IT READINESS, ICT USAGE, AND NATIONAL SUSTAINABILITY DEVELOPMENT: TESTING THE SOURCE-POSITION-PERFORMANCE FRAMEWORK

Completed Research Paper

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Abstract

Utilizing the Source-Position-Performance (SPP) framework of competitive advantage and the literature on information technology (IT) and sustainability as the guiding theoretical lenses, we posit that the government and business IT readiness (i.e., sources of advantage) leads to differentiation in government and business ICT usage (i.e., positional advantage), which in turn affects the national sustainability (i.e., performance) in terms of economic, environmental, and social developments. Based on secondary data from 108 countries, our results generally supported the hypothesized model. Specifically, government and business IT readiness in a country appeared to be a significant enabler of government and business ICT usage respectively, which in turn led to enhancement of national sustainability development. Post hoc mediation analysis indicates that government ICT usage (1) fully mediated the effect of government IT readiness on environmental and social developments; and (2) partially mediated the effect of government IT readiness on economic development. On the other hand, business ICT usage (1) fully mediated the effect of business IT readiness on economic development; (2) did not mediate the effect of business IT readiness on environmental development; and (3) partially mediated the effect of business IT readiness on social development. Our findings contribute to the theoretical discourse on "IT and sustainability" by identifying the role of IT readiness among government and businesses in a country and provide indications to practice on enhancing its sustainability by increasing the levels of ICT usage among them.

Keywords: IT readiness, ICT usage, sustainability development, SPP framework, archival data

Introduction

The potential of information technology (IT) to provide organizations and countries competitive advantage has been a topic of debate to practitioners, policy makers and academicians. This argumentation is reflected in the large number of firm- and national-level studies that have examined the strategic and operational value of IT and its impact on organizational performance (Bharadwaj 2000; Melville et al. 2004) and national competitiveness (Meso et al. 2009; Srivastava and Teo 2008; 2010). It is widely acknowledged that the investments in IT infrastructure and resources, if appropriately targeted could engender valuable outcomes (Barua and Mukhopadhyay 2000) such as effective governance and business innovation. Concurrent with this view, an equally important debate is taking place concerning the pressing need for stakeholders in a country (i.e., government and businesses) to engage in sustainable practices (Dunphy et al. 2003; McIntyre 2003). In other words, there is a recent upsurge across pubic- and private-sector organizations in nations to take issues of managing sustainability seriously and hence, seek a balance between short- and long-term considerations (Raynard and Forstater 2002).

According to the World Commission on Economic Development (Brundtland 1987, p.43), sustainability development is "development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs." This definition is related to triple-bottom-line (TBL), a broad conceptualization of organizational and national sustainability encompassing three principles namely, (1) economic prosperity; (2) environmental integrity; and (3) social equity (Bansal 2005). Whereas the economic prosperity principle promotes a reasonable quality of life through the productive capacity of organizations and individuals in society (Holliday et al. 2002), the environmental integrity principle ensures that human activities do not erode the earth's land, air, and water resources (Bansal 2005). The social equity principle ensures that all members of society have equal access to resources and opportunities (Bansal 2005). In other words, while the economic dimension relates to issues concerning profit, the environmental and social dimensions pertain to issues relevant to planet and people respectively (Elkington 1998).

An emerging recognition is that IT has become a critical enabler of sustainability, and has led to calls for more systematic research that examines the interaction between IT and sustainability outcomes (e.g., Elliot 2011; Melville 2010; Watson et al. 2010). Existing studies on sustainability incorporating information systems (IS) perspectives can be broadly classified into three streams. First, descriptive and anecdotal studies, while offering benchmarks for practitioners to assess and evaluate their sustainability practices and to progress against their peers, provide little value to theory (e.g., Molla 2009). Second, studies which focus on "particular aspects" of sustainability in reference to an IT innovation. For instance, a study by Haigh (2004) focused only on the environmental aspect of sustainability in reference to electronic business (e-business) innovation and ignored the other two bottom lines (i.e., economic and social dimensions). Similarly, a study by Srivatsava and Teo (2010) focused only on the economic aspect of sustainability pertaining to e-business and electronic government (e-government) innovations in a country and ignored the other two aspects (i.e., environmental and social dimensions). A third related stream is the case studies that are micro in orientation or studies that are conceptual in nature (e.g., Elliot 2011; Melville 2010; Watson et al. 2010). Whereas case studies capture the richness of context in which the researched object is embedded, conceptual studies lay the theoretical foundations for future empirical exploration (Srivastava and Teo 2010). While such studies address important aspects of academic research, they cannot possibly address the broad macro-level issues pertaining to sustainability.

This classification of existing studies, as shown in Figure 1, reveals that there is a dearth of quantitative empirical studies examining the "IT-sustainability" linkage from a global perspective. In other words, there is a paucity of research at cross-country level in the field of IT impact (Melville et al. 2004). Thus, there is an imperative need to conduct large-scale quantitative empirical studies exploring the impacts of IT on sustainability. To our knowledge, there is no large-scale empirical study, involving more than a hundred countries, which aims to understand the impact of IT on national sustainability development (encompassing all three dimensions of TBL). Consequently, the prime motivation of this research is to examine the impact of IT on economic, environmental, and social developments at the country-level.

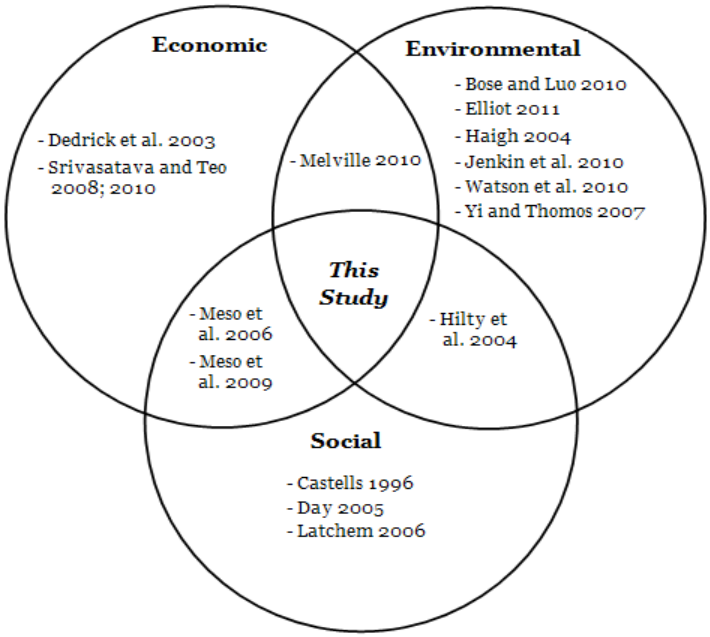


Figure 1. Sample Studies Examining 'IT-Sustainability' Linkage

In this paper, we center upon government (i.e., public-sector organizations) and businesses (i.e., private-sector firms), the major stakeholders in a country who are "ultimate keys" to respond to issues pertaining to sustainability (Dutta and Mia 2009). Specifically, by utilizing the Source-Position-Performance (SPP) framework of competitive advantage (Day and Wensley 1988) and by drawing from the literature on "IT-Sustainability", we posit that government and business IT readiness in a country (i.e., preparedness and willingness of government and businesses in a country to use ICT in their day-to-day activities) as sources of advantage facilitates government and business ICT usage respectively (i.e., positional advantages), which in turn impacts national sustainability (i.e., performance) in terms of economic, environmental, and social developments. We empirically test the proposed model using archival data from 108 countries (see Appendix for the list of countries). In sum, the specific research questions we examine in this study are:

