

Article

Transformational and Transactional Factors for the Successful Implementation of Enterprise Architecture in Public Sector

Seogjun Lee ^{1,*}, Seung Woon Oh ² and Kichan Nam ^{3,*}¹ School of Business, Konkuk University, Gwangin-Gu, Hwang-Dong 1, Seoul 05029, Korea² Yesser, Ministry of Communications and IT, Riyadh 11112, Saudi Arabia; soh@yesser.gov.sa³ School of Business Administration, American University of Sharjah, P.O. Box 26666, Sharjah, UAE* Correspondence: seogjun@konkuk.ac.kr (S.L.); knam@aus.edu (K.N.);
Tel.: +82-2-450-3645 (S.L.); +971-6-515-4693 (K.N.)

Academic Editor: Marc A. Rosen

Received: 29 February 2016; Accepted: 4 May 2016; Published: 9 May 2016

Abstract: Enterprise architecture (EA) is one of the most important and effective tools for delivering high-quality e-government services to citizens. In this study, we used organizational performance and change theory to determine factors that contribute to the successful implementation of EA. We classified these factors as one of two types: transformation change (TFC) and transactional change (TSC). To identify these factors, we collected survey data from Korean public sectors that have implemented EA for years. Results show that while EA management systems (EAMS) and EA guidelines directly affect EA performance, laws and regulations, and EA organization exert an indirect effect. Further, top management support had both direct and indirect effect on EA performance. Ultimately, the findings produced by this study have implications for government institutions that plan to implement EA.

Keywords: e-government; enterprise architecture; change management; organizational change; information and communication technologies (ICT)

1. Introduction

As advances in information technology continue to accelerate, the public continues to demand an ever-increasing level of information technology (IT)-based services. To meet this demand, most governments around the world have expended a great deal of money, time, and effort to apply information and communication technologies (ICTs) in innovative ways to deliver e-government services. Previous studies have shown that e-government capabilities have significantly changed the way in which governments function, and, thus, have increased citizen's satisfaction from government services [1,2]. As the demand for high-quality service increases, integrative planning and effective management of IT resources has grown increasingly important. Further, the complexity and difficulties associated with IT management have grown in parallel. To overcome these challenges, many countries have attempted to increase their efficiency through the use of enterprise architecture (EA) in the provision of e-government services.

EA is one of the most important tools for delivering effective e-government services. However, a wide range of definitions and proposed utilities of EA have resulted in substantial variance in the methods EA comprises and the objectives it pursues. For instance, whereas some countries implement EA at the individual ministry or agency level, other countries apply it at the central government level. Moreover, some countries develop their own EA reference and maturity models, while others merely adopt and modify extant models. Although the manner in which EA is defined and interpreted is

largely dependent on its proponents in a given context or the purpose of its implementation, many organizations and countries are consistent in the belief that EA can be quite useful.

Early researchers of EA used case study approaches to evaluate conceptual issues and optimal methods of implementation. Later studies were geared towards identifying factors that facilitate the success of EA, but failed to include empirical tests of the factors' effects. Because EA requires a comprehensive understanding of technology, management, and organization, the simple identification of EA success factors rendered these studies limited in terms of their conceptual contributions. Understanding the factors that contribute to the successful implementation of EA is critical for supporting and facilitating the efforts of government agencies, institutions, and private companies. Specifically, researchers should adopt an organizational perspective when studying EA because such a perspective accounts for not only how a technology is implemented, but also how it affects diverse interest groups within organizations.

Given these shortcomings of past research in this domain, we attempted to identify and empirically validate factors that contribute to the successful implementation of EA in the context of organizational change. To do so, we adopted two types of organizational change: transformational change (TFC) and transactional change (TSC). On the basis of these concepts, we explore the relationship between two different types of success factors.

2. Literature Review

To provide a comprehensive understanding of e-government and how the progression of EA has affected it, we offer reviews of the literature related to each respective domain.

2.1. Literature Review of E-Government

As e-government is perceived as an effective tool for providing public services [3], studies on e-government have become increasingly diverse. Early research focused primarily on the evaluation of e-government performance and what makes it successful [1,2,4]. This line of research includes the development of indicators and the evaluation of e-government to facilitate their introduction [5–7]. More recently, however, e-government researchers have focused on issues related to privacy [8–10], transparency and anticorruption [11–13], and future-oriented e-government [14,15]. This change in focus suggests that, as technologies advances and social dynamics change, e-government research topics are becoming increasingly diverse.

One study that is largely representative of this avenue of research derived and summarized e-government success factors based on a review of salient literature [16]. They classified applications of e-government into four areas, and based on this classification taxonomy, proposed 20 factors related to the success of e-government. Moreover, they proposed tools and practical guidelines for practitioners, and presented associations between each tool and the 20 success factors. This study remains one of the most comprehensive summaries of success factors related to e-government.

In a similar line of scholarship, Heeks and Bailur [17] reviewed 84 studies to identify five key elements of research concerning e-government. These elements include: (a) perspectives on the impacts of e-government; (b) research philosophy; (c) use of theory; (d) methodology and method; and (e) practical recommendations. They found that most research has been overly optimistic and limited by unclear research methodologies. In the same vein, Yildiz [18] argued that e-government research suffers has failed to provide a precise definition of e-government, oversimplified e-government development processes and suffered methodological limitations. Similarly, Snead and Wright [19] reviewed and analyzed 100 studies on e-government in major journals. From this review, the authors found that methodologies for researching e-government were not adequately described, data collection practices were not systematic, and most studies were atheoretical. Taken together, extant research on e-government suggests that future scholarship on e-government (including EA) should be based on robust research models and methodologies.

2.2. Literature Review of EA

Enterprise architecture provides a long-term view of a company's processes, systems, and technologies, so that individual projects can build capabilities [20]. EA objectives are to support business and IT alignment, investment decision-making, system integration, and IT risk management [20–22]. It also provides a general blueprint for creating enterprise-wide information systems that can help support an organization's strategy execution in a coordinated manner, by aligning business processes with data and technologies that support them.

Zachman [23] defines EA as the logical structuring and classification of descriptive representations of an enterprise, which are significant to the enterprise management and development functions. Moreover, Bernard [24] describes EA as the analysis and documentation of an enterprise in its current and future states from an integrated strategy, business, and technology perspective. Hilliard [25] defines architecture as the fundamental organization of a system embodied in its components, their relationship to each other, and to the environment and the principles guiding its design and evolution. In summary, EA can be defined as a management practice to achieve organizational performance goals, based on well-defined components and their relationship using a holistic approach.

