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# Dynamics of Enterprise Architecture in the Korean Public Sector: Transformational Change vs. Transactional Change

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Academic Editor: Yongrok Choi

Received: 8 August 2016; Accepted: 18 October 2016; Published: 25 October 2016

**Abstract:** Enterprise architecture (EA) is one of the most important tools for implementing e-government effectively and delivering high-quality information technology services to citizens. To develop a robust EA research model with key success factors, we apply the theory of organizational change proposed by Burke and Litwin, using the concepts of transformational and transactional change. The analysis is conducted by using South Korea's EA project launched in 2003. This study classifies EA implementation in the South Korean public sector into three stages and explains the characteristics of each stage from the organizational change perspective. We raise the issue of EA application level compounded by the problem of diverse EA definitions and discuss the difficulties of EA implementation based on the framework of organizational change. In addition, 20 EA experts are surveyed to confirm the findings of this study. Finally, we propose a new research model for future empirical study based on the presented findings. We believe that this study, as an in-depth review of EA implementation from an organizational change perspective, will benefit EA experts from a practical point of view, as well as academics from a research perspective.

**Keywords:** e-government; enterprise architecture; change management; organizational change

## 1. Introduction

As wireless technology and cloud environments have matured in recent years and as the Internet of Things has advanced accordingly, the public is demanding an increasing level of information technology and control. To meet citizens' demands, governments have implemented diverse e-government information systems (IS), expending a vast amount of money and effort [1,2]. Governments need more reliable operational platforms to maintain their extensive systems and are desperate to cultivate well-planned systems in the future. Such activities require a tremendous amount of coordination and performance measures across different organizational layers, simultaneously compelling the government to save resources without sacrificing IS objectives. To overcome these difficulties, many countries have attempted to adopt enterprise architecture (EA) when implementing an e-government system.

However, despite consistent efforts to implement EA successfully, some common limitations remain. First, a wide range of definitions and concepts of EA exist in the literature [3,4], and its methods of implementation tend to vary considerably depending on the implementer and respective country. Further, although commonly-accepted frameworks, systems and methodologies do exist [5–11], the

scope and level of EA practices vary from organization to organization and from country to country. Second, although EA success factors [12,13] are widely recognized and understood, they lack theoretical bases and empirical validation. Hence, more robust research in this area is needed to develop meaningful and specific EA guidelines and success factors.

This study views EA adoption as an organizational change process based on the framework proposed by Burke and Litwin [14], which classifies organizational change into transformational change (TFC) and transactional change (TSC). TFC is associated with the fundamental change of altering the culture and the value of an organization, while TSC aims to improve the short-term performance of an organization. Traditional IS success models, or similar research frameworks, fail to explain the drivers of the successful implementation of EA because EA requires intensive coordination and information sharing among interest groups within the organization. For these reasons, we explore EA success factors by using these two contrasting organizational change concepts.

This study conducts a case analysis based on South Korean EA experiences. The South Korean government initiated its EA program in 2003, and its ongoing effort to implement EA-based e-government is a key factor driving the success of e-government in South Korea [15]. However, although EA in the South Korean public sector has been acknowledged globally as a best-practice implementation [15,16], the South Korean government has also experienced many challenging tasks during the implementation process.

We classify South Korea's EA implementation process into three stages and apply the concepts of TFC and TSC to study the difficulties and problems endured while implementing EA. We confirm our initial findings of the case study by surveying 20 EA experts in South Korea. Finally, we propose a new research model for the empirical validation of the success factors of EA implementation.

The structure of the remainder of this paper is as follows. Section 2 reviews the EA literature and presents the theoretical framework of TFC and TSC. Section 3 discusses the e-government implementation process in South Korea using a three-stage approach. Section 4 examines the problems and gaps found in EA implementation processes and proposes a research model based on such an examination. Section 5 concludes this study with limitations and contributions.

## 2. Theoretical Development

### 2.1. Literature Review of EA Success Factors

Although EA research has increased in terms of the quantity and quality of publications, most studies have been conducted for practical application purposes rather than academic purposes [5–7,17]. Zachman's framework was found to be the most popular, followed by the various models and guidelines developed by the U.S. government and several other countries [8–11,18–21]. In many countries undertaking EA projects, the Open Group Architecture Framework, which was developed by EA-related institutions in different countries, is frequently adopted as the preferred EA framework.

Ylimaki [12] performed an early study of the critical success factors (CSF) of EA. While he found a lack of scientific research in general, 12 CSF were derived with explanations based on interviews and literature reviews: scoping and purpose; communication and common language; business-driven approach; assessment and evaluation; IT investment and acquisition strategies; organizational culture; skilled team, training and education; project and program management; EA models and artifacts; development methodology and tool support; governance; and commitment. Ylimaki [12] further suggested certain ways in which to use these CSF in practice. However, their validation was beyond the scope of his study.

In the context of the financial services industry, Schmidt and Buxmann [13] conducted a field survey to identify CSF in terms of IT flexibility and efficiency. By using structural equation modeling, they found that EA management increases IT flexibility and IT efficiency, while it is positively influenced by eight EA success factors (which overlap with Ylimaki's [12] CSF). In addition, they

showed that the duration of EA implementation is another significant factor increasing the success of EA implementation.

Nikpay et al. [3] reviewed five EA studies and listed 20 EA factors. Of these, they found that planning, governance, management and communications and support are essential factors, while documentation, stakeholder participation and architects' skills are also important factors in EA projects. Gil-Garcia and Pardo [22] proposed 20 CSF for the successful implementation of e-government. Although few of the factors proposed were specifically mentioned as EA success factors, a significant overlap with previously-described CSF was recognizable.

Moreover, several studies have examined EA concepts and guidelines [23,24] in both the private sector [1,25–28] and the public sector [2,29–31]. In the public sector, Janssen and Hjort-Madsen [32] proposed a framework on national enterprise architecture (NEA) and used it to compare the implementation processes of Denmark and the Netherlands. This was one of the first attempts that highlighted the importance of EA by comparing two different nations' EA strategies, but it had limitations in analyzing the ultimate goals and performance of EA.

