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2019

Development of a Big Data Platform for Converged and Integrated Applications in Land and Housing

Mijeong Kim

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This study is to create an easy and convenient base for convergence and processing from a user perspective and to propose measures to provide standardized data that can be used in various fields. In this contest, the land and housing big data platform will play an important role in creating various new industries in the future by acting as the seed of data-based policy decision making in the public sector and the creation of new industries in the private sector.

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- The 6th National GIS Planning, 2017, MOLIT
- A study on Policy Directions for Geospatial Information in a Hyper-connected Society, 2016, KRIHS
- Cloud Computing Adoption for the Geospatial Information System of Public Sector, 2015, KRIHS
- Spatial Big Data Utilization for National Lnd Policy, 2013, KRIHS

Contents

Summary	04
Chapter I. Research Background and Purpose	05
Chapter II. Status of informatization in land and housing and the implications	
1. Status of informatization in land and housing	07
2. Big data policy status	11
3. Environmental change and demand	13
4. Implications	15
Chapter III. Vision and strategies for the convergence of land and housing	
1. Development direction for the convergence of land and housing	16
2. Vision and strategies	17
Chapter IV. Measures and tasks for promoting convergence in the field of land and housing	
1. Provision of reliable data with high applicability	19
2. Construction and provision of user-friendly platform	21
3. Development of services with diverse applications in the public and private sectors	23
4. Establishment of the base environment for the promotion of land and housing big data platform	24
Chapter V. Conclusion	25
References	26

Summary

This study aims to suggest directions and strategies for promoting the industries related to land and housing in Korea by creating a base that enables easy and convenient data sharing and utilization in various fields.

In the land and housing sector, an information system is being built and operated for the efficiency of administrative work and convenience of citizen services. However, different data are being provided for the same contents because the linkage among data is not smooth and similar data have been developed in duplication by different institutions. These problems are hindering the promotion of the real estate industry and the private market.

Therefore, it is essential to build a basis to establish the master data that are commonly used in land and housing and to standardize and provide various data in the land and housing sector. In addition, a land and housing big data platform should be built to store, collect, process and analyze the data to then create new services.

Creation of a base environment is essential such as the institutions and public relations to be able to smoothly build and operate the land and housing big data and platform. Furthermore, it is important to improve the institutions related to personal information to enable diverse utilization of data as well as the institutions related to real estate market promotion to invigorate the market.

The land and housing big data platform will play an important role in creating various new industries in the future by acting as the seed of data-based policy decision making in the public sector and the creation of new industries in the private sector.

CHAPTER I.

Research Background and Purpose

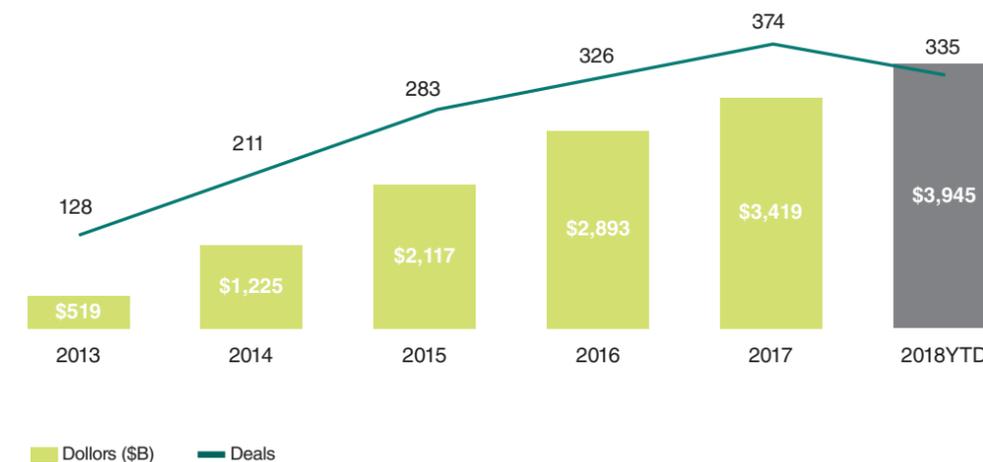
1) Data are the key driving force of the Fourth Industrial Revolution and serves as a catalyst for the development of all industries and value creation

Large amounts of data generated from sources such as the internet of things (IoT) and social networking services (SNS) are expected to serve as a driving force for the promotion of data-based industries and economies, and based on this, economic value creation will become possible. In particular, the range of application of land and housing data is expanding from the land planning sector to the financial sector following the growth of the related new industries such as PropTech¹⁾ and FinTech²⁾, resulting in the rapid increase of private demand for data.

1) PropTech : A compound word for "property" and "technology." Real estate services based on advanced information technology such as artificial intelligence, big data and block chains.

2) FinTech : A compound word for "finance" and "technology." Financial services through the convergence of finance and information technology.