RQ1: *What is the relationship between (a) government IT readiness and government ICT usage; and (b) business IT readiness and business ICT usage?*

RQ2: *How do government ICT usage and business ICT usage in a country contribute to its economic, environmental, and social developments?*

The rest of the paper is organized as follows. First, we present the conceptual framework that underlies our rationalization of the effects of government and business IT readiness in a country on government and business ICT usage, and on national sustainability development with the range of hypotheses that flow from those rationalizations. Thereafter, using archival data from 108 countries (see Appendix for the list of countries), we test the hypothesized model. Lastly, we discuss the findings and their contributions to the knowledge base in "IT-sustainability." Then, we highlight the major limitations of our study and offer future research directions.

Theoretical Background

We use the theoretical framework proposed by Day and Wensley (1988) as our foundation. According to Day and Wensley, "the creation and sustenance of a competitive advantage are the outcomes of a long-run feedback or cyclical process" (p. 2), which is underpinned by a simple, yet elegant framework called the "Source-Position-Performance" framework of competitive advantage as shown in Figure 2. This framework embraces elements from the resource-based-view (RBV) of a firm. According to this

framework, superior skills and resources are sources of advantage. While superior skills are the distinctive capabilities of personnel that set them apart from the personnel of competing firms, superior resources are more tangible requirements for advantage that enable a firm to exercise its capabilities. Superior skills and resources, taken together, represent the ability of a business to do more or do better (or both) than its competitors (Day and Wensley 1988). In our context, government and business IT readiness are sources of advantage. According to Parasuraman (2000), IT readiness represents firms' propensity to embrace and use new technologies for accomplishing organizational goals. Extending this definition, we define government and business IT readiness as the preparedness and willingness of government and businesses in a country to use ICT in their day-to-day activities (Dutta and Mia 2009). In other words, while government IT readiness attempts to gauge government's vision and prioritization of ICT in the national agenda and competitiveness strategy, business IT readiness assesses firms' capacity and inclination to incorporate ICT into their operations and processes. A firm's ability to discriminately invest and build its capabilities not only enables it to operate differently from its competitors but also constitutes a unique set of valuable skills that would be hard for others to imitate. Likewise, government's and businesses' preparedness of using ICT (for instance, by investing in R&D and by providing staff training) in a country enables it to operate differently from its neighbouring countries (or competitors), thereby making it harder for them to imitate.

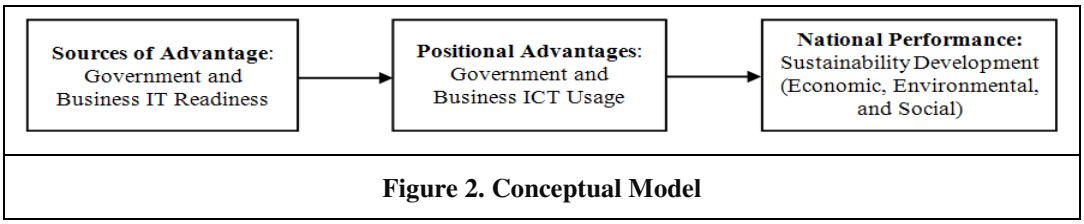


Figure 2. Conceptual Model

Day and Wensley's (1988) framework reflects Porter's (1985) view of positional advantage in terms of either cost leadership or differentiation. According to them, positional advantages (or positions of advantage) of a business are directly analogous to competitive mobility barriers that could deter a firm from shifting its strategic position. While this dichotomous view of positional advantage has been challenged by several researchers such as Booth and Philip (1998) suggesting that organisations need to be more flexible and combine cost leadership and differentiation to offer unique value to their customers, Day and Wensley's (1988) considers different forms of differential positional advantage with brand name, innovative features and superior product quality offering potentially defensible market positions that will in turn lead to superior performance. Fahy et al. (2000) established that product quality, service quality and price positions in the market will lead to superior performance. Another study by Matear et al. (2002), in the context of service organizations, expanded the differential position to include relationship, brand and new service positional advantages in the market. In our context, we posit ICT usage (i.e., penetration and diffusion of ICT) among government and businesses (that facilitates effective governance and business innovation respectively) as positions of advantage of a nation as the higher levels of ICT usage among them is thought to be rare, valuable and difficult to imitate for governments and businesses of neighbouring countries (or competitors). Further, ICT usage takes time to develop, thereby conferring those countries with high ICT usage, a positional advantage.

The significance of the link between ICT usage and firm performance has been long discussed in the literature (Devaraj and Kohli 2003). Doll and Torkzadeh (1998) note that ICT use is a pivotal construct in the system-to-value chain that links upstream research on the causes of ICT success with downstream research on the organizational impacts of ICT. In a similar vein, the relationship between ICT utilization and firm performance has been proposed as pivotal by Delone and McLean (1992). Extending this argument to the country-level, we reason that for national-level ICT impacts to occur, it is necessary that ICT usage among government and businesses is tied to national performance metrics. That is, at the national-level, countries derive competitive advantage by "effectively utilizing" their resources and capabilities (Farhoomand et al. 2001; Porter 1985). To measure the impact of ICT investments and usage, researchers have used multifarious measures of organizational performance, such as productivity enhancement, inventory reduction, cost reduction, and competitive advantage (Devaraj and Kohli 2003; Hitt and Ireland 2000). In this research, we define national performance metrics in terms of a country's sustainability development comprising economic, environmental, and social dimensions. Hence,

countries that possess such a positional advantage of higher levels of ICT usage among governments and businesses should enjoy superior performance in terms of economic, environmental, and social developments. In sum, within the SPP framework, government and business IT readiness in a country has the potential to be sources of advantage that facilitates government and businesses to improve their ICT usage (positional advantage), which in turn enhances national performance in terms of economic, environmental, and social developments. This forms the basic premise of our research model depicted in Figure 3.