In South Korea, EA research began in the early 2000s, with most findings published in domestic journals. Representative empirical studies of the CSF of EA include Lee and Chae [33] and Hong and Kim [34]. Shin [35] studied the review and assessment model of EA maturity, while Oh et al. [36] described 10 years of EA experience by classifying it into three stages.

A review of the EA literature presents several common findings. First, common EA success factors are readily available; however, empirical studies with advanced research models that explain the real problems and difficulties of EA implementation are scarce. Second, most EA studies are limited by the application of non-systematic research methodologies, as noted by Zheng and Zheng [4] among others [37–41]. For instance, Snead and Wright [40] stated that the major problem of EA research is a lack of, or weak, methodology. Moreover, they showed that few studies include multi-evaluation approaches for data collection and analysis efforts or apply a theory-based approach.

To summarize, although the CSF of EA can be easily identified, they have failed to provide a practical roadmap for the successful implementation of EA and, as such, have not been empirically tested on a sound theoretical basis. Based on this gap in the literature, this study overcomes some of these limitations by proposing an empirical research model using a case study approach taking into account the past 10 years of South Korean EA experiences. In addition, as a theoretical foundation of the case study, Burke and Litwin's [14] organizational change framework is employed.

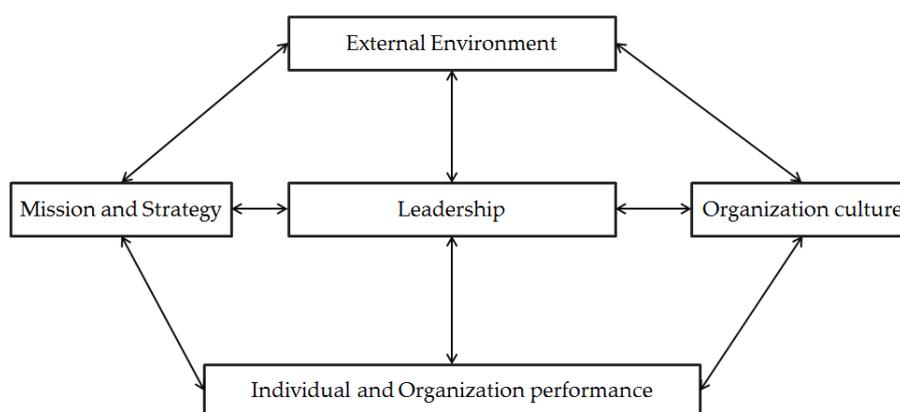
## 2.2. TFC vs. TSC

EA is neither a simple application of technology nor a diverse combination of methodologies and guidelines. By examining the CSF proposed by previous studies [3,12,13,32], it is clear that the success of EA requires continuous efforts from the organization, technology and management. Based on this holistic view, we consider EA to be a process of organizational change and adopt the framework proposed by Burke and Litwin [14].

The implementation of information systems is closely associated with organizational issues. In 1981, Keen [42] raised an argument that the development of information systems is inherently technical, as well as political, so that MIS(Management Information System) managers need to take over more active roles with authority and resources within the organization. An effective strategy should deal with the politics of data and the likelihood of counter implementation. One of the notable studies investigating the relationship between information technology and organizational change is that of Markus and Robey [43]. Markus and Robey stressed identifying the clear causal structure of theory development for the study of relationships between organizational change and information technology. Based on three different types of theories, such as technical imperative, organizational imperative and emergent perspective, they argued for a balanced view between technical and organizational perspectives for the successful implementation of information systems [44,45]. In particular, organizations are viewed as the interaction of four highly interrelated variables: task, people, structure (or roles) and technology.

This approach can be found in most areas of information system topics, such as IT innovation [46], business process reengineering, knowledge management, enterprise resource planning, customer relationship management, etc.

In the area of public sectors, organizational issues have been considered as important success factors for the successful implementation of information systems [47]. However, even though EA requires extensive coordination among different agencies and organizations, previous studies have not investigated the organizational change perspective. This study investigates the success factors of EA under the organizational change framework of TFC and TSC. TFC refers to the fundamental change that alters the culture and value of an organization. TFC is usually caused by external factors, and it influences the mission, strategy, leadership and culture of the organization. In addition, under TFC, all members of the organization must have a new set of values regarding change and engage in different behaviors compared before. Therefore, TFC is likely to be successful when it is implemented by using purposeful behavior connected to a strategy with clear objectives from top management (Figure 1).

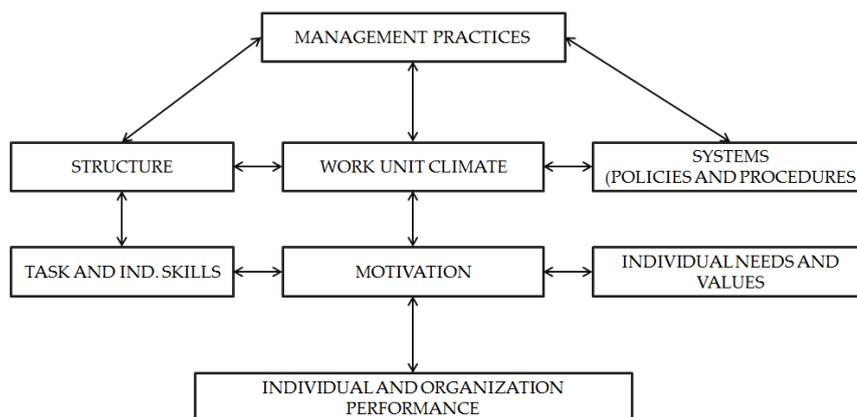


**Figure 1.** Model of organizational performance and change: transformational factors [14].

If EA is considered to be a type of TFC in certain organizations, the desired performance will be achieved only when it is preceded by changes related to leadership, mission and strategy and organizational culture. The required laws and regulations of EA should be established in advance, and clear EA objectives and missions must be delivered to the organization by top management. From the CSF noted by Ylimaki [12], the relevant factors here would be “scoping and purpose” and “organizational culture”. Further, “planning” is an additional factor [3]. Hence, a limited number of TFC factors has been suggested in previous studies.

