A Study on the Success Factors of Architectural Information System(SEUMTER) in South Korea

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Abstract

Since the late 1990s, the Korean government has attempted to develop the Architectural Information System (AIS, SEUMTER), led by the Ministry of Construction and Transportation, in order to improve civil complaint convenience and administrative efficiency in architectural administration. Since then, for nearly 30 years, the Korean government has been continuously upgrading the SEUMTER system. Based on these advancement projects, it is now possible to conduct civil affairs through the Internet, and civil petitioners can file complaints with government offices without visiting and without documents. In addition, statistical work and performance management became possible in real time for civil servants. And recently, by clouding the SEUMTER system, intelligent services have become possible.

In this paper, the development process of the SEUMTER was divided into four stages and evaluated, and the main success factors were derived. The main success factors of SEUMTER are 1) Promotion as a National Agenda - Leadership of the President and Ministers, 2) Outsourcing of Information System Development and Dissemination, 3) Overcoming Selfishness between Ministries - Integrating Building Permits System and Building Ledger Systems, 4) Continue to Promote Information System Advancement. Subsequently, three global diffusion strategies for SEUMTER were presented: 1) the Need to Establish Globalization Strategy: Linkage with Smart City Business, 2) Small and Medium-sized System Model Needed for Globalization and ODA, and 3) System Success Needs to be Publicized Internationally.

Keywords: *The Architectural Information System (SEUMTER), Electronic Government, Digital Government, Official Development Assistance (ODA)*

I. Introduction

South Korea is currently receiving the world's highest level of evaluation in e-government and digital government, which has been confirmed in the recent UN and OECD evaluations as follows. In the 2020 UN e-Government Evaluation Survey announced by the United Nations, South Korea ranked 2nd in the e-Government Development Index (Denmark, 1st) and tied for 1st in the Online Participation Index (Korea, USA, Estonia) among 193 member countries [1]. In the 2022 UN e-Government evaluation, South Korea ranked third in the world after Denmark and Finland [2]. As a result, South Korea became the only country in the world to have ranked in third place seven consecutive times since 2010. In particular, South Korea has ranked first in the world in both the e-Government development index and the e-Government participation index for three consecutive times in the UN e-Government evaluation survey in 2010, 2012, and 2014 [3][4][5].

Subsequently, South Korea once again confirmed the world's highest level in the digital government evaluation conducted by the OECD in 2020. According to a report published by the OECD in 2020, in the digital government evaluation conducted for a total of 33 countries, South Korea ranked first in the world in the comprehensive index, followed by the United Kingdom [6].

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South Korea has become a global leader in e-government and digital government because, over the past 30 years, investments in informatization have been carried out in various fields, and many information systems have been built and operated [7]. Among them, the most important information system is the Architectural Information System [8][9].

The Architectural Information System is a representative complex civil service application in South Korea; through the computerization of overall architectural administrative work, citizens can conveniently apply for permission via the Internet without visiting government offices, and public officials can conduct overall architectural administration work (Start of construction with permission, completion of construction, use approval and demolition, etc.) that electronically handles one-stop work. Therefore, the Architectural Information System is a national standard information system in South Korea's e-government [10].

In this way, it was the Architectural Information System that played the role of basic infrastructure in the process of promoting South Korea's e-Government. Still, it has not been properly evaluated so far. The reason for this was that the information system was developed over the past 30 years, and the accumulation of data on the advancement process and the management of data to inform the results of advancement were insufficient at home and abroad.

Therefore, this paper was written to publicize the Architectural Information System (SEUMTER), which has been the basis of South Korea's e-government worldwide and to suggest policy advice that can spread it. To this end, the architectural administration system's past development process and contents, which have been in progress for the past 30 years, are organized and analyzed, major success factors are derived, and future global development directions are presented.

II. Current Status and Performance of Architectural Information System (SEUMTER)

The background, current status, and performance of the architectural information system are summarized as follows.

2.1. Background of the Architectural Information System Development

In general, architectural administration refers to various governmental activities to solve problems related to the overall life of construction, such as building review, permission report, construction start report, use approval, and maintenance, and resolving pending issues in construction policy. And the target of architectural administration is to lead the policy direction in public architecture, apply minimum regulations in private architecture, and respond to the entire life cycle of a building, including planning, design, construction, management, and dismantling.

Architectural administration needs to be computerized for the following reasons [11]. First of all, architectural administration has the characteristics of complex civil complaints. Construction-related work is related to permit work under the jurisdiction of most local governments. Also, the building permit items are to be notified to the relevant departments.

In addition, construction administration has complicated procedures and takes a long time to process. In order to obtain a building permit in the past, thousands of blueprints and about 50 types of certificates had to be handwritten, and there was the inconvenience of having to visit the relevant government office several times to submit them. In addition, manual statistical processing took 2 to 3 months to collect from the central government. There was a problem in that it was not known whether the administrative processing of the civil petition submitted by the person was in progress. Furthermore, due to partial development by local government, problems such as overlapping investment in development and maintenance costs raised the need for an integrated system.

Due to this peculiarity of construction administration, the construction administration caused inconvenience to related public officials or civil petitioners. Accordingly, the Architectural Information System (AIS) computerizes the complicated architectural workflow to solve the inconvenience of civil petitioners due to the excessive work burden and time delay of public officials and the submission of duplicate documents.

The AIS is a project that computerizes overall construction and housing administration tasks from construction to demolition and overall tasks performed by local governments, from building/housing

approval and permits to building ledger issuance and statistics. The main purpose of AIS is to computerize the system to improve the efficiency of administrative work and public service and to establish a system that can utilize architecture-related data in a timely manner when establishing national policies.

Since the late 1990s, the Korean government has attempted to develop the Architectural Information System (AIS), led by the Ministry of Construction and Transportation, in order to improve civil complaint convenience and administrative efficiency in architectural administration. The Ministry of Construction and Transportation established a basic plan for the computerization of architectural administration in 1996, and from 1998 to 2002, the AIS was developed and distributed to local governments nationwide [12]. Since then, this system has been selected as one of the 31 tasks of the Republic of Korea's e-Government in 2003 and has been established as an Internet architectural administration information system in earnest.

2.2. Current Status of Architectural Information System

The recent status of the Architectural Information System(AIS) is divided into major contents, applied for tasks and utilization status, as follows.

2.2.1. Main Contents of AIS

The Architectural Information System (AIS) is an e-government system that allows citizens to conveniently apply for approval and permission via the Internet without visiting government offices and allows public officials to electronically handle overall architectural administrative tasks through the digitalization of overall architectural administrative tasks [13]. Since this AIS was promoted as a government innovation task using information technology, it is to innovate work processing in the following three areas.

The first is innovation in the way public officials work. This is to break away from manual work by changing the existing paper document processing into an electronic document method. Furthermore, it is to break away from the existing departmental work processing method and work for each service flow. The second is public service innovation. This is to move away from each institution's existing window-to-door and face-to-face processing methods and aim for a single window, non-visit, online processing. Third is the innovation of information resource management. Through the establishment of the AIS, integrated information resource management became possible, escaping from the past resource management by institution and task.