Figure 1. Investment into Real Estate Tech is Growing (unit : USD billion)



Source CBInsights, 2018, The rise of real estate tech

2) Data and information systems are being developed and utilized for effective administration, convenient public services, and effective policy making, however, they are inadequate to be utilized by the private sector and new industries

In the field of land and housing, various systems have been developed and utilized such as the Korea Land Information System (KLIS), Real Estate Transaction Management System (RTMS), and Urban Planning Information System (UPIS). The data provided through such systems have limitations in that it is difficult to link them with various other data and conduct integrated analysis due to the issues such as lack of data standards, absence of metadata, and limited disclosure of related information such as personal information.

3) The purpose of this study is to create an easy and convenient base for convergence and processing from a user perspective and to propose measures to provide standardized data that can be used in various fields

This study aims to suggest directions and strategies for promoting the industries related to land and housing in Korea by creating a base that enables easy and convenient data sharing and utilization in various fields.

CHAPTER II.

Status of informatization in land and housing and the implications

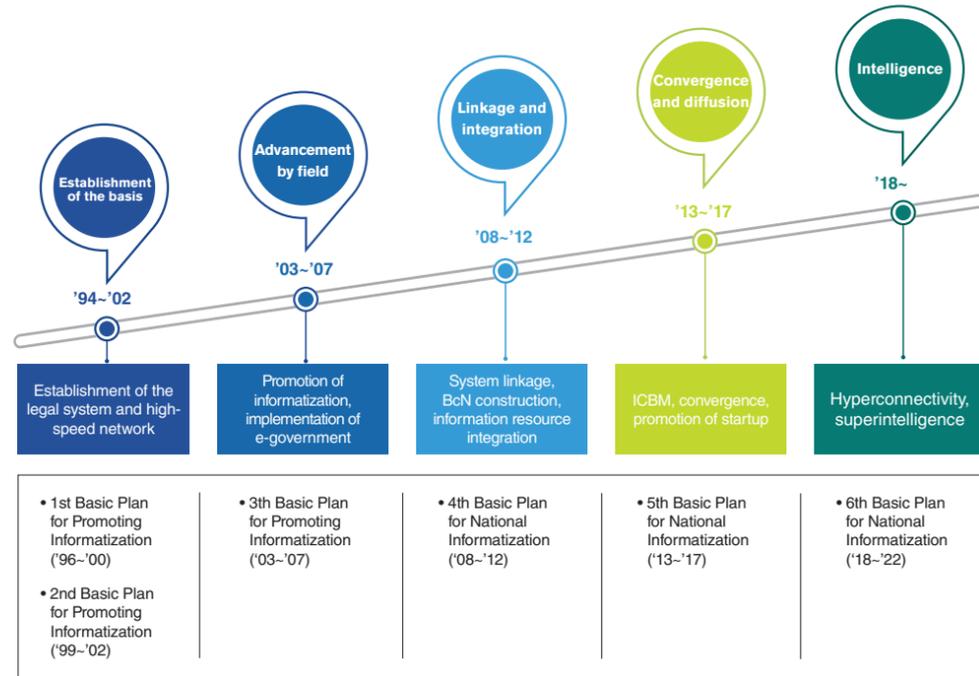
I. Status of informatization in land and housing

I) Background of the national informatization project

In the Republic of Korea, computers were first introduced to government work in 1961 when the punch-card system was used at the Ministry of Home Affairs Statistics Bureau (now the National Statistical Office) and in 1967 when 'IBM4101' was used at the Economic Planning Board (now the Ministry of Economy and Finance) for statistical task. A full-scale e-government policy was introduced in 1978 when the 5-year basic plan for administrative computerization was established and administrative information systems were built for every department and unit work to improve administrative efficiency and statistical processing. Since then, in 1994, the Framework Act on Informatization Promotion was enacted and a high-speed information communication infrastructure was established to start the realization of e-government based on the Internet. In 2006, the government established the 'basic plan for u-KOREA' to realize the advanced ubiquitous society and led the country to develop into a world-class leader in informatization, achieving the world-class e-government and broadband penetration rate. In 2011, a public data portal was built to open various data owned by the government so that anyone can use them conveniently and easily. In recent years, there has been a continuous occurrence of problems such as low compatibility among the systems of different departments, joint use of insufficient data, and information security issue including the hacking and leakage of personal information. The new 'basic plan for national informatization' is being promoted to solve these issues.

Source ICT Strategy Committee, 2018, The 6th Basic Plan for National Informatization for the Creation of Intelligent Information Society

Figure 2. Implementation of the basic plans for informatization



2) Status of information systems in the field of land and housing

The purpose of the information systems in land and housing can be divided into three types: the systems for carrying out efficient administrative work, the systems for providing transparent and convenient public services, and the systems for performing statistical work and issuing official documents.

