sample size, given the changes in the *R*-square in our models, assuming 0.80 power and a 5% level test. The tests indicate that sample sizes of 46 and 94 firms are required to detect corresponding increases in the *R*-square after adding interactions in the *sustainability-monitoring capability* and *profit* models, respectively. Our sample sizes of 239 and 114 firms for the *sustainability-monitoring capability* and *profit* models, respectively, are well above these required sample sizes, and are thus sufficient for our analysis. Moreover, our sample size is also similar to other firm-level studies (Khuntia et al., 2018).
Accounting for the potential effect of *sustainability-monitoring capability* on *profit*	As an exploratory analysis, we reestimated the *profit* models by including *sustainability-monitoring capability* as an additional control variable to account for the possibility that *sustainability-monitoring capability* may influence *profit*. We found a positive and significant coefficient of *sustainability-monitoring capability* in the *profit* models, consistent with the idea that capabilities may influence firm outcomes. The results for the profit hypotheses H1b and H2b are retained, suggesting that our findings are robust, even after accounting for the potential effect of *sustainability-monitoring capability* on *profit*.
Alternate ways to measure *green IT organizational strategy*	We repeated the analyses using three alternate ways of measuring green IT organizational strategy: 1. As discussed in the Empirical Models and Econometric Considerations section, we used the first principal component to compute the *green IT organizational strategy* variables. For robustness, we used a summative score of the indicators, and find substantively similar results. 2. We created a single variable for strategic orientation (*diff*) computed as: *diff = Environment-focused green IT organizational strategy - Cost-focused green IT organizational strategy*. We tested the moderating effect of this variable. The results are consistent with our main findings, i.e., we find a positive and significant interaction between *diff* and *green IT standards* in the *sustainability-monitoring capability* and *profit* models, suggesting that green IT standards have a greater effect on sustainability-monitoring capability and profit when there is a net increase in the *environment-focused green IT organizational strategy* relative to the *cost-focused green IT organizational strategy*. Nonetheless, using two variables to measure the *environment-focused green IT organizational strategy* and *cost-focused green IT organizational strategy* is more appropriate because firms can be environmental- and cost-focused to varying degrees. 3. We repeated the analysis using three binary variables created as follows: *EnvFocused* = 1 if *environment-focused green IT organizational strategy* is above the median, otherwise 0. *CostFocused* = 1 if *cost-focused green IT organizational strategy* is above the median, otherwise 0. *DualFocused* = 1 if both *environment-focused green IT organizational strategy* and *cost-focused green IT organizational strategy* are above the median, otherwise 0. The results are substantively similar to the main results. Using the mean instead of the median also yields similar results.
Additional approach to address endogeneity	We reestimated all our models by using an approach used in prior research that accounts for multiple endogenous variables in a two-stage model (Saldanha et al., 2017). This approach extends Garen's (1984) approach to multiple endogenous variables. We treat the *green IT standards* and green IT organizational strategy variables as endogenous and include endogeneity-correction terms in the models. All findings are substantively unchanged.

Second, our findings offer a reason as to why prior studies on the effects of sustainability standards on financial and environmental performance have yielded mixed results. Our results suggest that the mixed findings in prior studies can be resolved by using the moderating factor of an organizational strategic focus, which influences whether firms achieve sustainability and financial outcomes from sustainability standards. Building on the idea that firms develop sustainability systems with an eye toward either efficiency or effectiveness (Aragón-Correa & Sharma, 2003; Watson et al., 2011), our results imply that eco-effectiveness is more crucial than eco-efficiency for advancing the benefits of green IT standards. Given the role of emerging digital technologies and the emphasis on sustainability in Industry 4.0 (Mithas, Z.-L. Chen et al., in press), this contribution is important for future research.

Third, we build on prior research to articulate and explain sustainability-monitoring capability as a specific sustainability capability (Wu et al., 2013). Our definition and inclusion of sustainability-monitoring capability in our empirical models make this concept actionable in the literature. Sustainability-monitoring capability is especially important as firms seek to develop clear assessments of sustainability (Čuček et al., 2012; Lein, 2014).

