Land Management Information System in Korea

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FOREWORD

The twenty-first century is the knowledge-based information era. The social infrastructure in the industrial age centered on physical facilities like roads, railways, harbors, and airports. However, in a society based on knowledge and information, application systems and databases, including Geographic Information Systems (GIS), are the new social infrastructure. The Land Management Information System (LMIS) is a highly significant project in the establishment of a new age's social infrastructure. A demonstration of the LMIS project was carried out in Nam-gu, Deagu Metropolis, in 1998. As of the end of 2004, 163 areas of 253 municipalities will have completely installed the LMIS, and the remainder will be completed by 2005.

The LMIS increases the productivity of public land administration in cities, counties and districts by providing citizens access to land information at any time and anywhere. By using the LMIS database, the Ministry of Construction and Transportation can carry out better, more efficient and more timely decision-making regarding land use policies. The LMIS will also help to solve the problem of real estate speculation and assist in decisions about regulations and policies related to land. The LMIS is expected to become an integrated information infrastructure for managing *e*-Land by the e-Government in this knowledge-based information era.

Kyu-Bang Lee, President
Korea Research Institute for Human Settlements

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Land Management Information System in Korea

I. Introduction

Information on various maps and land documents, which are managed by land administration, is inaccurate and discordant. The various administration posts of the Korean government produce and maintain information involved in the maps and documents. Furthermore, people have to travel far to visit a city hall, county office or district office just to obtain information on land use regulations and even after arriving there, have to wait for answers. It usually takes several months for the information produced by municipalities to be utilized for land policy and it precludes the formulation of a timely policy.

To solve these problems, the Ministry of Construction and Transportation (MOCT) implemented the project of Land Management Information System (LMIS) in 1997. The LMIS has a tripartite objective: to provide land information to people upon request, to enhance the productivity of public land administration, and to establish rational land policies. A topographical map, cadastral map, and zoning map are built into land database in order to actualize these objectives. The applications that carry out land operations such as land appraisals, transactions, land use plan, have been developed and set up in all Korean municipalities. In addition, to install the LMIS smoothly, scientific studies have been carried out to arrange institutional adjustment, guidelines, standardization, etc.

The demonstration of the LMIS project was carried out in Nam-gu, Daegu Metropolis in 1998. As of the end of 2004, 163 areas of 253 municipalities will have completely installed the LMIS while others will be completed by 2005.

II. Issues of Land Administration and the LMIS

1. Land Administration

1) Present status

• Operational procedures

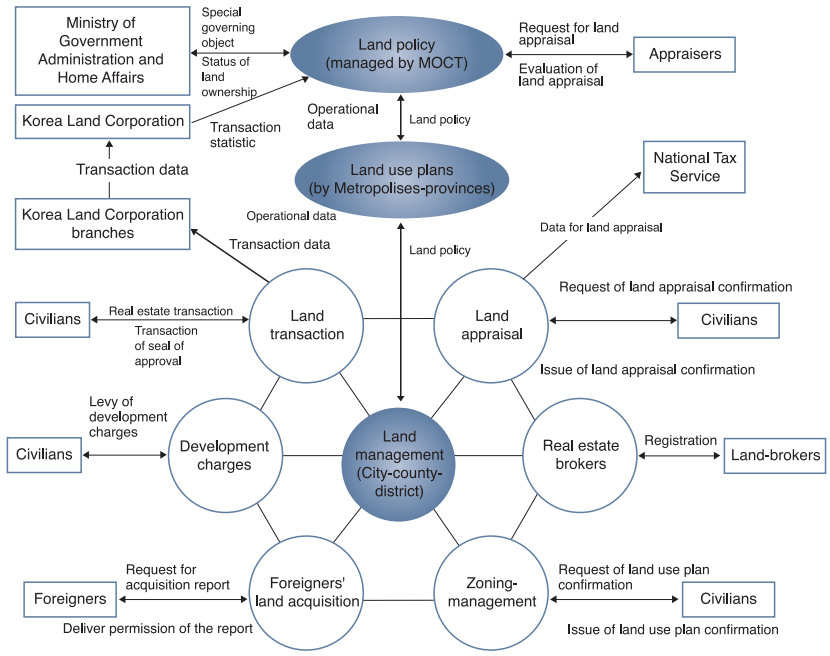
The land administration can be divided into the operations of land management and land policy according to the hierarchical characteristics of an administrative institution. The operations of land management include land transactions, publicly announced land price, development charges, foreigners' land acquisition, management of real estate brokers, and the provision of land information. All of these functions are carried out in a city hall, county office or district office. Metropolises play an important role as an intermediary between central organizations and those at the city-county-district levels. They also combine the land information produced by each city-county-district to provide the information to the central place and to take charge of national land use and urban planning. The operations of land policy are national interventions to maximize the use of limited land resources and to distribute profits and wealth generated from the land fairly. It includes policy for land ownership, land use, development profit redemption, and land management, all of which are carried out by the MOCT. The MOCT has been recording statistics on the land data produced by the operations of land management through the metropolis and Korea Land Corporation to establish land policy (Figure 1).

• Land data

Data produced by the land administrative operations or necessary data, can be divided into spatial data and attribute data (non-spatial data). Spatial data includes the topographical maps, cadastral maps, and zoning maps which have different types and scales depending on the purpose of the maps.

Topographical maps are produced and distributed by the National Geographic Information Institute. The National Geographic Information Institute made the digital maps (DXF format) of several scales nationwide for five years, from 1996 to 2000. For example, 1/1,000 is a scale for downtown areas in the 78 cities that need a management for facilities, 1/25,000 for mountain areas, and 1/5,000 for other areas. The digital topographical map is composed of nine large-category layers, railroads, hydrography, roads, buildings, tributaries, facilities, topography, administration, etc. The layers consist of the hierarchical structure of three categories: large, middle, and

<Figure 1> Procedures of land administrative operations



small. The digital topographical maps have an enormous amount of information. Thus, it has the advantage of including many kinds of information that various fields need. However, it also includes a lot of superfluous information, which interferes with the construction and maintenance of a spatial database. In addition, the digital topographical map has not only a lack of topology that is required for the LMIS, but also a lack of attribute data on a topography because it has originated from paper maps. Therefore, the database needs to be built through the editing process, which converts the digital topographical map into the GIS data.