Table 1. Current status of information systems in the field of land and housing

Field	System
Urban and construction	Urban Planning Information System (UPIS), Land Use Regulation Information Service (LURIS)
	Architectural Information System (AIS)
Housing and land	Apartment Housing Management Information System (K-apt), Public Price Information System, Real Estate Trade Management System (RTMS), Housing Site Information System, REITs Information System, Housing Information System (HIS), Rental Registration System, Real Estate Trade Statistical System
Spatial information	Spatial Information Open Platform
	Korea Real Estate Administration Intelligence System (KRAS) (Korea Land Information System (KLIS)), National Spatial Information Integration System, National Spatial Data Infrastructure Portal (NSDI), Spatial Information Dream
	Spatial Big Data System

First, the information systems for efficient administration in land and housing sector include Housing Site Information System (<http://www.jigu.go.kr>), Urban Planning Information System (<http://upis.go.kr>), and Architectural Information System (<https://www.eais.go.kr>). Housing Site Information System is built for the systematic management of information related to housing site development and project districts. Architectural Information System electronically handles the administrative tasks related to building licenses and provides public services. While not directly related to land and housing administration, Urban Planning Information System can be used to as a reference, which supports the administrative work and provides services related to urban planning.

Figure 3. Housing Site Information System (left) and Architectural Information System (right)



Second, the systems for providing transparent and convenient public service include Real Estate Trade Management System (<https://rtms.molit.go.kr>), Land Use Regulation Information Service (<http://luris.molit.go.kr>), and Apartment Housing Management Information System (<http://www.k-apt.go.kr>). Real Estate Trade Management System contributes to the transparency of real estate transactions and stabilization of the real estate market by computerizing the transactions. Land Use Regulation Information System aims to provide the citizens with the land use regulation contents and licensing procedures. Apartment Housing Management Information System was built to improve the transparency of management fees and sound management culture.

Figure 4. Real Estate Trade Management System (left) and Apartment Housing Management Information System (right)



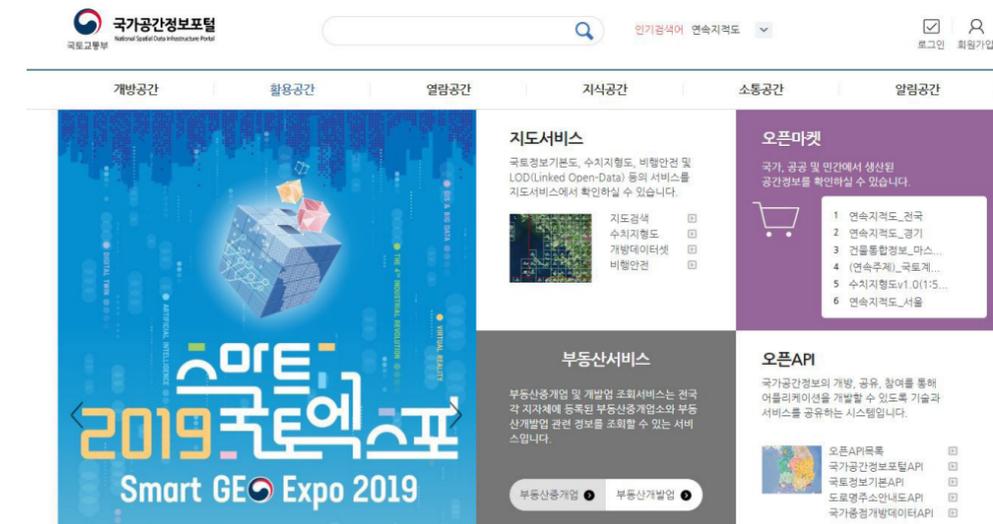
Third, the systems for performing statistical work and issuing official documents include Housing Information System (<http://www.housing.go.kr>) and Korea Real Estate Administration Intelligence System (<https://kras.go.kr>). Housing Information System was built for the national and local governments to utilize the housing supply statistics. Korea Real Estate Administration Intelligence System is a document issuance system for issuing 18 types of administrative documents related to cadastre, buildings and land use together at one window .

Figure 5. Korea Real Estate Administration Intelligence System



In addition, the systems related to spatial information which form the basis of other systems in the land and housing sector include National Spatial Information Integration System, National Spatial Data Infrastructure Portal (<http://www.nsd.go.kr>), and Spatial Information Dream. National Spatial Information Integration System operates within the administrative network and aims to collect and provide spatial information produced by various organizations. National Spatial Data Infrastructure Portal is a portal that allows anyone to easily utilize spatial information produced by the government, public and private sectors in one place. Also, Spatial Information Dream provides spatial information and analysis tools so that spatial information can be utilized in policy support systems.