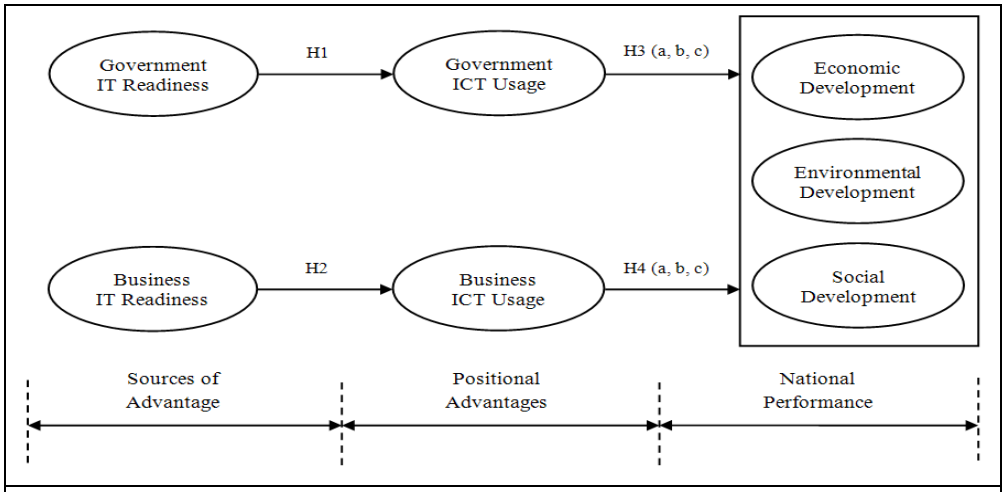


Figure 3. Research Model

Hypotheses Development

Effect of IT Readiness on ICT usage

According to Parasuraman (2000), IT readiness is defined as firms' propensity to embrace and use new technologies for accomplishing organizational goals. Such a tendency is likely to occur only when profound facilitators (e.g., advanced technologies) are available with them. Given this, and by building on the notion that technological readiness is determined by organizational routines (Collis 1994), we adopt a process focus and define government and business IT readiness as their willingness and preparedness to use ICTs. Specifically, following Clark et al.'s (1997) conceptualization of technology readiness as an indicator of agility of a business and a capability that needs constant building, re-building and upgrading; we argue that a nation's ability to increase penetration and diffusion of ICT among government and businesses is likely to be contingent on their IT readiness. That is, a country whose government agencies and business firms is more ready and show a greater interest towards ICT advances is likely to use it at a greater extent for effective governance and business innovation respectively (Dutta and Mia 2009). This leads to the following hypotheses:

H1: *The level of government IT readiness in a country is positively associated with the level of its government ICT usage.*

H2: *The level of business IT readiness in a country is positively associated with the level of its business ICT usage.*

Effect of ICT Usage on Sustainability Development

Sustainability development implies seeking a balance between short- and long-term considerations (Raynard and Forstater 2002), and often involves large group of stakeholders such as government agencies and business firms. While the three dimensions of sustainability development (economic,

environmental, and social) are distinct spheres, they sometimes overlap (Petrini and Pozzebon 2009). Figure 4 (Krishnan and Teo 2011) shows the definition of different components of sustainability development (Brundtland 1987; Harris et al. 2001; Holmberg 1992; Reed 1996).

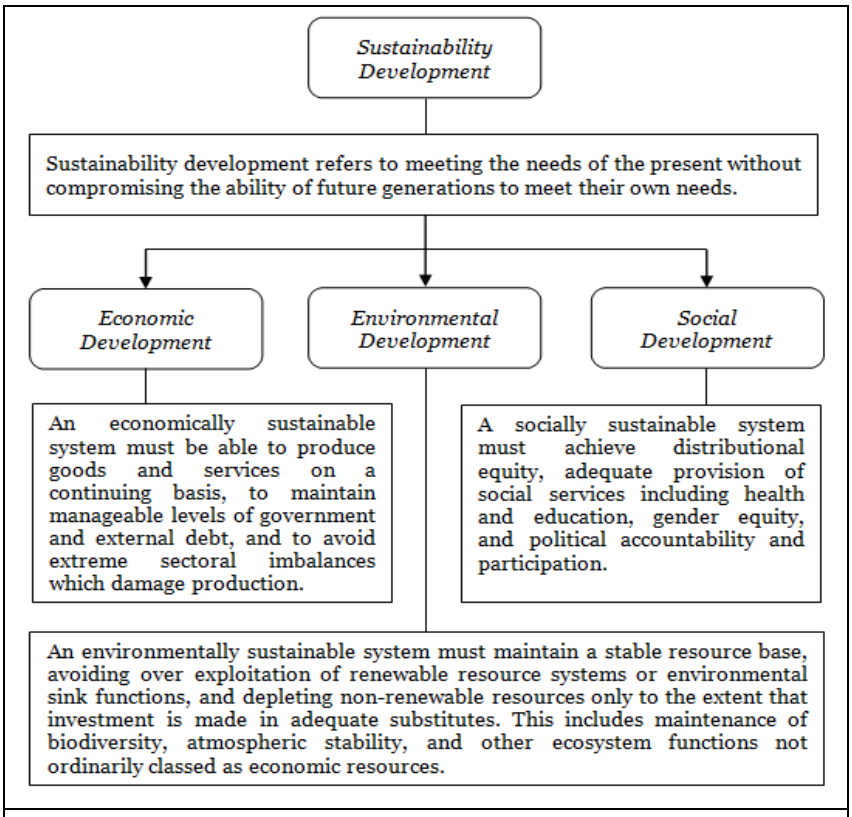


Figure 4. Definitions of Components of Triple-Bottom-Line

Relationship between ICT Usage and Economic Development

ICT enables economic development by widening the reach of technologies such as high-speed Internet, mobile broadband, and computing (Dutta and Mia 2009). Statistics indicate that bringing mobile broadband levels in emerging markets up to those of more mature markets could add between US$300 and US$420 billion to the world's GDP and 10 to 14 million direct and indirect jobs in areas such as equipment manufacturing and outsourcing/offshoring services (Dutta and Mia 2009). Research indicates that ICT's role in enabling economic development has become more significant (e.g., Dedrick et al. 2003). For instance, Clark et al. (2003) highlights how the use of the Internet technologies at the local government level leads to proliferation of e-government resulting in economic welfare of the country. Similarly, Moynihan (2004), Von Haldenwang (2004) and West (2004) indicate that e-government development and usage impacts the efficiency of a country in a number of ways, thereby improving the national economic performance. Further, recent studies by Srivastava and Teo (2008, 2010) indicate that national economic performance and business competiveness of a nation are dependent on the development and use of online public and private services. Another study by Dutta and Jain (2005) in the context of e-business development, indicate that the greater usage of e-business in a country will increase its productivity, leading to enhanced economic development. Consistent with the extant studies, we argue that ICT usage among government and businesses affects a nation's performance in terms of its economic development. This leads to the following hypotheses:

H3a: *The level of government ICT usage in a country is positively associated with its economic development.*

H4a: *The level of business ICT usage in a country is positively associated with its economic development.*