Cadastral maps specify the location, lot number, land category, and boundary of a land parcel, etc., and are made for managing lands, as well as for protecting land ownerships. The scales for the cadastral maps have been regulated to be made out with 1/500, 1/600, 1/1,000, 1/1,200, 1/3,000, and 1/6,000. Additionally, boundary-coordinates registers can be made and installed according to the needs of the competent authorities. The boundary-coordinate registers were produced after the introduction of digital surveying and they are card type-cadastral registers, which

<Figure 2> Digital topographical map

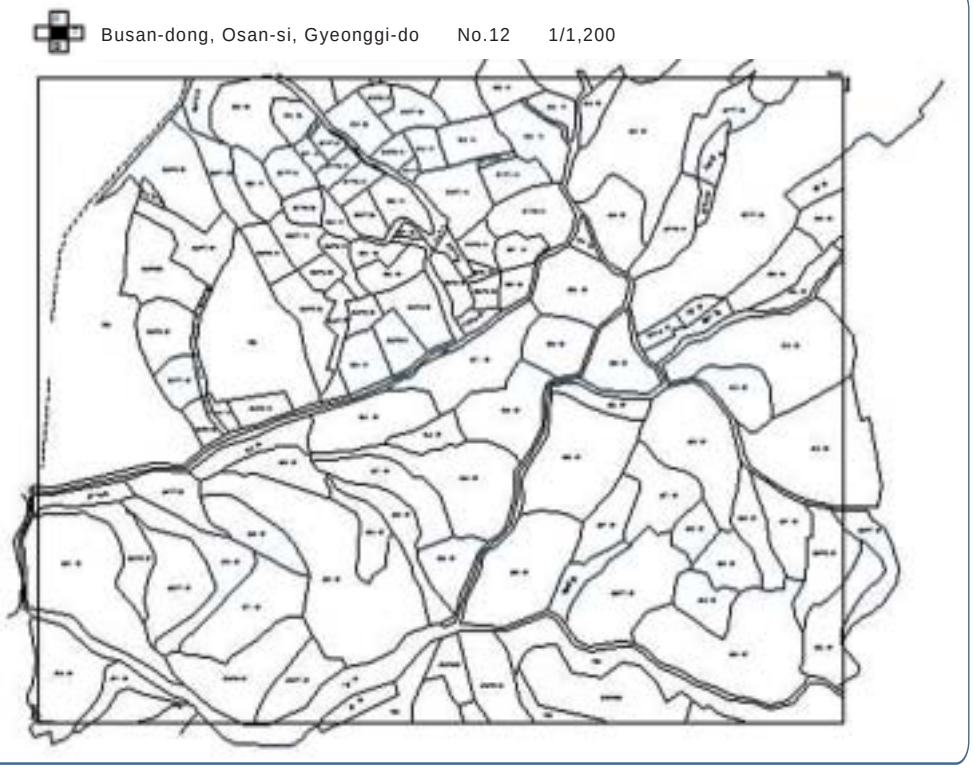
record boundary points as coordinates. The cadastral information has a land ledger that includes the location, lot number, land category, area of land, name and address of owner, etc. The cadastral map is utilized not only for land register-management operations, but also for civil affairs such as an issue of confirmations on land-use plans, and for zone selection, land appraisals, and land price.

The Ministry of Government Administration and Home Affairs (MOGAHA) started the computerization of cadastral maps in 1999 and completed the work in 2003. Such cadastral maps are fairly important in representing property rights, but it can be problematic. First, coordinates in cadastral maps are not standardized. Second, joining points between two cadastral maps do not match each other and the points between two maps are discordant. The computerized cadastral maps include problems of paper cadastral maps such as difference of coordinates, because the cadastral maps were computerized while the problems of existing cadastral maps have not yet been solved.

There are more than 270 zones and 80 different laws and regulations regarding the efficient land use and preservation. The zones have been designated by government organizations according to each relevant law and regulation and the organizations are also responsible for the management, production, and utilization of zones. Relevant zonal laws and regulations have stipulated scales of maps, types of maps, etc. The scales of maps vary from 1/500 to 1/50,000 and types of maps such as topographical maps, cadastral maps, and zoning maps vary as well. The relevant laws and regulations do not yet stipulate the size of the maps. However, they have been producing and been utilizing the same size maps as topographical maps or cadastral maps produced in the National Geographic Information Institute, using a topographical map or cadastral map as a base map. The map is generally produced on

paper, but it is sometimes produced as a film type-map in civil service cases. Thus, municipalities have been computerizing zoning maps for use in related operations such as civil services. There are still no laws and regulations for the computerized zoning maps. Thus, various formats and types of maps are produced in each municipality. The legal subject of productions on zoning maps is stipulated by a director in each municipality. The information is produced by private organizations, which establish land-related plans and professionally select and modify zoning maps. Each organization in a municipality inspects produced maps during the process of turning out information. As mentioned above, each post in the municipality administers the modification of a boundary on zones and land register post is administering changed items on the land registers. The municipality does not manage modification for topography, but the modification is reflected in zoning maps by

<Figure 3> Examples of cadastral map



operating aerial survey. Thus, the management of zoning maps needs a great deal of cooperation and collaboration among posts. In other words, zone-boundaries require cooperation of zone-related posts, whereas cadastral boundaries need cooperation of land register-related posts. Additionally, cooperation between zone-related posts and civil service-related posts should maintain some consistency in the maps for legal decisions and civil services.

<Figure 4> National land use planning map

<Figure 5> Urban planning map

<Figure 6> Forestland use map

<Figure 7> Road preservation boundary map

Base maps expressing zone-boundaries also need to be accurate because the selection of zoning maps is directly connected with individual property rights. However, topographical maps and cadastral maps that become the basis of zoning maps have fundamental problems with information quality. Without solving these problems, the zoning map will also have the same problems. In the meantime, zones are specified on many different kinds of maps according to the legal subject of productions and relevant laws. It results in boundary discrepancies among zoning maps. Also, logical relationships between zones have discordances as utilizing various scales and types of maps.

Attribute data consisting of figures, exists as land registers. Attribute data related to land use plans is made from metropolises, whereas attribute data related with land appraisal and land transaction is produced at the city-county-district level. Those produced at the city-county-district level or metropolis are utilized for statistical analysis by combining a data in the MOCT or metropolis levels to support the land policy establishment. However, connections among relevant land registers are insufficient. In particular, most land-related services utilizing spatial data have difficulties in executing operations because overlaps in data management often occur as land registers and spatial data are not closely connected. Provisions of the laws that manage land registers involved similar content also become a main cause of the overlaps of similar land data in the management.