The Korean government has continuously carried out the AIS advancement project for the past 30 years to innovate the architectural administration process. As a result, various detailed information systems have been developed and operated, as shown in <Table 1> below [13].

Table 1. Main Contents of AIS

SYSTEM	LAW	FUNCTION	PURPOSE
Building Life Cycle Management System	BUILDING MANAGEMENT ACT	• Building management • Building inspection • Demolition work • Building life cycle data	• Building inspection • Provision of building life history information • Provision of construction-related services
National Building Energy Integrated Management System	GREEN BUILDINGS CONSTRUCTION SUPPORT ACT	• Energy usage data • Building energy-saving plans and certifications, etc. • Green buildings data	• Management of building energy consumption to the reduction of CO2 emissions • Provide policy information on green building services
Building Data Open System	ACT ON PROMOTION OF THE PROVISION AND USE OF PUBLIC DATA	• Building data by type • Data visualization • Map service • Big data	• Opening of building data to create new industries and added value
Architecture Service Industry Information System	ACT ON THE PROMOTION OF BUILDING SERVICE INDUSTRY	• Building services industry data • Industry survey • Building My-Data	• Convergence of building data to the promotion of related business

2.2.2. Applications of AIS

The Architectural Information System (AIS) is an information system that performs the application, processing, and management of a total of 141 civil applications for building permits and building records. The specific major application tasks are shown in <Table 2> below [13].

The AIS building register, building permit, business operator, and housing permit information are currently operated in connection with 324 systems of central, local governments, and public institutions in addition to the Ministry of Land, Infrastructure, and Transport. Regarding the various construction-related information provided by AIS, the main information requested by other organizations to AIS is building register (55%), building permit (34%), business operator (11%), and housing permit (7%), and maintenance business (3%) shows the ratio of information.

Table 2. Applications of AIS

TASKS	MAJOR CONTENTS
Building Licensing (34 types)	• application for permission for construction, major repair, change of use • notification of commencement • application for approval to use • application for interim supervision report
House Licensing (33 types)	• application for building projects approval • notification of commencement • application for inspection of use • application for permission to establish a housing association
Maintenance Works (25 types)	• application for approval of the housing association establishment promotion committee • safety inspection request • permission to conduct • approval of the disposal management plan
Building Register (19 types)	• application for building resister creation • application for separation and integration of building resister • application for conversion of building resister • report cancellation of housing rental management business
Business Proprietor (25 types)	• application for notification of the establishment of an architectural firm • reporting of the subject of engineering activities and architect belonging to a construction company • application for housing management business registration • application for cancellation of housing management business
Deliberation (5 types)	• application for deliberation by the building committee • application for reconsideration by the building committee • application for structural safety deliberation by the building committee • building committee appeal

2.2.3. Usages of AIS

Architectural Information System (AIS) has a total of 791,089 members as of the end of 2021. A total of 97.28 million building registers were issued through AIS, and a total of 1.34 million were processed for building permits. AIS constructs and manages all building information in Korea as a database of 7.3 million buildings, and is utilized in connection with a total of 348 other information systems [14].

Based on this utilization, AIS records the largest number of civil service applications within Government 24, the Korean e-government portal, as of the end of 2021 (Figure 1 and Figure 2). Building register issuance of AIS ranks first, followed by resident registration issuance at second, and land register at third.

In addition, in terms of shared use of administrative information with other agencies, it ranks second after the land register among various types of information of the Ministry of Land, Infrastructure and Transport.