Finally, our results suggest that although a dual focus can help firms leverage green IT standards for profit, it hinders firms in leveraging green IT standards for sustainability-monitoring capability. Given that dynamic capabilities involve reconfiguring resources, and because a sole focus on cost leads only to a reduction (rather than a shift) of resources, a dual focus makes it less likely that a firm will build a sensing capability. This insight is supported by our interview with *ElectronicsCo*, which attempted to use a dual-focused strategy but found that the cost aspect of the dual focus impeded the firm's ability to achieve its sustainability objectives. The *ElectronicsCo* executive we interviewed noted: "It is not easy to be sustainable while also focused on cost." Interestingly, this interview finding contrasts with prior research, which finds that a dual emphasis on the revenue and cost of IT investment is beneficial for market value but not profitability (Mithas & Rust, 2016).

Before discussing the implications, we acknowledge four limitations that open avenues for future research. First, because we use a cross-sectional design and despite our extensive robustness checks, caution is needed in attributing causality, and we call for longitudinal studies to enable stronger claims of causality (Mithas & Krishnan, 2009). Second, future work can use other measures to assess performance or sustainability outcomes (e.g., carbon reduction). Although our measures of green IT organizational strategy are consistent with the concept of *realized* strategy (Mintzberg, 1978), future work could explore alternate operationalizations. Furthermore, although the binary nature of the *sustainability-monitoring capability* variable may be viewed by some as a limitation, such measures facilitate a clear interpretation of the findings (Wanous et al., 1997), and ease communication with practitioners—a key issue for management research. Moreover, binary variables have been widely employed in prior studies (Mithas & Rust, 2016; Saldanha et al., 2020; Tallon, 2007).

Third, although our measure of green IT standards is consistent with measurement approaches in prior studies that do not account for implementation dates, and although we conducted many robustness tests to assuage reverse causality concerns, it would be useful to collect data on the implementation dates of green IT standards in firms to develop richer insights. Finally, our work is based on Indian firms; studies of firms in other nations could broaden the generalizability of our findings.

Research and Managerial Implications

This study has four main implications for research. First, our findings suggest that the effects of green IT standards on sustainability-monitoring capability and financial performance depend on the organization's green IT strategic focus. We call for research to study emphases in other functional strategies, such as autonomy versus discipline (Mithas & Kude, 2017) or centralization versus decentralization.

Second, future work could explore the implications of a strategic emphasis in other functional areas (e.g., marketing) for the effects of green IT standards on firm performance. Moreover, while we identified the underlying mechanisms to develop our hypotheses, empirically testing the mechanisms would be an avenue for future research. Third, whereas we focused on sustainability monitoring and profit, there is a need to assess the risks of different strategies, such as the downside risks of not adopting green IT standards or using unsuitable strategies.

Finally, future research could study ambidexterity in the context of green IT standards and complements (Kude et al., 2019), along with the complementary or substitutive effects among different green IT standards using configurational approaches (Park & Mithas, 2020). For example, the *ElectronicsCo* executive we interviewed mentioned that it is not easy to be sustainable while focusing on cost, suggesting that there may be a paradox in terms of sustainability and financial outcomes. While our study made some headway in understanding the type of organizational strategy required to

leverage green IT standards, we found that a dual focus was not beneficial for achieving sustainability-monitoring capability. Future research could tease out underlying reasons and identify ambidexterity-related solutions to address the plausible paradox of sustainability and financial outcomes. As such, configurations of complements may help firms develop ambidexterity to achieve environmental outcomes and profit from green IT standards, thereby addressing the paradoxical tensions in the governance of green IT standards (Wareham et al., 2014).

