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2013 Modularization of Korea's Development Experience:

The Establishment of Korea Land Information System (KLIS)

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MOLIT
Ministry of Land, Infrastructure and Transport

KRIHS Korea Research Institute for Human Settlements

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The Establishment of Korea Land Information System (KLIS)

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Prepared by	Korea Research Institutes for Human Settlements (KRIHS)
Author	Jong Taek Park, Korea Research Institute for Human Settlements (KRIHS), Research Fellow Joungyoon Chun, Korea Research Institute for Human Settlements (KRIHS), Assistant Researcher
Advisory	Hosang Sagong, Korea Research Institute for Human Settlements (KRIHS), Director Young Uk Kim, Ministry of Land, Infrastructure and Transport, Deputy Director
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Preface

The study of Korea's economic and social transformation offers a unique window of opportunity to better understand the factors that drive development. Within one generation, Korea had transformed itself from a poor agrarian society to a modern industrial nation, a feat never seen before. What makes Korea's experience unique is that its rapid economic development was relatively broad-based, meaning that the fruits of Korea's rapid growth were shared by many. The challenge of course is unlocking the secrets behind Korea's rapid and broad-based development, which can offer invaluable insights, lessons and knowledge that can be shared with the rest of the international community.

Recognizing this, the Korean Ministry of Strategy and Finance (MOSF) and the Korea Development Institute (KDI) launched the Knowledge Sharing Program (KSP) in 2004 to share Korea's development experience and to assist its developing country partners. The body of work presented in this volume is part of a greater initiative launched in 2007 to systematically research and document Korea's development experience and to deliver standardized content as case studies. The goal of this undertaking is to offer a deeper and wider understanding of Korea's development experience in hopes that Korea's past can offer lessons for developing countries in search of sustainable and broad-based development. In furtherance of the plan to modularize 100 cases by 2012, this year's effort builds on the 20 case studies completed in 2010, 40 cases in 2011, and 41 cases in 2012. Building on the past three year's endeavor that saw publication of 101 reports, here we present 18 new studies that explore various development-oriented themes such as industrialization, energy, human capital development, government administration, Information and Communication Technology (ICT), agricultural development, and land development and environment.

In presenting these new studies, I would like to express my gratitude to all those involved in this great undertaking. It was their hard work and commitment that made this possible. Foremost, I would like to thank the Ministry of Strategy and Finance for their encouragement and full support of this project. I especially would like to thank KSP Executive Committee, composed of related ministries/departments, and the various Korean research institutes, for their involvement and the invaluable role they played in bringing this project together. I would also like to thank all the former public officials and senior practitioners for lending their time and keen insights and expertise in preparation of the case studies.

Indeed, the successful completion of the case studies was made possible by the dedicated efforts of the researchers from the public sector and academia involved in conducting the studies, which I believe will go a long way in advancing knowledge on not only Korea's own development but also development in general. Lastly, I would like to express my gratitude to Professors Kye Woo Lee, Jinsoo Lee, Taejong Kim and Changyong Choi for their stewardship of this enterprise, and to the Development Research Team for their hard work and dedication in successfully managing and completing this project.

As always, the views and opinions expressed by the authors in the body of work presented here do not necessary represent those of the KDI School of Public Policy and Management.

April 2014

Joon-Kyung Kim

President

KDI School of Public Policy and Management

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Summary

The Korea Land Information System (KLIS) aims to provide information necessary for land policy establishment promptly and accurately. This system manages accurate information on land use zoning designated by land use regulations and provides it to government agencies, local governments, and people. KLIS manages and provides specifically the land information database to prevent duplication of investment among agencies and to effectively manage the land by securing the compatibility of data sets. Hence, KLIS is the very foundation of the "national geospatial data integration system" that combines environment, forest, cultural assets, and agricultural land information, playing a key role as an infrastructure for land-related administrative affairs and a civil service of local governments as well as land policy affairs of the Ministry of Land, Infrastructure and Transport.

There were many difficulties during the construction process of KLIS. The first of these difficulties was to produce a serial cadastral map with single cadastral maps, because of different scales of cadastral map in the characteristics of land parcels. Secondly, there was a discrepancy in each different zoning map. Thirdly, the flawed legal system for data sharing in land policies and lastly, the central government experienced conflicts to initiate the KLIS incorporation. In spite of these challenges, the Korean government was able to establish the KLIS.

The KLIS performed better than anticipated and its effects were both tangible and intangible. Enhanced public services through the Internet have been welcomed by the public, and are helping to save time and costs.

The tangible effects of the KLIS are cost reductions and time savings. In local governments, it was expensive to produce land price maps every year for the land administration to be distributed by the central government. However, outsourcing costs to produce the land

price map is no longer necessary, because the KLIS has taken over this task. As a result of implementing the KLIS, public officials were able to improve the efficiency of cadastral administration affairs and resulted in expense-savings of approximately 47.25 billion in 2008, 53.4 billion in 2009, and 50.33 billion won in 2010, which came to an average savings of 50 billion won. After 2009, the expense savings in using electronic documents at local governments after the KLIS was established was about 9 billion won per year. After analyzing the expense-savings effects of KLIS, the expense came to approximately 380 billion won while the benefits resulted in approximately 1 trillion 400 billion won. Thus, the expense to benefit ratio exceeded 3.0.

The intangible effects of the KLIS were improvements to civil services from local governments, increased efficiencies of administrative duties, contributions to scientific land policies and lastly, the foundation of a future-oriented information society is established.

The KLIS brought improvments to local government civil services, by making it possible for citizens to request land-related civil documents to be issued at eup/myeon/dong offices or through public-accessible automated kiosks. All updated and accurate information regarding land including the current condition of land use zoning, restrictions, and publicly announced land prices was available, and the contents of civil documents are easier for users to understand since they contain detailed descriptions. Hence, this system helped individuals to plan land use in a more streamlined manner and thus contributed to the convenience of civil services.

Secondly, the KLIS improved administrative efficiencies by restructuring land-related systems and integrating everything into one comprehensive information system, saving time and manpower and therefore making governmental operations more compact and efficient. In addition, the geospatial information system plans divided among local governments were implemented comprehensively and collectively in order to prevent duplicate investments into the database and application system development.

Thirdly, the KLIS contributes to scientific land policy decisions. The systematic land administration system among the central government, metropolitan cities, si/gun/gu, eup/myeon/dong, is able to collect data promptly, accurately and comprehensively analyze the current conditions across the country. Therefore, land policies are produced in a prompt and streamlined manner with national lands developed and managed more efficiently.

Fourthly, the KLIS brought made it possible to establish the foundation of future-oriented information society. Information from the land management information system is shared nationwide for various tax-related administrations, land-use plans, and site selections.

The KLIS cannot be applied to developing countries because the legal system and executing bodies differ for each country, as are land-related administrative systems and

service methods. Those in charge of land policies from developing countries may be impressed during briefings about Korea's KLIS, but adopting the system in their own countries could be a challenge, as their legal structures are very different. It is necessary, therefore, to adjust the architecture of the KLIS to the legal system and environment of each country.

Chapter 1

Introduction

1. Background and Objective
2. Domestic Conditions at the Time of KLIS Construction

Introduction

1. Background and Objective

1.1. Background of Land Information System and KLIS

Korea has gone through rapid industrialization through powerful government-led economic development policies since the 1960's. Rapid industrialization and urbanization resulted in large-scale migration of rural populations to cities as well as various land use and development projects such as urban development, industrial complex developments, and express way/railroad/harbor developments. In the process, land and housing prices increased, especially in the large cities and development districts where populations were concentrated. Speculation for land lots and apartments was common around development districts, and insufficient acquisition of development profits led to serious social problems such as illegal and unearned revenues.

Accordingly, the government introduced various land policies such as the public development system, real estate taxation, the development impact fees system, the development permission system to solve problems of land use and speculation. Due to the variety of land legislations and complexity of land-related administrative affairs of local governments, there were questions about the effectiveness of speculation controlling policies. Land-related issues were time consuming and an excessive amount of socio-economic expenses were used and the limitations of land policies became evident.

Land-related affairs included a wide range of areas such as policy, possession, transaction, use control, development, and management. The central government would entrust local governments for most land-related matters except establishing land policies. Without a proper system to integrate and manage such a broad range of projects, coordination between

the central division and local governments was not systematic. The central government had difficulties in collecting information on land policies accurately and promptly, frequently failing to cope with land-related problems in a timely manner. Local governments were also struggling with heavy workloads of handling hundreds of thousands of land-related civil complaints every year.

Further complicating matters, there were more than 80 laws concerning land use, and 170 laws for land use zoning maps. Land regulations were so complex that public officials in charge of issuing civil documents did not fully understand details of the restrictions. In addition, the confirmation documents of land planning, which provided those who filed a civil complaint with the most important information on land use, specified only eight items on the Regulation of Land Use. Hence, as it was unable for both the land seller and purchaser to obtain the general information on the targeted land, those who filed civil complaints had to go through a series of as trial and error in the process of land use.

Also, data related to land management lead to various types of ledgers, attribute data including public reports, topographic maps, cadastral maps, urban plans, and other geospatial data that were quite complicated and varied. There were more than 10 drawings produced and utilized to designate and manage urban planning land use zoning, and these divisions in charge had to manage various drawings and ledgers. Since this data was mostly handled manually, it experienced various problems such as duplication, recording error, and inconsistencies. In addition, some local governments implemented their land-related computerization projects autonomously. In the government's perspective, this duplication of investment would lead to budget wastes and make it difficult to secure data compatibility.

Therefore, it was urgent to provide those who filed civil complaints with accurate information promptly, improve productivity of public officials in charge, and prevent budget wastes, data compatibility problems in the process of developing separate land-related information systems. It was also necessary to establish a comprehensive information system to secure information to establish reasonable land policies accurately and promptly, systematically integrate and manage geospatial, attribute, and law data on land use, and organically link land affairs specified in individual laws.

In addition, the information system was expected to remove the possibility of injustice and corruption among public officials in charge of handling land affairs in an analog manner. Land-related regulations and designations of land use zoning were so complicated that it was difficult for the average person to understand them except the public officials in charge. In addition, the progress of land-related affairs was not made transparent publicly, there was a high possibility of injustice among public officials in the progress of decision-making of land use zoning and development projects. Against this background, geospatial information

systems including the KLIS received a fervent response as it was expected to make land handling procedures clear and thus remove room for injustice and corruption in handling land-related affairs.

1.2. Objective of KLIS

The objectives of the establishment and operation of the KLIS are 1) streamlining of land policies and affairs and 2) efficient management of geospatial information. In streamlining land policies and affairs, KLIS aimed to secure fundamental data for the government's land policies promptly, establish and implement accurate land policies, improve the quality of land policies, and handle land-related administrative affairs efficiently. Previously, changes in land transactions and prices were investigated only by individual administrative si/gun units, but the establishment of the KLIS made it possible to examine the details of each district, area, and lot. While it would take a tremendous amount of time to understand changes in land transactions and prices based on statistics in the previous analog method, information systems made it possible to investigate and understand si/gun/gu transactions and areas of speculation. Therefore, it became possible for the central government to promptly and accurately understand changes in land transactions and prices as well as the time and place of land transactions through the KLIS. As a result, the central government was able to establish and execute land-related policies in a proper, timely manner, which improved the quality of land policies.

The second objective of the establishment and operation of the KLIS is to efficiently carry out various land-related affairs in the related division of local governments and comprehensively manage land-related projects. Before the KLIS was established, si/gun/gu local governments handled land affairs manually, which involved the following problems: ① duplicated production of land-related data among related divisions; ② cadastral discrepancies between the actual land situation and documented information and between related divisions; ③ the process of handling civil services delayed due to the complicated reference to paper drawings and ledgers; ④ inconvenience and transportation expenses in reading and issuing land data available only at land seat offices; ⑤ duplication of duplicate or similar land-related affairs in various divisions of a local government; ⑥ unavoidable but unnecessary complicated procedures of land management; and ⑦ duplicated investments into land information management since some local governments promoted their own information management projects independently.

The KLIS aimed to solve these problems by establishing an integrated database for land management in utilization of GIS and an ultra high-speed national network. Specifically, it focused on ① management of accurate data, ② drastic improvement of civil services, ③ improvement of work productivity, and ④ timely and scientific land policies.

The third purpose of the establishment and operation of the KLIS is in relation to geospatial information policies. In 1995, the Korean government established fundamental plans for NGIS as the basis for national geospatial information policies. The major goal of national geospatial information policies is to establish a geospatial information infrastructure to share geospatial information. In the process of the establishment and operation of the KLIS, the serial cadastral map was produced as the basic geospatial data set, one of the most important elements in a geospatial information infrastructure.

Previously, it had been common to provide a sheet of cadastral map or a rough cadastral map, but there was no serial cadastral map reflecting major topographical objects such as roads and rivers. For the KLIS to function properly, it was necessary to establish a serial cadastral map whose demand was the highest in land policies and markets. The serial cadastral map established by the KLIS reflected the divisions and merged individual lots that are frequent in land transactions real time to keep up-to-date and provide high quality geospatial information.

2. Domestic Conditions at the Time of KLIS Construction

2.1. Socio-economic Demands for Land Policies

It is very challenging for less developed countries to create a strong securities market. They lack many of the institutions that control information asymmetry and self-dealing. This includes, legal and market institutions that ensure that minority shareholders (i) receive good information about the value of a company's business and (ii) allow them to trust and have confidence in a company's management and controlling shareholders. Regulators, prosecutors, and courts may not be honest or sophisticated enough to carry out this task. Accounting and financial disclosure rules may not be comprehensive or independently audited. Reputational intermediaries, such as investment bankers, accountants, and securities lawyers, may not be sophisticated enough nor subject to liability risk. Since Korea started promoting powerful government-led economic development policies in the 1960's, urban regions have been rapidly industrialized and rural populations have migrated into large cities. Large-scale development projects inevitably led to rapid increase of land and housing prices especially around the development districts. With no proper measures for speculation control and acquisition of development profits, serious social problems such as social inequality due to serious land speculation and illegal and unearned revenue occurred. Accordingly, the government introduced various land policies and legislations to solve such land problems. To promote large-scale urban development projects in line with rapid urbanization, in 1966, the government stipulated a separate legislation entitled the

'Land Compartmentalization and Rearrangement Projects Act', which used to be part of the Urban Planning Act. To control land speculation which was spreading nationwide, it stipulated the 'Act on Special Measures for the Restraining Estate Speculation' in 1967. In 1971, it revised the 'Urban Planning Act' to control land speculation around metropolitan cities and designated limited development districts.