The importance of EA is closely related with strategic alignment of IT business operations, stable operation of complex information systems, and interoperability of IT resources. For this reason, the early EA approaches have been focused on the understanding of the concept and its philosophy. Additionally, early research on EA was performed for practical reasons rather than academic progress. Many applied models were developed on the basis of Zachman's [23] framework, but the models and guidelines developed by the U.S. government are most widely known and adopted [26–28]. Developed by several EA-related institutions, the Open Group Architecture Framework called TOGAF is currently available and widely used by private companies and government institutions [13]. Martin and Gregor [29] review diverse EA issues from a policy perspective, with business and IT strategy and architecture. Moreover, Rohloff [30] discussed the integration aspect of EA architecture and mentioned the importance of organizational issues.

Many researchers have published studies from the private [31–34] and public sectors [35,36]. As a representative case study from the public sector, Janssen and Hjort-Madsen [37] proposed a framework on national enterprise architecture (NEA), and compared the processes by which EA was implemented in Denmark and the Netherlands. This study marks one of the first attempts to highlight the importance of EA in implementing e-government services.

Zheng and Zheng [38] reviewed journal articles related to EA published over a six-year period. Taken together, the studies they reviewed suggested that the implementation of e-government services had steadily grown. These findings were consistent with research performed in other geographic domains [39]. Unlike these other studies, however, Zheng and Zheng [38] made note of the weak research methodologies employed in most EA research.

Many EA studies have been geared towards suggesting critical factors for successfully implementing EA. Ylimaki [40], for example, classified critical success factors (CSFs) for EA into twelve domains. Similarly, Nikpay *et al.* [41] derived 20 CSFs from a review of diverse literature on the topic (but the authors failed to empirically validate these factors). Schmidt and Buxmann [42] performed a more targeted study, empirically investigating factors that contribute to success (or failure) of EA in private financial institutions.

3. Research Model

Zachman [23] introduced EA as a conceptual framework to overcome difficulties of fast changing information systems in terms of complexity and size. The purpose of EA is to determine how to integrate information and processes from the enterprise viewpoint, not from that of an individual employee [43]. Furthermore, EA provides the central authority and control necessary to effectively govern IT resources. Thus, the focus of EA implementation is not to satisfy individual employees' request, but to fulfill and optimize the organization's overall needs. This implies that extant EA success factors need to be studied from the organizational change point of view.

Many researchers have investigated organizational change from different perspectives. Burnes [44] maintains that change is a continuous, dynamic, and contested process that emerges in an unpredictable and unplanned fashion, and emphasizes five major determinants for successful organizational change: organizational structure, organizational culture, organizational learning, managerial behavior, and power and politics. Among many studies that adopt these five determinants, Burke and Litwin [45] developed new concepts of TFC and TSC and subsequently classified relevant determinants into two different concepts accordingly. Research [46–49] was conducted in both TFC and TSC, while EA practitioners and researchers were not interested in these concepts.

TFC refers to those fundamental changes that alter organizational culture and values. It requires all members of the organization to adopt these new values, and engage in new behaviors that are consistent with them. Given this, TFC is likely to be successful when it is implemented by purposeful behavior connected to a strategy. Factors associated with TFC that affect individual and organizational performance are the external environment [45,50,51], the organization's mission and strategy [29,45,52], leadership [45,52,53], and organizational culture [45,52,54].

In contrast to TFC, TSC seeks to change short-term performance by changing organizational climate and systems rather than fundamentally altering the nature of the organization. Relevant organizational factors include structure [45,50–53], management practices [45,48], systems (*i.e.*, policies and mechanisms) [45,50–53], task and individual skills [45,48,51], motivations [45,48], work climate [45,48], and individual needs and values [45,48,51].

Past EA research has largely failed to differentiate these two types of organizational change, despite the fact that doing so provides a more nuanced understanding of organizational performance and EA success. In this study, we first propose that both TFC and TSC factors are required to successfully implement EA. We then propose that TFC factors should precede TSC factors, as organizations cannot achieve strategic alignment between different areas or optimize management of IT resources without first enacting fundamental changes. Figure 1 provides a visual depiction of our research model. Although previous research proposed four variables associated with TFC, we incorporate two: laws and regulations, and top management support. We opted to incorporate only these two variables because at the government level, once laws and regulations are enacted, they supersede the forces exerted by the external environment or organizational mission and strategy. In addition, we excluded organizational culture from our research model. Although organization culture is an important consideration related to organizational performance, the effect of organizational culture is pervasive and it can affect not only EA implementation but also the organizational performance. Thus, this study narrows the focus on “organizational structure” for EA implementation, rather than the organizational culture *per se*.

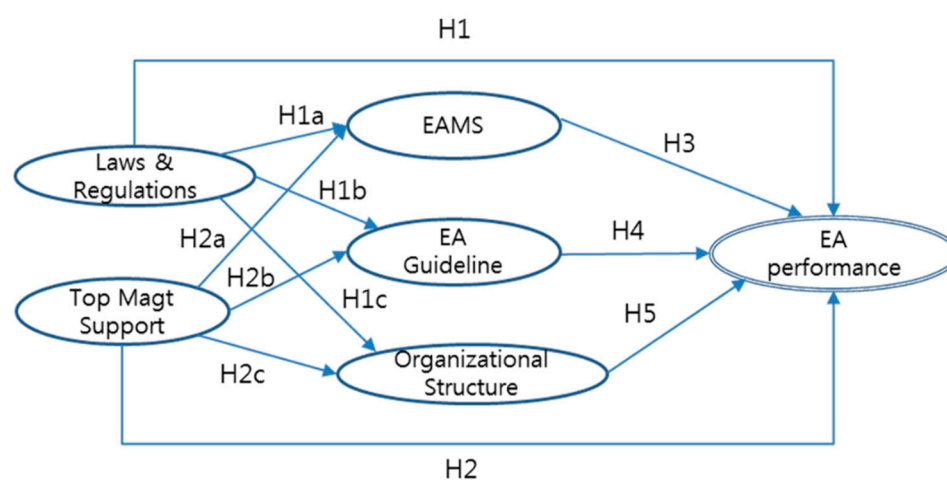


Figure 1. Research model.

Regarding TSC factors, we first deleted three individual-level variables (*i.e.*, task and individual skills, motivation, and individual needs and values), since EA relates to organizational (rather than individual) performance.