• Organizations

The central institutions relevant to land administrative operations are the MOCT, the MOGAHA, and the Supreme Court. The MOCT takes charge of operations of land policy related to land transactions, publicly announced land price, the management of real estate brokers and zoning maps. The MOGAHA is in charge of administering a system of taxation, such as cadastral management. Lastly, the Supreme Court takes charge of managing real estate registration related to land ownership. Most land-related administrative operations except land ownerships (such as real estate registration) are entrusted to metropolis and municipalities (city-county-district). In municipalities, urban planning and land register related posts are responsible for managing the operations of land administration. In addition, organizations that manage and produce spatial data for utilizing the operations of land administration are also separated. For example, the National Geographic Institute is responsible for managing topographical maps, land register posts in municipalities for cadastral maps, and urban planning posts in municipalities for zoning maps. These organizations do not produce maps themselves, but take positions in evaluating the maps. However, in the case of cadastral maps, municipalities directly manage maps.

Except for managers in the MOHAHA and land register posts in municipalities, most land-related administrative organizations are organized as rotational appointments. Most operational managers in municipalities, who are hired as computer operators, work in computer-related posts instead of in posts of land administrative operations.

2) Problems

The most important factor in the vertical and horizontal relationship of land administrative operations is that activities on data production, utilization, distribution, and maintenance have to be organized efficiently. However, many problems arise from data disorganization.

First, there are more than 270 zones in the 80 different laws and regulations regarding the use of the land, which results in discrepancies in information in various maps and land registers. There are some cases of a municipality issuing civil affair documents because the lands are misunderstood as quasi-agricultural areas in spite of lands that cannot be built upon because of land use policies of the government. For this reason, many civilians and government employees can suffer from a loss in the

<Figure 8> Example of discrepancies on zones

Source: National land use planning map (1/5,000)

economic value of the property. Investigation in all municipalities found that such problems are not unique to particular areas, but more than five problems in each municipality have occurred every year. These situations show the seriousness of the problems. Figure 8 shows the zonal discrepancies between a national land use planning map and forestland use base map. Points indicated by arrows in the map are areas that are unable to coexist spatially or logically. That is, sub-preservation areas by forestland use are the areas, which cannot exist in agricultural areas under national land use plans.

Second, duplications in investment of land information production and management often occur, causing discrepancies in the information. In most cases, posts that are in charge of regulating land use plans play the leading role in limiting land use and reserving it for particular purposes. Also, posts for civil services provide information on synthetic land use plans, produce and manage similar land information.

Third, government employees have repeated many operations by transacting many similar framing operations such as statistics, ledgers and written applications. Especially, there are many instances of recording and transacting similar framing operations in the process of notifying civil affairs after recording documents in the ledger and investigating related laws and regulations.

Fourth, people have to travel far to visit a city hall, county office, or district office just to get land information. Even after arriving there, they have to wait for 20 to 30 minutes.

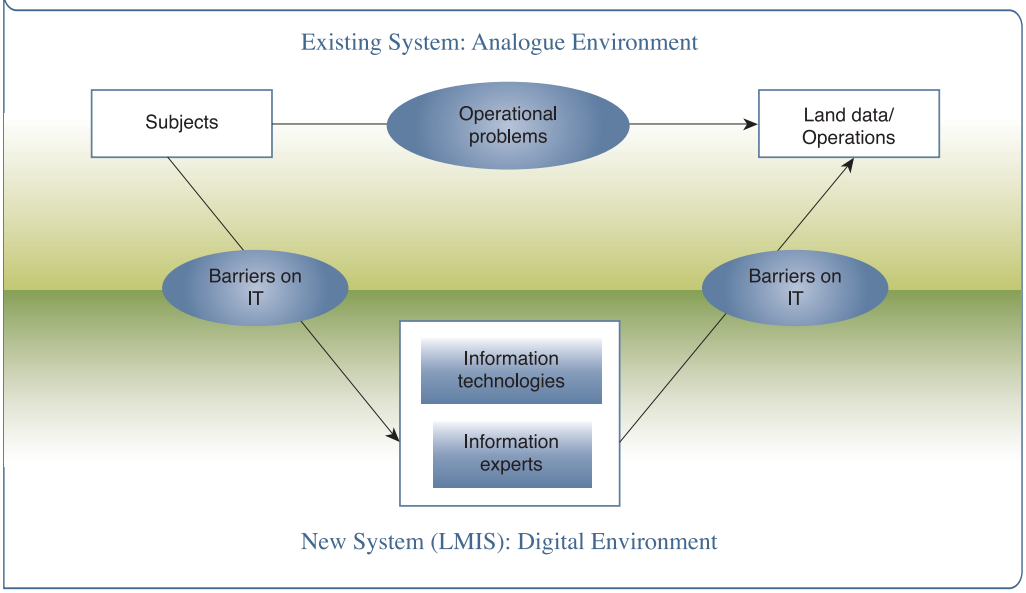
Last, it is fairly difficult to combine information produced by the operations in municipalities. It also takes several months to combine information due to passing through many steps such as metropolis level-municipalities and it results in a debase of establishing land policy in timely manner.

2. Issues on the Land Information-oriented System

Our society is making the transition from an industrial to an information society. Under such circumstances, everyone accepts the role of the land information-oriented system in solving many problems pertaining to land administration. Some basic level-municipalities[1)], for instance, had partially success by introducing IT to solve the problems, but many cases of utilization of the information system have not been

1) Several municipalities, such as Gangnam-gu, Seoul, have promoted LMIS development since the early 1990s.

<Figure 9> Issues of the land Information-oriented system



activated because of the incongruity of the system.

The land information-oriented system is the process of introducing IT (method) to assist officials in charge (subject) of operations of land administration (object). However, officials in charge (subject) and the operations of land administration (object) are in an analogue environment, whereas IT is in a digital environment (Figure 9). There are many obstacles to the application of digital technologies to solve the problems caused by the existing analogue working environment. Other problems, such as a failure of an information-oriented project and waste of the budget, will be raised unless these obstacles are eliminated.

1) Absence of specialists / experts

The MOCT, which is responsible for land policy, plays a leading role in promoting the LMIS development project. However, the LMIS development project constructs the land management operations that are executed by active partners in city-county-district. Therefore, regarding the management of nationwide business, specialists and experts who execute planning and management on the information-oriented business, and who plan and manage the domain business in municipalities, are needed. In

general, information experts are indispensable to successfully promoting the information-oriented business.

However, there are not many specialists and experts among members of the MOCT, who can lead the construction of the LMIS or who are familiar with the operations of land administration. There are many factors to be considered in the process of applying IT regarding the complicated land data and operations. Under this situation, which is necessary to mediate comprehensive relationships among related posts, the absence of specialists and experts is the main obstacle to promoting successful projects.

2) Digital IT above analogue settings

The land data in Korea has been stored and managed in the paper maps as analogue settings. In addition, operation transactions, procedures and standardization for data production and management regulated by many laws are not clear because of analogue settings. In this regard, existing data and systems (laws) are not appropriate to build a digital information system. Therefore, there are many difficulties in mediating comprehensive relationships among related organizations.