In 1972, the first 'Comprehensive Plan on the National Territory' was established for the comprehensive development and preservation of national land. The 'Act on the Utilization and Management of the National Territory' divided national land into six land use districts and land use zones, controlling the use of land. The government established the 'Industrial Complex Management Act' in 1975 and 'Arrangement of Industry Act' in 1977 to acquire land for the development of industrial complexes, and it also introduced the system of the standard land price for expropriation and compensation of land necessary for industrial complex development. In addition, it stipulated 'Exemption law on Acquisition of Land for Public Use and Loss Compensation' in 1975. Many special advantages were endowed for land expropriation to facilitate bargaining acquisition. In 1980, 'the Housing Site Development Promotion Act' was stipulated to introduce the public-managed development method.

As such various land-related systems were introduced, the government recognized the necessity to establish and implement land policies and related affairs effectively on the part of local governments as well as the central government. In particular, it was urgent on the central government's part, to secure fundamental policy data promptly and accurately to control land speculation while the demands for prompt and accurate understanding of land-related administrative affairs and quality improvement of local government civil services such as issuing of civil documents were emphasized by local governments.

2.2. Demands for Administrative Information in Line with IT Advancement

For the successful establishment of information systems, the physical infrastructure for IT advancement such as information and communication networks, computer technology that had to be accompanied by policy makers' information-oriented will, participants' awareness, and passion, and securing human resources such as information experts. In the 1980's, Korea initiated information-oriented projects in various areas in addition to establishing the national communication network. Although industrialization was delayed, information-oriented efforts focused on IT advancement in an effort to join the ranks of developed countries. As a result, the information and communication infrastructure of Korea including electric communication networks, optical communication networks, wireless communication networks advanced faster than any of the other countries in the world.

The advancement of IT and establishment of the national key communication network contributed greatly to the successful realization of administrative informatization. As a result of establishing the five national key networks in the 1980's, the optical communication networks linking administrative agencies made administrative services available around the country. The previous telephone network of modems among agencies was replaced with the high-speed optical communication network, which made it possible to access all documents and materials promptly. In the early years, the optical communication network was available only in central regions around the country, but it gradually expanded to local cities, counties and borough offices as well as major administrative cities. The wide spread of the optical communication network enabled average people to have civil documents issued through online anywhere in the country.

Rapid advancement of computer technology was another key factor that enhanced the quality of administrative services. While all administrative affairs were handled manually until computer technology finally advanced up to the point of computerization and informatization. In the early stages, mainframe computer technology that required large-scale storage capacity was the mainstream, but the performance of personal computers quickly advanced. Developments of computer technology made it possible for informatization of administrative affairs. Administrative affairs were computerized as the contents were loaded on a communication network. As administrative works of statistics and documents became informatized and GIS was introduced into Korea, it was possible to establish geospatial information system as well. Accordingly, the demand for geospatial information in handling land-related administrative affairs increased.

Chapter 2

KLIS Development Methods and Promotion Strategies

1. KLIS Development Method
2. Promotion Bodies
3. Project Development Strategies
4. Expected Effects of KLIS Introduction

KLIS Development Methods and Promotion Strategies

1. KLIS Development Method

1.1. Top Down KLIS Development

Since GIS was introduced by some local governments and public enterprises in the 1990's, the history of Korea's GIS is short. Due to the relatively short tenure of GIS, public agencies did not consider compatibility of data sets among them when introducing GIS and producing GIS databases. Since GIS DB was established according to the need of each agency, it was difficult to share and link geospatial data sets. Finally, in 1995, the national basic plan for GIS was established and the government-led geospatial information policies were initiated.

The first national basic plan for GIS included the cadastral map computerization project, and land-related informatization were planned as part of a public GIS utilization system development project. The national basic plan for GIS specified that major GIS DB establishment and utilization projects were to be formed under the government's leadership and that the established geospatial database should be open to the public to foster the geospatial information industry in private sectors. Accordingly, individual cadastral map computerization was conducted by the Ministry of Government Administration and Home Affairs while serial cadastral map and land policy system development was led by the Ministry of Construction and Transport in a top down approach.

Since the central government established the basic plan, local governments distributed it in this top down development approach so that various agencies could share and standardize data sets. This system was applied to all local governments nationwide, so the project would progress rapidly and managed effectively. In regards to KLIS, the central

government invested its financial resources along with matching funds in cooperation with local governments, and expenses were reduced in comparison with the bottom up approach of individual local governments.

Since the problems and solutions found in the process that individual local governments conducted projects could be reflected in other local governments, and project know-how could be accumulated. The establishment of national basic plans for GIS would be followed by government-led foundation of standards, and then the central government would provide financial resources to establish the GIS DB. This top down approach from the government to private sectors was found to be effective. The central government appointed the Korea Research Institute For Human Settlements as the technical support agency in establishing KLIS, entrusting it for KLIS project planning, ISP projects and pilot projects. Thereafter, the Korea Research Institute For Human Settlements played a role as the general support agency for the nationwide implementation of KLIS.

The central government planned KLIS projects and provided financial resources while local governments participated in KLIS projects through matching funds and investigated private sectors on whether they produced serial cadastral maps and land use zoning maps in accordance with the standards and methods set by the central government and inspected the errors and quality of each database. Local governments operated and maintained each KLIS database and KIS system with regard to land-related affairs.

1.2. Procurement and Share of Financial Resources

As the computerization project of cadastral maps, and geospatial data of KLIS, was promoted as part of the administrative informatization project of the Ministry of Government Administration and Home Affairs, and the all expenses were covered by the national fund. But, after implementation, the expenses for the establishment of geospatial databases including serial cadastral maps and use zoning maps and the KLIS information system were funded by the central and local governments. The investment into KLIS projects was funded by the central government from the beginning or by the central government and local governments in a 50:50 investment. The administrative informatization project promoted by the Ministry of Government Administration and Home Affairs was funded by government, and the informatization promotion fund of the government was used until it became difficult to use the budget of the central government. Therefore, the central government conducted the project in cooperation with local governments to reduce budgets, encourage local governments with a weak financial basis to participate in the projects, and distribute the KLIS project as soon as possible.

For the Land Management Information System (LMIS) establishment project, the Ministry of Construction and Transport procured government budget annually on the principle of 50:50 financing in cooperation with the local government involved. The financial resources of the Ministry of Construction and Transport were utilized mainly for KLIS DB establishment while the budget of local governments was used to purchase computer equipment (hardware and software). When the local government completed cadastral map computerization or owned H/W for the land management information system, the expense could be reduced by utilizing existing equipment. Programs such as project expansion management, institutional improvement, land management information system development and establishment, GIS S/W supply, geospatial database, and educational support were conducted at the central government's expense.

In the case of PBLIS, the Ministry of Government Administration and Home Affairs secured and procured all expenses since it was handled mainly by the Department of Cadastre. The governmental subsidy was allotted from the e-government. PBLIS projects were operated in a way of outsourcing in the early stage, but as the public officials in charge of cadastres at the local government became familiar with the affairs, some of them established their own databases.

1.3. Stepwise Development of the KLIS Project

The KLIS project was conducted step-by-step for years as it was expanded nationwide after the pilot project by the central government. Due to the insufficient government subsidies and a lack of GIS workforce, KLIS projects were unable to expand to more than 250 cities, counties, and borough units simultaneously. To establish and operate KLIS, large-scale financial resources were required to digitalize cadastral maps, establish serial cadastral maps and various databases including thematic maps production on the land, develop application system for land-related affairs, and adopt hardware equipment for system operations. The KLIS establishment project was expected to require a tremendous amount of expense and a lot of human resources.

It was difficult for the central and local governments to procure enough financial resources and GIS human resources capable of establishing KLIS DB were rare in private sectors. Therefore, KLIS could not be conducted for all local governments and it was thought to be efficient to initiate it in medium and large size cities where demands for KLIS were strong and then to expand into small cities and counties.

1.4. Application of the Information System Developmental Methodologies

The KLIS project was conducted in application of the information system development methodologies. Establishing or developing information systems are totally different from common software. Information systems are an integration of various systems and technical elements such as software, hardware, system software, network, and DBMS. Mere development of program techniques or improvement of procedures would hardly contribute to system integration. State-of-the-art technology needs to be reflected in the IT strategy rather than relying on technicians' experience and skills when it comes to establishing information systems.

In particular, as recent information systems feature complex, large scale, and strategic information utilization, and more sophisticated methods are required than the existing development methods without any clear plans. To establish information systems, it is necessary to automate and systematize the general steps from planning the system strategy to thorough analysis of users' demand and to design and development. Since a number of technicians participate in the development of information systems and it takes a long period of time, therefore, project management and adopting developmental methodologies is required throughout the process.

Also, in KLIS establishment, information system development method theories were applied with regard to work procedures, work methods, products, work techniques, and management tools. The Ministry of Construction and Transport conducted the KLIS project systematically by initiating an ISP in advance. Prior to starting the KLIS project on a full scale, a development method was designed for preparation of related systems, preparation of necessary data, establishment of a database, and KLIS system development. Based on this basic KLIS development method, a pilot project was implemented for Namgu, Daegu City, which was followed by the specification of KLIS maintenance instructions to be referred to in KLIS projects.

For KLIS to be successfully established, existing land-related regulations and systems had to be readjusted since they were based on analog land policies and work systems, which would not be applicable to new digital methods. Therefore, related systems were examined in terms of production, management, utilization, and distribution. Basically, the readjustment of existing systems for KLIS establishment aimed to share land-related information among divisions of the central and local governments. Accordingly, the institutional foundation had to be established for the information system to work properly

through data standardization, procedural simplification, and automation. The systems for land management informatization, land data rearrangement, land management database, and for the foundation and maintenance of KLIS also needed to be complemented.

To digitalize the existing analog data, it was important to secure accurate data and to standardize various data forms. The shortage and inaccuracy of existing analog data and differences in input forms of registers caused many problems during the digitalization process . Therefore, it was necessary to analyze and complement adverse factors related to land data such as land registers, forestry registers, cadastral maps, and forest land maps and to apply the solutions to the pilot project. This was one of the institutional measures to use the existing registers and spatial data sets.

For effective data sharing and links, the database was designed with GIS technology and database standardization in mind, based on which the geospatial data and attribute data were accumulated. The KLIS application system was developed for the future expansion of KLIS and in analysis of practical affairs.

2. Promotion Bodies

Various organizations participated in KLIS project such as the central government, local governments, research institutes, and private geospatial information agencies. The central government acted as the general project coordinator, planning and budgeting KLIS and adjusting related systems such as regulations and instructions. Local governments secured budgets to establish KLIS from each region, inspected the digitalized geospatial and attribute databases, maintained the KLIS DB, and operated and maintained KLIS information systems.

The Ministry of Construction and Transport (MOCT) and The Ministry of Government Administration and Home Affairs (MOGAHA) played leading roles in promoting the land management information systems development project. MOGAHA was in charge of cadastre computerization and PBLIS establishment while the MOCA was responsible for LMIS establishment. Municipalities were responsible for the adjustment and examination of data. However, a considerable proportion of work that was to be carried out by the MOCT and municipalities was outsourced to expert groups. Among the outsourcing expert groups, the Korea Research Institute for Human Settlements carried out practical planning, management and standardization, whereas SI companies developed technologies for database building, application, hardware and network building.

The Korea Research Institute For Human Settlements (KRIHS) analyzed the project methodology, current conditions, and problems of the initial ISP (Information Strategy

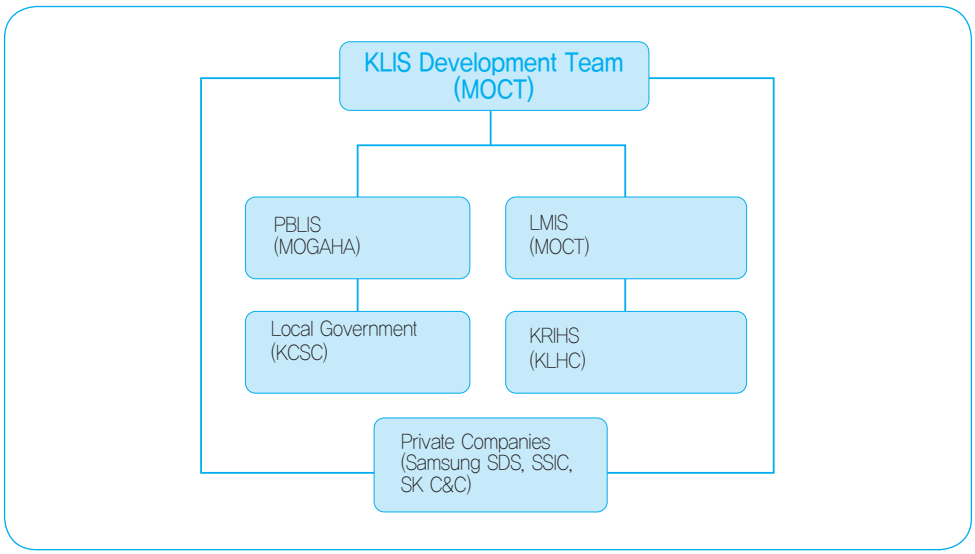
Planning) project, presented improvements and alternatives for related systems, and managed related projects for local governments. Geospatial information companies established the KLIS information system and geospatial database of local governments. As stated above, the KLIS project was conducted based on the cooperative system among the central government, local governments, research institutes, and private information companies. In 2005, PBLIS and LMIS were integrated into KLIS. After the KLIS project was completed, The Ministry of Construction and Transport was entrusted to manage KLIS.

The KLIS project was conducted in a top down manner. While the central government developed and presented various standardized specifications related to KLIS database and system development, local governments established geospatial databases with the central government's instructions.

