

Determinants of E-government Readiness: An Application of Canonical Correlation and SEM Analysis Techniques

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Abstract

E-government represents more than a diffusion of some technology in the public sector. Rather, e-government, along with the set of its accompanying operations, can promote important changes resulting in more streamlined operations and better citizen-oriented services. Previous research was mainly concerned with providing conceptual models of e-government measures, with relatively few studies empirically investigating e-government initiatives using cross-country analysis. Based on secondary data derived from UNPAN and the World Bank, a socio-technical perspective will be applied in this paper in order to present a more comprehensive model and empirically investigate the role that social, technological, and economic factors play in the enhancement of countries' e-government readiness. To this end, structured equation modeling is applied. The results show that infrastructure, human capital, and the level of online presence and interactive services initiated by the government are significant determinants of e-government readiness. Contrary to expectations, no significant relationship was found between e-participation and e-government readiness. The paper has important implications for government decision makers, e-government systems designers, security specialists, and e-government scholars and researchers

Key words: E-government, e-government readiness, e-participation, Technology readiness, Human Capital, Structured Equation Modeling (SEM)

1. Introduction

E-government has emerged as a discipline concerned with the online provision of public services to citizens and as an interesting area to be studied and researched. This has come out not only as a digitization of public administration processes, but more as a transformative force, affecting all operations and functions in government. The purpose here is to ensure that the public services are being performed and delivered to the concerned stakeholders in an efficient and effective manner.

Within this context, information and communication technologies (ICT) offer governments with a powerful means with which their basic role to serve their people and communities can be better facilitated. Previous research defined e-government in various ways. While some researchers emphasized the technology element (example, West, 2004; Koh and Prybutok, 2003), others conferred that the focus in e-government is not about the technology it uses, but rather about the development and improvement in services that it ensues (example, WorldBank, 2008; Rahman, 2007; Bagchi, 2000; Kovacic, 2005; UNDESA, 2003; and Brown, 2002). Besides definitions, several research papers have elaborated on the advantages and disadvantages of e-government as well as the opportunities and challenges that it raises. For example, competitiveness and knowledge advancements can be realized through e-government (Signore et al, 2005); however, digital divide and human capital development are two key issues that need to be addressed (Dugdale et al, 2005). Nevertheless, these advantages, disadvantages, opportunities, and challenges were not examined in relation to a global context where the different characteristics pertinent to different countries would be taken into consideration. This is important because different governments have different ways of applying e-government initiatives, and thus reap various benefit levels.

Previous research also muses that the resources (technological, human, financial, and legal) that a government has in command would influence the level of its e-government readiness (Al-Omari & Al-Omari, 2006; Arevalo et al, 2006; Bertucci, 2005; UNPAN, 2005). Some researchers have so far majorly developed conceptual models (example, kunstelj and Vintar, 2004). Even the empirical models either depended on case studies related to one or few more countries (example, Grant and Chau, 2005), or were descriptive approaches in terms of evaluating government websites for availability, service delivery, and public access (West, 2005). Srivastava and Teo (2007) offered a contribution, where the authors conducted an empirical study to analyze e-government development from a global perspective, using the technology-organization-environment model and secondary data related to 115 countries (Srivastava and Teo, 2007). This could probably be considered the only empirical large scale analytical study so far, where the author applied the partial least square regression technique to examine the effect of certain country-specific characteristics on e-government development. Similar contributions were made by Singh et al (2004) and Bagchi et al (2005). While recognizing the remarkable contribution the previous research provided to the understanding and conceptualization of e-government, it could be noticed, in general and with few exceptions, that in most studies, there was either no empirical testing done, or there was no diversity in statistical techniques used.