Our study has at least two managerial implications that are vital given the salience of green IT standards for sustainability (Masanet et al., 2020) and the renewed push from countries to limit greenhouse gas emissions (Dalton & Hua, 2021).[25] First, we uncovered the environment-focused green strategy as a key contingency that amplifies the effect of green IT standards on sustainability-monitoring capability and profit. Nonetheless, it remains unclear whether a cluster of (or a few) standards is optimal, particularly in terms of how such a choice may affect the resources available to make the required organizational changes. Although neither our empirical results nor interviews directly addressed this topic, when standards are related and reinforce one another, symbolic environmental behavior (i.e., legitimizing environmental performance without environmental commitment) may be reduced (Vílchez, 2017), raising the prospects of environmental benefits. Recent research (Wiengarten et al., 2017) has suggested that firms adopting a cluster of sustainability standards have higher environmental performance than firms adopting a single standard. Managers should determine the number of green IT standards based on the extent to which they support or reinforce each other and should be mindful of choosing organizational investments to align with the requirements of that choice.

Second, our results suggest that firms can boost sustainability-monitoring capability and profit from green IT standards by complementing the standards with an environment-focused green strategy. Whereas a dual focus can help firms leverage standards to achieve a profit, a dual focus is not beneficial for sustainability-monitoring capability. Thus, the choice of which strategy to pursue may depend on the firm's strategic objectives. Analogous to the findings of the organizational ambidexterity literature, a galvanizing strategic intent around environmental sustainability may drive the need for a dual focus. Nonetheless, as with other forms of investment, a phased investment-return strategy may be a pragmatic approach to limit risk (Cooper et al., 2000). This approach may enable a firm to progress from the introduction of green IT standards, with the impact of an enhanced sustainability-monitoring capability, to the introduction of an environment-focused green IT strategy, with the impact of enhanced profits in addition to monitoring capabilities. We suggest that managers assess their organizational capabilities and evaluate whether an environment-focused, cost-focused, or dual-focused strategy is more appropriate. Instead of viewing environment-focus and cost-focus as two ends of a spectrum, we suggest that managers view them as separate dimensions that can be managed with organizational complements (Mithas & Kude, 2017). For instance, firms lacking resources to make investments that complement green IT standards (e.g., by changing management, training, or consultants) may be better off by first focusing on cost as a learning process and then progressing to an environment-focused strategy. Firms that adopt a dual-focused strategy need to ward off the tendency to let the cost focus dominate, which can hinder the complementary investments required to develop a sustainability-monitoring capability. Moreover, our finding that an environment-focused strategy is more effective at a high level of green IT standards implies that firms must synchronize green IT standards and strategies, and not view them separately.

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References

Ambec, S., & Lanoie, P. (2008). Does it pay to be green? A systematic overview. *Academy of Management Perspectives*, *22*(4), 45-62.

Amui, L., Jabbour, C., Jabbour, A., & Kannan, D. (2017). Sustainability as a dynamic organizational capability: a systematic review and a future agenda toward a sustainable transition. *Journal of Cleaner Production*, *142*, 308-322.

Aragón-Correa, J., & Sharma, S. (2003). A contingent resource-based view of proactive corporate environmental strategy. *Academy of Management Review*, *28*(1), 71-88.

[25] For example, prior research (Masanet et al., 2020) has recognized that, although data centers are currently "estimated to account for around 1% of worldwide electricity use" (p. 984), "diligent efforts will be required to manage possibly sharp energy demand growth once the existing efficiency resource is fully tapped … One key strategy includes further strengthening and promotion of efficiency standards such as *Energy Star* for servers, storage, and network devices … Such efforts are important in all world regions and particularly in Asia [which includes India, the empirical context of our study], where data center energy use is poised to grow" (p. 985-986).

Atasoy, H., Banker, R., & Pavlou, P. (2016). On the longitudinal effects of IT use on firm-level employment. *Information Systems Research*, *27*(1), 6-26.

Atuahene-Gima, K. (2005). Resolving the capability: Rigidity paradox in new product innovation. *Journal of Marketing*, *69*(4), 61-83.

Barla, P. (2007). ISO 14001 certification and environmental performance in Quebec's pulp and paper industry. *Journal of Environmental Economics and Management*, *53*(3), 291-306.