In the early stages of the land management information system, The Ministry of Construction and Transport entrusted the Korea Research Institute For Human Settlements (KRIHS) to develop theories and methodologies and private agencies were entrusted with development. For cadastre computerization, the Ministry of Government Administration and Home Affairs entrusted the Korea National Computerization Agency to develop project logics and methodologies and a private agency for specific plans.

Under the central division's direction, the KLIS development project team was formed, and the Ministry of Government Administration and Home Affairs and Ministry of Construction and Transport acted as the research institutes and project management agencies respectively, supported by private companies. The KLIS development project team consisted of three individuals from the cadastre department of the Ministry of Government Administration and Home Affairs, 32 cadastral officials from local governments, and 5 individuals from the Korea Cadastral Survey Corporation.

Figure 2-1 | KLIS Promotion System



3. Project Development Strategies

3.1. System Architecture of the KLIS

The most important element when establishing the KLIS information system was how to design the system structure in a way that made it available to the average person as well as land-related officials. This reflects intentions for KLIS to provide the public and private sectors with basic geospatial information including serial cadastral maps rather than merely assisting with administrative services. There were many problems on land markets in Korea. Thus prior to the actual development of the land information system, a pilot study was conducted to understand the current conditions, situation, and possible problems of the LMIS project, and to come up with information system development methodologies, content, and institutional measures to solve such problems.

The system architecture, application architectures and data model of LMIS were designed on the basis of the pilot project in the early stages of LMIS. The architecture and data models were applied to the KLIS without any changes.

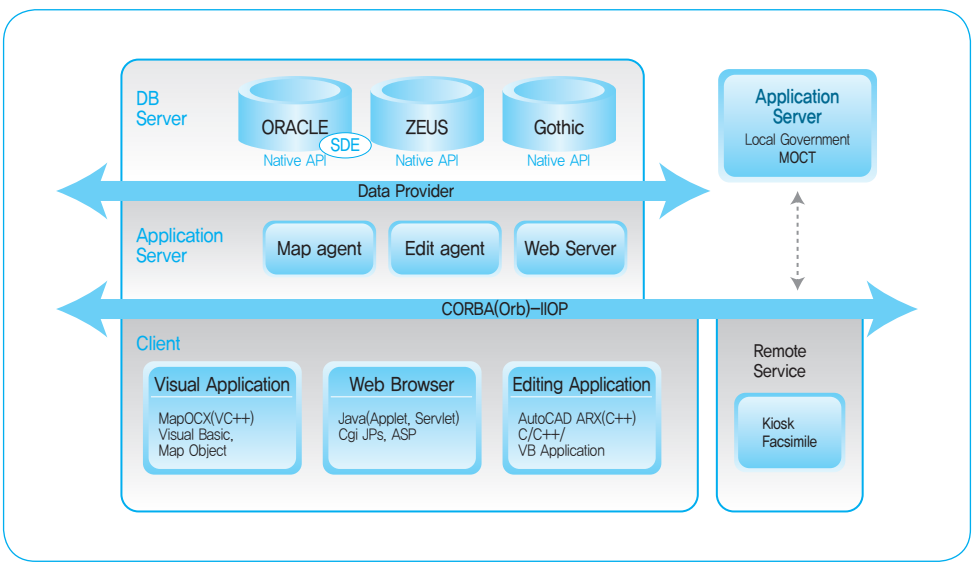
KLIS was designed to be open architecture in order to support distributed computing environments of local governments consisting of hierarchical 3-Tiered systems: the clients, the application server, and the database server. The application server was operated on the

bases of CORBA (Common Object Request Broker Architecture), which mainly consists of the Data Provider, the Edit Agent, and the Map Agent as illustrated in [Figure 2-2].

Considering the different operational environments and computer systems in municipalities, an open type information technology that emphasizes interoperability, portability, extensibility and reusability was used in developing a land management information system. The open type information technology enables free access between different types of platforms and application programs made in different languages and it is also possible to allocate a data layer to a specific server, desktop, computer, internet or intranet. The Government adopted a 3-tiered client server architecture that applies the standard specifications of CORBA suggested by the Open GIS Consortium. Thus KLIS was designed based on the 3-Tier architecture of LMIS in spite of the 2-Tier architecture of PBLIS.

The Data Provider searches special data from the database using the GIS engine, and relays them to the Map Agent or Client. The Map Agent creates a map image from the spatial data relayed from the Data Provider, and relays the created maps to the Client. The role of Edit Agent is to edit (input, modify, and delete) the spatial data. In addition, the web server can be added to the architecture, to facilitate application from the public via the Internet.

Figure 2-2 | System Architecture of the KLIS



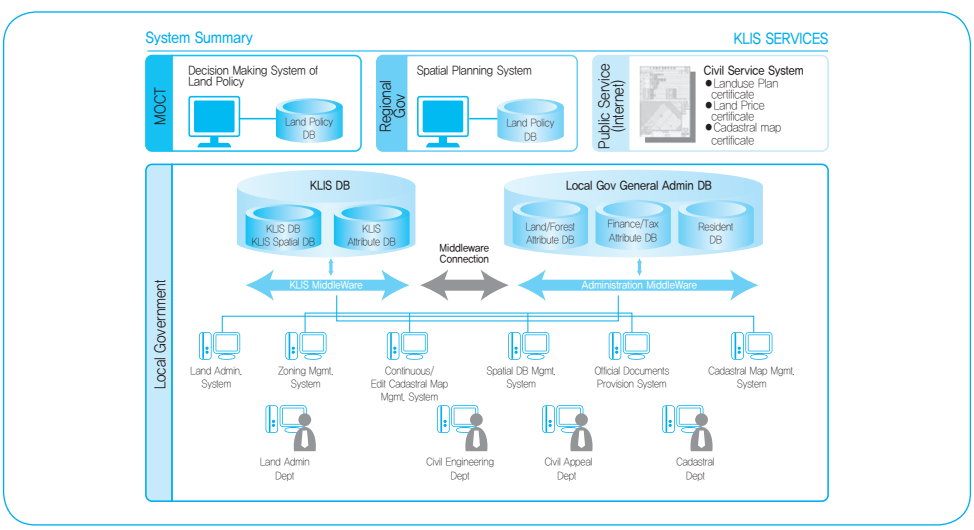
Source: KRIHS, 2007, Special Report p 57.

3.2. Application Architecture of the KLIS

The core of the KLIS is the management support systems for the land administration of local governments. Data produced at the local government level is collected and relayed to the regional and central government, to support the decision making process on land policies. Public services can also be provided by the local government, regional government and central government level via the Internet and through specially designed Web portal services. Communication between the public and administrators of local/regional/central governments takes place both via the Internet and the governmental intranet. Other client devices are tightly connected with the high-speed governmental intranet, so that data produced and modified in a specific client can be shared and synchronized with others (see [Figure 2-3]).

The application system ware established suitable to the hierarchical characteristics of the operations of land administration in ministerial, city-provincial, and city-county district levels. For example, the Land Policy-Making Support System is an application system designed for the Ministry of Construction and Transportation, the Land Use Plan Management system for metropolises and cities, and the Land Administration and Management System for city-county district. In particular, the Land Administration and Management System is composed of six application systems each for land transaction, publicly announced land price, development charges, foreigner land acquisitions, the management of real estate brokers, and the management of spatial data. Users of land databases can be divided into government organizations and civilians. The former accesses land databases through the national administration information network and the latter through the internet.

Figure 2-3 | Application Architecture of the KLIS



Source: KRIHS, 2007, Special Report p 58.

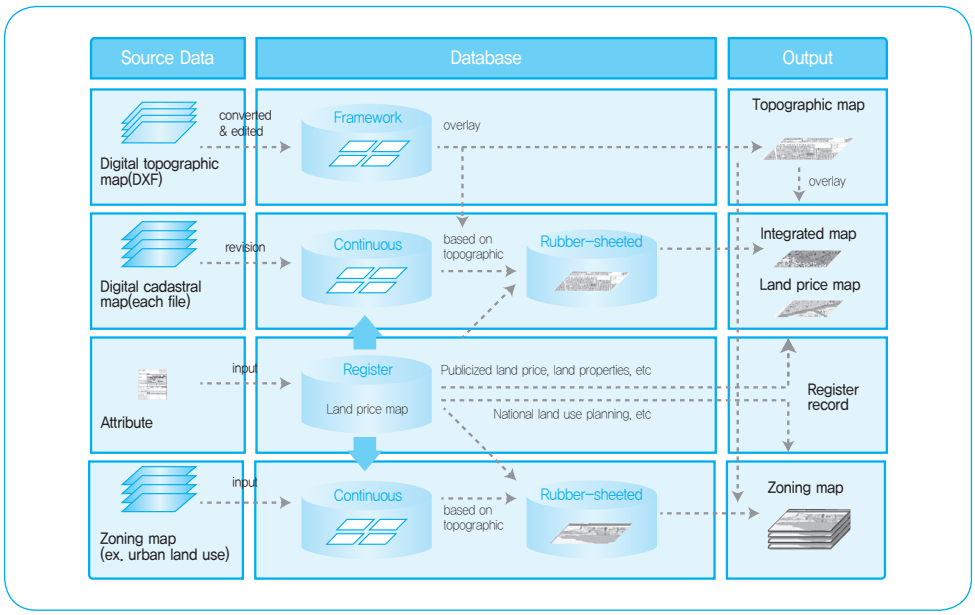
3.3. Database of the KLIS

Essentially, two kinds of databases were constructed in one physical database server by local governments, which were spatial databases and attribute databases. Spatial databases include cartographic map databases, cadastral map databases, serial cadastral map databases, edited serial cadastral map databases, and zoning map databases. Rather than all of the information in the original cartographic maps, only the major spatial features such as roads, buildings, and railways, were collected and included in the cartographic map databases. Serial and edited cadastral map databases were built by merging tile-based digital cadastral maps. A zoning map database was created using the information gathered from zoning maps maintained by local governments and the central governments' individual departments (See [Figure 2-4]).

Attribute databases contain information on the physical characteristics of lands, land prices, and real estate brokerages. The KLIS database provides spatial databases to the other information systems in local governments and the KLIS databases were standardized so that they could be easily accessible to other information systems.

The land database provides spatial data such as topographical map, cadastral map and zoning map and non-spatial data such as publicly announced land prices, land use plans, and land transactions. For topographical maps, major data layers concerned with land management operations such as roads, buildings, rivers and contour lines in 1/1000 and 1/5000 maps produced in the national GIS project were utilized. For cadastral maps, those produced in the computerization of cadastral maps project by the MOGAHA was used. However data of zoning maps were newly built into a database by using national land use plans kept by municipalities. In addition, non-spatial databases were built on land transactions, land appraisals, land use plans including publicly announced land price and land characteristics data for 32 million land parcels.

Figure 2-4 | Database of the KLIS



Source: KRIHS, 2007, Special Report p 59.

The most important strategic element when it comes to establishing the geospatial database of KLIS is to include cadastral maps and serial cadastral maps in the basic geospatial information as one of the core elements of the national spatial data infrastructure. To accomplish this, cadastral and serial cadastral maps established by KLIS are standardized as part of the basic geospatial data and supplied through the distribution system that complies with the standard.

When the geospatial database of KLIS including digital cadastral maps, serial cadastral map, and land use zoning maps is established, the focus is on expanding data utilization and meeting future data demands rather than the accuracy and precision of properties. Accordingly, individual cadastral and serial cadastral maps currently produced by KLIS are playing an important role as the basic geospatial data for various geospatial information systems in such areas as national defense, disaster prevention, environment, agriculture, forestry, and facility.

Currently, there are 98 geospatial information systems related to the KLIS DB. These 98 information systems share geospatial data with KLIS as the hub. In other words, related information systems share the data as KLIS handles the common cadastral-related administrative affairs and provide the general public with cadastral services.

The KLIS database was utilized not only for cadastral-related administrative affairs but also for land-related administrative work. The serial cadastral map reflected the land use and demands from various sectors. In fact, the demands for serial cadastral maps were quite high not only in public sectors but also in private sectors such as transportation, communication, and other business.

3.4. Institutionalization

The government worked on institutional adjustments and standardization to convert the analog settings that ruled the production, utilization, management and dissemination of land information to the digitalized environment. In addition, specific guidelines was prepared such as guidelines to correct and renew existing maps produced in analog methods, guidelines to the conversion of numerical geographic map files in DXF (Data Exchange Format) to GIS data, guidelines to the extension of individual cadastral maps, guidelines to conforming an extended cadastral map to a numerical geographic map, and guidelines to moderating of inputting zoning map data.

The data model and content of databases were standardized to share land information between relevant organizations so that land database could be used as a spatial data infrastructure in municipalities. KLIS is operated in accord with many legislations concerning geospatial information establishment and land use. For instance, the 「National Spatial Data Infrastructure Act」 stipulates the production, utilization and distribution of geospatial information as well as national geospatial information infrastructure. The 「Land Survey and Waterway Service and Cadastral Act」 defines cadastral survey, cadastral administration and management. The 「Act on Planning and Utilization of the National Territory」 covers various types of land use zoning and urban planning. The 「Restitution of Development Gains Act」 defines the restitution of development gains. 「The Act on Special Cases concerning the Acquisition of Lands for Public Use and the compensation for their Loss」 regulates individual land prices and the 「Real Estate Brokerage Act」 are related with sound fostering of real estate agency and the duties, and 「The Aliens Landownership Law」 covers foreigner's land acquisition.

KLIS is divided into three elements: cadastral administration, land use, and property rights. When KLIS was founded in Korea, there were three different laws – the Cadastral Act, the Act on the Utilization and Management of the National Territory, and the Real Estate Registration Act. Also, there were three different Ministries in charge of land management, the Ministry of Government Administration and Home Affairs (MOGAHA), the Ministry of Construction and Transport (MOCT), and the National Court Administration. Cooperation among these three elements was essential for the operation of KLIS.

While the close association among these three elements was required in KLIS, it was difficult in reality since computerization was conducted independently by various divisions in such ways as PBLIS, LMIS, and computerized registration. Hence, to associate and integrate laws concerning these three elements was a major goal in conducting KLIS.

As a result, the cadastral division of the Ministry of Government Administration and Home Affairs was transferred to the Ministry of Construction and Transport in 2008. The registration data computerization system of the National Court Administration was also to be operated in association with KLIS. Due to the integration of the three elements related to land use, Korea could successfully establish the national spatial information infrastructure of KLIS nationwide within 10 years.