This paper intends to fill these research gaps by presenting a model for e-government readiness that takes into consideration certain factors that were not included in previous research. Moreover, the paper attempts at using various quantitative techniques that would help in identifying the factors that are most likely to be associated to e-government readiness. More specifically, the questions *what are the country characteristics that would play a role in enhancing e-government readiness*, and, *what factors play a mediating role in the relationship between country characteristics and e-government readiness* will be addressed. The authors believe that this study could be useful to different groups affected by and interested in this area. These would include government agencies, citizens, policy makers, academicians and researchers.

The next sections of this paper are organized as follows. First, a review of literature related to e-government, its stages of evolution, and e-government readiness models will be presented. Next, the data that will be used in the study and the methodology followed will be discussed. After that, the proposed model and the empirical test results will be depicted. The paper concludes with the study implications and the recommendations for future research.

2. Review of Literature

E-government initiatives are increasingly capturing the attention of government policy makers, government development agencies, and even citizens. Governments all around the world are making huge financial and financial investments to establish and improve e-government initiatives. The efforts in many of these countries are focused on developing service-oriented, citizen-centered e-governments that are truly representative of the people (Accenture, 2004; Woolfson, 2004). Accompanying this trend, e-government has also been increasingly the topic of an extensive body of research examining ways for enhancing the efficiency and effectiveness of government operations, citizen access to public data sources, e-government strategies, and e-government system design, development, and implementation. The following sections will be a presentation of the e-government literature pertinent to this study, including e-government definitions, stages of evolution, requirements of success, and the various frameworks of e-government readiness.

2.1. E-government and E-government Readiness: Definition and Conceptualization of Terms

The literature has provided various definitions to e-government. Earlier research looked at the process as an attempt to make use of technological advancements in the Internet and communication fields in order to realize more efficiency levels in running e-government operations (Koh and Prybutok, 2003). Similarly, Deloitte (2000) defined e-government as the deployment of technology to facilitate the access to and delivery of public services to employees, citizens, and business partners (Deloitte Research, 2000). Needless to say, these definitions miss the complexity of the development process and the transformation elements needed to make the e-government initiative and objectives plausible. According to the World Bank: (World Bank, 2008)

E-Government refers to the use by government agencies of information technologies - Wide Area Networks, the Internet, and mobile computing- that have the ability to transform relations with citizens, businesses, and other arms of government. These technologies can serve a variety of different ends: better delivery of government services to citizens, improved interactions with business and industry, citizen empowerment through access to information, or more efficient government management. The resulting benefits can be less corruption, increased transparency, greater convenience, revenue growth, and/or cost reductions.

The definition sheds light onto the value intended to be derived from the implementation of e-government at both the government and the citizen levels. At the government level, the application of e-government has the potential to enhance effectiveness and efficiency, and at the customer level, e-government can promote satisfaction and empowerment. In reference to the value chain model suggested by Porter

(1985), e-government can enhance both the strategic and the competitive advantages of the governmental agencies. In fact, the advantages in terms of service promptness, responsiveness, and cost advantages are outstanding. The definition also emphasizes the importance of the service component.

2.2. E-Government Effectiveness: Critical Success Factors

E-government is more than a web presence of government information, forms, and public services. Rather, it is a catalyst that has the potential to facilitate change, simplify processes, and induce high levels of efficiency and effectiveness. But for this catalyst to work, several requirements should be met. To start with, Koh et al (2006) consider e-government strategic, and hence, it requires a lot of change in processes. Furthermore, Fang (2006) draws the features that characterize e-government initiatives in countries that have been successful in implementing them. E-government initiatives in these countries are: comprehensive and interoperable, integrated, ubiquitous, easy to use, accessible, secure and private, and re-engineered (Fang, 2002).

Similarly, West (2003) contends that “anything that constrains public access compromises the ultimate goals of e-government” (West, 2003). Based on this, West mentions six factors that should be taken into consideration if the e-government initiative is to be successful. These are: disability access, readability, non-English language accessibility, interactivity, equity of access across agencies, and user fees (West, 2003). Finally, Caldow (2001) suggests seven factors as milestones for e-government leadership. These are: (1) process integration and technology integration, (2) economic development, (3) e-democracy, (4) e-communities, (5) intergovernmental relations, (6) policy environment (legal framework), and (7) internet connections (that are fast, always on, everywhere, natural, intelligent, easy, and trusted (Caldow, 2001).