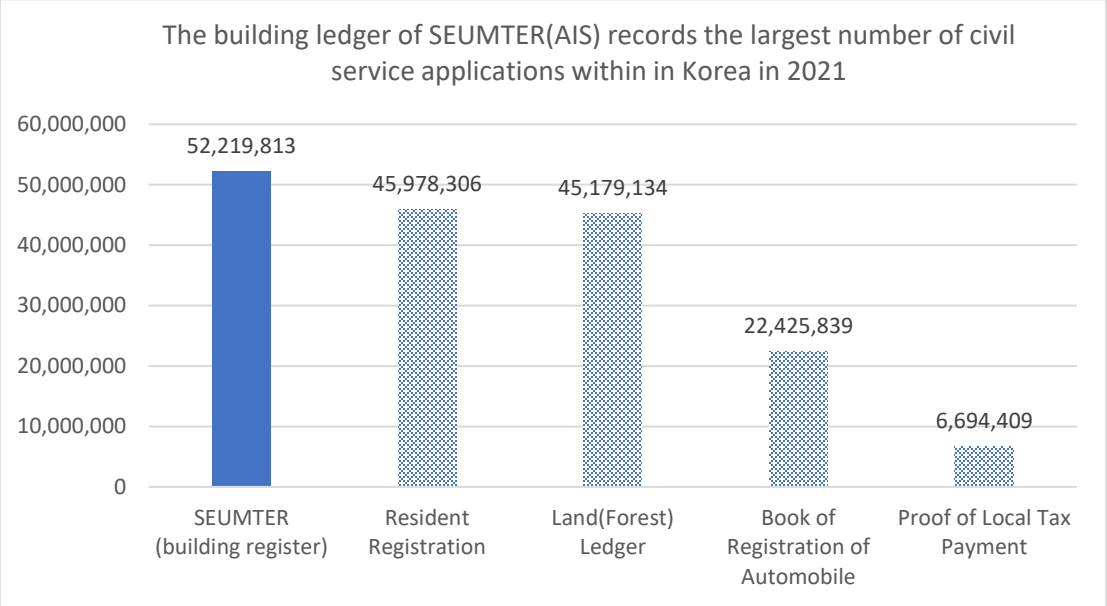

Figure 1. Number of applications for civil services in Government 24

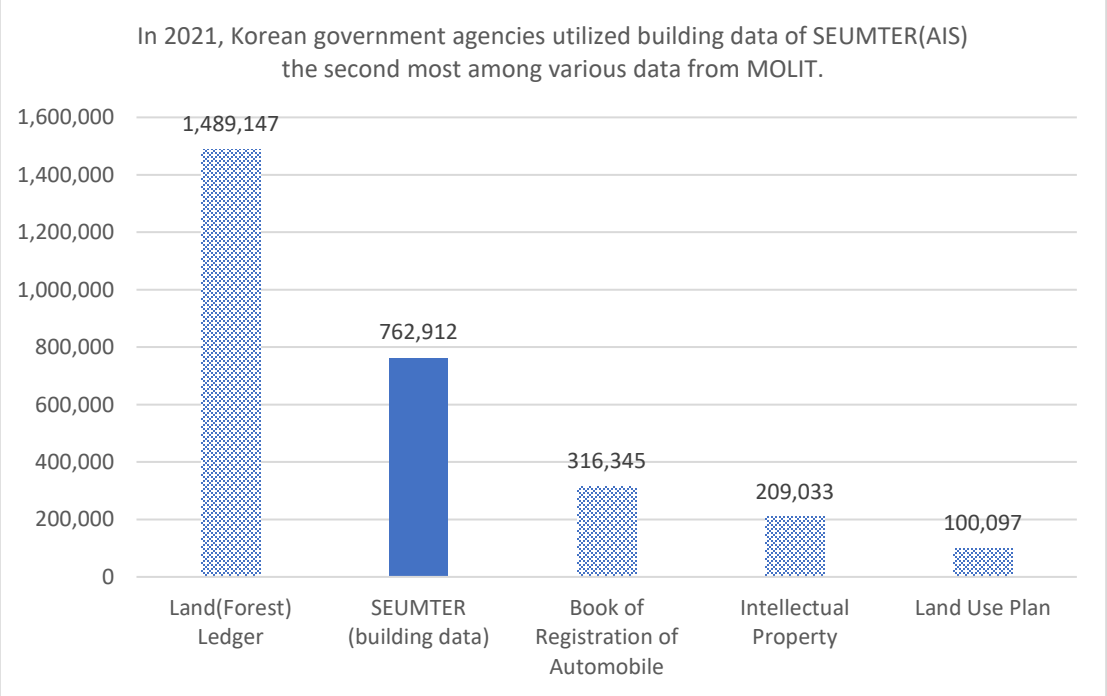

Figure 2. The Shared Use of Administrative Information (based on data from the Ministry of Land, Infrastructure, and Transport)

2.3. Performance Analysis of Architectural Information System

Through AIS, civil complaints can be received, work related to construction and housing can be processed immediately, and work efficiency is improved by automatically creating ledgers previously written by hand. In addition, it reduces administrative inefficiency by making it easy to write housing-related tasks and statistical tasks requested from time to time on the system. In addition, AIS computerizes and manages complex data that civil petitioners must abide by, such as all necessary administrative

procedures, design drawings, and supervision conditions, from application for building permits to usage inspections, enlargement, remodeling, and change of use. It is dramatically improving public administration services by reducing the inconvenience and providing basic data on related taxes to improve the transparency of work.

The major achievements of AIS can be summarized as follows [15]. First, in the approval and permission process, civil petitioners do not have to visit government offices, and real-time Internet processing is possible, so the approval and permission processing time, which took more than 60 days in the past, was reduced to 9 days. Specifically, in the past, government offices had to be visited five times, but now One-Stop and No-Visit administration is possible. Business innovation through AIS is achieving an economic effect of more than US$ 812 million annually.

Second, through the joint use of the Internet and administrative information, the tasks of related organizations were carried out sequentially in the past, but now parallel processing is possible.

Third, all 6.7 million buildings across the country were converted into a DB, and the reliability of national statistics was secured through rapid issuance. Specifically, the ledger, which used to be issued over a month for 2,000 households in the past, can be issued quickly in just one minute. Furthermore, construction-related statistics, which used to take 2-3 months, are now calculated in real time.

Fourth, efficiency was maximized through information sharing between public and private institutions. Building-related information is currently being jointly utilized by about 200 institutions, and the provision is also made in real time.

Lastly, by providing a preliminary legality review service that allows anyone to check whether or not construction is feasible in advance, an annual savings of US$36.5 million is achieved.

III. Analysis of the Development Process of Architectural Information System

The development process of Architectural Information Systems in Korea for the past 30 years can be divided into four stages as shown in (Figure 3) below [15].

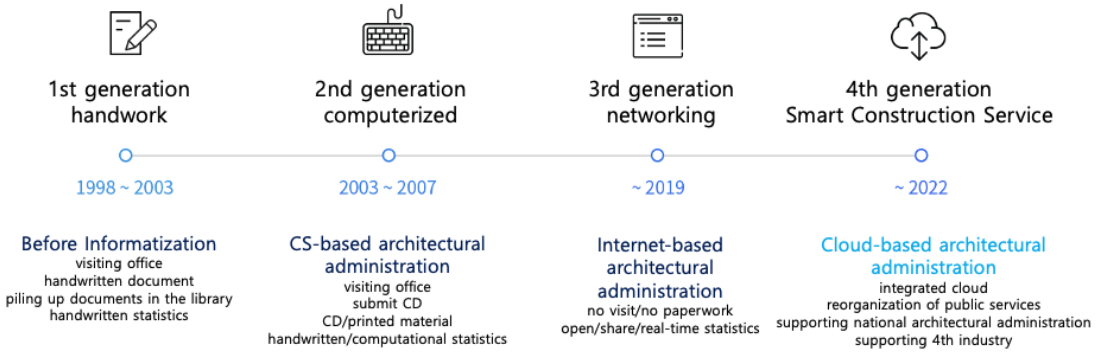

Figure 3. Development Process by Period of Architectural Information System
Source: https://cloud.eais.go.kr/moct/awp/agd03/AWPAGD03V01

First of all, the first step, before 2003, began with the computerization of architectural administrative procedures that had previously been done manually. Subsequently, the second stage (2003-2007) was based on computerization, enabling Client-Server (CS)-based architectural administration to be performed. In the third stage (2008-2019), Internet-based architectural administration was realized through computerization followed by networking. Lastly, the recent 4th generation stage (2020 to present) clouded AIS, enabling intelligent services. Looking at these contents in more detail, they are as follows.

3.1. 1st Generation (Embryonic Period): development and dissemination of the basic system (1998-2003)

This stage can be divided into two main periods. The first is the time to plan for system construction and perform Business Process Reengineering(BPR) and Information Strategic Planning(ISP) in the

existing manual work. The second is the period of developing the basic Architectural Information System (AIS) and distributing it to local governments across the country.

3.1.1. Started building the system of the Ministry of Land, Infrastructure and Transport (1996-1997)

In June 1996, the Korean government announced the Basic Plan for Informatization Promotion (1996-2000). This was a pan-governmental national informatization plan, which was supervised by the Ministry of Information and Communication at the time, and brought together informatization promotion plans of each ministry. According to this informatization promotion basic plan, the policy areas for informatization promotion were classified into four areas: informatization promotion, establishment of foundation for information and communication industry, construction of high-speed information communication network, and maintenance of social conditions.

Accordingly, the then Ministry of Construction and Transportation (currently the Ministry of Land, Infrastructure and Transport) established a basic plan for computerization of construction administration in June 1996 as part of the Basic Plan for Informatization Promotion [16]. At that time, the Architecture Department of the City Bureau of the Ministry of Construction and Transportation was in charge of the computerization of architectural administration. The architectural administration computerization project of the Ministry of Construction and Transportation was a project to computerize the construction and housing sector, and the computerization target included architecture offices and architecture and housing-related departments in cities, provinces, and counties.

institutional improvement plans for computerization, computerization promotion plans, and standardization plans were presented. The required budget includes system development costs (US$ 375,295) from the Ministry of Construction and Transportation, research costs such as system maintenance (US$ 100,000), existing data maintenance and input costs (US$ 751,740,405), and hardware/software purchase costs nationwide (US$ 158,403) from the budget of local governments.