By contrast, TSC involves psychological and organizational variables that predict and control the motivational and performance consequences of a group’s climate and aim to improve short-term performance rather than fundamentally changing an organization. Therefore, this approach requires the organization to change its climate to suit its purpose, thereby not including cultural issues. Relevant key variables include the organization’s structure, management practices, systems, such as policies and mechanisms, and tasks and individual skills (Figure 2).

If EA is considered to be a type of TSC in certain organizations, desired performance should be achievable with management practices, structure, climate, systems and tasks and skills. Representative examples from previous studies of EA are “governance”, “communication and support”, “skills of architects”, “EA model and artifact”, “training and education”, “project and program management” and “tools and methodology”. It can thus be inferred that most EA CSF are closely related to TSC, which is more project-oriented in nature, while TFC factors are related to the executive-level organizational issues that an individual EA project team cannot directly control.



**Figure 2.** Model of organizational performance and change: transactional factors [14].

When applying the concepts of TFC and TSC, two specific guidelines should be mentioned. First, neither TFC nor TSC is a superior concept compared to the other, as the type of change is mainly determined by the organization's inherent vision and purpose. Second, in the same vein, the success factors of TFC and TSC are not exclusive to each, but reinforce each other depending on the purpose of the organizational change. If the organization needs a fundamental change, TFC factors should be focused upon more than TSC factors, although both factors are still employed together. However, if an organization fails to identify the inherent nature of the required change and employs an incorrect set of success factors between TFC and TSC, it is more likely to end up with undesired change. Therefore, the conceptual differences between TFC and TSC imply that the organization must identify the purpose of the change first and then employ the relevant success factors.

In the next section, we review the EA implementation process in South Korea and apply the concepts of TFC and TSC to discover the issues experienced by the South Korean e-government during a successful EA implementation.

### 3. History of EA Development in the South Korean Public Sector

South Korea's e-government was initiated in the early 1990s to build a communications infrastructure for improved government efficiency and administrative productivity and to raise national competitiveness gradually by providing the public with high-quality IT infrastructure that would expedite public services. As these concepts became more concrete, full-scale e-government projects began in 1996, with the creation of laws to facilitate e-government systems.

In terms of the success of its e-government, South Korea was ranked first place for three consecutive evaluations by the United Nations (2010, 2012, 2014) [48,49]. However, as South Korea continues to create new practices and obtain good ratings in e-government, consistently strong e-government leadership, a specialized workforce and policies that parallel technological advances are mentioned as the most significant CSF. Simultaneously, EA has played a key role in the improvement of South Korea's e-government performance [50]. However, the literature is limited in highlighting the nature of the difficulties and problems experienced during the implementation process.

We classify the history of the South Korean EA implementation into three stages: (a) preparation (2003–2005), (b) foundation/adoption (2006–2009) and (c) utilization (2010 to the present). Each stage has its own unique characteristics and development history [36]. As Table 1 notes, the South Korean government started its EA projects in 2003, but its e-government projects began as early as 1995. As a first step, the South Korean government prepared the required law by planning a future analytical framework. During the foundation/adoption stage, central government agencies began to adopt EA actively with the aid of aggressive promotion by the government. Most of the required models, including diverse guidelines, were prepared, announced and applied to real practices. Finally, during the utilization stage, EA was implemented at a central government level.

**Table 1.** History of the South Korean enterprise architecture (EA) implementation. IS, information systems.

Stage	Year	Major Policy
Preparation	2003	31 e-government roadmap projects adopted the National IT Architecture Plan Released EA Framework
	2004	Started EA Pilot Project Released EA Reference Model
	2005	Enacted laws for the implementation of EA (a law for the effective implementation and operation of IS)
Foundation/ Adoption	2006	Enforced laws for the implementation of EA (a law for the effective implementation and operation of IS)
		Announced the first stage of the EA Initiation Plan
		Released EA guidelines (Guidelines for the Adoption and Operation of EA) Released the agency EA meta-model
	2007	Released the integrated government-wide EA Maturity Model Prepared the EA implementation plan for individual agencies
Utilization	2008	Started to implement government-wide EA systems
	2009	Announced the government-wide EA plan with an activation plan
		Released the government-wide EA meta-model
		Launched the government EA portal (GEAP)
	2010	Prepared a comprehensive plan preventing the duplication of IT systems and resources Revised and merged the law for the effective implementation and operation of IS with the e-government law
	2011	Announced the second stage of the EA Initiation Plan
	2012	Began to manage IT resources through the GEAP at a government-wide level
	2013	Received the UN Public Service Award
2014	Announced the third stage of the EA Initiation Plan	

In this study, the three stages of the EA framework were adopted from the work of Oh et al. [36]. Based on this framework, the authors interviewed EA experts, who had participated in EA tasks for over five years, to obtain additional data. Table 2 presents a profile of the interviewees who took part in this study and their organizations remain anonymous. The interviews ran for about 90–120 min.

**Table 2.** Profiles of interviewees. NIA, National Information society Agency.

No.	Organization	Rank	Years of Experience
1	NIA	Senior Researcher	11
2	NIA	Senior Researcher	8
3	Ministry of AAAA	Senior Manager	9
4	Ministry of BBB	Manager	7
5	Public Firm	Team Leader	6
6	Private from Consulting Firm	Senior Consultant	11

### 3.1. Preparation Stage

The first stage of EA is called “preparation” because only pilot projects started during this stage, with the preparation of the required laws and guidelines. During this stage, EA was included as one of 31 e-government roadmap projects, and the required laws were studied and prepared. The EA preparation stage ended in June 2006, and the required law was enforced in July of the same year. The most important mission of this stage was the preparation of legal aspects and guidelines. In 2003, the EA framework was prepared, and the technical reference model was developed in 2004 as one of the EA reference models. Figure 3 shows the South Korean EA framework and its components, which have different types of EA models, such as “reference model”, “meta model” and “maturity model”.

In addition, the first version of the Technical Guidelines for Information Systems Implementation and Operations was released to secure the interoperability of different IS.