2.3. E-Government Models

The topics of e-government and e-government readiness are increasingly becoming areas of interest in IS research. Several models were formed to explain the relationship between e-government on one hand and other factors influencing its performance and effectiveness (Ranerup, 2007). Other models depicted the factors that are most likely to be associated with e-government maturity (Singh et al, 2004). Still others discussed the elements that would facilitate e-government development (Srivastata and Teo, 2007). Finally, several research papers developed models for assessing e-government readiness at country and global levels as well as presenting the factors that can play a role in affecting the e-government readiness level (Rahman, 2007; Bagchi et al, 2005; Al-Omari and Al-Omari, 2006; UNPAN, 2008). Following is a description of these models along with the factors they comprise.

In an attempt to assess, categorize and compare e-government efforts of various administrations in different contexts, Grant and Chau (2005) developed a generic framework for e-government. According to the model, for government x to deploy the e-government initiative, the transformation process requires five major elements for it to be successful. These are service delivery, citizen empowerment, market enhancement and development, exposure and outreach, and infrastructure (Grant and Chau, 2005)

Emphasizing maturity rather than readiness, a study was conducted to examine the factors that are most likely to determine the e-government maturity level (Singh et al, 2004). Using a path model analysis, it was found that there is a relationship between e-government and GDP (especially in affluent countries). This relationship, however, is mediated by Human capital index, ICT infrastructure, and the governance index (Singh et al, 2004).

Moreover, in a study representing a cross-country analysis for examining e-government development facilitators, a model was introduced using the technology – Organization –

Environment (TOE) theoretical framework (Srivastava and Teo, 2007). Using the partial least square (PLS), the analysis showed significant relationship between all factors and e-government development, except for the environment factor. Coming to e-government readiness, a study was conducted by Bagchi et al (2005) to assess the roles of institutional efficiency and interpersonal trust in determining the level of e-government readiness across countries. Using the OLS (ordinary least squares) regression, the study showed that e-government readiness is influenced by these factors.

Finally, a study conducted by Al-Qmari and Al-Omari (2006) shows that there are six important factors to guarantee the success of e-government initiatives and consequently increase the e-government readiness level of a country. These factors are: government organization readiness, leadership and IT governance, customer readiness, accessibility by all, competency and technology readiness, and legal readiness (Al-Omari and Al-Omari, 2006).

3. Study Design and Methodology

The targeted population in this study is the set of countries that have implemented – even at a small scale – the e-government initiative. The study will mainly depend on two data sets covering the years 2004, 2005, and 2007. In particular, the data used in this study were obtained from three sources: one is generated by the United Nations Network of Public Administration and Finance (UNPAN) (2004, 2005, and 2008), whereas the others were obtained from the World Bank and the World Economic Forum. Data generated by a government or an international organization like the United Nations or the World Bank are considered fairly accurate, as they are drawn from large samples. Also, the possibility of having inherent bias in such data sets is relatively low. As for the sample size, the study will have an overall number of cases ranging between 306 and 576 cases, depending on the data lists used. Knowing that a minimum sample size of 200 is required for SEM modeling, it could be safe to say that the sample is fairly adequate for this study.

3.1. Variables and Research Methodology

The variables included in the data sets are listed in table 1. To start with, the different data sets were organized according to country and year in a spreadsheet file. After that, cases with important values missing for unavailability were deleted.