In September 1997, as the architectural administration computerization project was selected as an informatization support project of the Ministry of Information and Communication, the Ministry of Construction and Transportation formed a promotion planning group headed by the Director of Housing and Urban Affairs and established a full-scale promotion plan. In addition, US$ 1.2 million was supported for the cost of building an architectural administration management system. The promotion planning group consisted of a system improvement group, a practical promotion group, and an administrative support group, and an advisory committee was separately operated to receive professional technical advice [17].

The Ministry of Construction and Transportation stationed a promotion planning team in one local government (Eunpyeong-Gu, Seoul Metropolitan Government) that showed a strong will for the development of a standard system in the previous stage of the informatization project, selected a major operator, and developed application programs in earnest from November 1997. For step-by-step promotion as a promotion strategy, the nine years until 2005 were divided into three stages, and the national Internet online service was set as a goal in 2005.

Projects subject to computerization are: 1) building (property) permit management, 2) housing construction project management, 3) building statistics creation and management, 4) related agency management (architects, housing construction companies, etc.), 5) legal information and buildings legality verification service, etc.

At that time, apart from the central government's policies, local governments carried out individual computerization of construction administration. At that time, the local governments that promoted computerization of architectural administration on their own were Eunpyeong-gu in Seoul, Daedeok-gu in Daejeon City, Ulsan City, and Gwangju City.

In particular, in the case of Eunpyeong-gu in Seoul, the ‘Administration Comprehensive Information System’, which began in 1994, computerized various approvals and permits, eliminating official documents and replacing the memo book with a computer. In the field of civil complaints for construction, the design drawings were not computerized, and consequently, there was no significant effect due to the reluctance of civil servants in the construction field.

Afterwards, Eunpyeong-gu successfully developed and applied the ‘building and housing administration management system’ based on the overall business analysis of architecture and housing administration. However, since the development of these programs by individual local governments was carried out without prior consultation with the relevant central government agency, the Ministry of

Construction and Transportation, there was a possibility of insufficient information sharing and overlapping investments in the future.

3.1.2. Proliferation and Dissemination of Architectural Information System (1998-2002)

As such, the architectural administration computerization plan, which began in 1996, was developed and materialized as an architectural administration management system in 1998. It developed into Architectural Information System(AIS) that computerizes tasks such as receipt and processing of architectural civil complaints, building ledger management, group management, and statistical processing, and has been disseminated and spread to local governments across the country.

Of particular importance is the integration of several related systems into the Architectural Administration Information System in 1998. The core functions of building administration are building approval and permits, management and issuance of building ledgers, and follow-up management following changes in use, extensions, and renovations. These core functions have clear precedence relationships between tasks and are closely related to each other. Therefore, in order to increase the smooth flow of the architectural administration process and the efficiency of business processing, these functions must be integrated and managed.

At that time, the Ministry of Government Administration and Home Affairs (formerly the Ministry of Home Affairs) developed the building register management system, so the integrated management function could not be activated.

As the problems in this matter emerged, at the 1999 budget-related meeting presided over by the Ministry of Planning and Budget on June 26, 1998, the two ministries (the Ministry of Construction and Transportation and the Ministry of Government Administration and Home Affairs) decided that building permits and building ledgers should be integrated and managed. The two ministries agreed on the basic principles and agreed to coordinate mutual opinions for this purpose.

On July 15, 1998, at a meeting of officials from the two ministries (the Ministry of Construction and Transportation and the Ministry of Government Administration and Home Affairs) presided over by the Ministry of Information and Communication, a final agreement was reached to integrate and integrate the building inventory management system into the building administration management system under the supervision of the Ministry of Construction and Transportation. Accordingly, in December 1998, it was decided that the Ministry of Construction and Transportation should take over the building ledger management system.

As a result of analyzing the possibility of simple integration between the building ledger management system of the Ministry of Government Administration and Home Affairs and the building administration management system of the Ministry of Construction and Transportation, the development system and structure of the two systems were different, so redevelopment of the system was inevitably promoted. Building ledger record management and issuance functions were added to the existing architectural administration management system with a total budget of $130,000 to establish a single system integrated with building permits and permits, which was converted into new integrated system. It was named Architectural Information System (AIS).

The Ministry of Construction and Transportation distributed the AIS to all local governments on three occasions, from October 1999 to the end of 2001, to drastically improve residents' services and enhance the self-governing administration's productivity. First, from October 1999 to February 2000, it was supplied to 37 local governments. Second, from March 2000 to February 2001, it was supplied to 100 local governments. Thirdly, the supply was completed to the remaining 111 local governments from March 2001 to February 2002. In particular, this AIS has been distributed in connection with the Comprehensive Local Government Administration Information System developed and disseminated by the Ministry of Government Administration and Home Affairs [18]

In this way, as the building administration information system was disseminated in connection with the Comprehensive Local Government Administration Information System, expenses necessary for dissemination were supported by the national budget. At that time, there was no case where government funding was provided to disseminate and spread the information system developed by the state. At the same time, when carrying out the specific promotion of system expansion, it was entrusted to a private business operator, and the completeness of the project was improved through various and continuous education.

3.2. 2nd Generation (System Stabilization Period): Establishment of CS-based Architectural Information system (2003-2007)

During this period, AIS, which was basically developed in the previous stage, was upgraded and developed into an Internet-based e-AIS. The specific details are as follows [19].

3.2.1. Analysis of e-Architectural Information System (e-AIS)

The architectural information system (AIS), which was completed in 2002, was built mainly on the computerization of internal affairs of civil servants, so there were still inconveniences in that it was difficult for civil petitioners to visit government offices and grasp the progress. In addition, there were problems such as the processing of work with institutions related to building permits were still carried out manually.

To solve these problems, the Ministry of Construction and Transportation decided to promote a new Internet-based architectural information system (e-AIS) from 2003. Through this, civil petitioners can conveniently apply for complaints through the Internet anytime, anywhere, review drawings online, and online consultations between internal and external organizations are possible, thereby greatly enhancing administrative efficiency. Specifically, in February 2004, as the architectural administration information service was selected as one of the 31 e-government roadmap tasks of the government at the time, stable budget support was secured.

The goals and contents of the newly promoted architectural administration information system (e-AIS) are as follows. The Internet building administration informatization task is to rebuild the entire process of building concession and permits based on the Internet, such as prior consultation on building concession and permits, application for civil complaints, use approval, and issuance of building ledgers, and to improve the efficiency and transparency of construction administration by reorganizing building ledgers. As the main contents, it was decided to promote the establishment of an Internet-based architectural administration service system and maintenance of the building ledger.