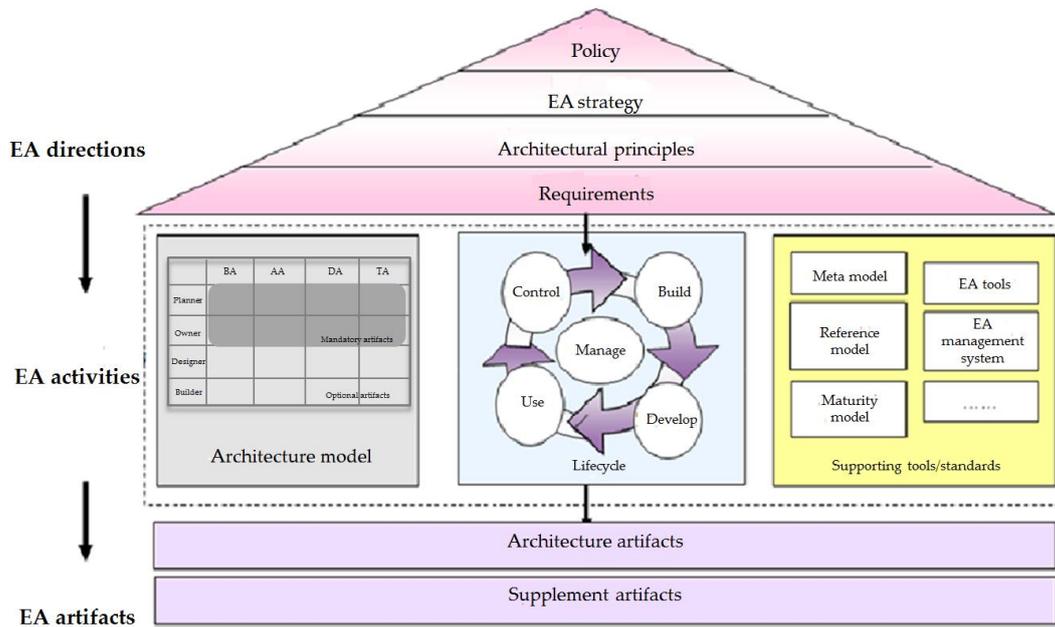


Figure 3. South Korean EA framework of the preparation stage [50].

In this stage, three agencies carried out these tasks together: the Ministry of Information and Communication (MIC) as the primary agency, the Ministry of Government Administration and Home Affairs (MOGAHA) as a supporting agency and the National Information society Agency (NIA) as the execution agency. The MIC was in charge of pilot projects and reference models, while the NIA was responsible for designing and carrying out detailed EA tasks.

The technical aspects of EA were emphasized to secure interoperability among the diverse systems. Although IT resources were managed systematically by using optimized IT investment decisions, the content was either abstract or ambiguous because of EA’s short history, as well as the lack of expertise and experience. During this stage, four pilot projects were carried out, and standards for interoperability were established as major achievements. However, with the exception of these four pilot projects, other visible results were limited.

Table 3 summarizes the characteristics of the first stage. During this period, focus was placed on the preparation of the required foundations for EA’s future implementation. The required laws, guidelines and pilot projects were important activities. From an organizational change perspective, the TSC factors were more dominant than the TFC factors; examples of TSC include the technical reference model and EA framework. Pilot projects were also initiated at an operational level instead of changing the fundamentals of IT management. Moreover, most people treated the EA pilot projects as one of many IT projects because of a lack of understanding about the nature of EA. EA failed to mention long-term chronic problems to management, such as a lack of effective IT investment decision making, a lack of effective IT resource management and a lack of evaluation of IT projects.

**Table 3.** Major characteristics of the preparation stage. (MIC, Ministry of Information and Communication; MOGAHA, Ministry of Government Administration and Home Affairs.)

Issues	Contents
Law/Guidelines	<ul style="list-style-type: none"> <li>• Enacted EA law</li> <li>• EA Framework</li> <li>• Technical Guidelines for Information Systems Implementation and Operations</li> <li>• Technical reference model</li> </ul>
EA Governance	<ul style="list-style-type: none"> <li>• The MIC as a major agency in charge of EA</li> <li>• MOGAHA as a supporting agency in charge of EA</li> <li>• The NIA in charge of EA execution</li> </ul>
Objective	<ul style="list-style-type: none"> <li>• Assurance of interoperability, systematic and integrated resource management and improvement of IT decision making criteria</li> </ul>
Major Achievements	<ul style="list-style-type: none"> <li>• Number of agencies adopting EA: four pilot sites and Seoul City</li> <li>• Establishment of interoperability standards</li> </ul>
IS	<ul style="list-style-type: none"> <li>• Individual agency's EA management systems</li> </ul>
Limitations	<ul style="list-style-type: none"> <li>• No linkage between previous practices and systems</li> <li>• Pilot projects executed before guidelines and models were established</li> <li>• Objectives were partially achieved with operational weakness</li> </ul>

The establishment of the required laws was a TFC factor because the law forces the implementation of EA as an external force. However, its impact was not sufficiently widespread during the preparation stage, as only four pilot sites participated. At the onset, EA's mission and strategy were not well defined. Although a certain level of leadership existed, it was insufficient to motivate all public organizations to implement EA. In addition, the objective of EA was neither clearly established nor effectively delivered, even to the four pilot sites. Hence, the first EA period focused primarily on the TSC factors at the organizational level, even though it had been initiated by the central government to improve the overall effectiveness and efficiency of e-government.

The limitations of this period resulted from a lack of EA experts and knowledge. The NIA provided all of the required technical support to the four pilot EA project sites; however, the EA experts in the NIA, as well as at the pilot sites did not fully understand the importance of EA and focused on its technical aspects. Hence, none of the pilot project sites adopted or implemented EA as actively as expected, which resulted in a low utilization of EA systems. However, although there were several limitations by focusing on the TSC factors, during this stage, the legal foundation, as an important component of the TFC factors, was prepared for the future implementation of EA, and basic models were developed from the four pilot EA projects.