Figure 6. National Spatial Data Infrastructure Portal



2. Big data policy status

1) Government major project implementation policy

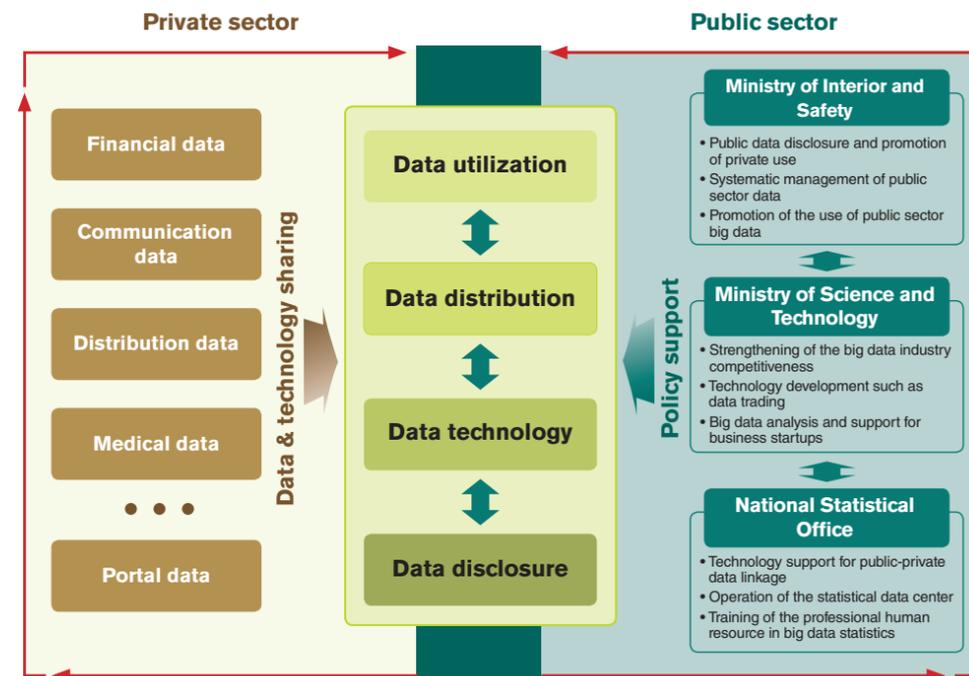
The current administration is promoting policies in two aspects: establishment of the foundation and discovery and fostering of new industries, aiming to lead the fourth industrial revolution and foster future industries. First, for the establishment of the foundation, the government aims to improve regulation and promote technology development to facilitate successful realization of the fourth industrial revolution, create the infrastructure and promote integration and diffusion by opening data and promoting distribution, and discover new growth engines and create jobs.

Second, for the discovery and fostering of new industries, the government aims to discover new industries through the convergence of the manufacturing, information and communication technology, and service sectors and foster them in key areas related to the fourth industrial revolution such as eco-friendly cars, autonomous vehicles, high-tech industry and drone industry. In particular, in the land and transportation sector, the government aims to build a foundation for the expansion of electric and hydrogen cars, the development of smart cars and autonomous vehicles, and the promotion of the drone industry.

2) Status of data policy promotion

The government is promoting the vitalization of big data in the public sector, enhancement of the competitiveness of big data industry, and technology development with the Ministry of Interior and Safety, the Ministry of Science and Technology, and the National Statistical Office as the central agencies with individual role allocations. The Ministry of Interior and Safety has enacted a data-based administrative law to facilitate the utilization of big data and the protection of personal information and is promoting the construction of a public big data center. The Ministry of Science and Technology is developing technologies that enable the utilization of personal information such as de-identification of personal information and block chain, is building an open data distribution platform, and is promoting policies for industrial revitalization and human resource training. The National Statistical Office is building a statistical big data center to share and provide statistical data.

Figure 7. The government's big data promotion policy



Source Hwang, Myung-wha, 2018, A Study on the Promotion Strategies and Change Plans for Land and Transport Big Data

3) Status of big data promotion at the Ministry of Land, Infrastructure and Transport

Since 2014, the Ministry of Land, Infrastructure and Transport (MOLIT) has been promoting about 17 projects for big data and platform construction individually at different bureaus and affiliated organizations. In addition, MOLIT established the Big Data Promotion Team through the development of data-based policies and the creation of demand from the private sector and is carrying out projects such as the making of 'land and transport information system guidebook', the organization and operation of the 'land and transport big data forum', and big data hackathon competitions for university students and startup companies. In addition, MOLIT has been establishing the spatial big data system since 2014, laying the foundation for application in land policies.

3. Environmental change and demand

1) Demand from the industry

To activate the industries that use public data, new policies are needed according to the environmental change in three major aspects.