Baron, R., & Kenny, D. (1986). The moderator-mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology*, *51*(6), 1173-1182.

Benitez-Amado, J., & Walczuch, R. M. (2012). Information technology, the organizational capability of proactive corporate environmental strategy and firm performance: a resource-based analysis. *European Journal of Information Systems*, *21*(6), 664-679.

Boiral, O. (2007). Corporate greening through ISO 14001: A rational myth? *Organization Science*, *18*(1), 127-146.

Butler, T. (2012). Institutional change and green IS: Towards problem-driven, mechanism-based explanations. In Y. K. Dwivedi, M. R. Wade, S. L. Schneberger (Eds.), *Information Systems Theory* (pp. 383-407). Springer.

Christmann, P. (2000). Effects of "best practices" of environmental management on cost advantage: The role of complementary assets. *Academy of Management Journal*, *43*(4), 663-680.

Chuang, S.-P., & Huang, S.-J. (2015). Effects of business greening and green IT capital on business competitiveness. *Journal of Business Ethics*, *128*(1), 221-231.

Cooper, B. L., Watson, H. J., Wixom, B. H., & Goodhue, D. L. (2000). Data warehousing supports corporate strategy at First American Corporation. *MIS Quarterly*, *24*(4), 547-567.

Corbett, C., & Muthulingam, S. (2007). *Adoption of voluntary environmental standards: The role of signaling and intrinsic benefits in the diffusion of the LEED green building standards.* Available at http://dx.doi.org/10.2139/ssrn.1009294

Čuček, L., Klemeš, J., & Kravanja, Z. (2012). A review of footprint analysis tools for monitoring impacts on sustainability. *Journal of Cleaner Production*, *34*, 9-20.

Curry, E., Guyon, B., Sheridan, C., & Donnellan, B. (2012). Developing a sustainable IT capability: Lessons from Intel's journey. *MIS Quarterly Executive*, *11*(2), 61-74.

Dalton, M., & Hua, S. (2021). EU, China unveil sweeping plans to cut greenhouse-gas emissions. *The Wall Street Journal.* https://www.wsj.com/articles/eu-to-propose-sweeping-economic-plan-to-combat-climate-change

Dao, V., Langella, I., & Carbo, J. (2011). From green to sustainability: Information technology and an integrated sustainability framework. *Journal of Strategic Information Systems*, *20*(1), 63-79.

Dedrick, J. L. (2010). Green IS: Concepts and issues for information systems research. *Communications of the Association for Information Systems*, *27*(1), 173-184.

Delmas, M., & Keller, A. (2005). Free riding in voluntary environmental programs: The case of the US EPA WasteWise program. *Policy Sciences*, *38*(2-3), 91-106.

Delmas, M., & Pekovic, S. (2013). Environmental standards and labor productivity: Understanding the mechanisms that sustain sustainability. *Journal of Organizational Behavior*, *34*(2), 230-252.

DesAutels, P., & Berthon, P. (2011). The PC (polluting computer): Forever a tragedy of the commons? *The Journal of Strategic Information Systems*, *20*(1), 113-122.

Dowell, G., Hart, S., & Yeung, B. (2000). Do corporate global environmental standards create or destroy market value? *Management Science*, *46*(8), 1059-1074.

Eisenhardt, K., & Martin, J. (2000). Dynamic capabilities: What are they? *Strategic Management Journal*, *21*(10/11), 1105-1121.

El-Gayar, O., & Fritz, B. (2006). Environmental management information systems (EMIS) for sustainable development: a conceptual overview. *Communications of the Association for Information Systems*, *17*(1), 756-784.

Fornell, C., Johnson, M., Anderson, E., Cha, J., & Bryant, B. E. (1996). The American customer satisfaction index: nature, purpose, and findings. *Journal of Marketing*, *60*(4), 7-18.

Frank, K. A. (2000). Impact of a confounding variable on a regression coefficient. *Sociological Methods & Research*, *29*(2), 147-194.