### 3.2. Foundation/Adoption Stage

The foundation/adoption stage ranges from the point of EA implementation law enforcement in July 2006 to EA's launch at a government-wide level in May 2009. During this stage, most of the required laws and guidelines were established. In particular, a law for the effective implementation and operation of IS required individual agencies to adopt EA. The Guidelines for the Adoption and Operation of EA, the Guidelines for the Adoption and Operation of Information Systems and the Guidelines for Technical Evaluations for Securing Interoperability were established and announced; thereby, every agency adopting EA was required to follow a meta-model guideline for the production of all EA deliverables. Hence, all organizations adopting EA were required to manage and register EA-related output and deliverables in a central EA repository.

This stage was the most productive of the three because EA was adopted by many agencies. At the central government level, 32 agencies implemented EA, achieving a 76% adoption rate, and 37 public firms at an adoption rate of 48%. In particular, some agencies, such as the Korean Postal Service and Ministry of Land, Transport and Maritime Affairs, were evaluated as having successfully handled system duplication problems and reutilized servers. The NIA also developed and provided a government IT architecture management system (GITAMS) to all agencies. A GITAMS is a standard

EA management system that allows all agencies to manage EA conveniently by sharing common information among central and individual agencies.

Table 4 summarizes the characteristics of the second stage, limited by the unclear role between the MIC and MOGAHA. Although the MIC was in charge of the overall execution of EA as the primary agency, the MOGAHA was in a more influential position to promote the implementation of EA in most government organizations because of its organizational structure. The coordination issue was broached as a future task to be resolved because of the dual structure between the organizations.

**Table 4.** Major characteristics of the foundation/adoption stage. (GITAMS, government IT architecture management system.)

Issues	Contents
Law/Guidelines	<ul style="list-style-type: none"> <li>• Enforced the Law for the Effective Implementation and Operation of Information Systems</li> <li>• Guidelines for the Adoption and Operation of EA</li> <li>• Guidelines for the Adoption and Operation of Information Systems</li> <li>• Guidelines for Technical Evaluations for Securing Interoperability</li> </ul>
EA Governance	<ul style="list-style-type: none"> <li>• The MIC as the major agency in charge of EA</li> <li>• The MOGAHA as a supporting agency</li> <li>• The NIA in charge of execution</li> </ul>
Objective	<ul style="list-style-type: none"> <li>• Realization of integrated national resource management based on performance evaluation</li> </ul>
Major Achievements	<ul style="list-style-type: none"> <li>• Number of agencies adopting EA: central government agencies (32), local government agencies (3), public agencies (37)</li> <li>• Maturity level: central government agencies (2.51), local government agencies (1.2), public agencies (2.0)</li> </ul>
IS	<ul style="list-style-type: none"> <li>• GITAMS</li> </ul>
Limitations	<ul style="list-style-type: none"> <li>• Difficulty in coordination between the major agency (MIC) and supporting agency (MOGAHA) with respect to the role and scope</li> <li>• Low level of participation by government-affiliated organizations and local governments</li> <li>• Deliverables produced by agencies were identical</li> </ul>

Although EA began to be adopted actively at the central government level with public firms, a second limitation involved the slow adoption of EA by government-affiliated organizations and local governments. Furthermore, most central agencies' IT resources were managed and operated by their affiliated organizations; no clear guidelines were provided for EA implementation from the central EA organization.

During the second stage, the TFC and TSC factors did not change markedly. Legal requirements were completed for the TFC factors, while top management attention increased at the central government level to disseminate EA across organizations. However, the objective of EA was not well delivered to the implementing agencies. For this reason, problems were prevalent, such as the severe duplication of IT investment, and EA was still ineffective at providing concise guidelines to improve this chronic situation.

As for the TSC factors, most guidelines were completed by the NIA and applied in practice, such as the business reference model, the performance reference model, the data reference model and the maturity model. In addition, the GITAMS was also implemented by participating organizations. As a result, during the second period, the TSC factors were more focused than in the first stage, while the TFC factors were simply maintained as before.

EA's ultimate goal was difficult to achieve, even during the second period, as EA became actively adopted by diverse organizations. In this sense, the most important achievement in the second stage was the active dissemination of EA adoption and the completion of the required EA implementation laws and guidelines.

### 3.3. Utilization Stage

The utilization stage refers to the time period after the foundation/adoption stage until the present date. During this stage, many changes occurred to the scope and fundamental understanding of EA; for example, laws and rules were integrated into the Electronic Government Act as a prime legal framework for assimilating all of the relevant laws, regulations and e-government rules.

From the third stage, EA was managed at a government-wide level, with an integrated view of resource management. One important change was that the amount of data and deliverables to be entered into the central EA systems was significantly reduced. The NIA and MOGAHA began to manage only items in which management was necessary at a government-wide level; otherwise, individual agencies were allowed to control and manage their own deliverables without submitting all artifacts to the central EA systems. Further, the EA experts in each organization were allowed to focus on core activities, while eliminating unproductive tasks.

During this stage, the GEAP completely replaced the GITAMS developed during the second stage. Instead of registering all final deliverables during the second stage, the GEAP in the third stage allows the registration of only some of the deliverables based on the new government-wide EA meta-model. Moreover, organizations that did not implement EA were allowed to access and utilize information from the GEAP. In December 2013, the GEAP had information on 1390 organizations, with 18,168 IS and 64,517 pieces of hardware. The GEAP was also interconnected with the National Consolidated Data Center's National Total Operating Platforms (nTOPS), which had full IT resource information, including legacy systems.

Another important change was that the responsible agencies were consolidated into one organization. For instance, the MIC disappeared following government restructuring, and the MOGAHA became the responsible agency, while the NIA became a professional agency providing expert knowledge and executing practical tasks. This new governance structure helped streamline the management of EA effectively. The objective of EA evolved from the integrated management of IT resources to the non-duplication of IT projects and resources at the IT development and planning stage. That means the objective of EA was increasingly clarified as one of the most important TFC factors, even though its importance had not been well recognized until the second EA stage.