3) Bureaucracy and poor information-orientation

The LMIS has been promoted by the MOCT. However, the levels of cooperation and the information oriented system in the municipalities affect the efficient promotion of the project because the main users of the LMIS are municipal officials. Especially, lack of communication among related municipal organizations in municipalities is more common than cooperation.

The production and utilization of the land information are being completed in various posts, but it is difficult to make enforce cooperation systems among posts in municipalities because of egoism and rivalry. In addition, many officials in charge of the posts tend to be indifferent and complacent, a lack of cooperation and poor communication impede the promotion of projects.

III. Strategies for Developing the LMIS

1. Purposes

The land information-oriented system is a method to maximize the use of limited land resources and to distribute profits and wealth generated from the land fairly by solving the problems caused by the operations of land administration. To solve these problems, the project has several objectives:

It is a scientific method to establish a land policy in timely manner and to build a network for collecting correct information quickly. It is also to construct the Land Policy-Decision Making Support System for analyzing collected data in various ways.

Second, it is to provide land information upon request. To minimize the inconvenience of visiting government organizations to obtain the land information, confirmations for land use plans and publicly announced land price should be obtained through the remote system and Internet without visiting city-county-district that manages information on individual lands.

Third, it is to reduce operations of government employees and to streamline the search for necessary information. It is also to construct a system that transacts the simple-duplicated operations automatically and to obtain necessary information related to operations for the government employees.

Fourth, it is to provide the land database as a spatial information infrastructure in each municipality. Demands for the land information are enormous because the land information is utilized not only for land administration, but also for other purposes. Therefore, the posts often duplicated production and management of the land information. This results in discrepancies and duplications of investment on the information. To eliminate these problems, an information infrastructure that allows users to share information by standardizing the land information needs to be constructed.

2. Strategies of the LMIS

The creation of the LMIS will not be easily achieved through the application of simple IT because of poor information-oriented mindsets and incongruity of applied technologies. The LMIS inevitably accompanies a radical change of working environment from analogue to digital. Therefore, comprehensive strategies on how to rationally adapt the operations of analogue land administration to a digital environment are necessary so as to solve the problems arising from the operations of

land administration, to eliminate obstacles to the land information-oriented system, and to construct the LMIS.

1) From the analogue to the digital environment

Present systems that are related to the production, utilization, management and dissemination of land information, are based on analogue technologies. However, existing systems might be the main obstacle to an efficient land information-oriented system because the information system applied to the operations of land administration is digital technologies. Therefore, a set of laws should be converted from analogue settings that rule the production, utilization, management and dissemination of land information suitable to the digitalized environment.

2) Information system of opening and dispersing types

Computing environments consisting of software/hardware platforms and operation system/networks are heterogeneous because each municipality already has several information systems. Heterogeneity will be a more serious issue, as the level of information-oriented system improves. Adopting standards of the useful IT systems and inducing open-component GIS technologies will make the system synthesis easy. Additionally, developing the LMIS, reducing maintenance costs and time, and synthesizing systems can be achieved through the reusability and interoperability of binary codes.

3) Spatial information infrastructure in municipalities

The land information is significant for social life because it has enormous demands concerning not only land administrative operations, but also land use and land transaction. In addition, it will be one of the most important items of information in the fields of industry, economy, culture, society, etc. Therefore, land information constructs a municipality-centered spatial information infrastructure to share the land information.

4) Organization and administration of cooperative system

The operations of land administration are divided into the vertical and horizontal relationships depending upon the characteristics and are carried out by several organizations. Municipalities are responsible for producing and managing the land

information, but many operations, such as land management, land register, land use plans, computerization, etc., are carried out by municipal posts. The MOCT is responsible for promoting the LMIS development project.

Officials who are in charge of executing these operations in the municipalities have to be active partners in the process of constructing the LMIS. However, a considerable proportion of works that need to be carried out by the MOCT and municipalities has been outsourced to expert groups. Therefore, concrete LMIS needs to be promoted by building close cooperation system among the MOCT, municipalities, and outsourcing expert groups.

5) Public relations and education for the innovative changes

Bureaucratic regulations, hierarchies, and technical specialization rule most public institutions. Thus, non-cooperative culture among related municipal posts is widespread. However, the land information-oriented system encourages innovative changes rather than a non-cooperative culture does, but these changes require more time and effort than expected. Therefore, it will be difficult to achieve a land information-oriented system unless officials actively work to solve the current problems. When the officials have confidence in the results of the information-oriented system instead of interfering with the system, they will become innovative pioneers on the LMIS.

3. Detail Strategies for the LMIS

1) Improving process of land administration

There is a problem of utilizing IT to carry out efficient activities. It is fairly difficult and inefficient to apply the IT systems to operational transactions, standardization, and processes. Additionally, in case of transacting with methods that are not regulated in the laws, the legal validity on the result will be questioned. Therefore, the present process of the land administrative operations needs to be improved to enhance the efficiency of the LMIS.

The purpose of the regulations governing land administration is to regulate procedures, methods, and standards related to the production, utilization, management and dissemination of land information that are created in the process of transacting the operations of land administration. However, the existing system regulations have inappropriate or inefficient parts to apply the IT systems because the regulations were based on the analogue working environment. Thus, these parts

should be improved or recreated. The parts for the improvement and recreation are the present data arrangement for land database building, the process improvement for efficient execution of the operations, and the management of the constructed information system.

It will be ideal to promote land databases after standardizing the systematic consolidation, but they have been carried out side by side due to actual difficulties. The systems related to building the information consolidation and land databases have been consolidated, but system improvement for the process of land administrative operations is one of the main parts, which needs to be promoted continuously.

2) Development guidelines for the LMIS

• Guidelines for project execution

To complete the LMIS development, the scope and process of information-oriented system, allotted duties by subject, etc. should be clearly stipulated. Only then can we promote consistent information system development. For this reason, we drafted guidelines for LMIS development, which stipulate scope and content of the DB construction and the development of application programs.

Furthermore, they stipulate the promotion process from the application to the completion of the LMIS development project and the allotted duties and cooperative systems between the central government and municipalities. The MOCT is responsible for the development of application programs, provision of GIS S/W, building continuous/rubber-sheeted cadastral DB and zoning DB, and setting up the system, whereas municipalities are responsible for possessing computerized equipments and also providing and inspecting input data.

• Operational management guidelines for the LMIS

From now on, the operations of land administration will be transacted by reciprocal reactions between officials (users) and the LMIS. In some cases, electronic transactions instead of the officials in charge will handle the operations. Therefore, the LMIS should always be in operative conditions to transact the land operations continuously and there should be methods of the operational transactions, standards for decision-making, and processes using the LMIS. In addition, details such as access-authority on land databases, accessibility of data to the public, and access methods need to be clarified to prevent the misuse of the land information.