Currently, KLIS legislations achieved not only the association of three laws concerning land use but also association of administrative organizations that supervised the three elements and integrating them to some extent. Due to the complete integration of the affairs and systems, the information system is recognized as one of the most successful in Korea and abroad. One aspect to be specifically addressed with regard to legislations is that in application of information technology to existing land-related affairs, the procedures and methods should be rearranged in line with the information environment.

In addition, specific standards should be established with KLIS for various aspects including production of serial cadastral maps and land use zoning maps not defined in existing laws, documentation such as land use plan confirmation and publicly noticed individual land price confirmation, and handling procedures. Accordingly, KLIS designed institutional strategies to complement the existing legislations with regard to specific drawing production methods, and administrative procedures.

3.5. Public Relations and Education Strategies

KLIS was implemented by public officials in charge of land policies and affairs at the central and local governments. For the successful establishment of the land information system, sound mind, awareness, and passion among the officials in charge were deciding factors. As the duties of officials at local governments had been little related to informatization, they did not show much interest in information systems development and thus did not actively participate in the project. Furthermore, many of them viewed the informization project as undesirable since it caused extra duties in addition to existing work. Therefore, KLIS had to provide strategies of active promotion and education to increase awareness of land informatization for the officials.

One of the obstacles in establishing KLIS was the lack of awareness among officials in charge of cadastral administration and reluctance of being involved in a new project due

to extra work. Proceeding with the project was not possible unless the officials at local governments actively participated. Therefore, education and promotion strategies aimed at public officials were implemented as part of the KLIS project.

A series of workshops were held for all local government officials in the affected areas nationwide as a joint project of central government officials, related agencies' experts, and private companies' engineers. They took these opportunities to introduce the KLIS project, and explained why and how it should be conducted. Such efforts put into educating local governments' officials contributed to promoting awareness of informatization as well as their pride of KLIS.

In particular, they also developed a network of acquaintances with officials after KLIS workshops of the day ended. The focus was to persuade local governments' officials through heart-to-heart conversations and having meals together in consideration of Korean emotions. Such efforts motivated officials to willingly participate in additional duties of land use zoning map inspections and quality improvements.

4. Expected Effects of KLIS Introduction

The LMIS, PBLIS, and KLIS integrated the former two through the land and cadastral informatization project and all aimed to digitize the existing analog type of land policy establishment methods. Therefore, the KLIS project strived to improve the efficiency of land-related policies as well as the speed and accuracy of affairs for higher quality local government civil services. KLIS was expected to avoid duplication of similar tasks and improve work efficiency by integrating work related to land transfers. In addition, as the system pursued user-friendliness, it tried to shorten the process of land transfer services, integration of cadastral map databases would improve data integrity, the utilization of cadastral map databases would be expanded, and general local government civil services would also be improved by saving transportation fees and waiting times through issuing civil documents online. Once KLIS was established, existing real estate systems related to cadastre and land would be linked and there would be no need to enter the same data repeatedly in different systems such as LIMS and PBLIS when there were cadastral divisions or changes.

Since cadastral and land regulation data sets were integrated into one database, they established the foundation for the government, local governments, and private sectors to all utilize the data in GIS-based informtization projects. Cadastre-related civil documents such as certified copies of cadastral register and land-related civil services such as land use plan confirmation become available online or in a remote area through the integrated civil service windows, local government civil service would be improved.

In addition, the real time renewal system for changes in land such as division and mergers was established by the Ministry of Government Administration and Home Affairs, and the Ministry of Construction and Transportation would be able to analyze various types of geospatial information related to land use. Accordingly, it was able to establish streamlined land policies including measures for regulation of real estate speculation, shorten the work process through the computerized land-related administrative systems, and improve productivity of land administration. To sum up,

① KLIS is expected to contribute to cost-savings and better reliability of administration through the efficient and prompt handling of administrative affairs, as land-related services of local governments were computerized.

② Since various types of land-related information became available through the network, it was possible to search and refer to necessary data, which would contribute to reasonable decision-making.

③ Thematic map making on land that had been outsourced was processed internally, and would bring great cost-savings.

④ Duplication of data production and repeated investment was prevented and thus costs would be reduced.

⑤ While high-level organizations such as city, province, and ministry of construction and transportation were able to comprehensively manage land-related statistics collected through si/gun/gu districts and utilize it in land policies, local governments could computerize the statistical tasks, which would improve efficiency.

⑥ Local government civil services increased time and efficiency in issuing civil documents, and civil service procedures were simplified due to the computer network. In addition, the necessary attachments were reduced and accurate, easy-to-understand civil information would be available.

As for additional effects of KLIS, it became possible to issue or read land-related civil documents nationwide such as land-use plan confirmations and publicly noticed land price confirmations through the national land management information system network through the internet and kiosks in public areas, thus improving civil administrative services. It is also expected that geospatial data including cadastral map, topographic map, and thematic map would be available for other informatization projects such as urban planning, road management, facility management, new address management as the spatial information infrastructure is established for local governments.

Chapter 3

History and Major Contents of KLIS

1. Major Contents of KLIS

2. KLIS Building History

History and Major Contents of KLIS

1. Major Contents of KLIS

1.1. Institutional Improvements for the Building of the Land Information System

Establishment and utilization of KLIS aims to establish land policies promptly and accurately by introducing information technology, efficiently implement land-related administrative affairs, and enhance the quality of local government civil services. To this end, it is necessary to establish the legal foundation for KLIS and to adjust existing land-related analog work methods and procedures to the new information-based working environment. Land-related institutions that need to be rearranged with regard to KLIS are related mainly to land information production, management, utilization, and distribution.

Land information is produced in the process of using and managing land lots. At the time of KLIS establishment, legislations concerning land use included 「the Act on Comprehensive Plans for Construction in the National Territory」, 「the Act on the Utilization and Management of the National Territory」, and the Urban Planning Act, which addressed national land and urban plans, land use zoning and designating. In addition, administrative affairs related to land management included land transaction management, development profits collecting management, management of real-estate broker agencies, management of publicly notified individual land prices, and foreigner-owned land management. These are based on 「the Act on the Utilization and Management of the National Territory」, 「the Restitution of Development Gains Act, Real Estate Brokerage Act」, the 「Public Notice of Values and Appraisal of Real Estate Act」, and the 「The Aliens Landownership Law」.

In production and management of land information, some information systems have been established and utilized, but most focused on attribute information such as statistics and ledgers. Existing attribute-centered information maps on land involved no standard for inter-system linkage and data sharing. Therefore, it was difficult to link data sets of information maps on land and to conduct significant analysis in terms of policies. Besides, such existing information systems would manage land information manually, which involved such problems as data duplication and cadastral discrepancies of the same items among information systems. Although information maps on land have been used for speculation-controlling policies, but it is difficult to make them in a timely manner due to the inaccuracy of land information and extended times for data collection. In addition, such information was distributed through offline methods until it started to be used for land-related administrative affairs and policies of the central and local governments, making it difficult to establish timely land policies.

To solve these land information problems, KLIS addressed the need to establish a national network of KLIS information systems. Thus, a standardized data model and a database had to be established on the proper institutional foundation. To this end, various institutional measures were initiated to secure consistency of geospatial data as well as to standardize land-related ledger forms.

1.2. Database Upgrades for KLIS Establishment

For basic data for the establishment of KLIS, data sets produced, utilized, and managed by the central and local governments for land-related affairs include various types of applications (reports), ledgers, public reports, notices, reports with letters and figures. They are divided to attribute data and drawings such as national land use plans, urban plans, and current land price maps. Since this land-related data was produced, utilized, and managed manually, it was necessary to digitalize it for the new information-based environment of KLIS database.

Existing land-related attribute data involved problems such as different forms of the same content depending on the divisions, duplication of ledgers, and discrepancy of items among ledgers. It was unable to properly maintain and renew land-related data in a timely manner with analog management. Land-related geospatial data included topographic map, cadastral maps (forestry), land use zoning maps, and cadastral maps matched with the topographic maps. Since KLIS had to establish a database of such geospatial data, each geospatial data set involved many problems.

In time, a digital topographic map was a digital version of a topographic map on paper, and thus it did not indicate the topological structure but contained an excessive amount

of information. Therefore, it was necessary to rearrange data sets by converting them into topological data and removing unnecessary layers to be utilized in the KLIS database. Since cadastral maps had no unified coordinate system and the reference point and scale of cadastral coordinates were different depending on the regions, they involved serious problems of cadastral discrepancy. A land use zoning map had no standard for production, and only topographic maps were produced even though the boundary lines of land use zoning maps had to be indicated on the designated drawings. Therefore, it was difficult to determine if the regulations of land use were properly complied with regarding individual lots of land. Besides, cadastral maps matched with the topographic map involved problems of cadastral discrepancy with regard to the configuration and cadastral features even without clear production instructions.

To solve these problems, it was necessary to standardize land-related data and establish the KLIS database with a combination of register and spatial data sets. To rearrange ledger data sets, regulations concerning land ledger preparation, utilization, and management were modified accordingly. Duplicated or similar items of ledgers such as civil documents were also revised and combined. Standardization of geospatial data was conducted for data sharing. As for digital topographic maps, the data model was newly designed for topological structures and spatial relations among them.

For cadastral maps, existing types of map sheets were produced as series data sets for combination of Land Register information and geospatial data. Land use zoning maps were produced on the basis of topographic maps and serial cadastral maps, and constant renewal became possible. For cadastral maps matched with the topographic maps, serial cadastral maps were combined with digital topographic maps for the NGIS project, and the standards for production were released separately.

1.3. Establishment of a Geospatial Database

KLIS geospatial database consisted of geospatial data, attribute data, various types of legal data, and meta-data. A geospatial database is to be established to share various types of information through one network. The database technology for data sharing adopted object-oriented database technology because of the outstanding data modelling capacity, work analysis, and database design. To share geospatial data, such international standards as ISO/TC211 standards for geospatial information, the OGC standard for open geospatial information, and standard for geospatial data transmission (SDTS) must be followed.

For the KLIS database design, OMT (Object Modeling Technique), adopted at ISO/TC211, was used as the data model to share geospatial data, attribute data, and legal data. The major geospatial data sets contained cadastral control points, cadastral information,

edited cadastral maps, administrative area boundaries, true elevation, digital topographic maps of roads, railroads, major buildings, and hydrospheres, which were all set and extracted as the framework data. Thematic maps such as land use zoning maps were established based on serial cadastral maps. An Attribute database including land registers was established in utilization of RDBMS in compliance with the standards for data models and content.

As part of the KLIS project, the Ministry of Construction and Transport conducted LMIS, whose pilot product was for Namgu, Daegu City, in 1998. After that, major LMIS projects gradually expanded nationwide. Details of the LMIS expansion project were decided by relevant local governments in consideration of the scale of investments for LMIS. Whether local governments wanted to participate in a way of matching funds was also considered in project expansion. By 2005, it was expanded to all local governments nationwide.

Since the early 2000's, the integration of LMIS of the Ministry of Construction and Transport and PBLIS of the Ministry of Government Administration and Home Affairs and the problem of database duplication and maintenance were continually discussed. Accordingly, the integration plan of LMIS and PBLIS was established, and integration was eventually initiated in 2005. Thereafter, the Ministry of Construction and Transport and Ministry of Government Administration and Home Affairs divided the responsibilities in integrating LMIS and PBLIS and establishing the KLIS database.

Table 3-1 | Progress of KLIS Project (LMIS)

Steps	Year	Target Regions
Pilot Project	1998	Namgu, Daegu City
1st Expansion	1999	12 si/gun/gu including Gangnamgu, Seoul
2nd Expansion	2000	4 metropolitan cities(Seoul, Busan, Jeonbuk, Jeju), 56 city, county, borough
3rd Expansion	2001	5 metropolitan cities and provinces (Daegu, Gwangju, Daejeon, Jeonnam, Gyeongnam), 58 city, county, borough
4th Expansion	2002	3 metropolitan cities, 32 city, county, borough
5th Expansion	2003	3 metropolitan cities, 42 city, county, borough
6th Expansion	2004	1 metropolitan city, 31 city, county, borough

Source: MOLIT, 2013.

1.4. System Design and Development

For KLIS system establishment, metropolitan cities and the Ministry of Land, Infrastructure, and Transport were united with the servers in si/gun/gu local governments. When computer equipment in cities, counties, boroughs were utilized, a GIS Tool called Gothic was installed at the 2nd step servers of city, county, borough. When ZEUS was selected as the GIS Tool, the ZEUS program also had to be installed separately. For middleware, proper programs corresponding to the selected GIS tool had to be installed.

Si/gun/gu computer equipment consisted of 1st step and 2nd step servers. KLIS connected the cadastral administration database and programs of the 1st step server. When the computer equipment of city, county, borough was utilized as a server, the proper programs and Gothic Tool had to be installed at the 2nd server of si/gun/gu for operation of the measurement results recording system. When ZEUS was selected as the GIS Tool for KLIS, the ZEUS Tool had to be installed.

When Gothic was selected, for example, there was no need for additional installation since the existing GIS Tool could continue to be used. The KLIS DB was installed on the existing architectural administration database with GIS engines and server programs newly installed accordingly. Individual cadastral maps of PBLIS and MLIS series/edited drawings had to be converted for the KLIS DB.

When a LMIS server was utilized as the KLIS server, the 2nd step server of the si/gun/gu had to contain the server program and Gothic Tool for operation of the measurement results recording system. Since the KLIS server already contained the GIS engine and S/W, there was no need for additional S/W. When a GIS engine was to be replaced with another tool, however, the GIS engine had to be installed with the corresponding middleware. Additionally, the database and server programs had to be converted for the KLIS server schema (existing individual cadastral data of PBLIS converted to the KLIS DB).