We similarly excluded the work climate variable, as it relates to too many individual behavioral issues. As a result of these exclusions, we included organizational structure, because the role of dedicated EA organization or team is imperative in public sector in contrast with private sector. To account for management practices, we included EA guidelines, as official guidelines regulate specific processes and procedures in the public sector. Finally, we incorporated EA management systems into the model. Definitions for all variables will be offered in the following section.

4. Hypothesis Development

4.1. Laws and Regulations

The implementation of government policies and programs is usually motivated and facilitated by laws and related regulations [55]. Organizational change is initiated by external environment forces, such as changes in competition, government regulations, and technological breakthroughs [45,54], as well as by internal motivation forces, such as top management's leadership, employee's change initiatives, and various management practice efforts [54]. Government-wide changes, however, are often initiated by external factors such as government policies, laws, and regulations rather than individual organizational internal motivation. Previous research [56,57] states that an evolving framework of laws and policies has been influencing the speed, scope, and direction of e-government initiatives. Similarly, laws and regulations typically motivate government-wide implementation of EA. Given this, we predict that laws and regulations positively affect the implementation of EA both directly and through the three TSC mediators.

Hypothesis 1: Laws and regulations positively affect successful EA implementation.

4.2. Top Management Support

Executive leadership is a significant TFC variable related to organizational performance [45,54]. Leadership refers to the tendency for executive personnel to provide overall organizational direction and serve as behavioral role models for employees. Although leadership is essential for long-term organizational performance and enterprise-wide organizational change, leadership must be interpreted more narrowly in reference to the implementation of EA. To successfully implement EA, top managers should set clear goals, provide clear direction for organizational change, continuously attend to organizational matters, and serve as active sponsors of EA implementation.

Continuous executive concern and support have long-been acknowledged as key factors for the success of IT [58,59]. Similarly, many researchers consider support by top management support to be critical for successful EA implementation [41,42,60]. Thus, as an important factor for TFC, top management support should exert a positive effect on not only TSC factors, but on the successful implementation of EA as well.

Hypothesis 2: Top management support positively affects successful EA implementation.

4.3. EA Management Systems (EAMS)

Proper use of EA tools has a significant effect on the successful implementation of EA [40,41,60]. Perkins [60] argued that EA tools have the most substantial effect on successful EA implementation, but are often ignored. The EA management system (EAMS) is known as a "new kind of EA tool, which collects and manages information from one or various sources, and presents it in a comprehensible time based format" [61]. According to Ghani *et al.* [62], EAMS manages enormous amounts of distributed information related to several domains, such as application software, project management, system interface design, *etc.* As such, EAMS is an information aggregator with connectors for main business and IT applications, and also a powerful visualizer for mapping information in relevant contexts by

establishing cartographical reference of all relevant information and adding a powerful feature for time navigation on the architectural blueprints [61]. EAMS referred to as the Government EA Portal (GEAP), provided by the Korean government, played a key role in diffusing government-wide EA principles and policies [63,64]. Therefore, we consider EAMS to be an essential tool for effectively implementing EA.

Hypothesis 3: The use of EAMS has positive impact on successful EA implementation.

4.4. EA Guidelines

Executive leaders can improve organizational performance by communicating organizational policies and guidelines with employees [65,66]. A number of researchers [40,42] have shown that the clarity of these guidelines significantly influence EA performance. Examples of these guidelines include rules, management processes, and employee roles and responsibilities.

Hypothesis 4: EA guidelines positively affect successful EA implementation.

4.5. Organizational Structure

Organizational structure refers to the arrangement of functions and people into specific areas and levels of responsibility, decision-making authority, communication to ensure the effective execution of the organization's mission and strategy [45]. Nikpay *et al.* [41] proposed that the visibility of an EA department is critical for effective EA implementation. For the purposes of evaluating the implementation of EA, we consider the existence of official EA organization and the efficient operation of the EA organization as a meaningful structural factor, because the role of EA is more critical in the public sector relative to the private sector.

Hypothesis 5: Organization structure for EA positively affects successful EA implementation.

4.6. Effects of TFC Factors

We proposed that both TFC and TSC factors are required for successful implementation of EA, meaning that EA implementation requires fundamental changes as well as short-term and operational changes. Thus, we propose that TFC factors should precede TSC factors and the effects of TFC factors on TSC factors are positive.

Hypothesis 1a: Laws and regulations positively affect the use of EAMS.

Hypothesis 1b: Laws and regulations positively affect EA guidelines.

Hypothesis 1c: Laws and regulations positively affect organizational structure for EA.

Hypothesis 2a: Top management support positively affects the use of EAMS.

Hypothesis 2b: Top management support positively affects EA guidelines.

Hypothesis 2c: Top management support positively affects organizational structure for EA.

5. Research Methodology

5.1. Measurement

To test the hypotheses outlined in the previous section, we adapted several instruments from the literature. More specifically, we slightly modified the phrasing for several measurement items to clarify the meaning of the constructs in the domain of EA.

To assess generally accepted constructs from management science, we measured top management support and performance. However, our study also includes measures that are specifically tailored for use in the domain of EA. These measures include laws and regulations, EAMS, EA guidelines, and EA organization.

EA expert groups reviewed the preliminary instruments to ensure their clarity. All items were presented as five-point Likert scales ranging from "strongly disagree" (1), to "strongly agree" (5).

Top management support was assessed with three items derived from Bae and Lawler [67] and Osterman [68]. Laws and regulation were assessed with three items derived from Bagozzi and Phillips [69], Boudreau *et al.* [70] and Locke and Latham [71]. Measurements for EA guidelines (five items) and EA organization (three items) were based on studies by French *et al.* [72]. We developed four items to measure EAMS. Finally, EA performance was also assessed with four items. All studies upon which the measurement items were based are summarized in Table 1. The actual questionnaire items are listed in Table 2.

Table 1. EA performance measures.

EA Performance Indicator	Related Research
Reduce IT cost	Boucharas <i>et al.</i> [73], Tamm <i>et al.</i> [74], Bernard [24], OMB [27]
Prevent IT resource duplication	Boucharas <i>et al.</i> [73], Tamm <i>et al.</i> [74], Bernard [24], OMB [27]
Enhance interoperability	Ross <i>et al.</i> [20], Boucharas <i>et al.</i> [73], Tamm <i>et al.</i> [74], OMB [28]
Increase efficiency of IT management	Hoogervorst [21], Ross <i>et al.</i> [20], Boucharas <i>et al.</i> [73], Tamm <i>et al.</i> [74]
Improve alignment between Biz and IT strategies	CIO Council [75], Ross <i>et al.</i> [20], Gregor <i>et al.</i> [22], Boucharas <i>et al.</i> [73], Tamm <i>et al.</i> [74]

Table 2. Construct items.