First of all, the establishment of an Internet-based architectural administration service system covers the entire architectural administration process, from building permit applications, which were processed through the existing client/server-based architectural administration system, to usage approval, building ledger issuance, and post-management. It was decided to rebuild based on the Internet. In addition, it was decided to promote mutual linkage with related institutional systems related to construction administration, such as real estate registration (registration commission, registered information) and land (site area district). Furthermore, it was decided to establish statistical data related to building permits, housing construction project approval, and construction. Along with this, standardization of design drawings and related application S/W development was promoted.

As a result, an Internet-based architectural administration information system (e-AIS, SEUMTER) was established, and a web portal used by civil petitioners and an intranet system used by public officials were developed. With the addition of the cyber consultation system and information sharing window, the system's overall appearance was completed. Since 2007, the Korean government has named the architectural administration information system SEUMTER and has been using it until today.

3.2.2. e-Architectural Information System Advancement Promotion Process

In August 2003, the Ministry of Construction and Transportation promoted Business Process Reengineering (BPR) and Information Strategic Planning (ISP) to establish an architectural administration informatization development plan and analyzed the current status and problems related to construction and housing administration.

Through this, specific directions for informatization of building administration were presented, such as work process and improvement of laws and systems, linkage with land and registration computer networks, standardization of drawings, and joint use of administrative information. Based on this, a budget of about $25 million was invested and promoted over four phases from 2004 to 2007, starting with the development project.

• 3.2.2.1 1st e-Architectural Information System (2004. 7 ~ 2005. 6)

In the first phase of the Internet Architecture Administrative Information System project, the development of the architecture field was promoted. Accordingly, an architectural administration web portal system was established so that civil petitioners can conveniently apply for construction civil complaints through the Internet and transparently view the progress. In particular, a construction administration intranet system was introduced to allow public officials to receive civil complaints and process them through internal consultation departments and online systems. In addition, a policy support system was prepared to quickly provide atypical statistical information requested by internal and external organizations and various statistical data for policy decision-making. In addition, information linkage for receiving and handling civil complaints with the local government administrative information system and linkage guidelines according to the advancement of the Internet Civil Service Portal (G4C) were also prepared.

During this period, the building register maintenance project (2004.10-2005.5) was also promoted. Ownership, lot number and display status, area use, etc. of about 17 million building ledgers nationwide were maintained, and the details were entered and modified into the building ledger DB.

• 3.2.2.2 2nd e-Architectural Information System (2005.12 ~ 2006.11)

During the 2nd project period, a building ledger management system and a nationwide integrated management system for construction-related business operators were established to manage the building ledger DB that had been maintained and established until May 2004. In addition, an online consultation system was established for consultation with external organizations for approval and permission processing, and the advancement of drawing standardization and design drawing registration and review functions of the drawing management system was promoted.

In addition, information linkage with related systems, such as the Internet Civil Service Portal (G4C), and a statistical system for construction, business operators, and buildings in violation were also established. In addition, through the revision of the “FRAMEWORK ACT ON BUILDING” (November 2005, May 2006), the basis for informatization of building administration and the establishment of a comprehensive plan and the delegation regulations for system maintenance were prepared, and various forms were revised for computerization.

• 3.2.2.3 3rd e-Architectural Information System (2006. 9 ~ 2007. 8)

In the 3rd project, system development for the housing sector was promoted. A web portal and intranet were established in the field of housing administration to provide inquiries and various issuance services for apartment construction permits and related information. Through this, housing-related tasks were processed electronically, and various statistics related to apartment housing, such as housing supply performance, were provided in real-time. The registration-land linkage function was also developed additionally. In addition, the basis for computerization of the building ledger was prepared through the complete revision of the “Building Ledger Management Rules” (February 2007), and the related forms were revised through the “Enforcement Rules of the Rental Housing Act” (March 2007).

• 3.2.2.4 4th e-Architectural Information System (2007. 8 ~ 2008. 2)

From August 2007, dissemination and expansion of the new system was promoted. If the distribution and expansion of the new system is divided into architecture (primary development) and housing (tertiary development), it is expected to generate double costs and overload local governments, so it is decided to replace it at once.

Since August 2007, the step-by-step dissemination and expansion of the metropolitan area have been promoted in the order of Seoul, Gyeonggi, Chungcheong, Jeolla, Gangwon, and Gyeongsang.

3.3. 3rd Generation (Maturity Period): Establishment of Internet-based Architectural Information system (2008-2019)

This period can be broadly divided into two parts. The first was the Lee Myung-bak administration (2008-2012) and the second was the Park Geun-hye administration (2013-2017). The Lee Myung-bak administration upgraded the existing e-AIS into an intelligent e-AIS, and the Park Geun-hye administration focused on data opening and developed the system.

3.3.1 The Lee Myung-bak administration's advancement to intelligent e-AIS

The Lee Myung-bak administration, which came into power in 2008, broke away from the previous government's e-government strategy and established a new vision and strategy for national informatization. The specific contents of this national informatization included the preparation of the basis for the creation of high value-added new growth industries through the combination of spatial information with IT and mobile technology in order to create new industries using spatial information [20].

At the end of 2008, e-AIS expanded its scope of business from "Building Act" to "Housing Act", enabling management of all buildings (general buildings and apartment buildings). In 2009, "Informatization Basic Plan for AIS Advancement" was established, and real estate official documents (architecture, cadastral registration, registration) were integrated by 2011.

From 2012 to 2013, AIS became more intelligent and advanced under the Lee Myung-bak administration, such as building spatial information-based services and Building Information Modeling(BIM) management foundations in preparation for the smart era.

Along with this, through the 1st - 5th projects of the intelligent architectural administration U-AIS, the construction of spatial information-based site service, the establishment of the site BIM management system, and the sequential spread of the nationwide distribution, building review management system, and mobile public service were expanded and established. The intelligent architectural administration system (U-AIS) implementation process and contents are as follows.

• 3.3.1.1 1st U-Architectural Information System (2009.8 ~ 2010.1)

A legality review system was established for 19 legal review items in the building permit investigation and inspection records, and functional and technical feasibility was verified. The main business contents include properties, drawings, Q&A-based legality review, legality review flexible user interface, additional services such as original text service, legality drawing standards, and CAD support tools. This system was tested in Songpa-gu and Gangbuk-gu in Seoul in December 2009 and then spread across the country.

• 3.3.1.2 2nd U-Architectural Information System (2010.4 ~ 2010.12)

A review service for building laws, ordinances, and related regulations was established, applied to building permits, and a service for reviewing applicable laws and regulations was provided. The main business contents are preliminary legality review service, required document review service, building review comprehensive information search service, legality review CAD support tool function enhancement, etc. Since November 2010, this system has been piloted in Seoul and its 25 districts and then spread nationwide.

• 3.3.1.3 3rd U-Architectural Information System (2011.6 ~ 2011.12)

Establishment of education, operation, and maintenance system for U-AIS nationwide service, settlement of service through nationwide spread and dissemination of system, improvement of service satisfaction by sufficiently collecting user opinions and upgrading functions, and establishment of BIM test system, the future foundation for the introduction of BIM was prepared.