The guidelines of operational management for the LMIS stipulate methods, standards, and processes to carry out relevant operations (data addition/

renewal / revision / utilization / dissemination) by using the system. For example, the Spatial Data Management System is an operational method designed for managing and supporting cadastral maps, the Zone Management System for creation-modification-abolition of zones. Additionally, the Land Use Plan Confirmation Document stipulated in "Laws for Land Use Plan" and the Public Land Price Confirmation Document stipulated in "Laws for evaluating Public Land Price" are designed as operational transaction methods.

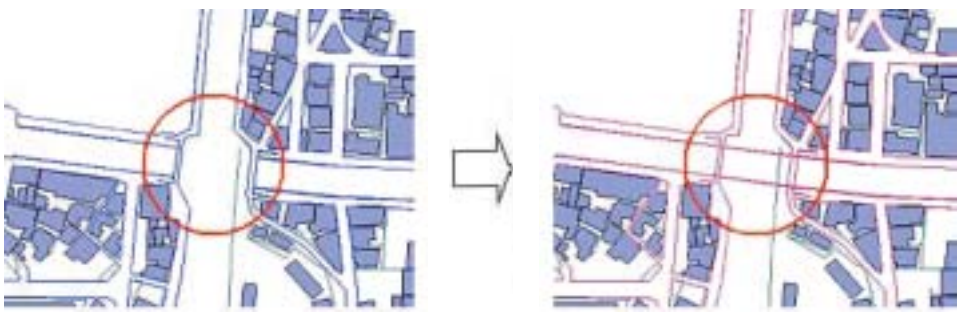
• Guidelines for building topographical DB

Most of the regions in Korea were turned out as 1 / 1,000 and 1 / 5,000 digital cartographic maps (DXF format) by the National Geographic Information System development project promoted in 1995. When boundary lines in roads (Figure 10) or railroads (Figure 11) are disconnected or building boundaries and contour lines are not amalgamated as polygons, the process that corrects these problems and converts the topographical information into the spatial database is required. In guidelines for building the topographical DB, topographical information necessary for the LMIS is extracted from a cartographic map so that guidelines set forth the standards, procedures, and methods to convert the topographical information into spatial databases.

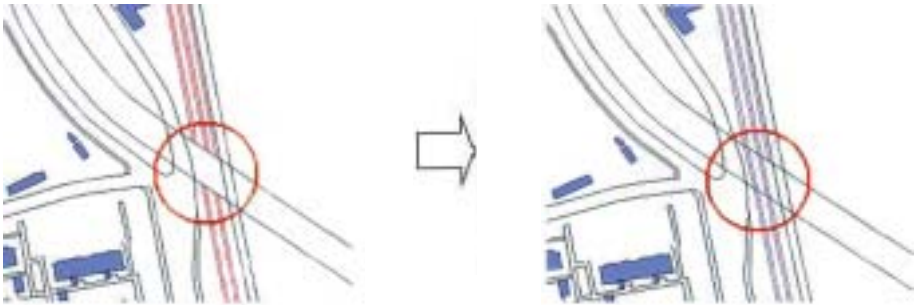
• Guidelines for building cadastral DB

The cadastral map is important spatial data that is utilized for administrative operations and civil affairs administration and has traditionally been managed as individual sheets. The individual sheeted-cadastral map was made approximately 70

<Figure 10> Modification of road boundary lines

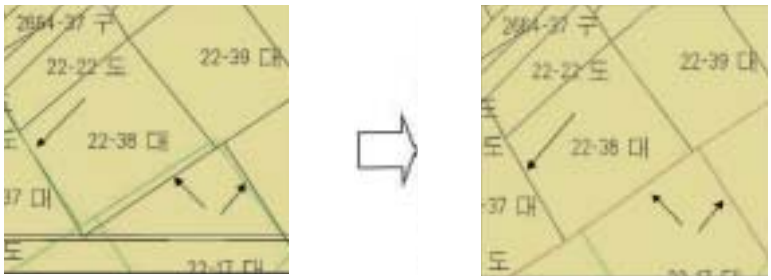


<Figure 11> Modification of railroad boundary lines



to 80 years ago, but the boundary lines often show discrepancies due to expansion/ contraction, abrasion, and modification of the map. In particular, boundary lines between cadastral maps, which have big differences in scale, have serious discordances. To solve these problems, we should take measurements of survey on lands again and redo the cadastral map. However, re-surveying lands is costly, time-consuming and also might cause many civil affairs relevant to the ownership of lands. For that reason, the second best policy builds continuous-cadastral databases by joining individual sheets in the cadastral map. Guidelines for building the continuous-cadastral DB eliminate phenomena of discrepancies between cadastral maps and also set out the standards, procedures, and methods that consistently join the individual sheets (Figure 12).

<Figure 12> Building the continuous cadastral DB (before/after)



Before applying guidelines

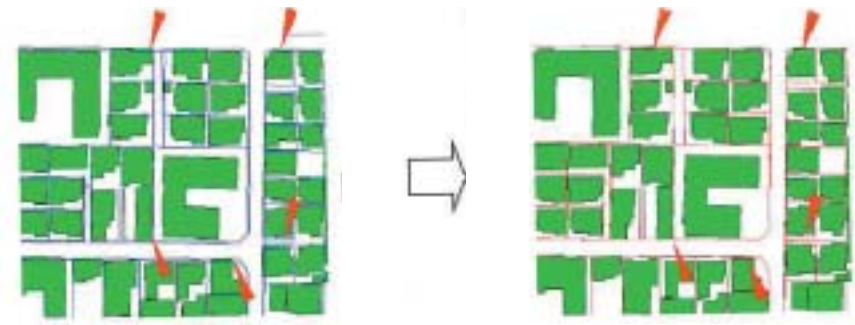
After applying guidelines

When two identical objects are presented in each topographical and cadastral map, spatial data that present locations of the objects should correspond to one another. For example, boundary lines between roads in the topographical map and roads in the cadastral map need to correspond. However, discrepancies between a topographical and cadastral map would occur when overlapping them with either of coordinate systems due to differences in coordinate systems, scales, and methods in two maps (Figure 12). To solve these problems, we should re-survey the lands (same as above case). However, we need the second best policy to solve discrepancies on the maps as overlapping the topographical and cadastral map considering re-surveying lands is fairly difficult. The guidelines for building rubber sheeted-cadastral DB stipulate standards, procedures, and methods that make boundary lines in cadastral maps correspond to boundary lines in topographical maps (Figure 13).