Construct (Abbreviation)	Questionnaire Items
Laws and regulations (LAW)	<ol style="list-style-type: none"> 1. Government's EA goals are clear 2. Government's EA goals are detailed and concrete. 3. Laws and regulations provided by the government are suitable for EA implementation in government organizations
Top management support (TOP SUPPORT)	<ol style="list-style-type: none"> 1. Top management officials (CEO and CIO) are concerned much on EA implantation efforts 2. Top management officials (CEO and CIO) support EA activities 3. Top management officials (CEO and CIO) have EA related knowledge
EA management system (EAMS)	<ol style="list-style-type: none"> 1. GEAP is actively used for our institution's works 2. The utilization of GEAP is high in our institution 3. The person in charge of EA implementation knows how to use GEAP. 4. GEAP has sufficient data and information for EA implementation.
EA guidelines (GUIDE)	<ol style="list-style-type: none"> 1. Our institution's EA guidelines are well established. 2. Employees understand the EA guidelines well. 3. Our institution's EA guidelines are comprehensive and sufficient. 4. Employees conform to EA guidelines well.
Organizational structure for EA (ORG)	<ol style="list-style-type: none"> 1. Our institution has EA organization which takes complete charge of EA implementation 2. The EA organization has relevant authority for EA implementation 3. The EA organization has responsibility for EA implementation
EA Performance (PERF)	<ol style="list-style-type: none"> 1. Our institution could reduce IT cost via EA implementation. 2. Our institution could reduce the duplication of IT resources (such as hardware, data, and application) via EA implementation. 3. Our institution could enhance IT interoperability via EA implementation. 4. Our institution could increase the efficiency of IT management via EA implementation. 5. Our institution could increase the alignment between business and IT strategies via EA implementation.

5.2. Survey Administration

The Korean government is comprised of roughly 1500 public institutions. The together with the National Information Society Agency (NIA), the Ministry of Government Administration and Home Affairs (MOGAHA) holds an official EA conference every year to announce government EA policies and guidelines to EA professionals. In 2015, the conference was held from 8 May to 18 May at six different locations. MOGAHA sent an official invitation letter to all public institutions; 1112 EA professionals participated in the 2015 EA conference. At the beginning of the conference, we held a short session explaining the purpose of our research and the survey we would be using to collect data. We distributed our survey to the 1112 participants during the conference, and collected the questionnaires at the conference's conclusion. Of the 1112 questionnaires we distributed, we received 255 in return. Fifty-eight of these questionnaires did not have complete data, so we removed them from the dataset. As a result, we received 197 response sets that we used for data analysis. Table 3 shows the demographic information for the respondents.

Table 3. Participant demographic data.

Work Experience	Frequency	Per Cent
Less than 1 year	48	24.4%
2–3 years	17	8.6%
4–5 years	10	5.1%
6–10 years	29	14.7%
>11 years	91	46.2%
No response	2	1.0%
Total	197	100%
Division Type	Frequency	Per Cent
IT division	158	80.2%
Business division	35	17.8%
Other or unanswered	4	2.0%
Total	197	100.0%

6. Data Analysis

6.1. Reliability and Validity

We established the reliability of our measurement indices with Cronbach's alpha coefficients. We also examined the composite factor reliability and average variance extracted (AVE), a measure of shared variance in a latent variable. We used Smart PLS 3 to establish all reliability measures. Table 4 summarizes the reliability estimates for our indices. Both the Cronbach's alpha values and composite reliability indices were consistently above 0.87, which well exceeds the recommended cut-off of 0.7 [76,77]. AVE values for all constructs were greater than 0.8, which exceeds the cut-off of 0.5 [78]. These results indicate that the explained variance in each construct is higher than the unexplained variance. They further show that the items appear to be indicators of a single underlying construct (*i.e.*, they demonstrate convergent validity).

We also performed a confirmatory factor analysis to examine the construct validity for all indices. With the exception of GFI, all fit index estimates surpass their respective recommended values [77] to indicate that the model is a good fit to the data (see Table 5). Specifically, the value of the GFI test was slightly below the recommended value of 0.9, and its p-value was 0. This result supports that the null hypothesis that the real covariate matrix is equal to the estimated covariate matrix could be rejected. Still, the overall test results suggest that the measures are reflective of a single factor.

Table 6 provides a synopsis of inter-construct correlations, which can illustrate the discriminant validity of the measures. Because all values on the diagonal exceed those that are off the diagonal, it seems that all constructs have discriminant validity.

Table 4. Reliability statistics.

Constructs	Mean (SD *)	Cronbach's Alpha	Composite Reliability	Average Variance Extracted
Law & Regulation	3.54 (0.73)	0.87	0.92	0.79
Top Management support	2.95 (0.98)	0.98	0.96	0.94
EAMS	2.75 (0.80)	0.94	0.96	0.85
EA Guideline	2.92 (0.93)	0.98	0.98	0.93
EA Organization	2.83 (0.92)	0.94	0.96	0.89
EA performance	2.88 (0.81)	0.95	0.96	0.87

* Standard deviation. Sample size: 197.

Table 5. Model fit indices for validity testing.

Fit Statistic	Value	Suggested Threshold
χ^2	370.08	
d.f.	194	
RMR	0.04	<0.1
GFI	0.86	>0.90
AGFI	0.81	>0.80
TLI	0.96	>0.90
CFI	0.97	>0.90
RMSEA	0.07	<0.08
p-value	0.00	>0.05

RMR: Root Mean Square Residual; GFI: Goodness of Fit Index; AGFI: Adjusted Goodness of Fit Index; TLI: Tucker Lewin Index; CFI: Comparative Fit Index; RMSEA: Root Mean Square Error of Approximation.

Table 6. Discriminant validity analysis.

Constructs	Inter-Construct Correlations					
	[1]	[2]	[24]	[3]	[4]	[5]
Law [1]	0.891					
Top Support [2]	0.483	0.970				
EAMS [24]	0.444	0.642	0.921			
Guideline [3]	0.393	0.792	0.720	0.962		
Org [4]	0.400	0.712	0.610	0.772	0.943	
Performance [5]	0.376	0.681	0.753	0.721	0.634	0.933

Diagonal elements are square root of average variance extracted (AVE).

6.2. Hypothesis Test

To test our hypotheses, we tested a structural model using Smart PLS 3. All test results are summarized in Table 7 and Figure 2. For our model, the R^2 value was 0.652, indicating that our model accounts for 65.2% of the variance in the model's predictions.