The main business details are the establishment of an operating system for nationwide expansion of the legality review system, development of advanced legality review service functions, pilot development for U-AIS BIM application, and expansion of U-AIS infrastructure. Through this system, it was applied to 248 nationwide local governments.

• 3.3.1.4 4th U-Architectural Information System (2012.06~ 2012.12)

The main project details were to improve building ledger-related services, such as establishing a spatial information-based pilot service, establishing a foundation BIM management system, and issuing building ledger status drawings.

• 3.3.1.5 5th U-Architectural Information System (2013.05~2013.12)

The main project contents are the establishment of an architectural review management system and nationwide expansion, the sequential expansion of the construction site BIM management system and spatial information service (Seoul, Busan, and 3 cities of Gyeonggi provinces), and the establishment of a mobile web-based public service for construction administration.

3.3.2 Development of U-AIS for Data Opening of the Park Geun-hye Government

In the Park Geun-hye administration, which began in 2013, in response to the Government 3.0 policy emphasizing openness, sharing, and collaboration, AIS focused on customized opening of architectural administration information. Specifically, from 2014 to 2016, the expansion of the facility's advancement and the public opening of building data were promoted. Let's take a look at these two policies [21].

• 3.3.2.1 Spatial Information Service Expansion and System Advancement

At this time, it was required to establish a comprehensive development plan for the architectural administration system to respond to the paradigm shift in architectural administration actively. In addition, it was required to expand computer resources for service security between the internal and external networks and stable public services due to the replacement of old equipment and changes in the network configuration of the facility.

With the sequential nationwide expansion of spatial information-based services, it is necessary to provide a foundation for playing a leading role in creating and distributing building-related spatial information generated during the building permit process. The need to secure the reliability of open data and meet the needs of consumers has emerged by establishing a private open system for building data such as stable service operation and building data mart and data provision service through the expansion of computer resources at the foundation site.

To this end, an active response plan was prepared and promoted according to the overall structural improvement of the architectural administration system and the paradigm change by establishing the Information Strategic Planning (ISP), including detailed action plans for the development of the future foundation and comprehensive development.

1) Expansion of geospatial information-based site service: Expansion of the service by local governments nationwide except for the 2013 spread (Seoul, Busan, and 72 cities and counties under Gyeonggi Province)
2) Establishment of a private open architecture data system: extraction of public data DB, refinement (standardization, etc.), the establishment of a collection system, the establishment of an architecture data mart using open architecture data and spatial information by type, and provision of various information access channels centered on consumers. Build Dataset and Link service for
3) Expansion of U-AIS computer resources: Introduction of computer resources to provide stable services by strengthening security between the U-AIS (Ministry of Land, Infrastructure and Transport) service internal network and external network
4) Establishment of the next-generation building administration system ISP: Establishment of a comprehensive building administration development plan and detailed implementation strategy to strengthen the integrity and stability of the building administration system in the short term and to promote the development of building administration in the long term and smoothly promote the building administration informatization project Establishment of building administration system management and operation system and improvement plan for related laws and regulations to prepare the foundation

• 3.3.2.2 Opening of building data to the private sector

Building statistics are important statistics for identifying economic trends and establishing architecture and urban policies, but have not been actively utilized through analysis. In addition, vast information on the status of approximately 6.8 million buildings and 970,000 approval/permits per year is collected and managed in the AIS, but only a part of the construction statistics, such as monthly/quarterly approval/permissions and completion status, is provided. However, there were limitations in policy development and utilization in the private sector.

Therefore, there has been a need to prepare a foundation for information disclosure that can actively respond to rapidly changing policy environments. As of the end of 2013, 189 tasks of 125 types were processed through AIS. Building information equivalent to 6.8 million buildings was contained in AIS through permit and permission tasks; 14 pieces of permission information, and 15 pieces of building ledger information were disclosed.

From February 1, 2015, the Ministry of Land, Infrastructure, and Transport fully opened building information (“AIS Data)” to promote business creation and revitalize new industries as a model case of

the Government 3.0 policy. The subject of disclosure consisted of 1,504 items of construction and housing information related to AIS's building register and housing project approval, excluding personal information, which amounted to 280 million pieces of information.

3.4. 4th Generation (Smart Administration Period): Establishment of Cloud-based Architectural Information System (2019 – Present)

Today, AIS is rapidly shifting to cloud-based in response to the great digital transformation. Specifically, it was promoted as a cloud-based architectural administration system reconstruction project (2019-2022).

In September 2020, the Ministry of Land, Infrastructure, and Transport launched the "Second Improvement of Reconstruction of the Cloud-Based Building Administration System" project to provide faster and more stable architectural administrative services, such as issuance of a building register and architectural review, and has been continuously promoted until now.

The main contents of the project are service reorganization to improve user convenience, provision of non-face-to-face service for architectural administration, preparation of BIM (Building Information Modeling) application guidelines when applying for approvals and permits, and support for online issuance of building drawings. Looking at these contents in detail, they are as follows [22].

3.4.1 Service reorganization to improve user convenience

- Enhanced user convenience by improving service functions, such as automatic reflection of current status information and online issuance of a building license certificate in connection with the existing building register when applying for permission for extension or change of use of apartment houses, etc.
- Strengthen the support function for national and local government policy establishment by providing a nationwide status inquiry service for building administrative information such as building permits, construction starts, use approvals, and sales reports

3.4.2 Non-face-to-face service for architectural administration

- Reinforcement of non-face-to-face architectural review service through online-based architectural review system. 11,742 cases were held in 2019 as a face-to-face meeting where building owners, designers, expert committee members, and public officials gathered.
- With the spread of non-face-to-face work due to COVID-19, services such as sharing deliberation materials online, conducting deliberation meetings, and managing results are supported so that the architectural deliberation meeting can be held non-face-to-face.
- Continue to discover non-face-to-face services for architectural administrative tasks such as permitting, consultation, inspection and maintenance, and expand the service nationwide by 2022

3.4.3 Preparing BIM application guidelines and supporting online issuance of building drawings when applying for approval and permits

- In the era of the 4th industrial revolution, BIM (Building Information Modeling) is attracting attention as an innovative technology for improving the productivity of the building industry and improving the efficiency of construction work.
- In line with this, the building administration system establishes a BIM permit management system and prepares design and review guidelines to enable BIM utilization.
- Improvements have been made so that appraisers, lessees, real estate agents, etc. can also issue floor plans through the Internet without visiting local governments, which was currently available only to building owners online.

IV. Analysis of Success Factors of Architectural Information System

Today, Korea's SEUMTER site is operating at the world's best level in the field of architectural administration information system, to the extent that it is difficult to find precedents in the world. As such,

the reason why Korean SEUMTER has been continuously promoted and advanced for nearly 30 years is that various factors have been supported. The success factors of these SEUMTER are analyzed as follows.