Relationship between ICT Usage and Environmental Development

There is a growing need to deploy IT innovatively to measure, report, and reduce greenhouse gas emissions (GHG), wastes and water use within core enterprise and business processes of public- and private-sector firms. This is brought about by adoption and usage of ICT innovations (e.g., e-government and e-business) by government and businesses. It has been argued that both government and businesses can bring their ICT innovations and environmental objectives together so that the usage of their ICTs can enhance environmental development through service and cost efficiencies (Prahalad and Hammond 2002). For instance, a service agenda released by the Australian Government in 2006, notes that electronic delivery serves the government's environmental objectives by helping to reduce paper, energy consumption and GHG emissions (Ausgov 2007). It also states that connected government provides greater opportunities for agencies to share and re-use technology, reducing overall infrastructure costs. Government and business ICT usage can enhance the environmental development or deliver positive environmental sustainability outcomes by (1) disseminating environmental sustainability issues faster and with broader coverage throughout the nation (Cormier and Magnan 2004; Judge and Douglas 1998); and (2) developing real-time decision support systems that integrate with government and business ICT innovations, and enable managers and policy makers to make operational decisions that are aligned with environmental sustainability goals (Box 2002). The information processing capabilities of government and business ICT innovations give them an important role in progressing organizations and nations towards more environmentally sustainable outcomes (Box 2002). Clearly, national environmental development, which indicates the environmental conditions of a nation (e.g., climate change variations and betterment) are dependent on the adoption and use of technological developments (Dutta and Mia 2009) by government agencies and businesses. Hence, we posit that government and business ICT usage in a nation will impact its environmental development. This leads to the following hypotheses:

H3b: *The level of government ICT usage in a country is positively associated with its environmental development.*

H4b: *The level of business ICT usage in a country is positively associated with its environmental development.*

Relationship between ICT Usage and Social Development

Social development in a country is brought about by improving the way government and businesses provide services to its citizens (Dutta and Mia 2009). In the government sector, the use of ICTs to provide and improve public services has enabled government agencies to deliver better services more efficiently. In addition, rapid proliferations of social media applications has changed the way people access information and interact with each other, thereby creating long term and largely positive changes in a variety of areas. This is also true in the context of business setting. For instance, in health sector, the use of ICTs (e.g., e-health) has transformed healthcare by efficiently connecting people and improving information sharing. Similarly, in the education sector, ICTs has dramatically changed the way people study. The use of email, websites, and virtual classrooms and libraries has proliferated, facilitating the sharing of information on a large scale. In sum, usage of ICTs by governments and businesses has increased societal cohesiveness, a key indicator of social development in nations. In other words, government and business ICT usage has facilitated the process of (1) building shared values and communities of interpretation; (2) reducing disparities in wealth and income; and (3) enabling people to have a sense that they are engaged in a common enterprise, facing shared challenges, and that they are members of the same community (Maxwell 1996, p. 13). Hence, the countries whose governments and businesses use ICTs tend to be winners and those without access often face a spiral of decline. This leads to the following hypotheses:

H3c: *The level of government ICT usage in a country is positively associated with its social development.*

H4c: *The level of business ICT usage in a country is positively associated with its social development.*

Research Design

In this research, to test the formulated hypotheses, we gathered archival data (for each of the main constructs) for two reasons. First, collecting large scale primary data from over hundred countries is constrained by the amount of resources and time available for conducting such research (Meso et al. 2009; Srivastava and Teo 2008; 2010). Second, archival data, as suggested by some researchers (e.g., Jarvenpaa 1991) offers several advantages namely, (1) easy reproducibility; (2) ability to generalize the results arising from larger datasets (Kiecolt and Nathan 1985); and (3) robust to the threat of common method bias (Woszczynski and Whitman 2004).

Hypotheses were tested via a cross-sectional analysis of 108 countries (see Appendix for the list of countries). To obtain consistent estimates, we lagged the independent and intervening variables by a year prior to the base-year. The primary sources of data were the World Economic Forum (WEF) Global Competitiveness Reports (Porter and Schwab 2008; Schwab 2010), the WEF Global IT Reports (Dutta and Mia 2006; 2007), the United Nations (UN) E-government Survey Reports, and the Environmental Performance Index Reports (Yale 2008; 2010). All the four data sources are considered to be reliable reports and have been widely used in past academic research. For instance, data from the Global Competitiveness Report have been used in studies such as Delios and Beamish (1999), Gaur and Lu (2007), and Srivastava and Teo (2008; 2010). Similarly, data from the Global IT Report have been used in studies such as Srivastava and Teo (2010). The data from UN E-government Survey Report have been used in studies such as Siau and Long (2006), Singh et al. (2007), and Srivastava and Teo (2008; 2010). And, data from the Yale Environmental Performance Index Report have been used in studies such as Feroz et al. (2009) and George (2007).

Operationalization of Constructs

There are seven main constructs in this study: government IT readiness, business IT readiness, government ICT usage, business ICT usage, economic development, environmental development, and social development. Government IT readiness was measured by the government readiness index and business IT readiness was measured by the business readiness index. The values for these indices were adopted from the WEF Global IT Report (Dutta and Mia 2006). Whereas government readiness index is a composite weighted average of five variables namely, (1) government prioritization of ICT; (2) government procurement of advanced technology products; (3) importance of ICT to government's vision of the future; (4) e-participation; and (5) e-government readiness, business IT readiness is a composite weighted average of nine variables namely, (1) extent of staff training; (2) local availability of specialized research and training services; (3) quality of management schools; (4) company spending on R&D; (5) university/industry research collaboration; (6) business telephone connection charge; (7) business monthly telephone connection subscription; (8) local supplier quality; and (9) computer, communications, and other services imports.

Government ICT usage was measured by the government usage index and business ICT usage was measured by the business usage index. The values for these indices were obtained from the WEF Global IT Report (Dutta and Mia 2007). While government usage index is a composite weighted average of five variables namely, (1) government success in ICT promotion; (2) availability of government online services; (3) ICT use and government efficiency; (4) presence of ICT in government offices; and (5) e-participation, business usage index is a composite weighted average of five variables namely, (1) prevalence of foreign technology licensing; (2) firm-level technology absorption; (3) capacity for innovation; (4) availability of new telephone lines; and (5) extent of business Internet use.

Economic development, according to Porter (2005), depends both on the value of nation's products and services, measured by the prices they can command in open markets, and also on the efficiency with which they are produced. Consistent with extant studies (e.g., Srivastava and Teo 2010), we use Porter's productivity paradigm for operationalizing economic development in terms of GDP per capita adjusted for purchasing power parity (PPP). Specifically, we operationalized economic development as the rate of change in GDP per capita adjusted for PPP between 2008 and 2010, the values for which were taken from the WEF Global Competitiveness Reports (Porter and Schwab 2008; Schwab 2010).

As no single set of measures can adequately describe the multifaceted nature of the environment or fully capture transboundary effects and pollution consequences (Ansuategi and Perrings 2000), we, consistent with existing studies (e.g., Grafton and Knowles 2004) used secondary indicators of environmental development. We define environmental development in terms of climate change, comprising three aspects: (1) GHG emissions per capita (including emissions from land use change); (2) CO2 emissions per unit of electricity generation; and (3) industrial GHG emissions intensity (Yale 2008; 2010). Specifically, we operationalized environmental development as the rate of change in 'climate change' between 2008 and 2010, the values for which were taken from the Environmental Performance Index Reports (Yale 2008; 2010).