• Data consolidation / building databases for zoning maps

There are more than 80 different laws and regulations regarding the use of the land in about 270 zones, but methods and procedures of making zoning maps are not concrete and depend on people's experience and subjectivity. Thus, it results in discrepancies among common boundary lines on zoning maps. Areas indicated by arrows in Figure 14 are the regions that cannot coexist with overlaps in designation regarding legal relationships. It was difficult to recognize discordances and discrepancies on zoning maps because the contents of zones were represented on different maps. However, it was possible to digitize and overlap the zones so that the discordances and discrepancies were readily understood. Such phenomena should be

<Figure 13> Building the rubber-sheeted cadastral DB (before/after)



Before applying guidelines

After applying guidelines

<Figure 14> Examples of zonal discrepancies

eliminated by building concrete and reliable zoning map databases. The guidelines of data consolidation and database building on zoning maps stipulate standards, procedures, and methods to build land databases by consolidating relevant information on the zones, which has problems of discrepancies or discordances. These guidelines are composed of inspecting inputted data and consolidating methods for eliminating discordances and discrepancies from zoning maps.

• Share of land databases

The purpose of an information-oriented project is the public use of land information. Therefore, we also need to establish standards, procedures, and methods for sharing land information with other information systems so that we can maximize the utilization of land databases produced by the LMIS. Guidelines for sharing the land database should provide land information to the public unless there are particular reasons for protecting the information.

• Dissemination of land databases

Demands for the land information have rapidly increased in the public and private sectors. Nevertheless, land databases produced by the LMIS do not have systematic regulations governing their use by the public and enterprises. Thus, the use of the land information is restricted. Therefore, guidelines for dissemination of the land database are needed. We are also preparing regulations, which provide procedures and methods necessary for making land databases available to the public. The guidelines for the dissemination will provide principles, procedures, and methods relevant to the application and the land information offering and are also going to regulate quality guaranteed-items and security-related items.

• Security of the land information

It is possible to incur illegal uses and information outflow on land databases when municipalities provide the land information to government organizations, enterprises, and the public. The guidelines for security of the land information play the leading roles in planning protection of personal information, national security, and public safety, as well as preventing public disadvantages by keeping off illegal information outflow. The guidelines prevent any unauthorized dissemination or illegal use of land information. Also, they clarify the limitation of application on security guidelines depending on users, levels of distribution, and offered information, in addition to stating the legal uses of the databases. They also describe the appropriate actions that information users (public) and providers (directors in municipalities) need to secure the land information. Lastly, illegal reprinting and security-related accidents on the information are regulated in the guidelines and penalties on users, who violate security obligations on the land information, are stipulated presented as well.

3) Organizations on the LMIS

The MOCT generalizes the nationwide operations of land administration, but the operations of land management about civil affairs are executed by the municipalities. In such an operational execution system, municipalities, which produce and maintain the land information (data), need to participate actively to promote a successful LMIS development managed by the MOCT. Additionally, most of the works that need to be carried out by the MOCT and municipalities have been outsourced to expert groups. Therefore, concrete LMIS needs to be promoted by building intimate cooperation system between the MOCT, municipalities, and outsourcing expert groups.

The MOCT plays the leading role in promoting the LMIS development project and it carries out establishment and execution of entire plans, project management and supervision, consolidation of relevant systems, standardization, and compromise and mediation among relevant organizations. Scientific research has been commissioned to technical supporting expert groups to execute these roles more efficiently.

Municipalities act as users, who demand technical skills for application systems while building the LMIS. Additionally, they consolidate existing data and information for urban planning, which will be built into databases and they also check whether the consolidated data and information have been correctly inputted into the database. The municipalities need to prepare operational management systems as they complete the operational education provided by technical development enterprisers and undertake the LMIS. Metropolis level-municipalities are to manage and supervise data

consolidation and operational management executed by basic level-municipalities for efficient promotion.

The MOCT builds the LMIS, but the technical supporting expert groups carry out the roles that cannot be executed by the MOCT and municipalities due to the lack of technical knowledge. Agencies for the MOCT generally carry out preliminary research and business management pertaining to development plans, the consolidation of relevant systems, and standardization. They also monitor completed business areas. Agencies for the municipalities set up the plans for establishing the LMIS in each municipality. The technical development enterprisers consist of SI (system integration) companies and consortia, data input-specialized companies. The SI companies develop application systems, databases, and set up the technologies in municipalities. They also train users and administrators to utilize and operate the technologies efficiently. Lastly, data input-specialized companies convert analogue data into digital data.

4) Public information and education

Users are the most significant factor for success of the information system and determine the success of the project promotion. However, officials in charge of practical affairs have limited time to participate in building the information system and are also more familiar with bureaucracy and industrialism. For these reasons, indifference, lack of cooperation, conflicts, and rivalries have surfaced. It is difficult to solve these problems quickly, but they interfere with the successful completion of LMIS development. First of all, officials in charge of the LMIS tried to lead the new information-oriented paradigm. Also, they tried to become active users on the information system instead of adhering to the existing system. To solve these problems, public information and education have been used to bring down the barriers between officials and agencies.

Each municipality should hold meetings on the information system development project, while providing pamphlets on the project and it will help the government officials to understand the LMIS development project. Furthermore, the officials will be able to see each of the functions and special features in the LMIS through the trial version of the system. The trial version, provided on a CD, includes information on GIS, examples of using GIS, and editing / revision / analysis of a spatial data. In addition, an LMIS website has been launched, allowing relevant organizations and the public to obtain and share the land information.

The LMIS project holds many seminars and workshops to assist people in finding solutions for operational execution. By recognizing the causes and solutions of

the problems, more active participation will be encouraged. Many government employees thought that it was difficult to implement the information-oriented land, and they were interested in building cases of information systems instead. However, there are no comparable cases in Korea that construct a spatial-information infrastructure and operate information-oriented land managed by municipalities. Therefore, we have been observing the present conditions for utilizing IT systems and promoting information-oriented projects of land fields on highly developed countries such as Germany, Finland, Norway, Denmark, Spain, Australia, and the United States. It has been the most effective and rapid method of improving our information-oriented mind.

5) Monitoring on LMIS operation

• Monitoring on the system operation

Voluntary municipal participation in the LMIS development is key to the success of the project. However, some officials actively or passively oppose the project. It delays the inspections of land databases in the municipalities. Further, promotion of the project might be difficult due to absence of specialists and experts. Therefore, monitoring systems on the LMIS that can detect problems are needed.