Garen, J. (1984). The returns to schooling: A selectivity bias approach with a continuous choice variable. *Econometrica*, *52*(5), 1199-1218.

Gilbert, D. U., Rasche, A., & Waddock, S. (2011). Accountability in a global economy: The emergence of international accountability standards. *Business Ethics Quarterly*, *21*(1), 23-44.

Goth, G. (2008). The net's going green: multipronged approach might save costs, energy—and the climate. *IEEE Internet Computing*, *12*(1), 7-9.

Granger, C. (1980). Testing for causality: A personal viewpoint. *Journal of Economic Dynamics and Control*, *2*, 329-352.

Green, K., Zelbst, P., Bhadauria, V., & Meacham, J. (2012). Do environmental collaboration and monitoring enhance organizational performance? *Industrial Management Data Systems*, *112*(2), 186-205.

Hart, S. (1995). A natural-resource-based view of the firm. *Academy of Management Review*, *20*(4).

He, Z.-L., & Wong, P.-K. (2004). Exploration vs. exploitation: An empirical test of the ambidexterity hypothesis. *Organization Science*, *15*(4), 375-497.

Hendricks, K. B., & Singhal, V. R. (2001). Firm characteristics, total quality management, and financial performance. *Journal of Operations Management*, *19*(3), 269-285.

Huang, P., Tafti, A., & Mithas, S. (2018). Platform sponsor's investments and user contributions in knowledge communities: The role of knowledge seeding. *MIS Quarterly*, *42*(1), 213-240.

Isaac, G., Rajendran, C., & Anantharaman, R. (2003). Do quality certifications improve software industry's operational performance? *Software Quality Professional*, *5*(1), 30-37.

Jalote, P., & Natarajan, P. (2019). The growth and evolution of India's software industry. *Communications of the ACM*, *62*(11), 64-69.

Jenkin, T. A., Webster, J., & McShane, L. (2011). An agenda for "Green" information technology and systems research. *Information and Organization*, *21*(1), 17-40.

Khuntia, J., Saldanha, T., Mithas, S., & Sambamurthy, V. (2018). Information technology and sustainability: evidence from an emerging economy. *Production and Operations Management*, *27*(4), 855-892.

Kim, K., Mithas, S., Whitaker, J., & Roy, P. (2014). Industry-specific human capital and wages: Evidence from the business process outsourcing industry. *Information Systems Research*, *25*(3), 618-638.

King, A., Lenox, M., & Terlaak, A. (2005). The strategic use of decentralized institutions: Exploring certification with the ISO 14001 management standard. *Academy of Management Journal*, *48*(6), 1091-1106.

Kleis, L., Chwelos, P., Ramirez, R. V., & Cockburn, I. (2012). Information technology and intangible output: The impact of IT investment on innovation productivity. *Information Systems Research*, *23*(1), 42-59.

Krishnan, M. S., Kriebel, C. H., Kekre, S., & Mukhopadhyay, T. (2000). An empirical analysis of productivity and quality in software products. *Management Science*, *46*(6), 745-759.

Kude, T., Mithas, S., Schmidt, C. T., & Heinzl, A. (2019). How pair programming influences team performance: The role of backup behavior, shared mental models, and task novelty. *Information Systems Research*, *30*(4), 1145-1163.

Lambin, E., & Thorlakson, T. (2018). Sustainability standards: Interactions between private actors, civil society, and governments. *Annual Review of Environment Resources*, *43*, 369-393.

Larcker, D. F., & Rusticus, T. O. (2010). On the use of instrumental variables in accounting research. *Journal of Accounting and Economics*, *49*(3), 186-205.

Lee, S. Y., & Klassen, R. (2008). Drivers and enablers that foster environmental management capabilities in small-and medium-sized suppliers in supply chains. *Production and Operations Management*, *17*(6), 573.

Lein, J. K. (2014). Toward a remote sensing solution for regional sustainability assessment and monitoring. *Sustainability*, *6*(4), 2067-2086.