Social development was operationalized using a summary of two indices: average rate of change in life expectancy and literacy between 2008 and 2010. While the values for life expectancy were obtained from the WEF Global competitiveness Reports (Porter and Schwab 2008; Schwab 2010), the values for literacy were adopted from the UN-Report (2008; 2010). This measure is used in past studies like Meso et al. (2006).

Control Variables

Control variables are used to account for factors other than the theoretical constructs of interest, which could explain variance in the dependent variable. First, as population density gives the direct measurement of a country's population pressure on its economic, environmental, and social developments (Schwab 2010; Vachon and Mao 2008), we controlled for its effect in our study. Specifically, we used the population density scores for year 2007, the values for which were obtained from the 2010 Environmental Performance Index Report (Yale 2010). In addition, we also controlled for the effect of ICT laws (i.e., laws related to ICT usage) in a country on government and business ICT usage. The values for this variable were taken from the WEF Global IT Report (Dutta and Mia 2006).

Analysis and Results

Descriptive Statistics and Correlations

Figure 5 presents the descriptive statistics and correlations for all variables in the research model. From the figure, it is evident that most correlations among variables were significant at $p<0.001$. In addition, as correlations among independent and intervening variables were below the threshold value of 0.8, multicollinearity may not be a problem (Gujarati 2003).

Variable	Mean	SD	1	2	3	4	5	6	7	8	9
1. Population Density[a]	3.83	1.08	-								
2. ICT Laws	4.04	1.42	-0.10	-							
3. Government IT Readiness	3.78	0.81	0.02	0.64***	-						
4. Business IT Readiness	4.11	0.91	-0.18*	0.66***	0.61***	-					
5. Government ICT Usage	3.82	0.89	0.15	0.58***	0.65***	0.57***	-				
6. Business ICT Usage	4.46	0.83	-0.08	0.67***	0.59***	0.63***	0.62***	-			
7. Economic Development	0.15	0.58	0.58***	-0.44***	0.51***	0.37***	0.52***	0.44***	-		
8. Environmental Development	0.23	0.27	-0.21*	0.33***	0.39***	-0.37***	0.25**	-0.39***	-0.26**	-	
9. Social Development	0.02	0.03	-0.20*	0.61***	0.55***	0.65***	0.47***	0.50***	0.14	0.18*	-

N=108 [a]Log-transformed variables *p < 0.05 **p < 0.01 ***p < 0.001 (2-tailed)

Figure 6. Descriptive Statistics and Correlations

Nevertheless, we tested for multicollinearity by examining the variance inflation factor (VIF). VIF assesses the effect that the other independent variables have on the standard error of a regression coefficient (Hair et al. 2006). In other words, it measures the degree to which collinearity among the predictors degrades the precision of an estimate. Although there is no universally agreed threshold point for values of VIF, most researchers are of the view that if VIF is below 5, then the problem of multicollinearity does not exist (Pedhazur 1973). Some researchers suggest that multicollinearity is not a significant problem if the value of VIF is below 10 (Hair et al. 2006). In our case, the independent and mediating variables had VIF values

below the conservative value of 5, thereby indicating that there was no significant problem of multicollinearity.

Reliability and Validity

All the three agencies (namely WEF, UN, and Yale) followed rigorous procedures for ensuring the reliability and validity of the data. The country-level data were collected by the WEF through a number of partner institutes, who were given a uniform set of guidelines that were strictly followed. Some of these guidelines included taking responses only from CEOs or equivalent rank company officials, facility for the respondents to answer in their preferred language, etc. In addition, the survey was administered in several forms such as face-to-face interviews with business executives, mailed or telephone interviews, and a version administered online as an alternative (Dutta and Mia 2006; 2007). Two techniques were adopted to minimize chances of perception bias (a systematic positive or negative bias found among all respondents in a given country. For instance, some might believe that people in a certain country are generally more positive about their own economic environment than people in another country, who might be pessimistic). First, the questions were framed in a way that asked the respondents to compare their own country to world standards, rather than thinking in absolute national terms. Second, wherever possible, the survey data was compared with hard data on similar issues (Dutta and Mia 2006; 2007). The collected respondent-level data were subjected to a careful editing process following several rules such as excluding the surveys with a completion rate inferior to 50%. Once the data have been edited, individual answers were aggregated at the country-level. Then, sector weighted country averages were obtained for analyses.

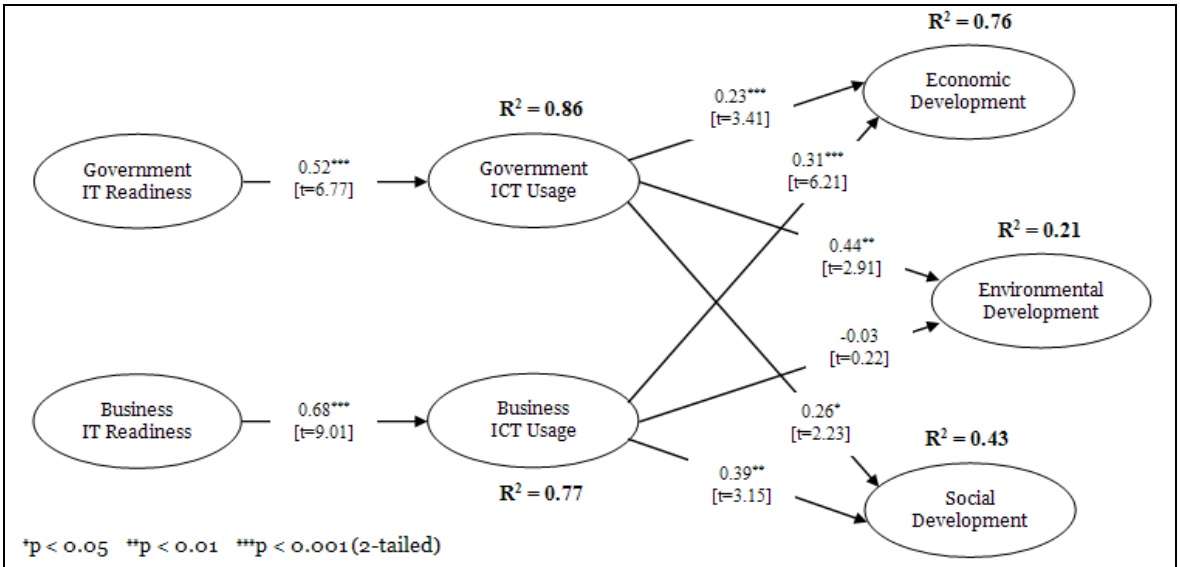
UN also followed similar procedures for ensuring the reliability and validity. For instance, the research team that was in charge of data collection was fully equipped to handle the six official languages of the UN (Arabic, Chinese, English, French, Russian and Spanish). A web-based information management system was used by the research team for managing the survey effort and tracking results. Appropriate training was provided to them to carry out data collection. Team leaders conducted training online, held virtual help sessions, and worked in tandem with country researchers and language specialists as needed to produce high quality results (UN-Report 2008; 2010). Further, the data sources (i.e., UNESCO and UNDP Human Development Report) utilized for computing literacy rate were reviewed for quality and verifiability. Before the computation of final literacy scores, the indicator was normalized by taking its value for a given country subtracting the lowest value for any country in the survey and dividing by the range of values for all countries (UN-Report 2008; 2010).