First, the government needs to develop a new business model for the big data industry. In other words, it is necessary to develop a business model for open data that benefits both the private sector and the public sector as well as the citizens and this requires a development of a data production and distribution model with the cooperation from all three parties. There is a need for a business model that can generate synergistic effects where, for example, the basic information is produced by the government, distribution is taken care by the companies, and the data are updated by the citizens using the service. It is also important to create a market for the new public data projects where the private sector can be actively engaged in adding intelligence to the data already established by the public sector.

Second, the data-related regulations need to be improved and new institutions need to be established. In other words, institutional restructuring should take place to relax the regulations so that the private sector can obtain the high-quality data they need when public data are opened and so that new data can be reprocessed and produced. In addition, while relaxing the regulations on personal information protection, new systems can be established regarding the compensation and safeguard associated with the use

of personal information. Furthermore, there needs to be a guidance with regard to the collection, management, and utilization of data generated from the new changes in the technological environment such as connected car and smart city.

Third, we need to overcome the limitations of the current base for public big data utilization. Several issues exist, for example, the ability of processing data in specific locations only and not being able to use the results, and the difficulty of obtaining integrated data even if the data type is the same due to the data belonging to different management organizations. Therefore, data access should be made easier, and data sharing and open data should be expanded. Also, it is important to provide a flexible platform that can link and analyze various data such as spatial information-based real estate data in an integrated and convergent way. In addition, efforts should be made to produce new high-value-added data from the raw data collected from various sources such as CCTVs, autonomous vehicles, and sensors. Standardization of data is also a very important issue to increase the usability of the data provided.

2) Demand from the public sector

The public sector demand survey centered on the MOLIT has pointed to a number of improvement measures in three major aspects.

First, it is necessary to establish policies within the MOLIT regarding issues such as data provision, personal information, data ownership and management responsibility. At present, the public officer who decides to provide data is responsible for any problem caused by data disclosure and this leads to a passive attitude toward data sharing. Therefore, there is a need to establish and operate decision support organizations for data disclosure and sharing, such as a central response center and deliberation committees.

Second, a big data platform is needed as a technology infrastructure that can identify the location of data, link and integrate data, and process personal information. Such big data platform should perform integrated management and standardization of public data as well as support the promotion of data-based industries by expanding the provision of high-quality data with high applicability in the private sector.

Third, there need to be efforts to improve the capacity and awareness of the use of big data, such as the reasons why big data utilization is crucial and how to use them. Building a continuous utilization system is important by reducing the negative perception and providing training programs for data utilization.

4. Implications

As a result of analyzing the informatization projects, the status of big data policies, and the demand from the public and private sectors in Korea, the following suggestions can be drawn.

First, we need big data that can be used widely by the public and the private sector as a resource shared by the MOLIT. The sharing and disclosure of big data and value creation should not be done in a short period of time, but rather in a long-term plan. Therefore, a system of integration and convergence can be built first by sharing real estate big data preferentially including land and housing data that have a large number of existing systems and data as well as a large interest from the citizens.

Second, there is a need for a system that can manage and distribute big data in an integrated manner. The government can select and manage a number of master data items that are reliable and are used commonly in many fields and a system can be built based on this master data where the public and the private sector can perform integrated management of various big data.

Third, there is a need for a foundation for producing and providing high quality, high value-added big data based on consumer participation. To enable this, it is important to build a system that can process, converge, utilize and trade public and private data in various forms.

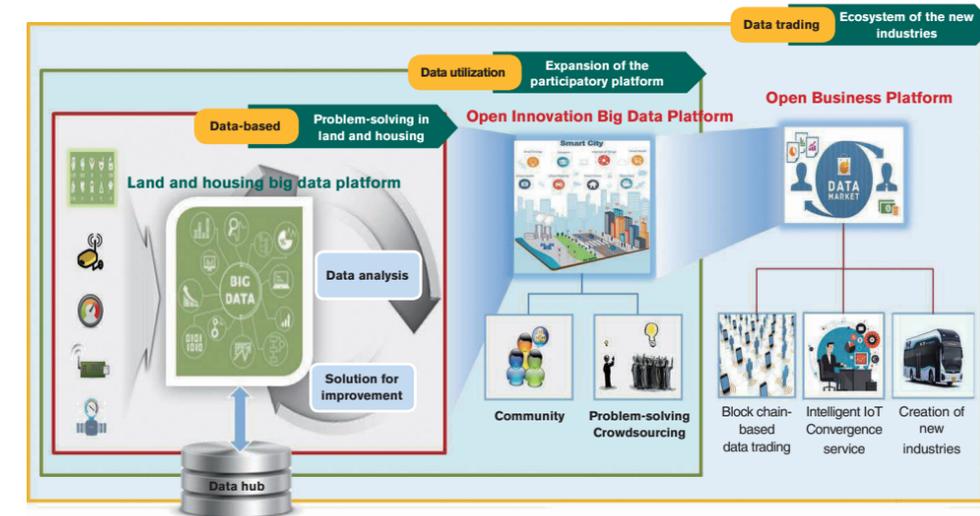
Fourth, it is important to expand the professional workforce so that big data can be used for diverse tasks internally and to build an external support system for the creation of new industries.