In December 2013, 116 agencies had adopted EA, and the central government agencies achieved an EA maturity level of 3.6 out of five, showing significant improvement compared with Stages 1 and 2. In addition, it was possible to eliminate duplicate IS projects, as agencies could share their project information with one another. Nevertheless, the most significant achievement was that the EA target architecture was presented at a government-wide level, with integrated and advanced views for every organization.

In a comparison of the TFC and TSC factors with those in the previous stages, the former were stressed, as EA was now managed at the central government level. Factors such as top management support and objectives became more significant than in previous stages because they were critical for coordinating IT resources across organizations. Simultaneously, TSC factors such as guidelines and EA systems were consistently enhanced. Therefore, the third stage balanced both the TFC and the TSC factors.

Some limitations existed in this stage. First, although the target IT architecture was presented at a government-wide level based on a national EA scheme, it was challenging for all e-government projects to capture the target model fully. Only a handful of projects, such as the National Statistics Systems, were considered to have fully targeted EA at a government-wide level. Second, the utilization of EA was restricted to IT resource management. That is, the scope of EA was narrowed from a strategic level to an operational level, even though the scope problem has improved thereafter. Third, in the same manner as the second limitation, the technical aspects of EA were still emphasized, even though the strategic application of EA must be further stressed. Therefore, the TFC factors for fundamental changes to IT resource management must be more focused in the future, while the TSC factors must be updated and simultaneously enhanced (Table 5).

In summary, during the utilization stage, the South Korean government came to understand the problems that occurred during the first two stages and successfully changed its overall EA approach from an individual agency level to a government-wide level. That is, the South Korean e-government fully understood the ultimate goal of the EA mission and found the right direction for the majority of e-government projects. In this sense, the target EA would be an important milestone

throughout EA implementation history, even though current progress is only gradually considering the target architecture.

**Table 5.** Major characteristics of the utilization stage. (nTOPs, National Total Operating Platforms.)

Issues	Contents
Law/Guidelines	<ul style="list-style-type: none"> <li>• Electronic Government Act</li> <li>• Update the Guidelines for the Adoption and Operation of EA</li> <li>• Government-wide EA meta-model</li> <li>• Second Stage EA Initiation Plan</li> </ul>
EA Governance	<ul style="list-style-type: none"> <li>• The MOGAHA as the major agency in charge of EA</li> <li>• The NIA as a professional agency</li> </ul>
Objective	<ul style="list-style-type: none"> <li>• Effective utilization of information resources and reevaluation of the results of the national adoption of information</li> </ul>
Major Achievements	<ul style="list-style-type: none"> <li>• Number of agencies adopting EA: central government agencies (40), local government agencies (17), public agencies (59)</li> <li>• Maturity level: central government agencies (3.6), local government agencies (3.2), public agencies (3.0)</li> <li>• Budget savings through the review of resource duplication</li> <li>• Establishment of target architecture based on a government-wide EA framework</li> </ul>
IS	<ul style="list-style-type: none"> <li>• GEAP</li> <li>• Interconnected with the National Consolidated Data Center's nTOPs</li> </ul>
Limitations	<ul style="list-style-type: none"> <li>• EA is not well reflected in the national adoption of information</li> <li>• The scope of EA is limited to information resource management</li> <li>• The strategic and business aspects of EA are not well utilized</li> </ul>

#### 4. Discussion

We have thus far examined South Korea's EA implementation process by dividing it into three stages. In this section, we examine the problems found during these three development stages and reanalyze them based on the proposed organizational change framework (i.e., TFC and TSC). In addition, we compare the results with those of an EA expert survey and, finally, propose a research model.

##### 4.1. Problems of the EA Definition and EA Application Level

Table 6 notes the various definitions of EA proposed by researchers. Common terms among the four definitions are "integration" and "strategy", and it can be inferred from these two words that the overriding goal of EA is the integrated management of various IT resources according to business strategies at the enterprise level. This view differs from the EA framework proposed by Zachman [8], who focused on the components of EA.

**Table 6.** Diverse definitions of EA.

Authors	Definition
CISR (Center for Information Systems Research) [5]	The organizing logic for business process and IT capabilities reflecting the integration and standardization requirements of the firm's operating model.
Zheng and Zheng [4]	To align the information, technology, standards, process, policy and framework of an organization with the goals and strategies of the organization as a whole in order to foster enterprises' standardization, integration, consistency and compliance.
Bernard [17]	The analysis and documentation of an enterprise in its current and future states, from an integrated strategy, business and technology perspective.
Lankhorst [51]	A coherent whole of principles, methods and models used in the design and realization of an enterprise's organizational structure, business processes, IS and infrastructure.

Applying this conventional interpretation of EA to a single organization engenders neither difficulties nor complexities. If EA is applied to a specific ministry or organization, strategies are built and resources are effectively integrated at the respective organizational level. However, if EA is applied at the national level by the central government to aggregate diverse agencies and organizations, the

methodology applied to a single organization is not as effective as before. The failure to recognize the difference would thus result in trial and error, as well as a failure to achieve the ultimate objective of EA.

In other words, the EA approach adopted depends on the level of application: nationwide versus an individual ministry or organization. If EA were applied at the organizational level, TSC factors would be more weighted than TFC factors as the scope of the project does not require fundamental changes of IT management beyond the boundary of a single organization. However, if EA is applied at the national level, TFC factors should be more heavily in focus since it requires coordination across organizations with fundamental changes in IT management.

From an EA methodology perspective, because the conventional EA methodology was developed for use by individual enterprises, its application to individual ministries would not be significantly problematic. However, its application at the national level would require considerable modification and improvement because of the absence of a national chief information officer to integrate and manage the information resources of individual agencies at the national level, as well as the difficulties involved in adjusting and controlling various agencies. Thus, the level of EA application is closely related to the level of implementation (i.e., organizational or national level).