4.1. Promotion as a National Agenda - Leadership of the President and Ministers

In general, regarding the success factors of Korea's e-Government, a technical point of view due to the completion of high-speed information and communication networks is sometimes presented. However, the success of these SEUMTER in Korea should be analyzed not from the technical aspect, but from the human point of view, and furthermore, from the institutional point of view promoted as part of the national agenda called Korea's e-government policy. And the promotion of these national agenda is realized with the leadership of high-ranking policy makers such as the president and ministers [23][24].

When the project was first promoted in the mid-1990s, the SEUMTER began at the level of local governments such as the Seoul Metropolitan Government and a single ministry, the Ministry of Land, Infrastructure and Transport. However, from 2000, it was included in the Korean government's promotion of e-Government and promoted as part of a national agenda. In particular, from 2003 to 2007, under the Roh Moo-hyun administration, e-government projects went beyond national agenda and were elevated to the presidential agenda. Therefore, a situation developed where the president periodically showed interest in the project and actually directly confirmed the progress of the project [25].

The reason for this was that the establishment of the SEUMTER was used as an important means of administrative reform that could reduce corruption by public officials, as well as administrative innovation using information technology, beyond the simple development and distribution of information systems. As an atmosphere was created in which the president directly stepped in and encouraged the establishment of the information system, it was possible to promote it as a multi-ministerial project, and furthermore, it was possible to build an integrated system rather than an individual system.

Furthermore, working-level public officials who were in charge of the SEUMTER in the late 1990s were promoted in the 2000s and served as ministers and vice ministers of ministries. Because the ministers and vice ministers of these ministries were well aware of the will of the then president and showed continued interest in the SEUMTER project, the project was able to continue for a long time and the information system to be advanced.

4.2. Outsourcing of Information System Development and Dissemination

In the early 1990s, when the SEUMTER was to be built, the Korean government's informatization projects were an environment in which the government directly developed information systems and promoted dissemination to users. At this time, informatization projects in the public sector were carried out with a top-down command system. However, the reason why the SEUMTER information system was able to spread nationwide in a relatively short time was that the government did not do it directly in the supply process, but outsourced it to private companies [26].

In order to build a completely new information system like SEUMTER and operate it nationwide, it is necessary to simplify documents for customers, citizens, and appropriately reflect the needs of front-line officials, users. Furthermore, the new system must be operated stably, and continuous education must be provided to public officials to improve their ability to use the new system.

From the beginning of the SEUMTER development, the Korean government formed a SEUMTER planning promotion team within the Ministry of Construction and Transportation to form a dedicated organization. Afterwards, in the development process, a development operating institution was selected from among the basic local governments. This was to reflect the experience and know-how of local governments that had independently developed and operated the building administration information system in the development of the SEUMTER. Through this method, the Korean government was able to successfully build a system with private development companies.

Later, in the process of distributing the system and expanding nationwide, outsourcing was done to private companies. The private business operator entrusted with the project of expanding the SEUMTER system formed a task force within the building administration informatization planning group, visited about 200 local governments in person, and supported the installation and operation of the system. As such, the private outsourcing of the SEUMTER project made it possible to provide more professional and flexible services, and provided high-level education to various stakeholders to support the successful operation of the system.

4.3. Overcoming Selfishness between Ministries - Integrating Building Permits System and Building Ledger Systems

E-Government projects through the establishment of information systems are areas that require cooperation among ministries more than any other government work. In particular, with the advancement of informatization projects, the importance of inter-departmental cooperation continues to grow as multi-ministerial tasks are promoted through joint utilization of administrative information. However, in the case of the SEUMTER system, the scope of related tasks was very wide, spanning the areas of several ministries, making it difficult for a single department to exclusively manage informatization tasks.

Furthermore, dominating the field of SEUMTER system is very essential for the growth of ministries and securing budgets. Therefore, in order to take the initiative, the relevant ministries have no choice but to make competitive efforts. When the efforts of these individual ministries collide in work areas where specific jurisdictions are not set, sharp competition and conflict arise. Therefore, compared to other tasks, the SEUMTER system was a field with a high possibility of expanding the issue of selfishness between ministries from the beginning.

The core of the building administration information system can be largely divided into approvals and permits related to construction and management of building ledgers. However, until the end of the 1990s, these two functions were established and operated as separate systems by two different ministries. Building-related approvals and permits were established by the Ministry of Construction and Transportation, and the management of the building register was established by the Ministry of Government Administration and Home Affairs, and they were operated separately without interconnection.

Therefore, the work to integrate these two systems was promoted by the Prime Minister's Office. In December 1998, the Ministry of Construction and Transportation took over the building ledger management system of the Ministry of Government Administration and Home Affairs and integrated it into the existing building management information system. In the process of this integration, the roles of the Ministry of Strategy and Finance and the Ministry of Information and Communication at the time were important. This is widely recognized as a successful case of resolving the leadership struggle between ministries and integrating information systems at the time.

The reason was that the building administration information system was selected as an informatization support project, and there was budget support using the informatization promotion fund of the Ministry of Information and Communication. Therefore, in the process of integrating these individual systems, the Ministry of Information and Communication played a large role through the fund. This example of system integration between the two ministries shows that the budget is the most powerful means of control in promoting digital government projects [27].

4.4. Continue to Promote Information System Advancement

In Korea, the implementation of the SEUMTER system was promoted in earnest from 2003. Of course, the building administration information system had been developed and operated even before that. However, at that time, it was at the stage of computerization with minimal functions, and a significant part of architectural administrative work was done manually. However, as the building administration information system was newly developed and operated based on the Internet from 2003, it was completed in 2007 under the name of SEUMTER. However, even at this time, citizens still visited government offices, submitted CDs, printed them out, and performed tasks. In the case of statistical work, handwriting and computerization were performed simultaneously.

Since then, for nearly 20 years, various governments have been continuously upgrading the SEUMTER system. Based on these advancement projects, it is now possible to conduct civil affairs through the Internet, and civil petitioners can file complaints with government offices without visiting and without documents. In addition, statistical work and performance management became possible in real time for civil servants.

And recently, by clouding the SEUMTER system, intelligent services have become possible. Based on this, the distributed operation system between the Ministry of Land, Infrastructure and Transport and local governments was linked to a clouding computer, realizing stable operation management and intelligent resource management. In addition, the information linked to the cloud enables the convergence analysis of other administrative information, going beyond the management of current status and attribute information, and enables linkage to the use of atypical building information.

Therefore, the current SEUMTER is the result of the Korean government's continuous advancement of the information system over the past 30 years. And the reason why the SEUMTER system has been able to receive budget support from various governments for such a long time is that it targeted architectural administration, which is very closely related to people's lives. Furthermore, it was because the use of the SEUMTER system was activated, and the expected effect was very large [28].

And although the SEUMTER system is operated by each local government, considering the importance of this project, it was carried out as part of a national agenda from the beginning. Therefore, one of the main success factors was that the fund was stably procured with government subsidy.