1.5. Foundation of Operation and Management System

KLIS was conducted in cooperation between the Ministry of Land, Infrastructure, and Transport and the Ministry of Government Administration and Home Affairs. The two parties established the operation and management system of KLIS in a way that improved the functions of LMIS and PBLIS respectively. For LMIS of KLIS, the Korea Research Institute For Human Settlements participated as the entrusted research center in the early stage, but the Ministry of Construction and Transportation and LH Corporation took the responsibility after KLIS stabilized. Thereafter, PBLIS was conducted mainly by the Ministry of Government Administration and Home Affairs and Korea Cadastral Survey Corporation until the cadastral division of the Ministry of Government Administration and

Home Affairs was integrated into the Ministry of Land, Infrastructure and Transport in 2008 when KLIS started to be operated mainly by the Ministry of Land, Infrastructure, and Transport.

1.6. Improvement of Legal Institution

Legal institutions were improved in various areas for the establishment and operation of KLIS. For example, guidelines for land management information systems, regulations concerning establishment and operation of land-related comprehensive information networks, and guidelines for drawing of district and zone topographic maps were newly stipulated to comply with LMIS establishment. For the cadastral map computerization project and PBLIS, the guideline for cadastral map computerization projects was specified as reference. In addition, after LMIS and PBLIS were integrated into the KLIS project, the regulations for Korea Land Information system were stipulated, and regulations concerning land use zoning and operation were also newly released to be complied with in KLIS operations.

1.7. Promotion and Education Activity

Due to continuous education and promotion of LMIS for public officials in cadastral divisions, the awareness of KLIS among the related officials greatly improved. These efforts continued for officials to actively participate and be proud of KLIS.

2. KLIS Building History

2.1. Cadastral and Land Register Computerization Projects

2.1.1. Land Register Computerization

Land Register computerization aimed to obtain information on land properties accurately and promptly. This objective was to prevent real estate speculation, and secure basic data for policy-making in an effort to stabilize land prices. As part of the first national administrative computer network project, land register computerization was promoted and the online service was initiated nationwide in April, 1990, which drastically improved local government civil services.

Specifically, the land register data of 34 million lots of land was computerized nationwide, and then the resident registration data of 43 million individuals at the Ministry of Government Administration and Home Affairs and publically announced land price data of 26 million lots of land at the Ministry of Construction and Transportation were integrated into the「National Land Information Center」to be newly established and operated.

The specific goal of Land Register computerization was to establish the foundation for real estate real-name systems, stabilize land prices, and root out real estate speculation. Populations in large cities increased in the 1960's and 1970's as a result of industrialization and urbanization, and demands for land increased in metropolitan cities and urban areas. In the process, real estate speculation including drastic land price increases were expected. However, there was no accurate and holistic data for land properties.

In particular, it was difficult to control real estate speculation as there was no standard for Land and Forest Areas Registers, and they were not linked to the resident registration information system. As a result, the land and forest areas register computerization was initiated to establish and execute effective land policies as well as control real estate speculation. In the early stages, land and forest areas register data input and basic file formats were unified in 10 city, county and borough units where real estate speculation was expected.

The cadastral computerization project led by the government aimed to streamline land management and accumulate accurate land-related information for data sharing, scientific handling of administrative affairs, and land-related civil service regardless of regions.

Additionally, Land Register computerization aimed to establish the foundation of the real-name property ownership system, stabilize land prices, and prevent real estate speculation by establishing cadastral computerization and comprehensive land-related information network of 35 million lots of land around the country.

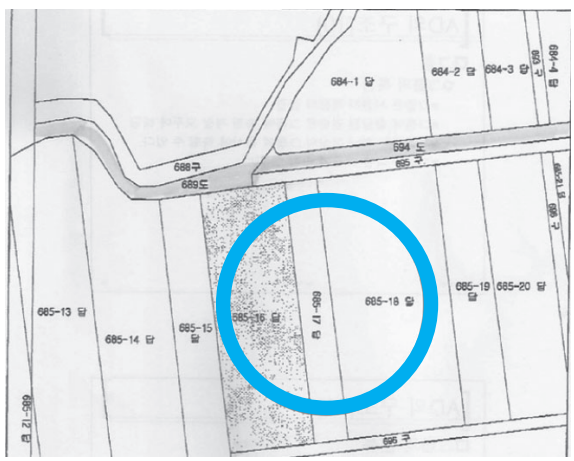
2.1.2. Cadastral Map Computerization

Cadastral map computerization aimed to streamline land management affairs and improve civil services through the land register-centered information system separated from cadastral maps. Cadastral information is in direct relation to national property rights and utilized in various administrative duties of both the central and local governments. In addition, various thematic maps were produced based on cadastral maps. A cadastral map should be attached to many civil documents in principle, and is important to secure accuracy of cadastral maps and computerize cadastral map data.

While land registry computerization was completed, cadastral maps were not. Therefore, to streamline local government civil services such as reviewing and issuing cadastral maps, which required a lot of human resources and time, computerization of cadastral maps was essential.

For cadastral map computerization, the land register-centered cadastral information system separate from that of drawings would cause insufficiency in land management work, and cadastral map computerization would integrate ledgers and drawings. As part of the first national GIS project, cadastral map computerization was initiated and the database of 720,000 cadastral and forestry maps was established from 1998 to 2000 for the cadastral map-centered Cadastral Information system. The objective of cadastral map computerization was to streamline cadastral work and establish a cadastral map database as part of the geospatial information infrastructure, which would facilitate geospatial information utilization. In time, the first national GIS project made it easy to procure funds for cadastral map computerization, and GIS technology as well was quite advanced enough to computerize cadastral maps.

Figure 3-1 | A Sheet of Cadastral Map Example



Source: Cadastral Map in Korea.

2.1.3. Parcel Based Land Information System (PBLIS)

PBLIS is a project to effectively save, manage, and process various types of attribute information connected to drawings of buildings and urban planning, especially individual lots of land. It strived to make a database of numerical files of cadastral maps, computerize and automate the procedures of information searching and management, and provide the government and public with land-related information promptly and comprehensively.

The major features of PBLIS are as follows: the result of the cadastral map computerization project with numerical information of existing cadastral maps accumulated and was

to be integrated with Land Registers. In other words, the diagram and text information was to be integrated into one system. The objective of PBLIS was to meet increasing and urgent demands for numerical data of cadastral maps in various areas that demanded land information. PBLIS was to integrate cadastral map information and attribute information accumulated in various systems.

In time, the PBLIS project included the establishment of the geospatial information system to facilitate the use of cadastral maps as specified in the basic plan of the first national GIS project. The project was implemented from 1996 to 2002 over 254 cities, counties and borough units.

2.2. Completion of LMIS

The necessity of LMIS can be seen in a variety of land-related aspects such as land ownership, transaction, use regulation, development, management, and policy. The majority of land-related affairs are handled by the entrusted local government. There were 80 laws concerning land use, and there were more than 170 land use zoning maps. Land regulations were so complicated that even public officials of local governments in charge of issuing civil documents did not understand all the details and limitations on land use. The types and content of geospatial data regarding land management were also varied including attribute data such as public reports and ledgers, topographic maps, cadastral maps, and urban plans. Most land-related data was handled manually, which caused many problems such as data duplication, typing errors, and a lack of consistency. Also, it took a long time to check related ledgers and have land-related civil documents issued, which inconvenienced applicants while increasing workloads of officials before the project even started.

Therefore, it was urgent to develop information systems to provide civilians with accurate land information promptly, improve work productivity of officials, prevent budgets from being wasted at each local government out of duplicated development of information systems, and provide information on various land use regulations systematically.

Accordingly, efforts were put into developing a comprehensive land management information system to gather information for streamlined land policy making, integrate and manage geospatial, attribute, and legal data systematically, and connect land-related affairs specified in laws organically.

As for major concerns of LMIS, the land management information system establishes various land use zoning maps and connects them with attribute and legal information based on the edited cadastral maps, which were a version of serial cadastral maps modified in line with topographic map.

Figure 3-2 | Serial Cadastral Map Example

Source: http://gris.gg.go.kr/.

2.3. KLIS that Integrates PBLIS and LMIS

The land management information system (LMIS) of the Ministry of Construction and Transport and Parcel Based Land Information System (PBLIS) of the Ministry of Government Administration and Home Affairs had issues of wasting budgets due to the duplication of data and utilization of computer equipment. To address this matter, in December 2001, the Office for Government Policy Coordination held a meeting on the integration of LMIS and PBLIS, direction of integration, and basic structure of the system in the presence of representatives from the Ministry of Government Administration and Home Affairs, Ministry of Construction and Transport, Board of Audit and Inspection, ETRI (Electronics and Telecommunications Research Institute), the Korea Cadastral Survey Corporation, and the Korea Research Institute For Human Settlements. As a result, they agreed to develop the KLIS, which performed all the functions of LMIS and PBLIS.

The integration system would be designed to be of a 3-Tier System, handling civil services real-time, and specify the boundaries of work to be handled so that it would not overstep into certain areas of expertise of the Ministry of Government Administration and Home Affairs and the Ministry of Construction and Transport, which were the cadastral management and land-related administration respectively. The Ministry of Government Administration and Home Affairs and Ministry of Construction and Transport would equally split the expenses for the integration system development.

The existing system continued to be used until the new integrated system could be stabilized. To avoid duplications of investment, additional budget was not put into the existing system except what was already secured. The two divisions would cooperatively manage the new integrated system, and a joint project team was formed to address specific plans of the integrated development.

During two meetings for the joint project team, the development subcommittee was formed and operation methods were decided for the technical development of the Korea Land Information System. The development subcommittee consisted of representatives from the Ministry of Government Administration and Home Affairs, Ministry of Construction and Transport, the Korea Cadastral Survey Corporation, the Korea Research Institute For Human Settlements, SK C&C, the Ssangyong Information and Communication, and Electronics and Telecommunications Research Institute, all of which participated in mutual system analysis, confirmation of the development scope, budget estimations, organization of the promotion system, and preparation of the project plans. The development subcommittee held seven meetings, where they agreed with the general implementation plan that covered mutual system analysis, confirmation of the development scope, plans for system linkage, technical tests, budget estimations, and organization of the promotion system.

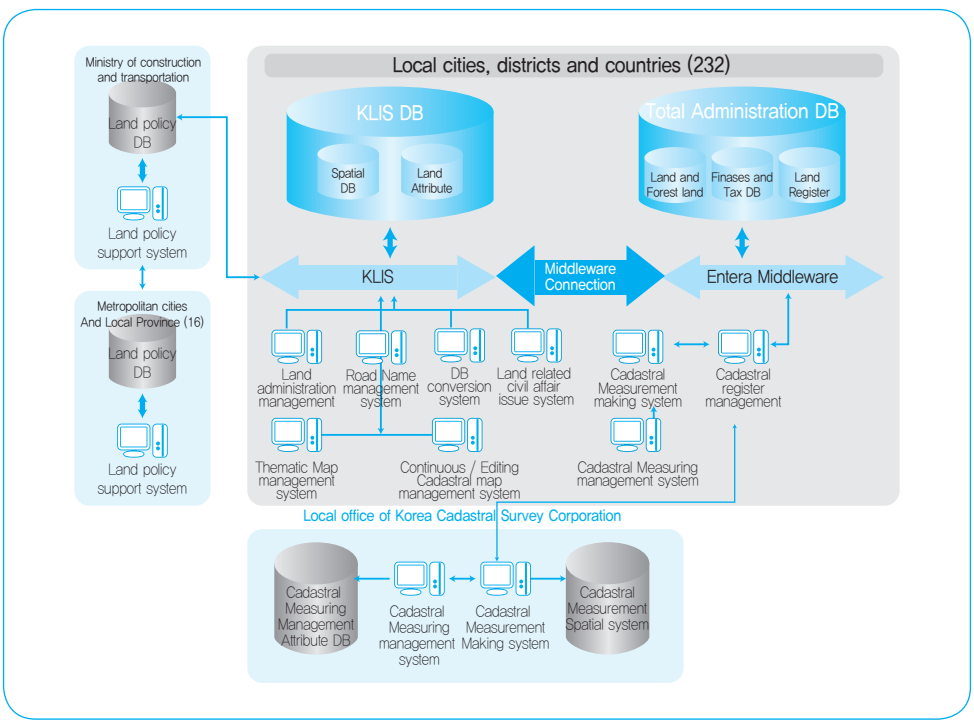
For major agreements, the electronic resources owned by the local governments such as Local Government's Comprehensive Administration Information Systems would be shared to form and operate KLIS, the data of Local Government's Comprehensive Administration Information Systems and KLIS would be shared through the connection of middleware, and other systems such as the G4C would be also used in a similar manner. The Local Government's Comprehensive Administration Information Systems would be utilized for cadastral management, document issuing services, user authorization management, and other civil services. For property rights transfer data, the application system at the Local Government's Comprehensive Administration Information Systems (cadastral administration) would continue to be used while standardization and reorganization of related systems would be implemented to share data and develop the optimal integration system. In March 2003, the Ministry of Government Administration and Home Affairs and the Ministry of Construction and Transport concluded the agreement that specified the budget and promotion system to develop the Korea Land Information System, and moved forward with the KLIS project.

KLIS was promoted for 14 months from June 2003 to August 2004. The development expenses were 3,361 million won, which was covered equally by the Ministry of Government Administration and Home Affairs and the Ministry of Construction and Transport. The land management information system and PBLIS (Parcel Based Land Information System) were integrated and redeveloped. A program to handle basic affairs such as road naming

and building number designation was developed accordingly. For system realization, the 3-Tiered client/server structure was adopted, and the GIS engine was designed in a way that all of GOTHIC, SDE, and ZEUS systems that were used for PBLIS and LMIS would be compatible. The open system structure made it easy to expand the system and develop upgrades. Once the cadastral information was updated, the related data (diagram-attribute) was also processed simultaneously. This way, the land-related aspects of PBLIS and cadastral administration system were integrated.

Civil service materials such as cadastral/forest maps, register of boundary point coordinates, land-related administration services including confirmation documents of land use planning, and publicly noticed individual land price management were integrated to the civil administration system, making it more efficient to issue civil documents, process statistics, and utilize computerized resources. For the same purpose, the Local Government's Comprehensive Administration Information Systems were shared.

Figure 3-3 | Structure of Integrated KLIS System



Source: Hyong Bok Kim, Dongsoo Ha, Hyung Tae Kim, 2008, GSDI, TS 12.3 - The Current Status and Development Direction of KLIS.