Table 1 Research Variables: List and Type

<i>e-government characteristic by country</i> N=192 countries	<i>Country Classification</i> N= 102 countries
Variable	Variable
<i>Country</i> : non-metric	<i>Country</i> : non-metric
<i>E-government readiness index</i> : metric	<i>Growth Competitiveness Index</i> : metric
<i>Rank (2007) Rank (2005) and Rank (2004)</i> : metric	<i>Education index</i> : metric
<i>Rank change</i> : metric	<i>Technology index</i> : metric
<i>Web Measure index</i> : metric	<i>PC Index</i> : metric
<i>Human Capital index</i> : metric	<i>Internet Index</i> : metric
<i>Infrastructure index</i> : metric	
<i>E-participation index</i> : metric	

As a matter of fact, the study attempts to answer the following research questions:

- What are the factors that are most likely to be associated to E-Government Readiness?
- To what extent can shared governance, infrastructure, human capital, and e-readiness contribute to the enhancement of e-government readiness?

To this end, and given the nature of data available in the two data sets, the study will adopt, besides descriptive statistics, the Structure Equation Modeling (or path analysis). This technique will be used in order to assess the effect of the various variables on e-government readiness index. Also, the effect of certain mediating variables will also be examined and assessed. Furthermore, the resulting model will be evaluated for its goodness of fit and parameter estimation significance.

3.2. Model Components

The model comprises three major parts: Country profile characteristics, E-government antecedents, and E-government readiness assessment. A preliminary description of the relationships among these components can be thought of as follows, and is depicted in Figure 1:

- Infrastructure, web measure, e-participation, and IT accessibility (PC and Internet) may possibly have a causal relationship with E-Government Readiness (Endogenous variable)
- Information Technology Development, Growth Competitiveness (GCI), and Human Capital are exogenous variables, which have possible causal relationships with the e-government readiness antecedents.

3.2.1. Country Profile Characteristics

Different countries have different resources and capabilities. Of course, while it is possible to imagine 24/7 electronic interaction with the government in developed countries, it is difficult to achieve the same level of efficiency and flexibility in developing countries (Rahman, 2007). This is because different countries have different infrastructures, GDP levels, education rates, and growth competitiveness rates, and all these are believed to be important ingredients to the ability to build and maintain effective e-government initiatives. The arrows in this model component are self explanatory. Developed countries are expected to have more advantages in these aspects than developing countries.

3.2.2. E-Government Antecedents

The major antecedents used in this study are: web measures, e-participation, IT-index (e-readiness), development index, and human capital index. According to the UN Global E-government Readiness Report (2005 and 2008), these measures are defined as follows:

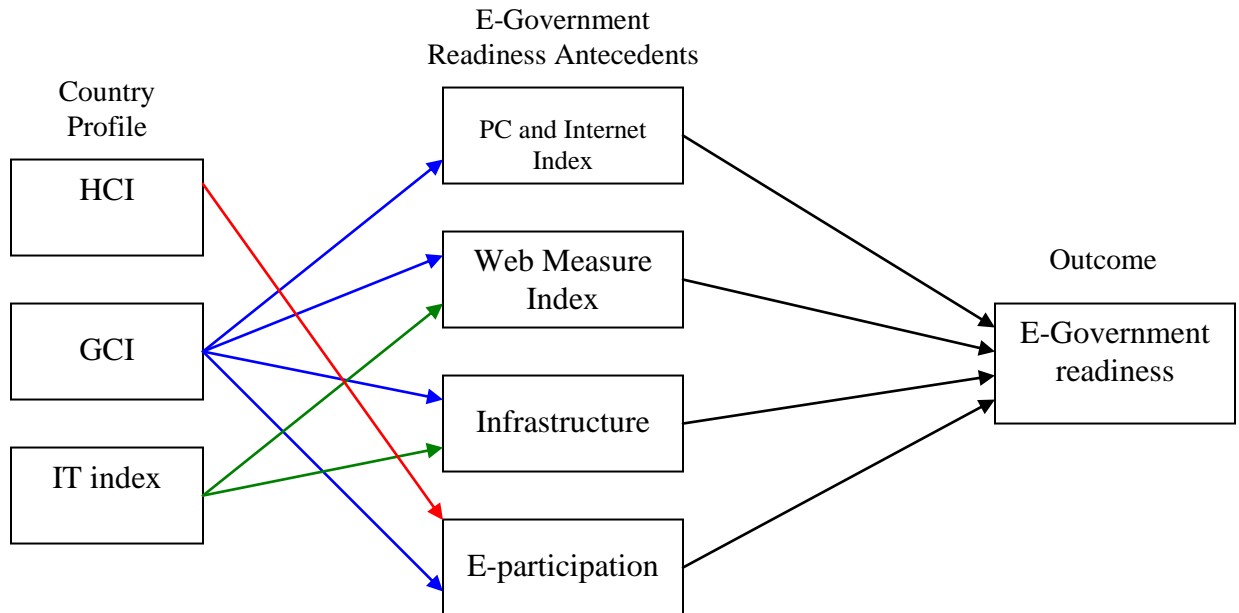
- The web measure index is based on a five-stage model. The level a country has depends on infrastructure development, data management, security and customer management, and the government process reengineering level. The stages are: emerging, enhanced, interactive, transactional, and connected (UNPAN, 2008).
- Human capital index is a composite that includes adult literacy rate and enrollment rate (UN Report, 2005).
- E-participation index is a qualitative assessment of the quality and usefulness of government websites in providing web based participation tools to people to enhance democracy and shared governance (UN Report, 2005).