Levene, H. (1960). Robust tests for equality of variances. In I. Olkin (Ed.), Contributions to probability and statistics (pp. 278-292). Stanford University Press.

Magazzino, C., Porrini, D., Fusco, G., & Schneider, N. (2021). Investigating the link among ICT, electricity consumption, air pollution, and economic growth in EU countries. *Energy Sources, Part B: Economics, Planning, and Policy*, *16*(11-12), 976-998.

Malhotra, A., Melville, N. P., & Watson, R. T. (2013). Spurring impactful research on information systems for environmental sustainability. *MIS Quarterly*, *37*(4), 1265-1274.

Masanet, E., Shehabi, A., Lei, N., Smith, S., & Koomey, J. (2020). Recalibrating global data center energy-use estimates. *Science*, *367*(6481), 984-986.

Melnyk, S., Sroufe, R., & Calantone, R. (2003). Assessing the impact of environmental management systems on corporate and environmental performance. *Journal of Operations Management*, *21*(3), 329-351.

Melville, N. (2010). Information systems innovation for environmental sustainability. *MIS Quarterly*, *34*(1), 1-21.

Melville, N., & Whisnant, R. (2014). Energy and carbon management systems. *Journal of Industrial Ecology*, *18*(6), 920-930.

Government of India Ministry of Law and Justice. (2010). The National Green Tribunal Act, 2010. https://legislative.gov.in/sites/default/files/A2010-19_0.pdf

Mintzberg, H. (1978). Patterns in strategy formation. *Management Science*, *24*(9), 934-948.

Mithas, S., Chen, Z.-L., Saldanha, T., & Silveira, A. D. O. (in press). How will artificial intelligence and Industry 4.0 emerging technologies transform operations management? *Production and Operations Management*. https://doi.org/10.1111/poms.13864

Mithas, S., Chen, Y., Lim, Y., & Silveira, A. D. O. (in press). On causality and plausibility of treatment effects in operations management research. *Production and Operations Management*. https://doi.org/10.1111/poms.13863

Mithas, S., & Krishnan, M. S. (2009). From association to causation via a potential outcomes approach. *Information Systems Research*, *20*(2), 295-313.

Mithas, S., & Kude, T. (2017). Digitization and disciplined autonomy. *IEEE IT Professional*, *19*(5), 4-8.

Mithas, S., & Rust, R. T. (2016). How information technology strategy and investments influence firm performance: conjecture and empirical evidence. *MIS Quarterly*, *40*(1), 223-245.

Molla, A., Cooper, V., & Pittayachawan, S. (2011). The green IT readiness (G-Readiness) of organizations: An exploratory analysis of a construct and instrument. *Communications of the Association for Information Systems*, *29*(1), 67-96.

Mousavi, S., Bossink, B., & van Vliet, M. (2018). Dynamic capabilities and organizational routines for managing innovation towards sustainability. *Journal of Cleaner Production*, *203*, 224-239.

Nishant, R., Teo, T. S. H., & Goh, M. (2017). Do shareholders value green information technology announcements? *Journal of the Association for Information Systems*, *18*(8), 542-576.

Olson, E., Slater, S., & Hult, G. (2005). The performance implications of fit among business strategy, marketing organization structure, and strategic behavior. *Journal of Marketing*, *69*(3), 49-65.

Park, Y., & Mithas, S. (2020). Organized complexity of digital business strategy: A configurational perspective. *MIS Quarterly*, *44*(1), 85-127.

Porter, M. (1980). *Competitive strategy: Techniques for analyzing industries and competitors*. Free Press.

Porter, M., & Linde, C. (1995). Green and competitive: ending the stalemate. *Harvard Business Review*, *73*(5), 120-134.

Porter, M. E., & Linde, C. v. d. (1995). Toward a new conception of the environment-competitiveness relationship. *Journal of Economic Perspectives*, *9*(4), 97-118.

Potoski, M., & Prakash, A. (2005). Covenants with weak swords: ISO 14001 and facilities' environmental performance. *Journal of Policy Analysis and Management*, *24*(4), 745-769.