The system coordination of KLIS, si/gun/gu systems and KLIS were connected to Entera and Corba. The diagrams of the cadastral register management system were connected to CORBA middleware and attributes to ENTERA middleware respectively. The land administration system was realized in application of CORBA middleware while ENTERA middleware, connected to CORBA, was integrated for data inquiries at si/gun/gu units. DLL was provided for connections between KLIS and other systems.

The cadastral register management system was based on the integrated information of attribute and topography. Related lots of land were searched in reference to the designated diagrams, and only when unavoidable, attributes were referred to. In addition, the streamlined sorting system of modifications was developed, and a database was designed for the diagram history of parcels or zones to make it easy to manage the history and refer to error messages of raw data.

In the process of integrating the existing functions of PBLIS and LMIS and redeveloping aspects of KLIS, newly developed and complemented functions were discovered. The aspects to be redeveloped were reflected in the land-related civil document issuing system in integration of the existing functions of PBLIS and LMIS. For functions developed in existing the LMIS, the serial/edited cadastral map management system was linked with individual cadastral data in real time. The PBLIS cadastral register management system of the 2-Tier structure was upgraded to the KLIS 3-Tier structure. In addition, the existing cadastral survey results recording system of PBLIS was linked to the cadastral register management system of KLIS. The KLIS database conversion management system was upgraded to make it easier to transform the structure of data to KLIS.

For aspects to be newly developed for KLIS operation, the middleware of Gothic, a GIS engine, was developed to adjust existing PBLIS developed in C/S environment to the 3-Tier structure of KLIS. To integrate databases of road names of different structures nationwide, a new road name and building number management system was developed.

For complementary aspects of KLIS, an RPC module was designed for the cadastral administration system of the 1st step server for linkage to si/gun/gu administrative information systems.

Chapter 4

Challenge and Achievements of KLIS

1. Problems in the Process of KLIS Establishment
2. Problem-solving in KLIS Establishment
3. Achievement of KLIS
4. Limitations of KLIS

Challenge and Achievements of KLIS

1. Problems in the Process of KLIS Establishment

1.1. Conflicts between Governmental Offices on KLIS Integration

KLIS is an information system that integrates LMIS of the Ministry of Construction and Transport and PBLIS of the Ministry of Government Administration and Home Affairs. PBLIS is an information system handling cadastral survey and cadastral administration affairs while LMIS is geospatial information system for land-related administration affairs such as land use zoning. These two systems had different objects of informatization and scope of utilization. As the problem of duplicated management of cadastral maps and duplicated use of servers continued, the Board of Audit and Inspection advised integration of the PBLIS and LMIS into one system.

The Office for Government Policy Coordination coordinated the information system integration between the Ministry of Construction and Transport and the Ministry of Government Administration and Home Affairs. At first, the two divisions went through conflicts regarding the structure, function, and scope of the integrated system. In particular, the fact that where the architecture of geospatial information system was located would decide the leading organization of the integrated system caused serious conflicts between the departments. The conflict between the two KLIS project operators delayed the progress of integrated system establishment. However, they continued to discuss the effectiveness of the integrated system and civil services of KLIS rather than the weight in oversight over PBLIS and LMIS.

1.2. Difficulty in Serial Cadastral Database Establishment

One of the biggest problems in KLIS establishment was the quality of paper cadastral maps. To establish the KLIS DB, it was necessary to digitalize paper cadastral maps produced in the 1910's and transform digital cadastral maps to serial cadastral maps. Sheets of cadastral maps, however, involved some problems: first, maps were produced in utilization of primitive measurement skills in the 1910's, where the cadastral control points were different from those of today and thus locations in cadastral maps were inaccurate.

Second, more than 100 years had passed since the production of paper cadastral maps, the wear and tear, and damage was so serious that the errors of cadastral maps were significant. As a result, when serial cadastral maps were combined, the boundary of individual lots of land involved cadastral discrepancies. In addition, the serial cadastral map combined with digitized sheets of cadastral maps did not correspond to digital topographic maps that indicated objects such as roads, buildings, and rivers, which also caused problems in producing serial cadastral maps reflecting configurations.

Third, the scales of cadastral maps and forest land maps were significantly different, which made it difficult to combine related cadastral maps and forest land maps. In the 1910's, the six levels of scale from 1/500, 1/600, 1/1200, 1/2400, 1/3000, to 1/6000 were used for cadastral maps and forest land maps. Therefore, it was very difficult to combine cadastral maps of different scales.

When serial cadastral maps were produced, forest land maps contained many errors while digital cadastral maps almost corresponded to the actual configuration. However, there was no way to make up for such errors of forest land maps. It was concluded, therefore, for forest land maps, serial cadastral maps had to be produced with errors remaining.

Fourth, the loss of cadastral control points caused cadastral discrepancies. After national liberation, followed by the Korean War, many cadastral triangulation points were lost. Temporary points were installed, but they caused major errors. When the cadastral system was incomplete, it was difficult to issue the confirmation of land use plans, which greatly affected the exercise of property rights. During this time, 78 individual laws concerning cadastral register stipulated a number of land use zones. As such land use zoning was indicated on urban plan maps, the procedures of urban planning and land use zoning were different among laws. For example, the Act on the Utilization and Management of the National Territory noticed the configuration and cadastral information on an urban plan drawing on a scale of 1/5000 while it noticed urban plans on a scale of 1/500~1/1200. Land use zoning and the way of noticing land use zoning were different depending on individual laws.

Therefore, methods to reflect cadastral information in serial drawings was not decided and thus production of serial drawings was delayed. Furthermore, the way of determining the lines of land use zoning on serial cadastral maps was also different depending on the local government. Therefore, it was of urgent to standardize the way of producing serial cadastral maps and land use zoning maps. There were situations where a local government would not specify land use zoning when permitting the project of certain land use zoning. In this case, when the zone turned out to be an area where development should not be allowed after the construction had already started upon approval from the local government, the project had to stop even if hundreds of millions had already been invested. Therefore, uninformed permissions would lead to serious civil complaints and claims for local governments.

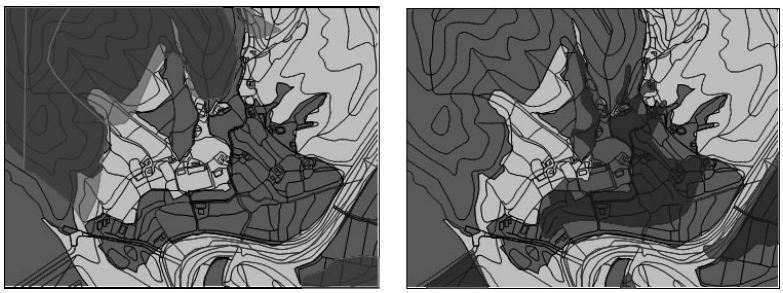
1.3. Quality of Land Use Zoning Maps and Attribute DB

Land use zoning in confirmation documents of land use planning were different among related laws and zone designation methods, resulting in many problems such as vague boundaries of administrative areas. To improve the quality of land use zoning maps, proper measures need to be taken, such as, when a type-2 aesthetic area is designated, the point 50m/100m from the road would be designated. In existing paper drawings, this parcel may seem to be in contact with the road. In other words, when the aesthetic area is visually observed on a paper drawing, it may seem to be in contact with the road, but in the information system, the boundary of the parcel would appear to overlap. There is a significant difference between contact and overlap in terms of land price and surface rights. Therefore, it is a challenge to accurately understand the attribute information on a land use zoning map.

For urban planning, when a protection zone of military installations is designated, zone A is a type-2 aesthetic area and a protection zone of military installations simultaneously. These two are exclusive to one another in terms of land use zoning of national land. The Act on the Utilization and Management of the National Territory specifies land use zoning as exclusive while urban plan facilities designate two parcels not as exclusive but as fragmentary and thus the two zones could not overlap. In land use regulation, the smallest may be regulated with three sections of land use zoning, but an area subject to multiple regulations may involve more than 20 sections of land use zoning.

As one parcel is subject to more than 20 land use zoning regulations, some may judge that this parcel is in contact while others judge that it overlaps. In this case, geospatial operations may involve a difference in precision, which may change the order of land use zoning of the parcels.

Figure 4-1 | Discrepancy Example of Zoning Map



Source: MOCT, 2001, LMIS Project Plan.

1.4. Lack of Legal Institution for Geospatial Data Sharing

In land administrations of a country, the structure of legislation may be different, but the shape of a land lot, such as the form of a parcel would be similar. Therefore, even if the form of a parcel is somewhat different, the same land geospatial drawing database may be utilized in other areas than land administration. For publicly announced land prices, even if the land shape in a serial cadastral map is not identical with that of the individual lot of land, the data may be utilized for land price evaluation.

During the KLIS establishment, the appraisal system of land price was introduced, and local governments implemented it. They produced serial cadastral maps for land price investigation, but the serial drawings were different. The publicly announced land price maps of A si/gun/gu was different from B si/gun/gu. In this case, it was unable to share land price information and use in civil services as the serial cadastral maps were different among local governments. Therefore, there had to be a standard concept of serial cadastral maps that could be commonly applied for various purposes of land administration, but there was no institutional foundation for it.

2. Problem-solving in KLIS Establishment

2.1. Conflicting Interests between Governmental Offices

For the establishment of KLIS, the integrated system of PBLIS and LMIS and the conflicting interests between the Ministry of Construction and Transport and the Ministry of Government Administration and Home Affairs had to be addressed through continuous

consultation between the two agencies. Although the effects of KLIS. PBLIS and LMIS were national information systems since the early stages, the scope and objects of utilization were different.

PBLIS was a system to handle cadastral survey and administration, and thus the major users were officials at local governments and the system architecture and model of the PBLIS was designed for them. In contrast, LMIS designed the architecture in consideration of related experts, private companies, and the public as well as public officials in charge of land use services. Hence, the architecture of PBLIS was designed as 2-Tier while LMIS was 3-Tier.

The differences between the two systems affected the functions of the integrated system. The system architecture of LMIS proved to be quite effective in terms of performance of the future geospatial information system. As a result of disputes between the two divisions, the KLIS integrated system adopted the 3-Tier structure to reflect the system architecture of the Ministry of Construction and Transport, and solved the problems of conflicting interests.

2.2. Problem-solving in Serial Cadastral Map DB Establishment

To find a solution to the problem of cadastral discrepancies of serial cadastral maps, the Ministry of Construction and Transport as the project operator, local governments, the Korea Research Institute for Human Settlements as the research center, and private companies held a series of meetings and discussions. It was concluded that for the appropriateness and quality of serial cadastral maps, the public officials in charge at local governments should address cadastral discrepancies. The central government presented a solution regarding cadastral discrepancies of serial cadastral maps, then the local governments were to settle the problem according to guidelines set by the central government.

The central government collected various cases of cadastral discrepancies among local governments and presented instructions on how to combine serial cadastral maps. By this guideline for serial cadastral map production, the local governments produced standardized serial cadastral maps. Due to this, the serial cadastral map DB of KLIS was established, and the boundaries of land use zoning in various types of urban planning maps were decided in reference to such serial cadastral maps. As a result, it became possible to share the land use zoning map DB settling cadastral discrepancies.

2.3. Quality Improvement of Land Use Zoning Maps and Attribute DB

One of the biggest problems in land management affairs was that cadastral discrepancies of land use zoning often caused civil complaints. One of the greatest challenges was how to secure the quality of thematic maps including the accuracy of land use zoning maps.

In fact, existing land use zoning maps based on the topographical foundation were of cadastral discrepancies in contrast with serial cadastral maps. More specifically, cadastral discrepancies in divisions of reserve forest and semi-agricultural zones or cadastral discrepancies of agricultural development regions and semi-agricultural zones often caused civil complaints. For example, a restaurant was constructed in a semi-agricultural zone and gained approvals for building inspections, but later it turned out that the zone was an agricultural development region, it would be announced that the restaurant violated the related laws.

Therefore, a lot of time and effort was needed to secure quality of land use zoning maps and attribute DB in KLIS establishment and public officials, system operators, and DB architects made a lot of effort for this. For about 37 million parcels around the country, public officials in charge of parcel management issued civil documents only after they examined attribute information.

In the early stages, officials had to manually examine if the existing land use zoning corresponded to the paper land use zoning map. They thoroughly inspected every data set from the KLIS system if they were accurate. Only when the land use zoning from the system corresponded to that of paper drawings, it was officially registered to the KLIS system and related civil documents were issued. Otherwise, documents were not permitted to be issued. Once the inspection was completed, the online issuing service was available nationwide, but otherwise, it was not. In the latter case, merely opening services were available with the statement that the information could not be used in a legal procedure. For legal use, the applicant had to visit a si/gun office and receive confirmation of land use planning. This was also applied to the computerization of land registers to improve the quality of the computer database.

2.4. Settlement of Legal Problems by Indicating that Serial Cadastral Maps were not in Relation to Property Rights

Serial cadastral maps were essential in the LMIS project and the cadastral map computerization of PBLIS, and ultimately strived to measure the property rights of the nation. Therefore, it was not possible to exercise proper rights of individual lots of land based on serial cadastral maps because of the cadastral discrepancy.

In particular, when sheets of map, scale and scales of cadastral maps were all different, differences were found even between two adjacent villages. A series of meetings and discussions continued to solve this problem of discrepancy. Once the accurate location information of individual lots of land is secured through the cadastral reinvestigation project in the future, it will be possible to produce precise serial cadastral maps with no discrepancies. Since it was impossible to produce serial cadastral maps that indicated exact

boundary locations at the time of KLIS establishment, it was concluded that serial cadastral maps had to be produced, for the convenience of administrative services. For serial cadastral maps, the accuracy and legal authority of individual lots of land were not guaranteed until the cadastral reinvestigation was completed in the future.

3. Achievement of KLIS

3.1. Economic Feasibility of KLIS

The establishment of KLIS contributed to efficiency of the cadastral administration as it computerized the process and improved accuracy. It also made it possible to informatize land use affairs in various areas based on the serial cadastral map, and improved the quality of local government civil services regarding land use. Also, it made it possible to better understand the Development Restrictions affected by land use zoning in advance and promote various plans and development projects effectively. KLIS is evaluated as contributing to social and economic development in various ways such as expansion of social overhead capital, regional development, and urban planning.