Table 7. Structural model test results.

Hypothesis (Path)	Path Coefficients	t-Values	Significance Levels	p-Values
H1 (Law → Perf)	−0.027	0.536	NS	0.592
H1a (Law → EAMS)	0.175	2.779	***	0.006
H1b (Law → Guide)	0.015	0.293	NS	0.770
H1c (Law → Org)	0.074	1.307	NS	0.192
H2 (Top support → Perf)	0.197	2.305	**	0.022
H2a (Top support → EAMS)	0.558	9.233	***	0.000
H2b (Top support → Guide)	0.785	20.787	***	0.000
H2c (Top support → Org)	0.676	13.753	***	0.000
H3 (EAMS → Perf)	0.456	7.699	***	0.000
H4 (Guide → Perf)	0.178	1.995	**	0.047
H5 (Org → Perf)	0.089	1.275	NS	0.203

** $p < 0.05$; *** $p < 0.01$; NS = Not significant.

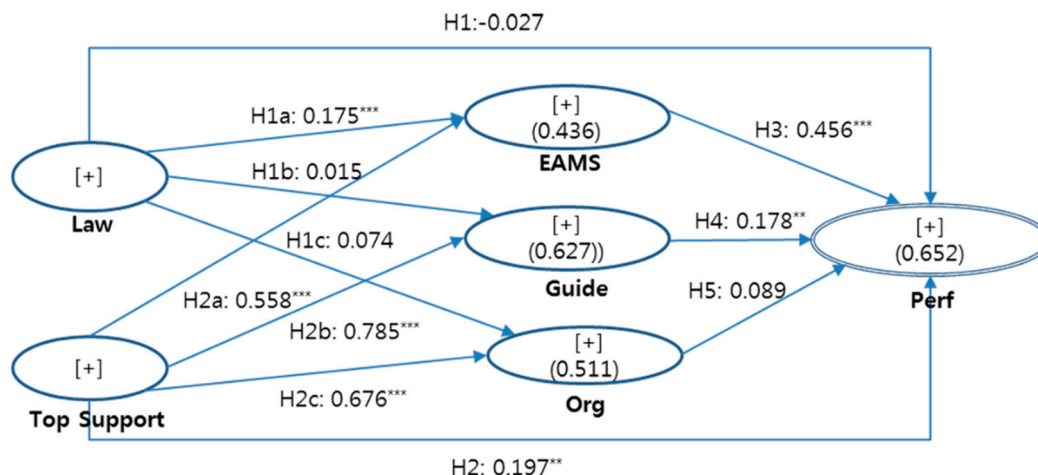


Figure 2. Structural model test results. ** $p < 0.05$. *** $p < 0.01$. NS = Not significant. The values in parenthesis represent R^2 .

7. Discussion

In this study, we have classified factors related to the success of EA into two categories: TFC and TSC factors. In this section, we discuss how the two respective groups affect EA performance. Among TFC factors, our results showed that laws and regulations have no direct effect on EA performance, but indirectly influence EA performance through EAMS. It is likely that EAMS mediates the relationship between laws/regulations and EA performance because laws and regulations require every institution to use EA information, which is created and stored within EAMS in Korea. More specifically, although laws and regulations do not mandate organizations to use EAMS, they are nonetheless forced to since EAMS is the only source of EA information. To successfully implement EA, laws and regulations should be prepared before operating factors (e.g., EAMS) are enacted. Top management support exerts a direct effect on EA performance, as well as indirect effects through all three TSC factors.

With respect to the TSC factors, we found that EAMS and EA guidelines significantly affected EA performance, but EA organization had no effect. Because we presumed that EA organization affects the creation and dissemination of EA knowledge across an organization, we tested whether EA organization indirectly affects EA performance via EAMS and EA. Figure 3 illustrates that this is indeed the case; there is a significant indirect relationship between EA organization and EA performance, when that relationship is mediated by EAMS or EA guidelines.

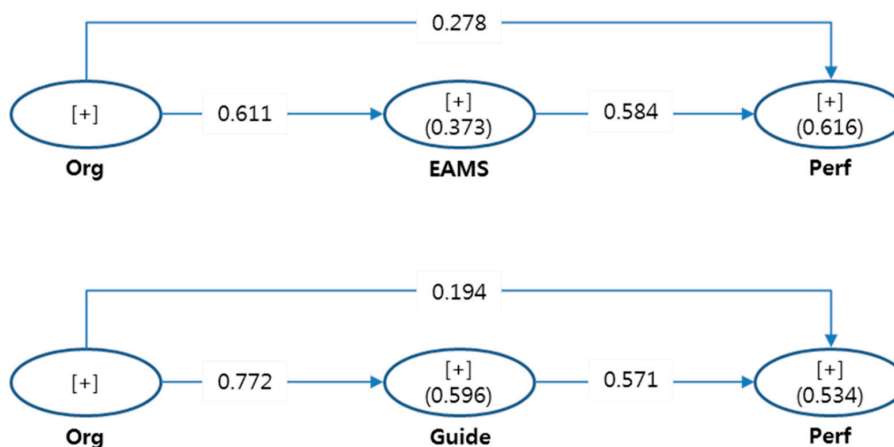


Figure 3. Direct and indirect effects of EA organization on EA performance. All path coefficients $p < 0.01$. Values in parenthesis are R^2 .

We also compared each independent variable's fixed-ratio effect on EA performance. Results of this comparative analysis show that EAMS exerts the most substantial impact on EA performance, followed by EA guidelines, top management support, EA organization, and laws and regulations. Every effect was statistically significant, and the R^2 values of the relationship between the aforementioned factors and EA performance were 0.569, 0.520, 0.464, 0.403, and 0.142, respectively. In proposing our research model, we expected the opposite—that the effects of TFC factors would be greater than those produced by TSC factors. However, these results suggest that TSC factors exert a greater influence on EA performance than TFC factors.

One practical implication of this finding is that the successful implementation of EA requires software tools with good guidelines (*i.e.*, sound methodologies, reference models, meta-models, and maturity models). Even with sufficient top management support and well-prepared laws and regulations, successful implementation of EA may be difficult without appropriate EA tools and guidelines.