Yale also adopted similar procedures for ensuring the reliability and validity. For instance, the climate change index was computed based on multiple data sources including (1) official statistics that are measured and formally reported by governments to international organizations; (2) spatial data compiled by research or international organizations; and (3) observations from monitoring stations. All potential datasets were reviewed for quality and verifiability. Those that did not meet baseline quality standards were discarded. The raw data was transformed to proximity-to-target scores ranging from zero (worst) to 100 (at target). To compute the composite index, data aggregation and weighting were performed (Yale 2008; 2010).

Hypothesis Testing

Structural equation modeling (SEM) analysis was chosen over regression analysis as SEM can simultaneously analyze all of the paths in one analysis (Chin 1998). Within SEM, we employed Partial Least Squares (PLS) over covariance-based SEM techniques (such as LISREL, EQS, or AMOS) for four reasons. First, PLS places minimal restrictions on measurement scales, sample size, and residual distributions (Chin 1998). Second, PLS analysis is distribution free and does not assume true independence of the variables, leading to more reliable results (Tobias 1999). Third, PLS is robust against data structural problems such as skew distributions and omissions of regressors (Cassel et al. 1999; Gefen et al. 2000). And fourth, the exploratory theory development stage that 'IT and sustainability' research is currently in makes PLS a suitable choice for analyzing data in our study (Barclay et al. 1995; Gefen et al. 2000). In the model tested, all constructs were modeled as reflective as their measurement items were manifestations of intended constructs (Barclay et al. 1995). SmartPLS (version 2.0.M3) was used to

analyze the data in this study (Ringle et al. 2005). In specific, we used a PLS bootstrapping technique with 500 resamples to assess the significance of model linkages. The results of PLS analysis for the structural model are shown in Figure 6.



Control Variables	Model Variables				
	Government ICT Usage	Business ICT Usage	Economic Development	Environmental Development	Social Development
ICT Laws	0.42*** [t=5.29]	0.20** [t=2.45]	-	-	-
Population Density	-	-	0.65*** [t=12.96]	-0.17 [t=1.46]	-0.24*** [t=3.23]
Note: Control variables were entered simultaneously with model variables					

Figure 6. Results of PLS Analysis

As shown in Figure 6, there was a positive association between government IT readiness and government ICT usage (β=0.52, t=6.77, p<0.001) and between business IT readiness and business ICT usage (β=0.68, t=9.01, p<0.001). Hence, both H1 and H2 were supported. Further, our results indicated that there was a positive association between government ICT usage and economic development (β=0.23, t=3.41, p<0.001); environmental development (β=0.44, t=2.91, p<0.01); and social development (β=0.26, t=2.23, p<0.05). Hence, H3a, H3b, and H3c were supported. In addition, while there was a significant positive association between business ICT usage and economic development (β=0.31, t=6.21, p<0.001) and social development (β=0.39, t=3.15, p<0.01), there was an insignificant negative association between business ICT usage and environmental development (β=-0.03, t=0.22, n.s.). Hence, H4a and H4c were supported, and H4b was not supported. The effect of the control variable, ICT laws was significant on government ICT usage (β=0.42, t=5.29, p<0.001) and business ICT usage (β=0.20, t=2.45, p<0.01). In a similar vein, the effect of the control variable, population density was significant on economic development (β=0.65, t=12.96, p<0.001) and social development (β=-0.24, t=3.23, p<0.001) and not on environmental development (β=-0.17, t=1.46s, n.s.). The proposed model explained 76% of variance in economic development, 21% in environmental development, and 43% in social development.

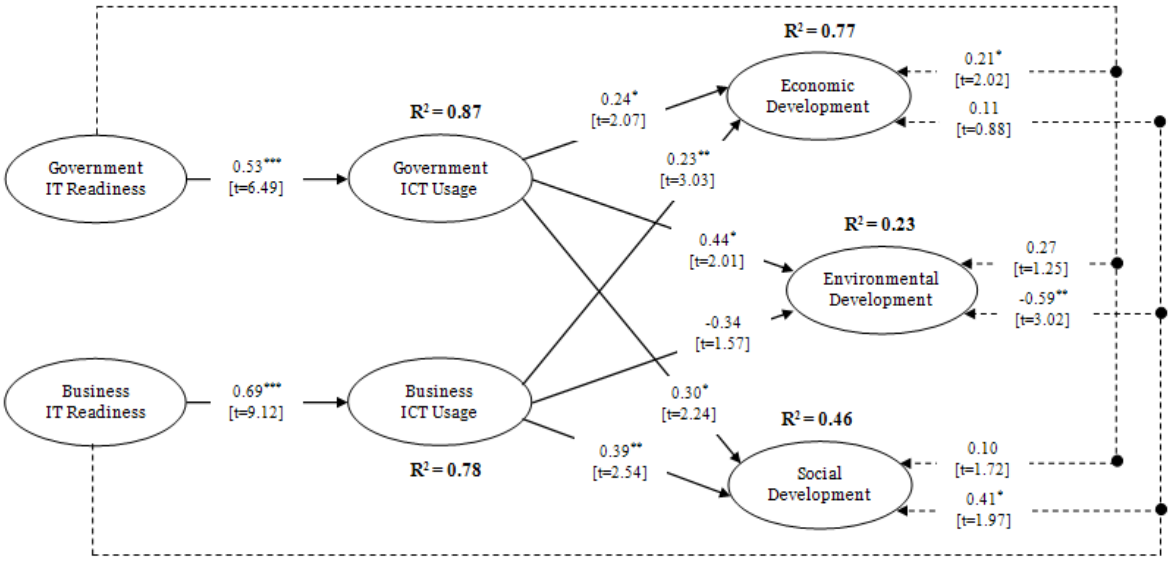
As power calculations are particularly relevant whenever the null hypothesis is rejected (Baroudi and Orlikowski 1989), we performed a power analysis for H4b, the hypothesis that was not supported due to lack of significance. The objective of this analysis was to determine the accuracy of this conclusion that the hypothesis is truly insignificant at the 0.05 alpha level. Power is the likelihood of a Type II error, and it requires parameters for sample size, alpha level and desired effect size (Meso et al. 2009). According to Cohen (1977), an effect size (d) of 0.2 or less is considered small, that of 0.5 is deemed moderate, while an effect size greater than 0.8 is deemed to be strong. Using the Gpower statistical program, the calculated

power for the hypothesis was 0.83, with a sample size of 108 and an effect size of 0.5. This, according to Cohen's (1977) threshold of 0.80, allows us to conclude that there was negligible Type II error and the lack of significance can be believed.