3.1.1. Overview of the Effects of Korea Land Information System

KLIS was established under the direction of the Ministry of Construction and Transport and Ministry of Government Administration and Home Affairs, and as of 2013, it is operated by the Ministry of Land, Infrastructure and Transport and includes over 16 metropolitan cities and 232 smaller administrative units. This project is conducted by the Ministry of Land, Infrastructure, and Transport, but it is utilized mainly by local governments since the land-use related affairs are handled by them in application and operation of KLIS.

The KLIS project made it possible for the public to read and receive confirmations of land use planning online and refer to public notice individual land prices. Since the integration of KLIS in 2006, the number of perusing and issuing various civil documents through KLIS has increased every year. Since it became possible to read and issue civil documents on land prices and land use plans wherever and anywhere online, the quality of public administration services improved. The time of perusing and issuing civil documents also has been greatly reduced as there is no need to visit si/gun/gu offices but it is possible to read and issue civil documents online.

Before 2008, online issuing and perusing of confirmations of land use planning and referring to publicly noticed individual land prices increased, and after 2009 the number drastically increased except in 2012 when the number of perusing publicly noticed individual land prices greatly decreased.

Table 4-1 | Issuing and Perusing of Confirmations of Land Use Planning and Publicly Notified Individual Land Prices through KLIS

Class.	before '08	'09	'10	'11	'12
Online issuing of confirmations of land use planning (million)	0.026	-	-	-	1.31
Reading of confirmations of land use planning (million)	133.8	53.7	48.5	57.7	63.1
Reading of publicly noticed individual land price (million)	73.8	21.6	20.8	39.9	10.7

Source: MOLIT, 2013.

For quantitative evaluation of the contribution of KLIS to economic and social advancement, the benefits and cost analysis were conducted to compare the effects of KLIS with the expense of KLIS establishment. The expense of KLIS is estimated based on the scale of funds gathered by the central government and local governments for KLIS establishment. The effects of KLIS include all possible achievements. Of course, indirect effects and especially qualitative effects that were difficult to measure were excluded.

3.1.2. Expense of Korea Land Information System Establishment

KLIS is an integrated system of LMIS and PBLIS which were operated separately. Before 2006 when they were completely integrated into KLIS, the budget for information system establishment was procured by the Ministry of Construction and Transport and Ministry of Government Administration and Home Affairs individually.

LMIS was operated by matching funds and the central and local governments sharing the expenses. The Ministry of Construction and Transport which was the central government's entrusted office, procured the funds for geospatial information database establishment including serial cadastral maps and land use zoning while the local governments purchased computer equipment and GIS software for the LMIS operation. From 1998 to 2005, the Ministry of Construction and Transport invested about 120 billion won for LMIS while local governments contributed about 100 billion.

The Ministry of Government Administration and Home Affairs secured 100% of the central government's budget for the project of PBLIS. The Ministry of Government Administration and Home Affairs invested about 120 billion won into PBLIS until 2005. Since 2006, it spent about 40 billion for the operation and management of KLIS. In total, it has put about 380 billion won into KLIS.

Table 4-2 | Investment into KLIS

(Unit: billion won)

Class.		Before 2006	After 2006	Total
Central Government	KLIS LMIS PBLIS	- 220 (100 from local governments) 120	40 - -	
Local Governments	LMIS	100	40	
Total		340	40	380

Source: MOLIT, 2013.

3.1.3. Economic Feasibility of KLIS

Effects of KLIS include policy quality improvements of the central government, efficiency improvements of public officials in charge of administrative affairs, convenience of civilians using administrative services at local governments, and quality improvements of public services. Among these, measurable the effects of KLIS include work efficiency of public officials, convenience of civilians using administrative services at local governments, and quality improvement of public services.

Specifically regarding the quantitative effects of KLIS, the time and transportation expenses were reduced among public officials and civil service users at local governments. The expenses for issuing civil document were also reduced and processing times were reduced in civil service, such as the process of submitting opinions/objections on publicly announced land prices was shortened from 10 days to three minutes. The process of land transaction permission was shortened from 10 days to one day. While real estate agency work took 5 days in the past, it was shortened to one day after KLIS was established. The judgment of development impact fees took three days in the past but now it is handled immediately. Issuing confirmations of land use planning and estimations of publicly noticed individual land price took 15 minutes and 10 minutes in the past, but now they are issued immediately.

Table 4-3 | Evaluation of KLIS Effects

Before KLIS	After KLIS
Overloading civil documents Time and expense on the part of civil service users Lack of land-related legal knowledge	Civil documents reduced Remote issuing and real-time service Legal information available
Effects of KLIS	- Time/transportation expense saving effects - National expense saving as civil documents decreased - Civil service processing time shortened - Submission of opinions/objections on publicly announced land prices: 10 days to 3 minutes - Land transaction permission: 10 days to 1 day - Registration of a real estate agency: 5 days to 1 day Judgment of development impact fees: 3 days to immediately Issuing of confirmations of land use planning: 20 minutes to immediately Issuing of publicly noticed individual land prices: 20 minutes→ to immediately

Source: MOLIT, 2013.

The number of reading land use planning confirmations and publicly noticed individual land prices and the time-saving effects were 523.6 million in total and 1.3 trillion won respectively from 2006 to 2012 as shown in <Table 4-4>. The improved efficiency of cadastral administration affairs among public officials using KLIS resulted in an estimated expense-savings of about 47.25 billion in 2008, 53.4 billion in 2009, and 50.33 billion in 2010, 50 billion won per year on average.

Table 4-4 | Time-savings in Pursuing on the Confirmation of the Land Use Planning and Publicly Noticed Individual Land Prices

Reading/issuing	Before 2007	'08	'09	'10	'11	'12	Total
Total No. (million)	78.0	129.6	75.3	69.3	97.6	73.8	523.6
Saving per each (won)	2,296	2,067	2,468	2,767	2,685	2,999	-
Amount of saving (billion)	179.07	267.88	185.84	191.75	262.06	221.33	1307.93

Note 1. Time saving: 60 minutes per each issuing of civil documents (visiting 40 minutes+waiting 20 minutes).

Note 2. Expense savings: Applications per year*Expense-saving per each (in referent to GNI each year, statistics from Bank of Korea).

Source: Ministry of Land, Infrastructure and Transport, national spatial data center. 2013.

Table 4-5 | Effects of KLIS on Land Property Transfer Works

Class.		'08	'09	'10	-
Land transfer without measuring*	No. of applications	1,951,857	1,976,317	1,964,087	
	Cost-saving (won)	1,236	1,273	1,255	
	Sub total (billion won)	2.44	2.52	2.48	
Land transfer with measuring involved**	No. of applications	755,636	832,603	794,120	
	Cost-saving (won)	53,309	61,111	60,210	
	Sub total (billion won)	44.81	50.88	47.85	
Total (billion won)		47.25	53.40	50.33	

*Time saving: waiting time per application.

**Time saving: 24 hours per application.

Source: Ministry of Land, Infrastructure and Transport, national spatial data center. 2013.

The expense savings from using electronic documents at local governments after KLIS establishment was about 9 billion won per year after 2009, as shown in <Table 4-6>. In analysis of the expense-saving effects of KLIS, the expense was about 380 billion won while the benefits amounted to about 1 trillion 400 billion won. Thus, the expense to benefit ratio exceeded 3.0.

Table 4-6 | Administrative Expense Saving Effects of Document Computerization of KLIS

(Unit: billion won)

Class.	Before '09	'10	'11	'12	Total
Local governments (each)	23.2	23.2	23.0	22.9	
Electronic documents (type)	19.7	19.7	19.7	19.7	
Cost-saving	36.4	9.1	9.1	9.0	63.6

Electronic document: cadastral registers: 39 types, development impact fees 23 types, individual housing prices 52 types, real estate agency 20 types, Land transaction permissions 7 types, integrated civil documentation 19 types. 197 in total.

Source: Ministry of Land, Infrastructure and Transport, national spatial data center. 2013.

3.2. Quantitative Evaluation of KLIS

3.2.1. Quality Improvement of Land-related Data

For the database of Information Maps on the Land, one of the most important objectives was to secure accurate data for land-related policy-making for improvements to policy quality. Before KLIS was established, various regulations were applied to land use zoning. Without fully understanding such laws, there was likely to be errors in the process of permissions at local governments. For instance, a project already in progress after the permission on the land use and development from a local government may be judged as illegal land use zoning according to another law. In this case, the project on the zone should stop even if hundreds of millions of won had already been invested.

When a project stopped due to lack of understanding of regulations of land use specified in related laws or cadastral discrepancies of the land use zoning drawings and attributes, several civil complaints would be raised by the project operators, followed by claims for compensation. In view of such opportunity costs, the operation of KLIS can save an a significant amount of expense. Since these types of problems were common during this time, the KLIS project was initiated even without cost-benefit analysis and ROI analysis. When these quantitatively unmeasurable opportunity expenses are counted, the expenses saved by KLIS are astronomical.

In addition, KLIS improves work efficiency by integrating existing PBLIS and LMIS as well as use in application of SSO (Single Sign On). Integrated management of cadastral map DBs, data consistency and integrity, efficient online civil documentations, and public utilization of electronic resources are some of the major effects of KLIS.

3.2.2. Efficiency Improvement Effects of the Information System Integration

Before KLIS was developed, information on one parcel was divided to three systems. The owner's information (resident registration number, seat and area) was managed by a cadastral administration division, existing cadastral map information including location and configuration of individual cadastres by PBLIS, and serial drawings by LMIS respectively. This caused confusion among the users. KLIS, in contrast, integrated these databases and application systems, which solved duplication problems, improved data integrity, and provided the integrated access screen that required only a unified ID. As a result, the fundamental cause of confusion by operating three different systems was removed.

3.2.3. Integration of Land Transfer Work Processes

Before the system integration, three separate IDs were required for one land transfer. First, the applicant had to log on to the cadastral administration division and modify the parcel owner's information. Second, he/she had to log on to PBLIS and handle the diagram data of individual cadastres. Third, he/she had to log on to LMIS to modify the serial map and edited diagram data.

After the integration, however, it became possible to handle the land transfer process by accessing only one system. The applicant accesses with the KLIS user ID, completes the land transfer procedure for the individual cadastre, modifies the owner information after being connected to the cadastral administration system automatically, and then the result is reflected in the serial map so that the effect of work automation is maximized.

3.2.4. Civil Service Improvement

Existing PBLIS was of C/S structure that connected the server directly to the client. Therefore, it was dependent on the GIS engine, a polygon management tool. In this environment, remote issuing or inquiry would involve inconvenient procedures. Since those services were handled by another system separate from the LMIS server, real-time connections with individual cadastres and serial cadastral maps were unable to be carried out. As a result, it took a long time until a civil document could be issued with the land transfer result reflected on it. For civil documentation by means of integrated KLIS, in contrast, documents may be issued not only at the local government in the same manner but also through the remote online issuing service provided by an office of the metropolitan city or province in the case of approved parcels. The applicant may visit the website of the city or province and peruse the information. As individual cadastres of PBLIS and serial cadastral maps of LMIS are handled by one system, the land transfer is reflected real-time, which speeds up the civil documentation process.

Improvement effects stated above may be summarized as follows:

Individual cadastres/serial cadastral maps/edited cadastral maps are integrated into one database to secure data consistency and integrity of the individual/serial/edited cadastral maps. Also, it became possible to share information with related agencies in need for Cadastral Information, and consistency of the same work is secured as the three different systems were integrated into one. In addition, existing multiple servers were integrated and, the efficiency of computer resource use also improved.

3.3. Comprehensive Effects

The performance of the KLIS was better than anticipated. Enhanced public services via the Internet have been welcomed by the public, and are helping to save time and costs. In local governments, it was expensive to make land price maps each year for land administration given by the central government. However the outsourcing costs to make land price map is no longer necessary, because the KLIS has replaced this task.

KLIS integrates work related to land transfer handled by PBLIS of the Ministry of Government Administration and Home Affairs and LMIS of the Ministry of Construction and Transport in order to avoid duplication, shorten the processing time of cadastral and land-related affairs at local governments, and improve work efficiency.

The integration of cadastral map and serial cadastral map databases secures the integrity of cadastral data, and maximizes the use of the serial cadastral map database through online civil document perusing and issuing. As a result, the quality of public services were improved, civil service procedures were simplified, and the waiting times decreased.

As the existing cadastral survey and involved preparation procedures, previously handled manually, are computerized, the number of civil services will be drastically reduced. The existing way that the constructor or measurement person made subjective judgments based on the paper drawings was improved to secure objectivity in measurement results.

Information on buildings and structures is registered and managed on the serial cadastral map of KLIS, and the roads, rivers, and urban plans registered on the topographic map can be managed simultaneously, which contributes to the efficient work process among those in charge of cadastral management and urban planning.

Since KLIS is linked to urban plan information system, governmental and publicly owned land information systems, electronic payment systems, cadastral survey management systems, nation defense facility integration systems, urban information systems, and other cadastral/land information systems, it is possible to prevent duplicated investment for the same materials and to save data renewal expenses.

First, local government civil service is enhanced, as land-related civil documents can be issued at eup/myeon/dong offices or through automated kiosks promptly. A wealth of precise information on land including the current condition of land use zoning, restriction, and publicly announced land prices is available, and it is easier for users to understand the content of civil documents because they contain drawings and descriptions. Therefore, this system helps individuals to plan land use in a more streamlined manner and thus contributes to the convenience of civil services.

Second, administrative efficiency is improved. The land-related systems are reorganized and integrated into one comprehensive information system, which saves time and workforce and thus makes the governmental operation more compact and efficient. In addition, the geospatial information computerization plans divided among local governments are implemented comprehensively and collectively in order to prevent duplicate investments into the database and application system development.

Third, it contributes to scientific land policy making. With the systematic land administration system among the central government/metropolitan cities/si/gun/gu/eup/myeon/dong, it is possible to collect data promptly and accurately and comprehensively analyze the current conditions across the country. Therefore, land policies are made in a prompt and streamlined manner with national land developed and managed more efficiently.

Fourth, the foundation of future-oriented information society is established. The information of the land management information system is shared nationwide for various tax-related administrations, land-use plans, and site selection.