Objects, proper time, contents, and methods in monitoring are closely correlated. Methodology of the monitoring is composed of placing immediate constituents into contact with each other. Some of the monitoring objects are land databases. Thus, software (development tools and application systems), hardware / network, promotion systems, users, etc. are tangible or intangible elements to promote LMIS building or operations successfully. The proper time of monitoring can be divided into installation-level (from a point when the LMIS development project was started to when land database-building, application system-installation, user-education, etc. are implemented) and operation-level (after taking over the system and utilizing the LMIS in municipalities). The monitoring contents specify details on monitoring objects and they will be differentiated according to the monitoring objects; proper monitoring methods are applied depending on monitoring contents. The monitoring methods can be divided into surveys, interviews, experiments, and reports.

User demands on the LMIS are managed by websites by analyzing and processing the monitoring results. It is possible to prevent similar problems when we promote the LMIS development project in other regions. Monitoring systems are utilized as a project management methodology to solve the problems caused by differences between development management-organizations and utilization-organizations by detecting and immediately rectifying the problems.

• Consulting on the system operation

It is necessary to introduce the LMIS to regions where they have not yet been promoted. This can help prevent overlaps with other information systems. There are public relations pamphlets and CD-ROM on the LMIS, the website for sharing project information, seminars and workshops, and a help desk for answering project-related questions. Municipalities, which will soon start the LMIS development project, can assist in setting the budget and establishing promotion plans, promotion organizations and public utilization on land information, so as to prepare for the project. On the other hand, municipalities which do not apply for the LMIS development project attend several workshops and seminars on necessity of the LMIS, its anticipated effects, and what the LMIS has done for other regions.

IV. Implementation of the LMIS

1. Structures of the LMIS

1) General structures

The users of land information were divided into government officials and civilians. They were categorized according to the hierarchical characteristics of the operations of land administration: ministerial, city-provincial, city-county-district, and civilians. A server system executing each function has been constructed because the contents and properties of the information demanded by each user are fairly different (Table 1).

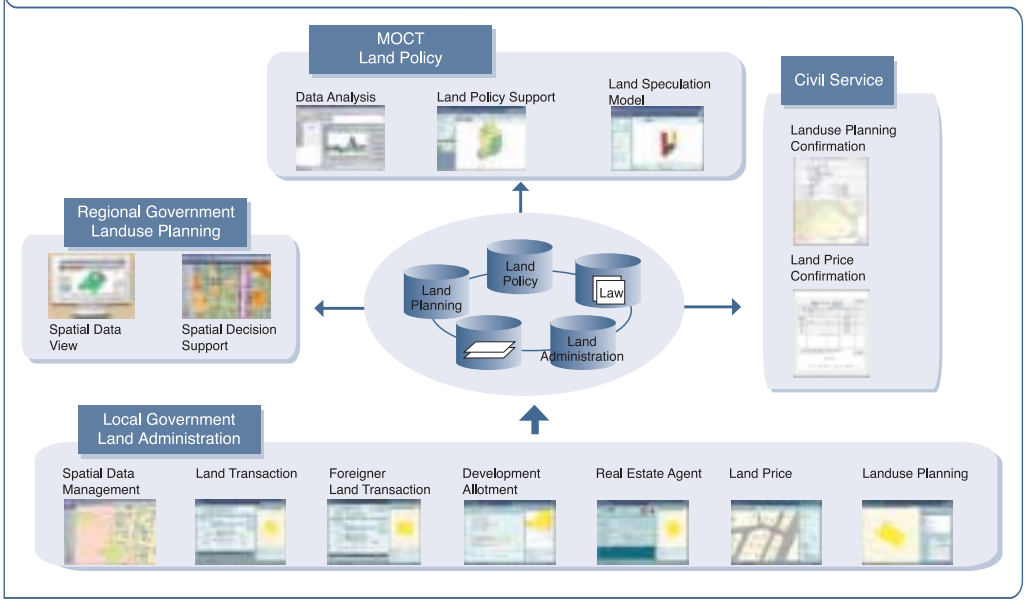
The network, which is designed to share the information among the systems, is

<Table 1> Serve systems and users on the LMIS

Serve system modules		Users				
Operations	Serve systems	MOCT	City-provincial	City-county-district	Town-township-village	Civilians
Land policy making	Land policy support system	○	○	×	×	×
	Land data statistic system	○	○	○	×	×
Land information inquiry	Land information inquiry system	○	○	○	○	×
Zoning management	Zoning management system	×	○	○	×	×
Land regulation	Land regulation system	×	×	○	×	×
Land administration and management	Land administration and management system	×	×	○	×	×
Land information service	Land civil affairs system	×	×	○	○	×
	Land regulation information service system	○	○	○	○	○
	Internet land information service system	×	×	×	×	○

○: Main users on serve systems, ×: No users on serve systems

<Figure 15> Nationwide constitution on the LMIS



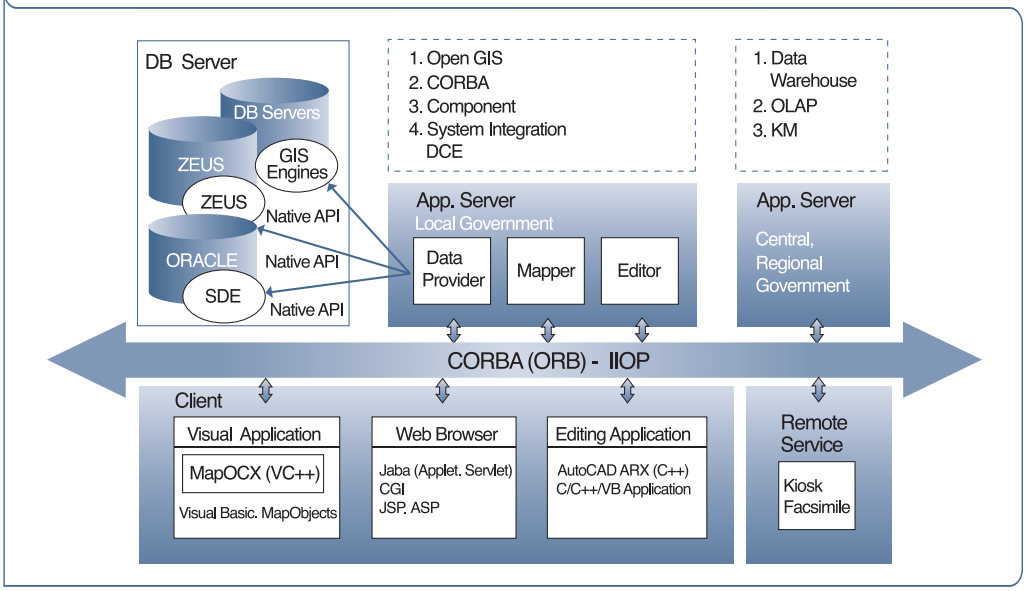
composed of the national administration information network and the Internet, in accordance with an environment of offering access to land databases. For example, the Land Information Service System provides the land information to civilians through the Internet. Other systems, except the Land Information Service System, are connected with high-speed national information communication network and they comprise a system to maintain efficient sharing and consistency of data between the MOCT and municipalities (Figure 15).