We would like to provide additional comments for further consideration with respect to the importance of TSC factors. The first relates to the level of analysis. We performed our study at the individual-institution level rather than at the central-government level. If we focused on the government's implementation of EA across the entire country, it is possible that TSC factors may remain more influential than TFC factors. At the central-government level, effective implementation of EA requires the coordination of diverse agencies and ministries. This can only be achieved through TFC factors, including strong top management and well-established laws and regulations. Another thing to consider is the degree of experience a nation has with respect to implementing EA. Korea has more than 10 years of experience implementing EA in the public sector; Korean government guidelines related to EAMS and EA are continuously established and upgraded. It is likely that the effect of top management support in experienced institutions may not be as substantial as the effect exerted by institutions that are just beginning their implementation of EA. In the case of the former, EA culture and systems are probably already well-established, but in the case of the latter, top management support may be more important than TSC factors. This dynamic is probably also present with respect to laws and regulations within EA organizations.

If this study were replicated in a country in which the implementation of EA is not widespread or mature, it is possible that management support and laws and guidelines would have a more substantial impact on EA performance. Although the above issues must be validated to provide a more complete understanding of EA, our study's most critical finding is that TSC factors have significant and direct effects on EA performance. That much is clear. Without preparing sound EA tools and guidelines, it is not possible for EA performance to be successful via laws and regulations, top management support, or EA organization.

8. Conclusions

EA is an important management tool that assists in the realization of effective e-government practices. Korea's implementation with EA has been recognized as one of the most effective in the world [79,80]. Because our study focused exclusively on the Korean public sector, its findings have implications for other nations who plan to implement EA for government institutions. The results of our study suggest that these other nations should be well-prepared for EA tools and guidelines along with top management support.

This study offers unique contributions to the literature. Whereas most previous studies on EA regard TFC and TSC factors as unidimensional, we differentiate them to evaluate their respective effects. By differentiating these factors, we allowed for an increased understanding in the successful implementation of EA. This should improve forthcoming e-government research.

Despite its contributions, our study also had a few limitations. Most notably, we included only five factors in our model as determinants of successful EA implementation. Our limiting of the number of predictors was based on an assumption that evaluating fewer variables would help to clarify the

respective roles of TFC and TSC factors in effective EA. However, there are other factors that may also affect EA implementation. These include objectives, good communications, EA management processes, and education and training. Future scholarship in this domain should extend our research model to include more success factors. Furthermore, it would also prove beneficial to extend the research framework described here to other nations. This would assist in validating the differential effects of TFC and TSC factors in nations of different EA maturity levels and cultures.

Acknowledgments: This paper was supported by Konkuk University in 2012.

Author Contributions: All three authors conceived and designed the research model; Seogjun Lee designed the survey questionnaire, analyzed the data, and wrote paper; Seung Woon Oh reviewed related literature on EA and collected the data; and Kichan Nam reviewed literature on change models and theories, and wrote paper.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Kim, H.J.; Pan, G.; Pan, S.L. Managing IT-enabled transformation in the public sector: A case study on e-government in South Korea. *Gov. Inf. Q.* **2007**, *24*, 338–352. [[CrossRef](#)]
2. Becker, J.; Niehaves, B.; Algermissen, L.; Delfmann, P.; Falk, T. E-Government Success Factors. In *Electronic Government*, Proceedings of the Third International Conference, EGOV 2004, Zaragoza, Spain, 30 August–3 September 2004; Springer: Berlin, Germany, 2004; pp. 503–506.
3. West, D.M. E-government and the transformation of service delivery and citizen attitudes. *Public Admin. Rev.* **2004**, *64*, 15–27. [[CrossRef](#)]
4. Almarabeh, T.; AbuAli, A. A general framework for e-government: Definition maturity challenges, opportunities, and success. *Eur. J. Sci. Res.* **2010**, *39*, 29–42.
5. Ayanso, A.; Chatterjee, D.; Cho, D.I. E-Government readiness index: A methodology and analysis. *Gov. Inf. Q.* **2011**, *28*, 522–532. [[CrossRef](#)]
6. Rorissa, A.; Demissie, D.; Pardo, T. Benchmarking e-government: A comparison of frameworks for computing e-government index and ranking. *Gov. Inf. Q.* **2011**, *28*, 354–362. [[CrossRef](#)]
7. Alshawi, S.; Alalwany, H. E-government evaluation: Citizen's perspective in developing countries. *Inf. Technol. Dev.* **2009**, *15*, 193–208. [[CrossRef](#)]
8. Wu, Y. Protecting personal data in e-government: A cross-country study. *Gov. Inf. Q.* **2014**, *31*, 150–159. [[CrossRef](#)]
9. Belanger, F.; Hiller, J. A framework for e-government: Privacy implications. *Bus. Process. Manag. J.* **2006**, *12*, 48–60.
10. Sarabdeen, J.; Rodrigues, G.; Balasubramanian, S. E-Government users' privacy and security concerns and availability of laws in Dubai. *Int. Rev. Law Comput. Technol.* **2014**, *28*, 261–276. [[CrossRef](#)]
11. Bertot, J.C.; Jaeger, P.T.; Grimes, J.M. Using ICTs to create a culture of transparency: E-government and social media as openness and anti-corruption tools for societies. *Gov. Inf. Q.* **2010**, *27*, 264–271. [[CrossRef](#)]
12. Kim, S.; Kim, H.J.; Lee, H. An institutional analysis of an e-government systems for anti-corruption: The case of OPEN. *Gov. Inf. Q.* **2009**, *26*, 242–250. [[CrossRef](#)]
13. Tolbert, C.; Mossberger, K. The effects of e-government on trust and confidence in government. *Public Admin. Rev.* **2006**, *66*, 354–369. [[CrossRef](#)]
14. Larsson, H.; Gronlund, A. Future-oriented eGovernance: The sustainability concept in eGov research, and ways forward. *Gov. Inf. Q.* **2014**, *31*, 137–140. [[CrossRef](#)]
15. Dawes, S. An Exploratory Framework for Future E-Government Research Investments. In Proceedings of the 41st Annual IEEE Hawaii International Conference on System Sciences, Waikoloa, HI, USA, 7–10 January 2008.
16. Gil-Garcia, J.R.; Pardo, T.A. E-government success factors: Mapping practical tools to theoretical foundations. *Gov. Inf. Q.* **2005**, *22*, 187–216. [[CrossRef](#)]
17. Heeks, R.; Bailur, S. Analyzing e-government research: Perspectives, philosophies, theories, methods, and practice. *Gov. Inf. Q.* **2007**, *24*, 243–265. [[CrossRef](#)]
18. Yildiz, M. E-government research: Reviewing the literature, limitations, and ways forward. *Gov. Inf. Q.* **2007**, *24*, 646–665. [[CrossRef](#)]