Ravichandran, T., & Rai, A. (2000). Quality management in systems development: an organizational system perspective. *MIS Quarterly*, *24*(3), 381-415.

Saldanha, T., Mithas, S., & Krishnan, M. S. (2017). Leveraging customer involvement for fueling innovation: The role of relational and analytical information processing capabilities. *MIS Quarterly*, *41*(1), 267-286.

Saldanha, T. J., Lee, D., & Mithas, S. (2020). Aligning information technology and business: The differential effects of alignment during investment planning, delivery, and change. *Information Systems Research*, *31*(4), 1260-1281.

Saldanha, T. J., Sahaym, A., Mithas, S., Andrade-Rojas, M. G., Kathuria, A., & Lee, H.-H. (2020). Turning liabilities of global operations into assets: IT-enabled social integration capacity and exploratory innovation. *Information Systems Research*, *31*(2), 361-382.

Siemsen, E., Roth, A., & Oliveira, P. (2010). Common method bias in regression models with linear, quadratic, and interaction effects. *Organizational Research Methods*, *13*(3), 456-476.

Simpson, D., Power, D., & Klassen, R. (2012). When one size does not fit all: A problem of fit rather than failure for voluntary management standards. *Journal of Business Ethics*, *110*(1), 85-95.

Szymanski, M., & Tiwari, P. (2004). ISO 14001 and the reduction of toxic emissions. *The Journal of Policy Reform*, *7*(1), 31-42.

Tallon, P. P. (2007). Does IT pay to focus? An analysis of IT business value under single and multi-focused business strategies. *Journal of Strategic Information Systems*, *16*, 278-300.

Tang, Z., Hull, C., & Rothenberg, S. (2012). How corporate social responsibility engagement strategy moderates the CSR–financial performance relationship. *Journal of Management Studies*, *49*(7), 1274-1303.

Vigneau, L., Humphreys, M., & Moon, J. (2015). How do firms comply with international sustainability standards? Processes and consequences of adopting the global reporting initiative. *Journal of Business Ethics*, *131*(2), 469-486.

Vílchez, V. F. (2017). The dark side of ISO 14001: The symbolic environmental behavior. *European Research on Management and Business Economics*, *23*(1), 33-39.

Wagner, M. (2010). The role of corporate sustainability performance for economic performance: A firm-level analysis of moderation effects. *Ecological Economics*, *69*(7), 1553-1560.

Wanous, J. P., Reichers, A. E., & Hudy, M. J. (1997). Overall job satisfaction: How good are single-item measures? *Journal of Applied Psychology*, *82*(2), 247-252.

Wareham, J., Fox, P., & Cano Giner, J. (2014). Technology ecosystem governance. *Organization Science*, *25*(4), 1195-1215.

Watson, R., Boudreau, M.-C., & Chen, A. (2010). Information systems and environmentally sustainable development: Energy informatics and new directions for the IS community. *MIS Quarterly*, *34*(1), 23-38.

Watson, R., Boudreau, M.-C., Chen, A., & Sepúlveda, H. (2011). Green projects: An information drives analysis of four cases. *Journal of Strategic Information Systems*, *20*(1), 55-62.

Watson, R., Corbett, J., Boudreau, M.-C., & Webster, J. (2012). An information strategy for environmental sustainability. *Communications of the ACM*, *55*(7), 28-30.

Whitaker, J., Mithas, S., & Liu, C.-W. (2019). Beauty is in the eye of the beholder: Toward a contextual understanding of compensation of information technology professionals within and across geographies. *Information Systems Research*, *30*(3), 892-911.

Wiengarten, F., Humphreys, P., Onofrei, G., & Fynes, B. (2017). The adoption of multiple certification standards: perceived performance implications of quality, environmental and health & safety certifications. *Production Planning and Control*, *28*(2), 131-141.

Wu, Q., He, Q., & Duan, Y. (2013). Explicating dynamic capabilities for corporate sustainability. *EuroMed Journal of Business*, *8*(3), 255-272.

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