4. Limitations of KLIS

The KLIS project has some limitations and consistent efforts have to be made for further development of the KLIS as follows:

① Information innovation can be an ideal goal for those who are working for local governments. The shift from an analog to digital environment requires many changes, and some resistance within an organization is inevitable. In addition, the launch and completion of information systems is a time-consuming task. Without consistent support from local government officials, information systems such as the KLIS will never take root. The planners who design information system should consider the end-users, and must devise the most appropriate way to motivate them – in this case, local government officials.

② For the government to successfully adopt an information system, there must be powerful organizational support. In the early stages of the information system, hard work at the individual level is definitely necessary, as well as organizational support, because there are many problems that cannot be solved by individuals.

③ The BPR (Business Process Re-engineering) before building the information systems is a prerequisite factor. It is hard to superimpose a new information system on outmoded regulations. Amendments and adjustments to out-of-date regulations in order to meet the requirements of the Information Age will enable a smoother and faster paradigm shift. One of the key factors that will determine the successful introduction of an

information system is how well we transition from the analog environment to a digital one.

The ultimate goal of the KLIS is to build an e-Land, where land does not simply mean soil or pebbles, but a historical ground, below which our history lies, and on which our future will stand. Thus, e-Land goes beyond its literal meaning – management of physical lands – and becomes a mirror that reflects philosophical perspectives such as personality, characteristics, and a way of life.

The Korea Land Information System can provide accurate data in almost real-time for land-related policy making in links with land-related geospatial and attribute information. As it also supports land-related administrative affairs of local governments, the workload and time of public officials in charge are also decreased and thus the quality of local government civil service is drastically improved. In addition, the KLIS database makes it possible to share data with geospatial information systems in various sectors such as agriculture, forestry, environment, disaster prevention, and national defense as well as national land. Thus, this is evaluated, in Korea and abroad, as a successful geospatial information system.

Due to the poor situation of the domestic geospatial information market and limitations of geospatial information technology, imported geospatial information software and database systems were used in the process of establishing KLIS. Although Korea has established a successful geospatial information system through KLIS, the independent technology of Korea is limited to the know-how of KLIS establishment when it comes to the domestic geospatial information system. Due to the lack of self-developed geospatial information software, the advancement of domestic geospatial information industry into the global market is likely to face the challenge of dependency on foreign software.

As the KLIS establishment experience and know-how are not shared as part of the national knowledge resources, there are few experts familiar in the project. Even geospatial information experts who participated in KLIS projects are working at different agencies and companies, there has been little momentum to combine the experiences and capacities of the KLIS establishment.

For the domestic geospatial information industry to be more activated and advance into the global market, a systematic measure to make use of knowledge assets such as experience and know-how of the experts who participated in establishing KLIS is needed. Fortunately, one domestic geospatial information company has attempted to utilize its knowledge resources experiences of those in charge of establishing geospatial information system. Korea has conducted the national software R&D project to operate geospatial information systems such as KLIS. In particular, efforts are put forth into the open source-based geospatial information software development to prevent global geospatial information companies in

advanced countries from exclusively dominate the market. It is expected that this way, geospatial information software applicable to any geospatial information systems as well as KLIS would be developed, and that once the quality is secured, Korea would become less dependent on geospatial information software imported from advanced countries. It is also expected that as the domestic geospatial system is applicable to any others in global markets, the market competitiveness also would be secured.

2013 Modularization of Korea's Development Experience
The Establishment of Korea Land Information System (KLIS)

Chapter 5

Implications of KLIS in Developing Countries

1. Implications of KLIS in International Society
2. Applicability of KLIS into Developing Countries
3. Guidance for the Application of KLIS to Developing Countries

Implications of KLIS in Developing Countries

1. Implications of KLIS in International Society

1.1. Implications of KLIS Initiative and Planning

Land regulations vary according to different countries. Land regulations in Korea can be broadly divided into three parts: cadastral management, ownership registry, and land use management. The cadastral management and cadastre specifies the tangible facts of land, which is represented by a land ledger and cadastral map. The former lists the lot number, classification and area of land, and the latter indicates the demarcation and coordinates of a land parcel. Before 2008, land regulations were under the charge of 3 central administrative organizations, MOGAHA, MOCT and the Supreme Court. MOGAHA managed cadastral management, MOCT was responsible for land administration and carried out the computerization of land information concerned with land policy, land appraisal, land transaction, and land use. Land ownership registry, and the land register book defines the regal rights of land and the Supreme Court has been going ahead with the computerization of land legal books. The Supreme Court oversees affairs rising from cadastral book and building registration, with each ministry and office tackling the related land use management affairs. Korean land management systems are largely governed by these central administrative organizations.

The legal basis and executing body differs for each part. For this reason, the information systems have been built in an exclusive rather than an in integrated manner. The MOCT managed the basic national data, state geodetic reference, digital maps, city planning map and land prices, While MOGAHA supervised cadastral control point, cadastral map and land register data. The Supreme Court dealt with the data related to the information of buildings

and land ownerships and registration data, whereas ministries and offices administer the data of thematic map.

Therefore, the comprehensive land information system, such as KLIS could be established by the cooperation of these different Ministries and Offices. The construction of Land Information System should consider the relationship of each different legal system and key elements of the land use and regulations. The legal system on cadastral and land use management, land ownership registry may be different from Korea. Thus if developing countries want to introduce the Land Information System, this system has to be a customized KLIS.

The success of the KLIS project in Korea is attributed to thorough advanced planning. While many variables could have affected the KLIS project, these factors were thoroughly examined and reflected in the planning stages when the KLIS project was conducted in Korea. In developing countries, political, economic, social, and institutional aspects are quite different from those in Korea. When Korea was used as a model by these countries, the possibility of failure is high. When KLIS is introduced in developing countries, the political, economic, social, environmental, and cultural characteristics of each country needs to be fully considered in the planning stages.

In addition, even when such political, economic, social, cultural characteristics of developing countries are reflected in introducing geospatial information systems such as KLIS, the level of economy and informatization in each country may also be influential. Since these factors are varied depending on the country, it is necessary to take into consideration both the socio-economic level and IT of each country in order to successfully establish and operate a land-related information system such as KLIS.

In Korea, the Korea Research Institute for Human Settlements thoroughly investigated the legal institutions, use of data, and database in advance through the pilot project of LMIS, which was the predecessor of KLIS. Likewise, when KLIS is introduced in a developing country, the environmental characteristics, socio-economic level, and IT of the country needs to be examined through an ISP project in advance.

In particular, the KLIS project is in close relation to the national land system and land administration. Thus, land-related legislations of the country needs to be fully examined from the planning stages. The political system and legal system may differ among countries, so the KLIS of Korea might be examined as one example of land information system establishment, it would be of no use when the application of KLIS is based on the land-related legal institution of Korea.

Thus, about 400 billion, including 200 billion of the national expenditure and 180 billion of local expenditure, was invested into the development of KLIS in Korea, it could not

be sold as-is to developing countries interested in it such as Uzbekistan, Bangladesh, and Chile.

Land-related legal institutions and structures may differ in terms of land property, registration, and use. While some countries integrate these three land-related authorities, some including Korea divide them into three, and some into two. As legal structures are different depending on the country, information systems may also have to apply different work procedures depending on the applicable laws, and thus the administration system should also be different according to work procedures. Therefore, it is important to understand such land-related legal institutions clearly and plan land information systems in reflection of these characteristics.

Land-related administrative systems and service methods are also different among countries. Those in charge of land policies from developing countries may be impressed while listening to the briefing on KLIS in Korea, but adopting the system in their own countries where the legal structure is different is another matter. It is necessary, to adjust the architecture of KLIS to the legal system and environment of each country.

Lastly, the land information system may have limitations when it is designed only for temporary use. The geospatial information infrastructure needs to be based on land information system and in close association with other existing geospatial information systems. Therefore, the system should be designed in a more macro-scopic and long-term perspective than the KLIS architecture.

1.2. Significance of KLIS Establishment

For developing countries to introduce KLIS, the awareness of informatization is of importance among public officials in charge of land-related services and KLIS establishment. As geospatial information system is to utilize analog-type land-related data, it is unable to establish, operate, or manage the system without the understanding of public officials in charge. In particular, a converged geospatial information system such as KLIS cannot be successfully established unless the public officials actively participate and show their will to succeed.

In addition, perseverance is also necessary to establish information systems such as KLIS. In fact, a KLIS project may be conducted mainly with outsourcing services of private companies, but public officials themselves may cause poor data and errors without thorough inspection of data accuracy and quality, which will lead to the inferiority of the general quality of land information system. Errors in the information system will be attributed to the public officials in charge, and then they are likely to hesitate to actively utilize the system.

Therefore, the successful progress of the project may be impossible without enthusiastic participation of public officials of developing countries in establishing and managing land information systems. When not utilized, the information system will be rapidly become obsolete and fail despite a tremendous amount of investment. Therefore, it is critical to induce passion among public officials.

When a developing country introduces KLIS, a partnership is required between the project management agency and public officials at local governments in order to raise awareness of informatization among public officials and induce their active participation in land information systems. Education and promotion needs to be actively conducted regarding land information systems, by public officials in developing countries. Although it seems that workloads increase due to the establishment of land information systems, the general competitiveness of the public sectors and advancement of administrative service will improve. The operation of land information systems cannot be successful unless this is fully understood by the participants.

1.3. Significance of KLIS Operation

Information systems can advance and expand as long as the quality and effectiveness of the database continue to improve. Since the cadastral map computerization project of KLIS was initiated in the early 1990's and LMIS was conducted in 1998, the foundation of KLIS was established and in 2006, the two information systems were integrated into KLIS.

Cadastral maps, serial cadastral maps, and land use zoning accumulated in the KLIS project are not shared by most of the geospatial information systems as a sort of framework data in Korea. Thus, linkage and integration with other information systems should be considered right from the early stages of operation so that the land information system can contribute to the general development and establishment of a national geospatial information system.

2. Applicability of KLIS into Developing Countries

Unlike developed countries or underdeveloped countries, developing countries are unique in terms of policy, economy, and social culture. Informatization projects such as KLIS depend on the political system, legal system, economic power, and level of national awareness in the country. In general, developing countries are interested in the development of national economy unlike advanced countries, putting a lot of effort into improving living standards. Accordingly, decision-makers in developing countries are very interested in establishing information systems such as KLIS.

However, many of them seek socialism, not a market economy, and thus land lots are government-owned or property rights are not clearly specified. Therefore, it is unable to apply KLIS in its current form. Public officials thoughts on informatization and land use patterns as well as political system are also quite different from Korea, making it difficult to apply domestic KLIS in these countries.

Developed countries have already advanced into the geospatial information system market of developing countries. As they have a hold on the market, advancement of KLIS in developing countries is even harder. Developed countries are advantageous in that they provide geospatial information software at lower prices based on their cutting-edge geospatial information technology and high market share. In addition, developed countries take advantage of various types of subsidies in advancing into geospatial information markets with loans of little or no interest. Therefore, it is a great challenge for KLIS to advance into developing countries.

As the level of informatization and geospatial information system in developing countries is relatively low, the highly capable geospatial information systems and solutions of advanced countries may not be quite applicable to the conditions of developing countries, and thus it would be difficult to continue operating their geospatial information system in importing countries. Basically, advanced countries should maintain the systems continuously, but it would be difficult to continue investing in operating and maintaining the systems and land policies unless profitability is secured. In contrast, it would be easier for developing countries to adopt KLIS or other geospatial information technologies of Korea which has yet to join the ranks of developed countries. The rapid economic growth of Korea, which is also called the 'miracle of the Han River,' is regarded as a good model for developing countries, and thus they may prefer the introduction of KLIS.

Korea has put forth concentrated efforts into advancing geospatial information markets of developing countries with geospatial information policies. With the central government and developing countries maintaining cooperative relationships, it has also made use of such measures as EDCF. In addition, as Korea continues to establish networks of acquaintances with high-ranked officials of developing countries on such occasions as Smart Geospatial Expo in Korea, it is still possible to apply KLIS to those countries.

3. Guidance for the Application of KLIS to Developing Countries

The success of the KLIS project is attributed to combined elements such as geospatial information technology, political system regarding land use, land-related institutions,

policies of the central government, cooperation with research centers, and active participation of local governments. Therefore, merely introducing the aspect of geospatial information technology of KLIS to developing countries is likely to lead to failure.

Various factors such as politics, economy, society, culture, level of informatization, awareness of land information among public officials in charge, and behaviors of land use among the common people should be taken into consideration before KLIS is introduced. The experience and know-how of Korea that established KLIS may be referred to as an example, but a lot of other factors also need to be considered. In particular, cooperation with various related governmental offices and local government divisions is essential when it comes to KLIS. Thus, the relationships with and among central offices and related divisions of developing countries should be carefully examined. Whether the leadership of governmental offices is capable of taking the lead in introducing KLIS has to be considered as well. Once such situations of a developing country are understood, then the political system, legal system, and land use patterns of it also should be analyzed for customization.

The maturity level of informatization in that country also needs to be examined. Some countries are in so poor conditions that even personal computers and communication networks might not be readily available. Such environments should be carefully examined before KLIS is initiated. Then, the geospatial information infrastructure including basic geospatial information, standards, distribution, technical development, and metadata needs to be systematically established prior to KLIS establishment since it is impossible to continue utilizing or maintaining geospatial data without such a geospatial information infrastructure.

In addition, related legal systems, technology distribution, standardization, and promotion and education on the KLIS project in the developing country also needs to support the promotion of the KLIS project. How geospatial data is renewed and how those in charge will manage the system should be thoroughly examined in developing countries to come up with proper alternatives.

The KLIS system also needs to reflect the economic condition of that country since software can be developed and KLIS can be continuously maintained only to the extent that the government can afford the expense.

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Ministry of Strategy and Finance, Republic of Korea

339-012, Sejong Government Complex, 477, Galmae-ro, Sejong Special Self-Governing City, Korea Tel. 82-44-215-2114 www.mosf.go.kr

KDI School of Public Policy and Management

130-722, 85 Hoegiro Dongdaemun Gu, Seoul, Korea Tel. 82-2-3299-1114 www.kdischool.ac.kr

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