3.2.3. E-government Readiness

This is a composite index designed by UN to assess the potential of countries' governments to participate in the networked world and thus promote citizen oriented public services, while at the

same time streamlining their operations to achieve more efficiency and effectiveness. Since the data set used in this study includes both developing and developed countries, the potential, rather than the demonstrated behavior, is emphasized. Based on this, readiness, rather than maturity, is chosen as the key dependent variable.

Figure 1 Global Perspective of E-Government Readiness: Anticipated Relationships



Descriptive statistics analysis was conducted to delve into the characteristics of the data being used. After that SEM was applied to examine the relationships (especially, the causal) among the variables, and more specifically, with the e-government readiness variable. The next section will be a description of the analysis done and a reporting of the major findings reached.

4. Study Findings and Analysis

Based on the data reported by UNPAN, the number of countries deploying e-government systems have been increasing throughout the years. Also, the ranks are changing from one year to another, depending on the efforts put, changes facilitated, and resources used or made available. This enhances the researchers' interest to understand the data details and investigate the types of relationships amongst the variables based on what the UNPAN report and previous research have established.

4.1. Examining Data

The descriptive statistics given in Table 2 shows that there is a disparity in the rank variable, which is expected since different countries occupy different ranks depending as mentioned earlier on internal governmental strategies and available resources (human, financial, and technological). Also, the skewness and kurtosis measures show that the data pertinent to *e-government readiness index*, *web measure index*, *GCI index*, and *technology index* are normally distributed. Note that the data available for the technology index are available to one year only (2004) and those of education index are related to two years (2005 & 2007).

4.2. Structural Equation Modeling: Path Analysis

Structural Equation Modeling (SEM) was applied in order to examine the factors that could be associated to e-government readiness and could have a causal relationship with it. Using AMOS,