2) Basic system architecture

In the LMIS, an open architecture, which emphasizes development of IT systems, economical efficiency and extensibility, was designed to support heterogeneous dispersion-environment among municipalities. Korea has adopted a three-tiered client server architecture (Clients-Application Server-Database Server) that applies the standard specifications of CORBA (Common Object Request Broker Architecture) and the server can be divided into data provider, edit agent, and map agent (Figure 16).

The map provider searches spatial data from GIS engine and transmits the data to map agent and clients; an edit agent carries out editing of the spatial data (input,

<Figure 16> System architecture on the LMIS

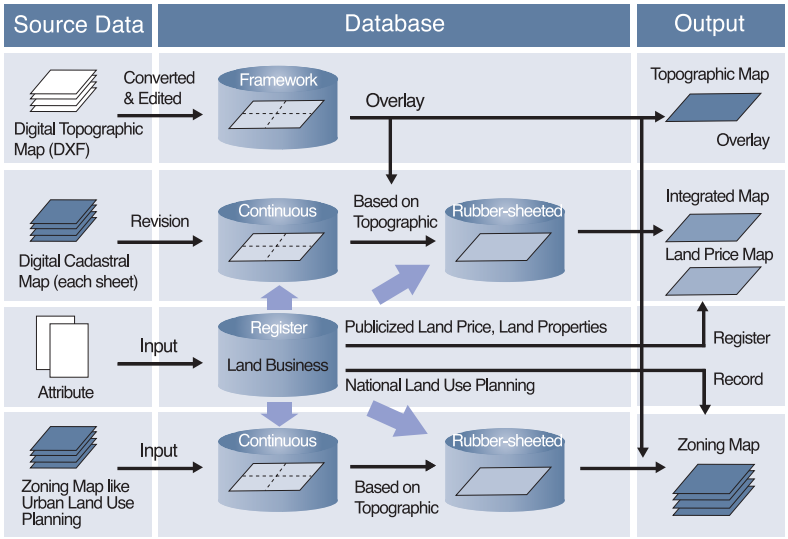


revision, and deletion). The map agent creates map images by using the spatial data received by the data provider and transmits the images to the clients. The map agent is embodied and operated by Java regardless of the platforms. Lastly, a web server provides spatial data to the relevant organizations through the intranet and also inquires into the spatial data for civilians through the Internet.

2. Land Database

The land database is a unit of municipalities and the land database will provide spatial data such as a topographical map, cadastral map, continuous-cadastral map, rubber sheeted-cadastral map, and zoning map and non-spatial data (attribute data) such as a publicly announced land price, land use plan, land transactions, and real estate brokers (Figure 17). As for topographical DB, major data layers concerned with land management operations such as roads, buildings, and railroads produced in the National GIS project[2], were built and utilized. As for continuous-cadastral and rubber sheeted-cadastral DB, files produced in the computerization of cadastral maps project by the MOGAHA were used. However, a zoning DB was built into the database by using national land use plans, urban plans, and cultural assets kept by municipalities.

<Figure 17> LMIS database creation



Except for spatial and non-spatial data, there are more than 80 different land use-planning regulations and urban planning regulations regarding the use of the land. These data have been composed of a spatial data infrastructure, which is popular among municipal and civil affairs administrations. The data model and contents of databases were standardized for the sharing of land information between among information systems so that land databases can be used as a spatial data infrastructure in municipalities.

2) The Korean goverment initiated the first phase construction of the National Geographical Information System in 1995. With this project, the large portion of the nation was mapped in scales of 1/1,000 and 1/5,000.

V. Conclusion

The city-county-district, which is utilizing the LMIS, has obtained remarkable land management outcomes. The Intranet allows for the efficient search of spatial data. Thus, it decreases the issuance of public civil affairs, whereas the Internet leads to rapid increases of citizens' perusal of the land information. Combining the issuance of civil affairs has improved the quality of civil services. It also significantly reduces outside costs by having land-price maps drawn internally. The system enables convenient operational transactions, as well as the enhancement of productivity of the operations without moving to a place where the data is kept.

There are several problems in promoting an efficient land-related project. Thus, continuing research and studies are needed.

First, the efficient land-related project depends on introducing the officials working in analogue setting to a digitalized world. It required a longer time and more efforts than we expected. Creating the land information-oriented system was an arduous process. Problems of accuracy and reliance on cadastral maps and zoning maps have been raised because it usually takes several months to evaluate the accuracy of the maps, and to identify the discrepancies within the existing data. There is no compensation for officials in city-county-district, who are responsible for solving these problems. Thus, the officials in charge tend to avoid working on the problems. We should have an inductive counter-plan that encourages related officials in municipalities to take an active interest and role in the projects.

Second, we need to have a systematic approach rather than approaching only the officials in charge of the LMIS. It takes time to correct discrepancies in the existing spatial data and to check the accuracy of inputted databases. Therefore, the officials need to be devoted. If the LMIS is actively operated from now on, required manpower for LMIS project would be reduced. However, the project has required sacrifice on the part of the officials because they do not have the extra time for data consolidation and data check at the inception of the project. Building databases in municipalities is too great responsibility for a single official, but should have a systematic approach and adaptability on operating manpower.

Third, in order to promote an efficient information-oriented system, relevant systems need to be consolidated prior to the applications of the information technologies, and then the technologies should be consolidated. By this time, we are being constrained by many written and unwritten rules. The rules are dictated by people's needs, thus everyone has an obligation to follow the rules. In compliance, development and use of the LMIS should be carried out systematically. Systems

sometimes act irrationally during the land information-oriented process. Thus, it should be modified to suit the working environment even when the systems are irrational. Therefore, the success of the LMIS development project depends on the rational conversion of the analogue land administrations to a digital environment. However, this is a time-consuming process because we need to collect a great deal of information while consolidating methods and standards of existing laws. In this case study, there were many difficulties in promoting the LMIS development project due to simultaneous system consolidation and information system development.

From now on, fundamental problems in a land information-oriented system should be addressed. People might think *e*-Land is just an information-oriented system or a digitization for managing lands. However, land is more than soil and stones; it is a part of people's history and values. Only when *e*-Land is like land will it be able to make our lives easier. This is the ultimate goal of the LMIS.

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