Vision and strategies for the convergence of land and housing

I. Development direction for the convergence of land and housing

The development direction of the big data platform for the convergence of land and housing can be divided into three steps. The first step is to analyze data using data hubs through the integration of public and private data, develop a data-driven platform to find solutions to address real estate issues such as land and housing issues, and develop a platform that can be utilized by the public sector for policy making. The second step is to evolve the platform into an open innovation big data platform that expands from a data-driven platform to a participatory platform where citizens can get engaged through communities and crowdsourcing. The third step is to develop the platform into an open business platform capable of generating block chain-based data transactions, providing intelligent IoT convergence services, and creating new industries centered on the private market so that the platform can ultimately play a key role in the ecosystem of the new industries.

Figure 8. Development direction for the land and housing big data platform



2. Vision and strategies

1) Vision and goals

The vision for building and achieving a land and housing big data platform is to create a real estate ecosystem by providing reliable data that users can utilize conveniently. To achieve this vision, we chose the goals as '3C': Credible, Cozy & Convenient, and Creative. The first is to provide credible data that are standardized, high quality, and up-to-date to enable efficient data utilization. The second is to provide an open platform based on cozy and convenient convergence to enable policy decision making and new business creation through processing, analysis and servicing of various data. The third is to create a basis for promoting a creative ecosystem including the institutions and education to enable creative activities using land and housing data.

2) Promotion strategies

To achieve the above vision and goals, we have derived four strategies in terms of data, platform, and infrastructure aspects.

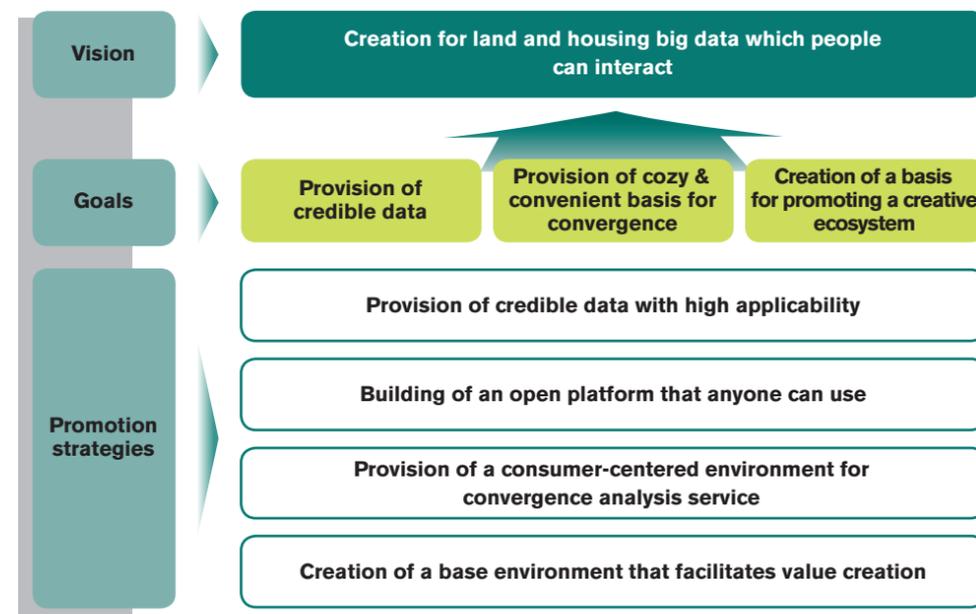
The first is to secure and provide credible data with high applicability. To be able to provide standardized and reliable data, we need master data that can provide standards for location and quality so that data can be processed into new data forms and be applied in various fields. Master data should be reliable and up-to-date with quality assurance and standards. In addition to these master data, the platform should also obtain and provide valuable data related to land and housing that can be applied in various fields.

The second is to build an open platform that anyone can use. This platform should be equipped with functionalities such as easy and convenient information search, reasonable price, and provision of services that the users want in both the public and the private sectors.

The third is to provide a consumer-centered convergence analysis service. The platform can build an analytical environment for new value creation by providing analytical tools that enable the private sector to develop and utilize data for new industries such as services that can be used for public policy making and FinTech.

The fourth is to create a base environment that facilitates value creation through big data and the platform. For this, it is important to build a foundation for sustainable growth including the governance and institutions for the central government, the public sector and the private sector as well as technology development.

Figure 9. Vision and strategies



CHAPTER IV.