V. Policy Implications

Today, the Korean government is pursuing a strategy for overseas expansion of SEUMTER system based on the achievements of SEUMTER. The following is a summary of policy proposals in relation to the overseas promotion strategy of the SEUMTER system.

5.1. Need to Establish Globalization Strategy: Linkage with Smart City Business

Today, many overseas institutions are paying attention to the construction or building permit system implemented as a digital system, and it shows that the solution is being specified. In particular, in light of the recent development of various solutions related to architecture or building permit systems and marketing activities, there will be various global market demands for them.

Furthermore, Korea is a very unique country that is carrying out aid, among countries that have received aid worldwide. Therefore, the current internationalization strategy of the SEUMTER system should be pursued from the perspective of official development assistance to developing countries. Currently, even in developing countries, there are cases of realizing architectural administration information systems through collaboration with developed countries' ODAs and international organizations [29].

In particular, the SEUMTER system in Korea has a building permit period of 27.5 days. Therefore, compared to systems in other countries where the permit period exceeds 100 days, it has considerable competitiveness. Therefore, it can be evaluated that Korea can make good use of its competitiveness in terms of processing time for building permits, and that Korea's SEUMTER can enter the global market.

However, in the case of the SEUMTER system, the completeness of the output of the corresponding information system is high, but the connectivity and functional dependence with other institutions and systems are also relatively high. Therefore, it is expected that it will be quite difficult to transfer and export overseas with almost all functions of the SEUMTER system currently in operation. This is because related laws and regulations, other administrative systems, and preceding DBs must be preceded in order for the relocated site to operate.

Therefore, in order to increase the possibility of overseas transfer and export of the SEUMTER, it is necessary to seek a strategy to reduce the complexity of the system by reducing the linkage and functional dependence with other institutions and systems. To this end, more specifically, an internalization strategy is needed when entering overseas smart cities.

On January 29, 2018, the Korean government announced the "Smart City Promotion Strategy for Urban Innovation and Creation of Future Growth Engines" jointly with the 4th Industrial Revolution Committee under the direct control of the President and related ministries [30]. According to this, smart city was selected as one of the future growth engines. In particular, it was decided to expand government support for the creation and spread of smart cities, and specifically to expand overseas expansion and strengthen international cooperation. To this end, Kuwait and Saudi Arabia were selected as key countries to enter and intensively supported.

More specifically, smart city policy support is currently being provided for the capital relocation project in Indonesia. Currently, the Korean government is strengthening cooperation related to smart cities, roads, and water resources with the new capital of Indonesia, and promoting information exchange, experience sharing, dispatch of experts, and education and training on urban planning, development, infrastructure, and housing construction technology. However, in the process of challenging smart city overseas expansion, only the infrastructure of roads and housing construction is emphasized, and software such as SEUMTER is not properly provided. Therefore, when supporting overseas smart cities, which are

expected to proceed a lot in the future, support plans for integrated promotion policies must be prepared so that the SEUMTER system can be internalized and provided.

5.2. Small and Medium-sized System Model Needed for Globalization

The current SEUMTER model, which was completed as a result of the system advancement project that has been continuously promoted for the past 20 years, needs to be strategically restructured for overseas expansion in the future. More specifically, for SEUMTER's overseas expansion, there is a need to focus on information linkage based on building ledgers and open data to the private sector in addition to the electronic building permit system. And for this purpose, a small & medium size international diffusion model through strategic function combination should be developed and disseminated.

Because the current SEUMTER system is a relatively large and complex system from the point of view of developing countries. Therefore, from the perspective of SEUMTER's support for developing countries, it is necessary to seek ways to selectively provide the current functions by dividing them into modules. Specifically, when constructing a SEUMTER for overseas expansion, it will be largely composed of the following three modules.

The three main modules are 1) building permit management system, 2) building ledger-based information management and utilization system, and 3) building data provision and linked utilization system. Here, Cloud Computing & Mobile Service will be able to provide a choice when needed.

As such, the internationalization strategy through modularization of the SEUMTER can be promoted in more detail through the support of the National IT Industry Promotion Agency (NIPA). The National IT Industry Promotion Agency has been promoting the modularization project for a long time to support the overseas expansion of the Korean e-government system. Therefore, it is necessary to promote the modularization of the SEUMTER system in connection with the projects of the National IT Industry Promotion Agency.

And based on this modular SEUMTER, the city management field should be revitalized in the field of international development cooperation (ODA) through collaboration with the Korea International Cooperation Agency (KOICA). KOICA's ODA field is facing the need for change in the era of global digital transformation. Korea International Cooperation Agency's international development cooperation focused on visible construction and support in the past, but is now rapidly changing to the invisible aid field through e-government and digital government system support.

This is possible because the recipient country recognized Korea's development experience, especially its status as the world's No. 1 global leader in the field of e-Government. In response to the e-Government system establishment support request of the recipient country, there is a need to actively promote policies to activate the urban management field based on the SEUMTER in the ODA field through collaboration with KOICA.

5.3. System Success Needs to be Publicized Internationally

The government of Seok-yeol Yoon in South Korea, which was launched in May 2022, is actively promoting digital platform government policies [31]. The Yoon Seok-yeol government of Korea announced 'the Republic of Korea's digital strategy' on September 28, jointly with related ministries. The digital strategy sets the goal of realizing a digital economy and society where people can prosper together and leap forward again with the vision of "a digital Republic of Korea that sets a model for the world together with the people" and consists of five strategies and 19 detailed agendas. Among them, in relation to the digital industry, support for overseas expansion will be further strengthened so that excellent ventures, start-ups, and young people can challenge the global market. In particular, it plans to operate the 'Digital Export Pioneer Group' for public-private cooperation overseas expansion, in which the government and the private sector work together.

Until now, the Korean government, centered on the Ministry of Public Administration and Security, has been carrying out international cooperation projects to introduce the Korean e-government system to many countries around the world. Specifically, cooperative activities such as signing memoranda of understanding for digital government cooperation between countries, dispatching delegations, holding cooperation forums, and operating cooperation committees were carried out, and customized policy and technical advice was provided to important partner countries. In addition, the Digital Government Cooperation Center was operated to support ICT consulting, system design, and pilot projects.

Specifically, ICT consulting, such as feasibility study, project planning, basic design, and scale calculation, supported to overseas expansion of Korea's digital government best practices. However, among these various government projects, there is no case of publicizing Korea's e-Government internationally by targeting SEUMTER system.

Therefore, it is necessary to publicize the excellence of SEUMTER more internationally in the future. Specifically, in terms of international promotion, it is necessary to prepare a strategy to win awards in international organizations. In order to win an award from an international organization and connect it to the ODA strategy of developing countries, it is important to divide the SEUMTER system into strategic function-oriented combination modules and exhibit it. Furthermore, in terms of supporting smart cities in developing countries, it would be effective to challenge the market with specialized functions/modules.

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