Then, an issue exists as to whether EA should focus more on TFC or TSC factors. For example, in the South Korean government's preparation stage, four ministries were selected as pilot projects without considering the EA level. Indeed, in spite of top management support, the EA objective was not clearly established nor delivered to the relevant organizations since TSC factors were more focused on an individual organization. A number of applied models, laws and systems were established in the second stage. Although the reference and maturity models were ready to be implemented, individual agencies experienced difficulty applying them because the EA levels were neither clearly differentiated nor understood. More efforts were subsequently made instead to increase the number of organizations adopting EA. In this same manner, the GITAMS was also developed; however, it was clearly underutilized because of the lack of clear differentiation and understanding of the application levels. During the second stage of EA, while the TFC factors improved to a larger extent than the TSC factors, the EA objective and level remained problematic.

At the onset of the third stage (utilization), the South Korean government recognized that EA should be applied at the national level and took various concrete measures in this regard. Table 7 summarizes the major changes in EA since it was implemented at the national level in 2009. For example, the organizational structure was changed and the reference and maturity models were modified to allow individual ministries to use them in a straightforward manner. The central government also improved resource integration and sharing, and the EA management system was completely overhauled, from the GITAMS to the GEAP, to maximize the effects of the integration.

**Table 7.** Key changes in national enterprise architecture (NEA).

Period	Topic	Content
2009–2012	Revision of the reference model	Enhanced reference model utility
December 2009	Revision of the meta-model and information registration method	Registration of only individual agencies' information resources that fit the government-wide EA objectives (simplification of information registration)
	NEA target architecture	Presentation of the implementation model and target architecture by the administrative service domain
May 2010	Revision of the government-wide EA system	Presentation of an agency information analysis feature based on the new meta-model
May 2010	Revision of the information adoption procedure (national IT planning, prior consultation, e-government support project)	Prior review and prevention of duplicate projects using NEA information
March 2011	Stage 2 master plan development	Presentation of five new key implementation projects due to the NEA implementation
July 2011	Revision of the EA maturity model	Promotion of NEA information registration and utilization
December 2011	Revision of EA-related guidelines	Revision of the Guidelines for the Adoption and Operation of EA to form a guideline focused on EA utilization and performance management

Therefore, the South Korean EA experience allows us to understand why EA objectives are important at a government-wide level, as well as at an individual organizational level. Depending on the EA level, success factors must be differentiated and balanced between TFC and TSC. In summary, although the South Korean government experienced a period of trial and error while implementing EA because of problems between the national government and individual organizations, South Korean EA came to maximize its effects in the third stage.

#### 4.2. Survey Data from the EA Experts

To further explain the differences between TFC and TSC, we surveyed 20 EA experts to establish the objectivity and validity of the research by obtaining data from various sources and to test how the difference between TFC and TSC, as discussed earlier, manifests in the data.

We extracted 15 EA CSF from major EA articles such as Ylimaki [12] and Nikpay et al. [3]. Among the 15 CSF noted in Table 8, the establishment of EA objectives and top management interest (sponsorship) were classified as TFC factors, as were the establishment of an EA management process and the required laws and guidelines because they were considered to be driving forces behind changing how an organization performs its tasks. The other 11 variables were classified as CSF that influence TSC.

The questionnaire consisted of 15 EA success factors, and the respondents—20 experts selected based on their experience and expertise from a list of government EA experts and practitioners who have worked on EA—rated their importance for the successful implementation of EA using a five-point Likert scale. Table 8 ranks the results from the highest to lowest, showing that the establishment of EA objectives and top management interest (sponsorship) were both ranked first, while the other two TFC factors were ranked fifth. By contrast, the TSC factors generally scored lower. That is, South Korean EA experts conveyed that TFC factors are more important for the successful implementation of EA, and they considered that successful EA should fundamentally transform IT management.

**Table 8.** Ranking of EA success factors evaluated by 20 EA experts in South Korea. (TFC, transformational change; TSC, transactional change.)

No.	Rank	Item	Type of Change	Score
1	1	<b>Establishment of EA objectives</b>	TFC	4.6
2	1	<b>Top management interest (sponsorship)</b>	TFC	4.6
3	3	Capability of national EA experts	TSC	4.4
4	4	EA management systems	TSC	4.3
5	5	<b>Establishment of an EA management process</b>	TFC	4.2
6	5	Good communication among the responsible departments and agencies	TSC	4.2
7	5	<b>Establishment of the required laws and guidelines</b>	TFC	4.2
8	8	Feasible EA action plans	TSC	3.9
9	9	EA reference models	TSC	3.8
10	10	EA organization	TSC	3.7
11	10	Climate favorable to change	TSC	3.7
12	12	EA maturity model	TSC	3.6
13	13	EA framework	TSC	3.5
14	13	Capability-building programs	TSC	3.5
15	13	EA methodologies for implementation	TSC	3.5

A few of the compelling results from the survey need to be discussed. First, the establishment of EA objectives was ranked as the most important factor, which verifies that it has been the most difficult aspect of the South Korean EA implementation. This is consistent with the fact that the EA application level (national, ministry or agency level) was unclear in the early stages. In addition, the successful implementation of EA requires both leadership and clear objectives. In the context of South Korean EA, while leadership was relatively strong, there was a problem with the lack of clarity in the objectives of the early stages.

Second, the factors directly related to EA experts' tasks in the organization were ranked relatively low. The highest-ranked factor was the EA management system, which ranked fourth; however,

the factors that EA experts performed directly involving many personnel and much time spent on projects were ranked relatively low in importance, namely the EA reference model (9), the EA maturity model (12), the capability-building program (14) and the EA methodologies for implementation (15). Does this mean that these items are not important? Although we noted the importance of TFC factors in EA implementation, we maintain that TSC factors are no less important. Without TSC factors, EA can never be implemented successfully because TFC must accompany TSC; therefore, all factors are necessary, as they tend to complement each other. We focus on the relationship between TFC and TSC in the next section.

### 4.3. EA Success Model

While previous EA research has focused on deriving the CSF of its implementation, this study classified EA success factors into TFC and TSC categories. Additionally, EA experts in South Korea evaluated the implementation of EA as a type of TFC that requires more fundamental changes to the organizational culture. This result is consistent with the situation at the onset of EA, in which the South Korean e-government system lacked clearly targeted EA objectives and application level. Moreover, this finding is consistent with the fact that EA was just regarded as one of many IT projects.