Measures and tasks for promoting convergence in the field of land and housing

I. Provision of reliable data with high applicability

I.1 Establishment and provision of standardized master data

Master data should be built in the form of standardized clean data for use in the administrative and private applications in the land and housing sectors. Master data are critical for the uniform integration and provision of diverse data. Master data are the most essential data necessary for the collection and integration of various data and require plans for their properties, definitions and connection methods. Master data should be selected in consideration of factors such as the standard, applicability, versatility and economic efficiency. Master data can include information such as buildings, parcels, roads, rivers, administrative boundaries, grids and point of interests (POIs) according to the selection criteria.

I.2 Provision of diverse land and housing data

Diverse data on land, housing and related sectors are needed to make policy decisions in this field or to create new private real estate markets. Land and housing related data are mostly produced by public agencies such as the central government, the Korea Appraisal Board, and the Korea Land & Housing Corporation. However, the data produced by individual organizations are provided individually by each institution, and it is difficult to

understand the status of the available data due to the absence of metadata. It is difficult to utilize such data because users need to make requests to individual institutions separately through on-line and off-line channels to obtain data. In terms of data quality, the standards and the up-to-dateness of data vary from system to system, so consumers are repeatedly performing correction and processing individually. There is a need to establish a system that enables systematic information collection to prevent such unnecessary costs in advance and build an efficient integration and management base that enables the generation of high value-added applications.

Table 2. Land and housing related data (example)

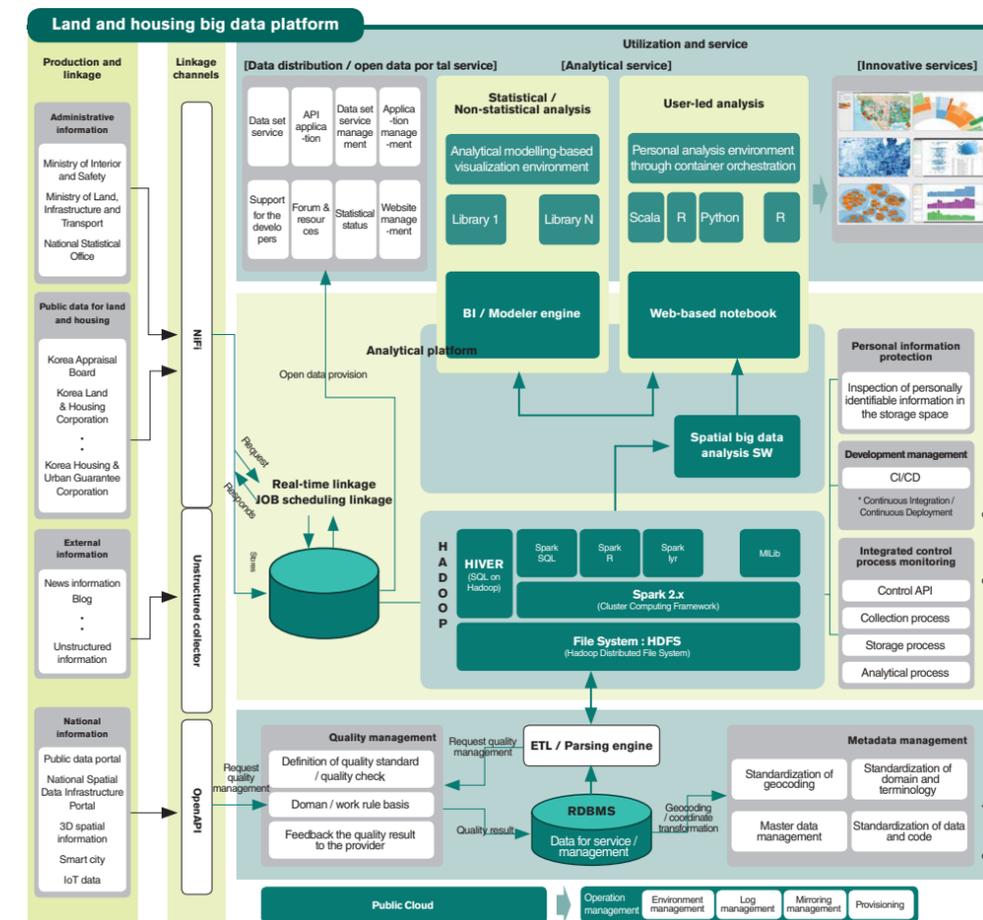
Name of the data provided	Data format	Source
Individual / standard public price	shp	MOLIT
Apartment house price	shp	MOLIT
Individual house price	shp	MOLIT
Real estate transaction information	API, CSV	MOLIT
REITs information	API, CSV	MOLIT
Apartment house maintenance fee	API, CSV	MOLIT
Individual public land price of parcels	API, TXT	MOLIT
Standard public land price of parcels	API, TXT	MOLIT
Public data for housing	API, TXT	MOLIT
Rate of change of land price	API, XLS, CSV	MOLIT
Housing price trend	API, XLS, CSV	MOLIT
Real transaction price index of apartment house	API, XLS, CSV	MOLIT
Office-tel trend	XLS, CSV	MOLIT
Commercial leasing trend	API, XLS, CSV	MOLIT
Real estate transaction status	API, XLS, CSV	Korea Appraisal Board
Store premium statistics	XLS	MOLIT