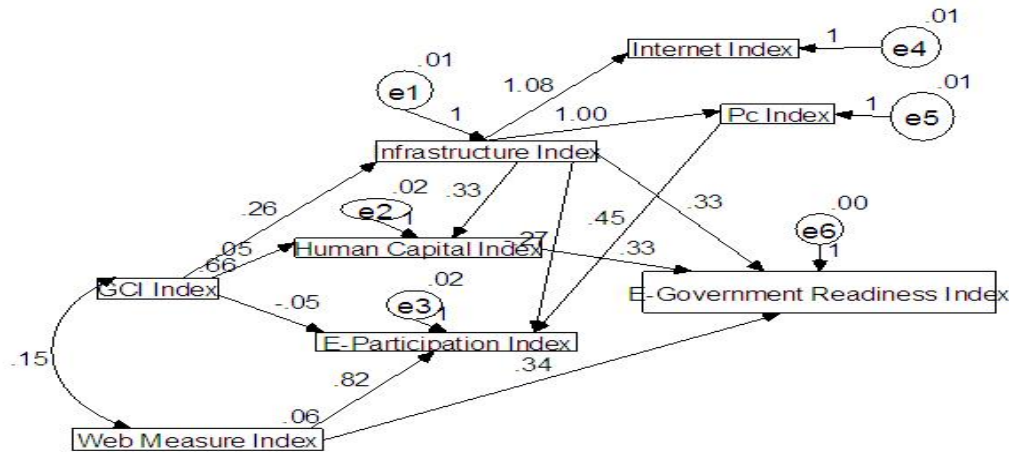
several run outs were done to get the optimal model specification. Figure 3 depicts the final run result.

Table 2 Descriptive Statistics

		Statistics										
		Rank	E-Government Readiness Index	E- Participation Index	Web Measure Index	Human Capital Index	Infrastructure Index	Education Index	Internet Index	Pc Index	GCI Index	Technology Index
N	Valid	327	327	327	327	327	327	230	327	327	327	97
	Missing	0	0	0	0	0	0	97	0	0	0	230
Mean		70.81	.505702	.244343	.45090	.8149	.252012	.8191	.261	.198	4.0762	3.9946
Std. Deviation		49.769	.1939114	.2399081	.239973	.17642	.2371126	.17571	.2669	.2514	.81256	.90988
Skewness		.494	.133	1.282	.164	-1.547	.882	-1.709	.972	1.435	.234	.009
Std. Error of Skewness		.135	.135	.135	.135	.135	.135	.160	.135	.135	.135	.245
Kurtosis		-.925	-.677	1.018	-.566	2.207	-.487	3.030	-.187	.934	-.769	-.426
Std. Error of Kurtosis		.269	.269	.269	.269	.269	.269	.320	.269	.269	.269	.485
Range		181	.8232	1.0000	1.000	.99	.8581	.99	1.0	1.0	3.71	4.24
Minimum		1	.0925	.0000	.000	.00	.0019	.00	.0	.0	2.30	2.06
Maximum		182	.9157	1.0000	1.000	.99	.8600	.99	1.0	1.0	6.01	6.30

As could be noticed from the figure, *GCI Index* and *web measure index* are the exogenous variables, and they have a significant covariance. *Growth competitiveness index* influences *infrastructure*, and *human capital index*, but has a trivial, although significant, influence on *e-participation index*. This finding is expected, since the economic and public institutions development in a country can lead to better infrastructure and more investment in human resources.

Figure 3 SEM: A Path Analysis for assessing e-government readiness



These results conform to the results reported by Singh (2004). The importance of infrastructure was highlighted by several researchers (Medjahed et al, 2003; Klischewski, 2001) and the importance of human capital index was emphasized by others (Al-Omari and Al-Omari, 2006 and Srivastava and Teo, 2007). Both variables were found significant in influencing *e-government readiness* in this study. The *web measure index*, the level of online presence and interactive services the government makes available via the Internet, also has a positive influence on *e-government readiness index*, which supports the analysis of UNPAN (2008). The negative and low influence of *GCI index* on *e-participation index* could be explained by the fact that the nature of the GCI index comprises economic, institutional, and technological factors, not human capital factors. At the same time, e-participation is a measure mainly, if not solely, determined by

the government body in its relationship with citizens. It is not a result of economic and institutional developments, at least so far.

Another interesting finding is that the *GCI index* **direct** influence on e-government readiness is not significant, while the influence of *GCI index* on *human capital index* and that of *human capital index* on *e-government readiness* are both significant. This implies a full **mediation effect** of *human capital index*. The same goes for *infrastructure index*. These results are interesting in the sense that if advancements in economy and public institutions do not contribute to the development of human resources and infrastructure, they can not have any effect on the e-government initiatives and developments.