One important question arises: Are TFC factors more important than TSC factors in other countries? We believe that the answer to this question varies depending on the situation facing each country. If TSC factors such as the reference model, meta-model, maturity model and EA management systems had not been well prepared, the importance of TSC factors would have been rated higher than TFC factors. However, this reversed result does not mean that TFC factors, such as leadership and objectives are less important than TSC factors. Similarly, if TFC factors were rated as more important in South Korea, this does not imply that TSC factors can be neglected in comparison with TFC factors.

We believe that the relative importance of TFC and TSC factors may change depending on the characteristics of the EA implementation and EA maturity stage. Hence, in this study, we propose a research model that generalizes the relationships among EA success factors, particularly between TFC and TSC. The proposed research model divides the 15 success factors into five groups. The first group includes TFC factors such as objectives and top management interest, while the other groups are governance, models, organization and tools and systems from TSC factors, with antecedent relations among them. The model proposes that achieving the desired EA performance hinges on meeting the prerequisites of satisfying clear EA objectives and top management support in the preparation stage. Then, governance and various models must be fully prepared based on the antecedents. Finally, EA must be successfully applied in the organization, using tools and systems factors from the implementation stage (Figure 4).

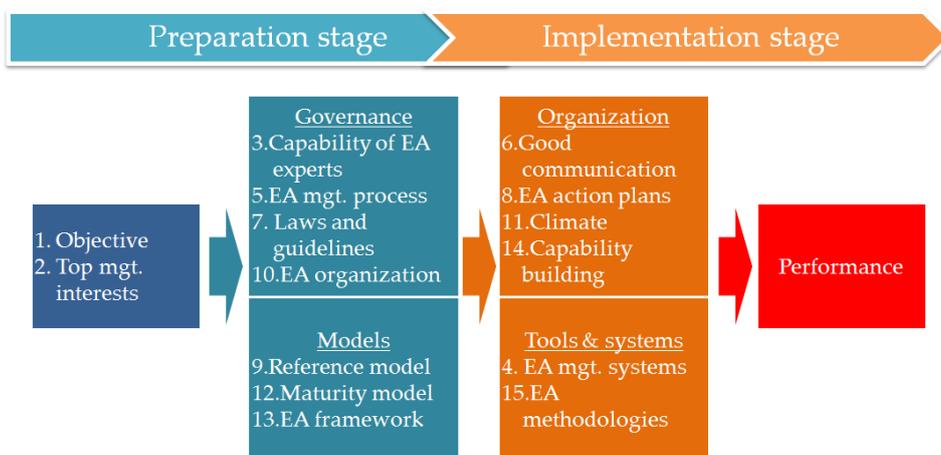


Figure 4. EA success model.

Research models can be divided into process and variance models [52]. Process models are research methods in which the antecedents must be satisfied for the consequents to be satisfied. On the contrary, variance model studies focus on the causal relationships among variables. Burke and Litwin [14] proposed the concepts of TFC and TSC based on the variance model. However, in this study, we suggest that the process model could provide a superior explanation of the EA implementation process.

Based on this proposed research model, it is possible to evaluate one of the major problems faced by the South Korean government during the EA implementation. As described in Sections 3.1 and 3.2, it is evident that the objective of EA was neither clear nor well understood in the first two periods, even though top management interest was the driving force of EA as a part of the e-government initiation. This problem affected subsequent factors, such as the definition, scope and level of EA. The proposed model explains that the failure to recognize the TFC nature of EA at the beginning consequently influences the performance of the TSC variables, thereby resulting in a failure to attain the ultimate goal of EA effectively. For this reason, the South Korean EA had to experience a period of trial and error during the first and second EA stages and then refocused in the third stage.

## 5. Conclusions

This study examined the key activities and characteristics of South Korea's EA implementation process by dividing it into three stages. Based on South Korean experiences, we discussed EA from an organizational change perspective, investigated whether EA is a type of TFC and TSC with additional survey results and proposed a research model with 15 previously-known EA success factors. In addition, we posit a relationship that TFC factors must precede TSC factors to achieve the ultimate goal of EA, which integrates diverse IT resources across agencies and ministries aligned with the business strategy.

A large number of organizations from the private and public sectors have implemented EA using generally-accepted frameworks and methodologies. However, finding a commonly-accepted definition is challenging, thereby leading to a serious application problem when EA is implemented at the national level as a part of an e-government project. From a research perspective, previous EA studies have simply listed success factors without offering an empirical validation. In addition, most EA studies have failed to overcome the common limitations of e-government research: a weak research methodology and theoretical foundation, failure to move beyond a cross-sectional study and a lack of diversity in data collection.

The present study overcame these limitations by developing a model of EA success factors. It analyzed the problems found in South Korea's EA implementation process based on the theory of organizational change, with additional survey data collected from 20 EA experts to complement the study results. The primary result, which should be noted by other countries that implement EA, is that EA is assessed as not only TSC, but also TFC; therefore, TFC factors must precede TSC factors.

This study has the following limitations. First, although the EA implementation process was divided into three stages for the presented analysis, the problems found in the entire implementation process were not discussed in detail. During our interviews with the EA experts, other important issues arose, such as EA management systems and maturity model application, which require further in-depth analysis. In this respect, this study was limited to examining specific issues in detail because of its varied scope. Second, as this study was based on a single case sample, South Korean EA experience, one limitation might be the generalization of the results to other nations. However, as it aimed to propose an enhanced model of EA success factors based on a theoretical framework of organizational change, this limitation does not depreciate the value of this study.

Future studies conducted in a variety of nations could provide more robust results. An empirical validation would also develop the proposed model and may be able to offer more precise implications. As models of e-government advance and become more widely applied, the importance of EA will be

highlighted. In this sense, other nations would benefit from the findings of this study, as its proposed model could help them understand the importance of and problems with EA.

**Author Contributions:** Kichan Nam and Seung Woon Oh conceived of and designed the research model and wrote the paper. Sung Kun Kim, Jahyun Goo and Sajid Khan reviewed the related literature on EA and double-checked the whole manuscript. All of the authors revised and approved the publication.

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

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