Post Hoc Mediation Analysis

Several researchers, by drawing on the RBV of a firm, argue that capabilities (here, IT readiness) can lead to competitive advantage (e.g., Bharadwaj 2000) and superior business performance (e.g., Wade and Hulland 2004). Further, research indicate that there is a positive relationship between capabilities and firm performance (e.g., Bhatt and Grover 2005; Dehning et al. 2003). Extending this line of reasoning, it is appropriate to argue that the higher the levels of government and business IT readiness in a country, the higher will be its performance in terms of economic, environmental, and social developments. While this is a common assumption, it should be noted that we have purposefully avoided the direct linkages between IT readiness and sustainability development (in our original research model) as this association is neither necessary for the definition of capabilities (here, IT readiness) (Ravichandran and Lertwongsatien 2005) nor required for theorizing about how government and business IT readiness can lead to government and business ICT usage. We note that a similar procedure has been adopted by Gold et al. (2001) and Ravinchandran and Lertwongsatien (2005) in their research.

We conducted PLS analysis (bootstrapping technique with 500 resamples) to see if the relationships of government and business IT readiness in a country with economic, environmental, and social developments are mediated by government and business ICT usage. Otherwise stated, we assessed if government and business ICT usage served as an intervening mechanism or, at the least, partial conveyors of the effect of government and business IT readiness in a country onto economic, environmental, and social developments by adding direct paths from government and business IT readiness to national performance outcomes. The results are shown in Figure 7.



*p < 0.05 **p < 0.01 ***p < 0.001 (2-tailed)

Control Variables	Model Variables				
	Government ICT Usage	Business ICT Usage	Economic Development	Environmental Development	Social Development
ICT Laws	0.42*** [t=5.04]	0.20** [t=2.44]	-	-	-
Population Density	-	-	0.65*** [t=11.77]	-0.19 [t=1.84]	-0.17* [t=2.07]

Note: Control variables were entered simultaneously with model variables

Figure 7. Results of Post Hoc Mediation Analysis

As shown in Figure 7, our results remained essentially the same, with significant direct effect of government IT readiness on economic development (β=0.21, t=2.02, p<0.05) and significant direct effects of business IT readiness on environmental development (β=-0.59, t=3.02, p<0.01) and social development (β=0.41, t=1.97, p<0.05). Hence, government ICT usage (1) fully mediated the effect of government IT readiness on environmental and social developments; and (2) partially mediated the effect of government IT readiness on social development. In a similar vein, business ICT usage (1) fully mediated the effect of business IT readiness on economic development; (2) did not mediate the effect of business IT readiness on environmental development; and (3) partially mediated the effect of business IT readiness on social development.

We also did an R^2 comparison between two models (i.e., original model with no direct links and competing model with direct links). For R^2 comparison, we used Cohen's (1988) formula for calculating f^2 as, $f^2 = (R^2_{competing} - R^2_{original}) / (1 - R^2_{competing})$. The value of f^2 captures whether the impact of a particular independent construct on a dependent construct is substantive. As to the f^2 statistics, 0.02, 0.15 and 0.35 are considered as the criteria for small, medium and large effect size respectively (Chin 1998). For the competing model, R^2 for "economic development" increased from 0.76 to 0.77 (f^2=0.04). Similarly, for "environmental development", R^2 increased from 0.21 to 0.23 (f^2=0.02), and for "social development", R^2 increased from 0.43 to 0.46 (f^2=0.05). The f^2 values suggested that the competing model only had small effect size. Hence, we conclude that the original model, being more parsimonious is better than the competing model.

Discussion

Findings from this investigation raise several issues that deserve mention. First, our results emphasize the significance of government and business IT readiness in facilitating government and business ICT usage respectively. That is, government and businesses in a country with the lower levels of IT readiness will be unable to embrace and use ICTs for accomplishing organizational and national goals. This result is consistent with Parasuraman (2000), who established the importance of profound facilitators (in form of capabilities such as advanced technologies) to increase the penetration and diffusion of ICTs. Hence, a nation whose government and businesses are more ready and show a greater interest towards ICT advancements will be likely to use them for effective governance and increased business innovation respectively (Dutta and Mia 2009).

Second, our results indicate that there was a positive association between government ICT usage and economic, environmental, and social developments. On the other hand, while the relationships of business ICT usage with economic and social developments were positive and significant, the relationship between business ICT usage and environmental development was negative and insignificant. One possible reason for this difference in results may be due to the relative differences in the characteristics of government and business firms. That is, compared to business firms, government agencies have a wider scope of concern and significance of actions in the "public interest" (Caudle et al. 1991). In addition, while usage of government ICTs is meant for providing services to citizens and businesses, usage of business ICTs, dependent on business firm's strategies and resources, exists for conducting commercial activities online. As government ICT usage is driven by the service motive and has a wider scope of concern in the public interest, it is likely that government will give equal importance to all the three aspects of sustainability developments and thereby will play a key role in enhancing all the three dimensions. In contrast, as business ICT usage is impelled by the profit motive, business firms may focus more at making money and enhancing social equity rather than building an environmentally sustainable future which may incur additional costs for them.

Turning now to the mediation effects (tested in post hoc analysis), results indicate that government IT readiness had a direct effect on economic development but no effects on environmental and social developments. On the other hand, business IT readiness had a direct effect on environmental and social developments but no effect on economic development. That is, while government ICT usage (1) fully mediated the effect of government IT readiness on environmental and social developments; and (2) partially mediated the effect of government IT readiness on economic development, business ICT usage (1) fully mediated the effect of business IT readiness on economic development; (2) did not mediate the effect of business IT readiness on environmental development; and (3) partially mediated the effect of

business IT readiness on social development. Several reasons can explain the differences in our mediation results, but these remain to be empirically validated. First, the strength of the insignificant direct effects of government and business IT readiness on sustainability development outcomes may have been weakened by the fact that this study did not divide the sample into developed and developing countries. It may be that because the vast majority of high-scoring countries on IT readiness are developed nations, the direct effects of (1) government IT readiness with environmental and social developments; and (2) business IT readiness with economic development are suppressed. We note that published research examining the effects of IT infrastructure and national sustainability development (e.g., socio-economic development) has either divided their sample into developed and developing countries (e.g., Dewan and Kraemer 2000), or has taken the format of developing nations only (e.g., Meso et al. 2006; 2009). This may have caused insignificant IT readiness to sustainability development linkage.

Second, we have not controlled for the business specific national variables such as the industrial nature of the nation. For instance, consider a nation that is predominantly agrarian in nature, as well as developed. Such a nation may possibly use more advanced technology in field of agriculture and farming in order to improve productivity and thus, will have high IT readiness. The predominance of agriculture may result in better environmental development but its economic development may be relatively weak compared to a service based economy. Another illustration is a developed economy, characterized by dominance of tourism-driven service sector. Such an economy may exhibit high level of IT readiness, due to application of ICT in tourism related sectors such as aviation, and hospitality. Because of dominance of tourism, its environmental development may be relatively better to a nation dominated by manufacturing sector. The social development measured by items such as literacy may be high as such economies may promote education to meet skilled work-force requirement of the tourism sector, however, the economic development may be relatively weak compared to an economy dominated by manufacturing sector. Further, there may be few developing nations, whose economies are characterized by export-oriented manufacturing sector. Such nations may focus on labour intensive technologies and hence, their IT readiness may be relatively low. But, due to the prowess of their strong manufacturing sector, they may perform relatively well in global economic arena. While these possible scenarios demonstrate that the relationship between business IT readiness and three aspects of sustainability is susceptible to the characteristics of industries in a nation, and may be the possible explanations for the nature of relationships observed in our empirical analysis; they need further exploration and validation in future research.