19. Snead, J.T.; Wright, E. E-government research in the United States. *Gov. Inf. Q.* **2014**, *31*, 129–136. [[CrossRef](#)]
20. Ross, J.W.; Weill, P.; Robertson, D.C. *Enterprise Architecture as Strategy: Creating a Foundation for Business Execution*; Harvard Business School Press: Boston, MA, USA, 2006.
21. Hoogervorst, J. Enterprise architecture: Enabling integration, agility and change. *Int. J. Coop. Inf. Syst.* **2004**, *13*, 213–233. [[CrossRef](#)]
22. Gregor, S.; Dennis, H.; Nigel, M. Enterprise architectures: Enablers of business strategy and IS/IT alignment in government. *Inf. Technol. People* **2007**, *20*, 96–120. [[CrossRef](#)]
23. Zachman, J.A. A framework for information systems architecture. *IBM Syst. J.* **1987**, *26*, 276–292. [[CrossRef](#)]
24. Bernard, S.A. *An Introduction to Enterprise Architecture*, 3rd ed.; AuthorHouse: Bloomington, IN, USA, 2012; pp. 31–33.
25. Hilliard, R. IEEE-Std-1471-2000 Recommended Practice for Architectural Description of Software-Intensive Systems. Available online: <http://standards.ieee.org> (accessed on 20 February 2016).
26. The Open Group. Available online: <http://pubs.opengroup.org/architecture/togaf8-doc/arch/> (accessed on 27 February 2016).
27. Office of Management and Budget. The Common Approach to Federal Enterprise Architecture. Available online: https://www.whitehouse.gov/sites/default/files/omb/assets/egov_docs/common_approach_to_federal_ea.pdf (accessed on 20 February 2016).
28. Office of Management and Budget. Federal Enterprise Architecture Framework Version 2. Available online: https://www.whitehouse.gov/sites/default/files/omb/assets/egov_docs/fea_v2.pdf (accessed on 20 February 2016).
29. Martin, N.; Gregor, S. Enterprise Architectures and Information Systems Alignment: Policy, Research and Future Implications. In Proceedings of the ACIS, Melbourne, Australia, 31 December 2002; p. 30.
30. Rohloff, M. Integrating Innovation into Enterprise Architecture Management. In Proceedings of Wirtschaftsinformatik, Zurich, Switzerland, 16–18 February 2011; p. 37.
31. Bradley, R.; Pratt, R.; Byrd, T.A.; Simmons, L. The role of enterprise architecture in the quest for IT value. *MIS Q. Executive* **2011**, *10*, 19–27.
32. Bricknall, R.; Darrell, G.; Nilsson, H.; Pessi, K. Enterprise Architecture: Critical Factors Affecting Modelling and Management. In Proceedings of the European Conference on Information Systems, Gothenburg, Sweden, 12–14 June 2006.
33. Oliveira, J.; Nightingale, D. Adaptable Enterprise Architecture and Long Term Value Added partnerships in healthcare. In Proceedings of the European Conference on Information Systems, St Gallen, Switzerland, 7–9 June 2007; pp. 1815–1826.
34. Kettinger, W.J.; Marchland, D.A.; Davis, J.M. Designing enterprise IT architecture to optimize flexibility and standardization in global business. *MIS Q. Executive* **2010**, *9*, 95–113.
35. Gill, A.; Smith, S.; Beydoun, G.; Sugumaran, V. Agile Enterprise Architecture: A Case of a Cloud Technology-Enabled Government Enterprise Transformation. In Proceedings of the Pacific Asia Conference on Information Systems, Chengdu, China, 24–28 June 2014; pp. 1–11.
36. Kaushik, A.; Raman, A. The new data-driven enterprise architecture for e-healthcare: Lessons from the Indian public sector. *Gov. Inf. Q.* **2015**, *32*, 63–74. [[CrossRef](#)]
37. Janssen, M.; Hjort-Madsen, K. Analyzing Enterprise Architecture in National Governance: The Cases of Denmark and the Netherlands. In Proceedings of the 40th Hawaii International Conference on System Sciences, Waikoloa, HI, USA, 3–6 January 2007.
38. Zheng, T.; Zheng, L. Examining e-government enterprise architecture research in China: A systematic approach and research agenda. *Gov. Inf. Q.* **2013**, *30*, 559–567. [[CrossRef](#)]
39. Anderson, P.; Carugati, A. Enterprise Architecture Evaluation: A Systematic Literature Review. In Proceedings of the 8th Mediterranean Conference on Information Systems, Verona, Italy, 3–5 September 2014.
40. Ylimaki, T. Potential critical success factors for enterprise architecture. *J. Enterp. Archit.* **2006**, *2*, 29–40.
41. Nikpay, F.; Selamat, H.; Rouhani, B.D.; Nikfard, P. A Review of Critical Success Factors of Enterprise Architecture Implementation. In Proceedings of the 2013 International Conference of Informatics and Creative Multimedia, Kuala Lumpur, Malaysia, 4–6 September 2013; pp. 38–42.
42. Schmidt, C.; Buxmann, P. Outcomes and success factors of enterprise IT architecture management: Empirical insight from the international financial services industry. *Eur. J. Inf. Syst.* **2011**, *20*, 168–185. [[CrossRef](#)]