Coming to the model goodness-of-fit, this model was found to be more acceptable than the ones based on canonical correlation analysis. It could be because the inter-relations amongst all the variables together are important for achieving a better fit. While the CMIN is still significant, the CMIN/df is lower in value. The GFI, CFI, and NFI show high values, which indicates that the model could be viewed as acceptable. Still however, the RMSEA is > 0.08 , which again weakens the model goodness-of-fit. Overall, however, the model can be considered good in explaining the factors that are most likely to be associated to e-government readiness.

5. Conclusion, Implications, and Limitations

The advents of information and communication technologies are making organizations of all kinds and sectors increasingly reliant on information systems. E-government, like e-commerce and e-business, emerged as a result of these ICT technologies. However, e-government readiness assessment is not an easy task, as each government deploys e-government systems according to certain missions, visions, and strategies. Moreover, different governments have different contexts, processes, and command over resource availability. This is a major reason why high e-government readiness ranks are occupied by developed rather than developing countries. This study discussed e-government initiatives as a means that would enhance efficiency and communications with citizens. These initiatives, however, are not challenge free. The economy level, infrastructure, human capital, and access to technology are few of many factors to be considered in studying e-government readiness. A major conclusion in this study is that web measures, infrastructure, and human capital development have a positive and significant influence on e-government readiness. Also, the infrastructure has a strong influence on PC use and Internet access, which is an expected result. Interestingly, human capital index and infrastructure have full mediation effects in the relationship between GCI index and e-government readiness. Finally, this study could not find any relationship between e-participation index and e-government readiness index, indicating the possibility that e-participation is more or less a government strategy and policy.

The study has an implication to the e-government systems designers and developers. They are recommended to take into consideration the different ability levels of people accessing the e-government services. This implies the necessity of having easy to use and integrated systems that would be efficient and effective for governments as well as citizens. Another implication is for governments to take into consideration the infrastructure and human capital factors in the country before and during the development of e-government initiatives. They should also work on raising the awareness level of people as well as training them on how to use e-government services and reap the benefits of the system. Still another implication is for information security specialists, especially that private and personal data are traveling over the net in the e-government transaction completion processes. An information security system should be a robust one, taking into consideration the types of systems employed by the government as well as its overall security and information protection strategies. Finally, the study has implications for IT education programs to include e-government processes as a part of the curriculum, thus ensuring better awareness of the field and that graduates would have the skills needed by the government body.

However, and like any other study, this study has certain limitations. Most importantly, the study depended on data in the form of indices. The indices could have been developed with some bias in the weights of the various components. If expert opinions about the nature of indices could have been located, the study would have had more robustness. Also, if original data – rather than indices – had been found and used, the analysis could have followed other directions, and more findings could have been probably reported. Moreover, since different countries have different resources, clustering countries into ‘developing’ and ‘developed’ groups, or into high, moderate, and low incomes would add to the richness of the paper results. Finally, certain behavioral factors, such as trust, resistance to change, and culture were not taken into consideration, although they may have a significant influence on e-government readiness assessment. Nevertheless, these limitations were somehow leveraged by the significant estimates and the moderate goodness of fitness results obtained from the SEM analysis.

Future research can take into consideration these limitations, depend on country categorization, and gather more data about the applications and results of e-government initiatives across different countries. Possible areas can also include behavioral, social, and process management factors that can help make the e-government initiative more efficient and effective.

E-government initiative developments are taking place at a rapid pace. Different countries are occupying different ranks every year. The difference between successful and failure e-government initiatives is the way these initiatives are managed, their opportunities are captured, and their challenges are handled. Understanding the effect of economic, human, and infrastructural factors on the success of e-government initiatives has the potential to make a difference in the efforts made by governments to make use of their human and technology resources in order to attain higher ranks in the e-government readiness, and consequently, the e-government maturity ladder.

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