In sum, our results provides empirical support for the basic premise of our study that within the SPP framework, IT readiness in a country has the potential to be source of advantage that facilitates ICT usage among government and businesses (i.e., positional advantage), which in turn impacts its national performance in terms of economic, environmental, and social developments.

Conclusion

Limitations

This study has two major limitations. First, we used secondary data obtained from four different sources. While primary data might have given us a better control over the definition of variables, it is less feasible for a small group of researchers to undertake a large scale cross-country data collection given the limited amount of resources and time. However, considering the fact that these indices have been formulated by reputable and authorized organizations and several suitable statistical procedures (e.g., use of multiple respondent expert surveys in each nation and correcting the internal consistency before index calculation) have been carried out to ensure the reliability and validity of the instrument, relying on these secondary sources provides a cost-effective way for conducting our study. Second, we analyzed data only from the countries commonly available in all the four sources. For instance, we could not include countries like Afghanistan, Cuba, Hong Kong, Taiwan, and so on as these countries were not commonly available in all the four data sources. However, given that we have only 7 main variables and sample size as 108, discarding few countries may not make a significant difference in the results because PLS places minimal restrictions on sample size, and residual distributions (Chin 1998). Despite these two potential limitations,

our study is the first study with macro-level orientation to empirically examine the role of IT on all the three dimensions of sustainability simultaneously and cohesively under a unified theoretical framework.

Implications and Future Research

Our study makes several important theoretical contributions. First, our study is the first study to empirically examine the impact of IT on all the three aspects of sustainability development under a unified theoretical framework in a cohesive manner. In addition, while existing studies examining the "IT-sustainability" linkage are either conceptual or case studies, our study is at macro-level, making innovative use of publicly available reliable secondary sources of data. By doing so, we heed to consistent calls from researchers (1) to simultaneously examine all the three aspects of sustainability development; and (2) to understand the critical roles of government and business IT readiness in enhancing national sustainability development. Future research may consider extending our cross-sectional study to a longitudinal panel study (with relevant robustness checks). This would help to examine the issue of temporal precedence (leads/lags) between independent, intervening and dependent variables. In regards to this, as the data pertaining to environmental sustainability is available only for 3 years (2006, 2008 and 2010) from the Yale Center for Environmental Law and Policy, researchers may need to consider using other indices like ecological footprint index and environmental vulnerability index. In addition, researchers, while doing longitudinal panel studies may also consider including other control variables like national industrial structure which may have an effect of environmental development. For instance, as indicated above, given the same level of business ICT usage among countries, a country that has a high proportion of manufacturing industry will be likely to produce more GHGs than a country that has a high proportion of service industry.

Second, our study contributes to the knowledge base of SPP framework of competitive advantage in two ways. Firstly, while SPP framework has emerged as a useful theoretical lens for understanding source-position-performance linkages in the context of business firms; we apply it in cross-country setting for understanding the issue of national sustainability development, and hence, demonstrate its usefulness in a global context. Secondly, in contrast to past studies that have implicitly assumed that organizational capabilities could have direct effects on firm performance, our study, by drawing from Day and Wensley (1988), posits that the effect of IT readiness on performance is mediated by ICT usage. In line with this, our results highlights the association of government and business IT readiness with government and business ICT usage, and national sustainability development, and hence, reiterates the synergistic connection between source of advantage, positional advantage, and national performance. Given several significant associations between ICT usage among government and businesses in a country and economic, environmental, and social developments; future research may test how the relationships are affected by introducing several contingency variables such as institutions, human capital, and macro-economy. In addition, future studies may also examine the relationships among different dimensions of sustainability development (in presence of IT).

From a practical standpoint, our study makes three important contributions. First, by examining the effects of government and business IT readiness on national sustainability development via government and business ICT usage, our study, helps practitioners and policy makers to understand why differing levels of sustainability development continues to prevail among countries. Second, our study suggests that while government ICT usage has a positive relationship with all the three aspects of sustainability development, business ICT usage have a positive relationship with economic and social developments. That is, increase in the levels of government and business ICT usage in a country will increase the levels of sustainability development. Therefore, practitioners and policy makers should make concerted efforts in enhancing national performance by appropriately targeting the ICT usage among government and businesses. Third, our results serve as a guide to countries striving to elevate and manage their sustainable development on what to focus their resources and capabilities on.

In conclusion, despite an extensive recognition on the importance of IT in causing and resolving issues surrounding sustainability, both research and practitioner communities knows relatively little on how IT can be effectively utilized to bridge the balance between different aspects of sustainability. As an initial step to be taken towards raising awareness for pivotal role of ICT usage in managing sustainability, we have constructed and validated a theoretical model that examines the role of government and business IT readiness on government and business ICT usage and on national performance in terms of economic,

environmental, and social developments. That is, we reasoned and demonstrated empirically the relationships between government and business ICT usage and sustainability development, and the mediating role of government and business ICT usage on the relationships between government and business IT readiness in a country and its sustainability. Our study, in sum, reiterates the synergistic connection between sources of advantage, positional advantage and national performance.

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Appendix

Countries Analyzed
Albania, Algeria, Argentina, Armenia, Australia, Austria, Azerbaijan, Bahrain, Bangladesh, Belgium, Benin, Bolivia, Bosnia and Herzegovina, Botswana, Brazil, Bulgaria, Burkina Faso, Burundi, Cambodia, Cameroon, Canada, Chad, Chile, China, Colombia, Costa Rica, Croatia, Cyprus, Czech Republic, Denmark, Dominican Republic, Ecuador, Egypt, El Salvador, Estonia, Ethiopia, Finland, France, Georgia, Germany, Greece, Guatemala, Guyana, Honduras, Hungary, Iceland, India, Indonesia, Israel, Italy, Jamaica, Japan, Jordan, Kazakhstan, Kenya, Kuwait, Kyrgyzstan, Latvia, Lithuania, Luxembourg, Madagascar, Malaysia, Mali, Malta, Mauritania, Mauritius, Mexico, Mongolia, Morocco, Mozambique, Namibia, Nepal, Netherlands, New Zealand, Nicaragua, Nigeria, Norway, Pakistan, Panama, Paraguay, Peru, Philippines, Poland, Portugal, Romania, Russia, Singapore, Slovakia, Slovenia, South Africa, Spain, Sri Lanka, Sweden, Switzerland, Thailand, Trinidad and Tobago, Tunisia, Turkey, Uganda, Ukraine, United Arab Emirates, United Kingdom, United States, Uruguay, Venezuela, Viet Nam, Zambia, Zimbabwe
Total number of countries included for data analysis = 108.