43. Cook, M.A. *Building Enterprise Information Architectures: Reengineering Information Systems*; Hewlett-Packard Company. Prentice Hall PTR: Upper Saddle River, NJ, USA, 1996.
44. Burnes, B. *Managing Change*, 4th ed.; Prentice Hall: Essex, UK, 2009.
45. Burke, W.W.; Litwin, G.H. A causal model of organizational performance and change. *J. Manag.* **1992**, *18*, 523–545. [[CrossRef](#)]
46. Janićijević, N. Business processes in organizational diagnosis. *Management* **2010**, *15*, 85–106.
47. Wooten, G.B. Testing the Relationships among Transformational Factors in a Postsecondary Environment. Ph.D. Thesis, The University of Texas at Tyler, Tyler, TX, USA, 2014.
48. Filej, B.; Skela-Savic, B.; Vivic, V.H.; Hudorovic, N. Necessary organizational changes according to Burke–Litwin model in the head nurses system of management in healthcare and social welfare institutions—The Slovenia experience. *Health Policy* **2009**, *90*, 166–174. [[CrossRef](#)] [[PubMed](#)]
49. Khan, M. Factors essential for longevity among Dow Jones Index organisations: QCA Analysis. *J. Dev. Areas* **2015**, *49*, 469–479. [[CrossRef](#)]
50. Porras, J.; Robertson, P. Organization development theory: A typology and evaluation. In *Research in Organizational Change and Development*; Woodman, R.W., Pasmore, W.A., Eds.; JAI Press: Greenwich, CT, USA, 1987; Volume 1, pp. 1–57.
51. Nadler, D.A.; Shaw, R.B.; Walton, E.A. *Discontinuous Change: Leading Organizational Transformation*; Jossey-Bass: San Francisco, CA, USA, 1995.
52. Waterman, R.; Peters, T.; Phillips, J. Structure is not organization. *Bus Horiz.* **1980**, *23*, 14–26. [[CrossRef](#)]
53. Weisbord, M.R. Organization diagnosis: Six places to look for trouble with or without a theory. *Group Organ. Stud.* **1976**, *1*, 430–447. [[CrossRef](#)]
54. Appelbaum, S.H.; St-Pierre, N.; Glavas, W. Strategic organization change: The role of leadership, learning, motivation and productivity. *Manag. Decis.* **1998**, *36*, 289–301. [[CrossRef](#)]
55. Altameem, T.; Zairir, M.; Alshawi, S. Critical Success Factors of E-Government: A Proposed Model for E-Government Implementation. In Proceedings of the Innovations in Information Technology, Dubai, UAE, 19–21 November 2006; pp. 1–5.
56. Lee, S.M.; Tan, X.; Trimi, S. Current practices of leading e-government countries. *Commun. ACM* **2005**, *48*, 99–104. [[CrossRef](#)]
57. Willemssen, J. Electronic Government: Success of the Office of Management and Budget’s 25 Initiatives Depends on Effective Management and Oversight. Available online: <http://www.gao.gov/assets/110/109713.pdf> (accessed on 20 February 2016).
58. Singh, V.; Sharma, R.R.K. Relating critical success factors of information system implementation with organizational strategy. *Int. J. Bus. Strategy* **2010**, *10*, 119–123.
59. Zwikael, O.; Globerson, S. From critical success factors to critical success processes. *Int. J. Prod. Res.* **2006**, *44*, 3433–3449. [[CrossRef](#)]
60. Perkins, A. *Critical Success Factors for Enterprise Architecture Engineering*; Visible Systems Corporation: Lexington, MA, USA, 2003.
61. Link Consulting. EAMS-Concept. Available online: http://www.linkconsulting.com/eams/detalhe_artigoEA.aspx?idsc=6985&ddl=2 (accessed on 20 February 2016).
62. Ghani, I.; Lee, C.Y.; Jeong, S.R.; Juhn, S.H. A role-oriented content-based filtering approach: Personalized enterprise architecture management perspective. *Int. J. Comput. Sci. Inf. Secur.* **2010**, *8*, 9–18.
63. Nam, K.; Oh, S.; Kim, S.K.; Shin, D. Case study of EA implementation in the Korean public sector: Guidelines, Lessons, and Future model. *Informatiz. Policy* **2015**, *22*, 45–67.
64. Lee, J.D.; Kwon, Y.I. A Study on Strategy Planning and Outcome of EA in Korea. In Proceedings of the Advanced Communication Technology, 15th International Conference, PyeongChang, Korea, 27–30 January 2013; pp. 873–879.
65. Abdulwahed, M.K. Information security considerations in IS/IT outsourcing projects: A descriptive case study of two sectors. *Int. J. Inf. Manag.* **2004**, *24*, 29–42.
66. Brammer, S.; Millington, A.; Rayton, B. The contribution of corporate social responsibility to organizational commitment. *Int. J. Hum. Resour. Manag.* **2007**, *18*, 1701–1719. [[CrossRef](#)]
67. Bae, J.; Lawler, J.J. Organizational and HRM strategies in Korea: Impact on firm performance in an emerging economy. *Acad. Manag. J.* **2000**, *43*, 502–517. [[CrossRef](#)]

68. Osterman, P. How common is workplace transformation and who adopts it? *Ind. Labor Relat. Rev.* **1994**, *47*, 173–188. [[CrossRef](#)]
69. Bagozzi, R.P.; Phillips, L.W. Representing and testing organizational theories: A holistic construal. *Admin. Sci. Q.* **1982**, *27*, 459–489. [[CrossRef](#)]
70. Boudreau, M.; Gefen, D.; Straub, D.W. Validation in IS research: A state-of-the-art assessment. *MIS Q.* **2001**, *25*, 1–16. [[CrossRef](#)]
71. Locke, E.A.; Latham, G.P. *A Theory of Goal Setting and Task Performance*; Prentice-Hall: Englewood Cliffs, NJ, USA, 1990.
72. French, W.L.; Bell, D.H., Jr.; Zawacki, R.A. *Organization Development and Transformation*; McGraw-Hill: New York, NY, USA, 2005.
73. Boucharas, V.; van Steenberg, M.; Jansen, S.; Brinkkemper, S. The contribution of enterprise architecture to the achievement of organizational goals: A review of the evidence. In *Trends in Enterprise Architecture Research*; Proper, E., Lankhorst, M., Barjis, J., Eds.; Springer-Verlag: Berlin, Germany; Heidelberg, Germany, 2010; pp. 1–15.
74. Tamm, T.; Seddon, P.B.; Shanks, G.; Reynolds, P. How does enterprise architecture add value to organizations. *Commun. Assoc. Inf. Syst.* **2011**, *28*, 141–168.
75. CIO Council. Available online: <http://www.gao.gov/assets/590/588407.pdf> (accessed on 26 October 2015).
76. Barclay, D.; Higgins, C.; Thompson, R. The partial least squares (PLS) approach to causal modeling, personal computer adoption and use as an illustration. *Technol. Stud.* **1995**, *2*, 285–309.
77. Hair, J.F.; Hult, T.M.; Ringle, C.M.; Sarstedt, M. *A Primer on Partial Least Squares Structural Equation Modeling (PLS-SEM)*; Sage: Thousand Oaks, CA, USA, 2014.
78. Fornell, C.; Lacker, D. Evaluating structural equation models with unobservable variables and measurement error. *J. Mark. Res.* **1981**, *18*, 921–950. [[CrossRef](#)]
79. Korea IT Times. Available online: <http://www.korea.net/NewsFocus/Sci-Tech/view?articleId=108100> (accessed on 26 October 2015).
80. Korea IT Times. Available online: <http://www.korea.net/NewsFocus/Policies/view?articleId=120268> (accessed on 26 October 2015).



© 2016 by the authors; licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC-BY) license (<http://creativecommons.org/licenses/by/4.0/>).