2. Construction and provision of user-friendly platform

2.1 Basic concepts

It is necessary to build a land and housing big data platform that collects, processes, stores, and manages data and provides application functions and services to promote the ecosystem of land and housing big data and develop services. The land and housing big data platform should play the following roles: ① collection and linkage of relevant data to provide data with high applicability in both the public and private sectors, ② life cycle management of data to ensure reliability, ③ standardized data management for easy and convenient data processing and convergence and provision of cloud-based analysis and development environment, and ④ continuous discovery and distribution of data and innovative services for the promotion of the ecosystem.

Figure 10. Composition of the functions of the land and urban big data platform



2.2 Platform functions

The functions of the land and housing big data platform can be divided into data collection and processing, data storage and management, portal service for data distribution, and analysis service.

For data collection, processing and storage, the application program interfaces (APIs) can be linked to enable collection in the case of the systems that provide data produced previously, and the ETL (extract, transform, load) tools can be used for data collection in other cases. The functions include the collection of large log data, gathering and monitoring, real-time data feed management, real-time data processing, and data storage.

Data distribution provides a data ecosystem through the land and housing big data and the analysis and services provided by the platform. The functions for distribution include three sectors: 1) data management sector which includes data classification, setting of the relationships among data, and definition of metadata; 2) service sector which includes inquiry and search, data service, distribution and community; and 3) data market sector which includes data trading, evaluation and price.

The functions of the data utilization and analysis service are to derive meaningful and insightful information by analyzing the data of current status spatially and visually in real time using the temporal and spatial land and housing data. To enable such analysis, the functions are divided into two domains: the domain for diverse analysis modules and the domain for producing new information using the data and analysis modules. Visualization functions are also needed to visualize these results in various forms.

Table 3. Analytical techniques required (example)

Type of analysis	Analysis method
General data analysis	Dispersion, correlation, regression, factor, cluster, optimization, time series, decision making, etc.
Spatial data analysis	Speed, density, pattern, autocorrelation, public office meeting, spatial interaction, location allocation, network, etc.
Future forecast analysis	Spatial diffusion model, SD model, simulation model, etc.
Policy effect analysis	Transfer function model, equation model, SD model, etc.

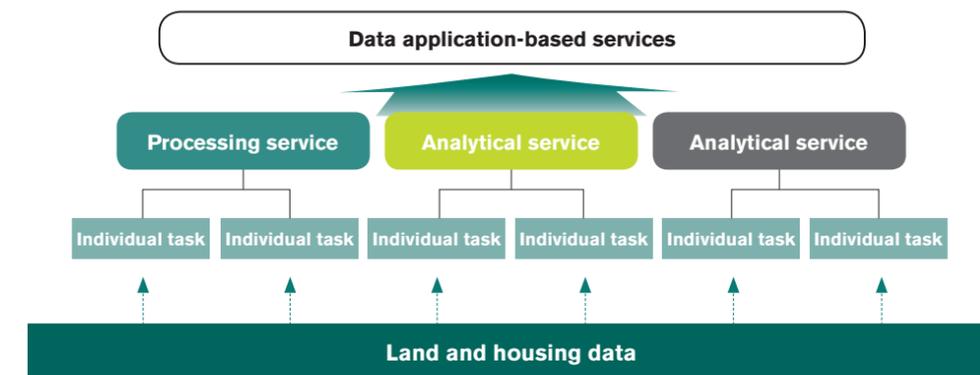
3. Development of services with diverse applications in the public and private sectors

It is necessary to actively identify and provide service cases by utilizing the big data needed by the central government and the public and the private sectors. Application services can be divided into three types according to the service target and objective.

The application services according to the service target can be divided into three types. The first is the platform application service for strategic decision making. This is a service to be used for national policy making and can be applied to data-based demand alignment, customized policy research for localities, and decision making conducted by various ministries of the central government (often conducted by national research institutes). The second is the platform application service for improving the productivity of institutions and reducing the risk which includes the use cases related to the work of public agencies such as the Korea Appraisal Board and the Korea Land & Housing Corporation. The third is the application for new business development of companies, for example, business creation of companies that are interested in using land and housing big data.

The application services according to the service objective can be divided into three types. The first is the processing service which collects the land and housing big data from public and private organizations that provide master data and processes and provides the data tailored to customers' needs. The second is the analytical service that analyzes the status of specific conditions or provides time-series forecast information using land and housing data. Finally, the third is the predictive service that performs simulations using the accumulated land and housing data.

Figure 11. Types of services to be provided by the land and housing big data platform



4. Establishment of the base environment for the promotion of land and housing big data platform

1) Publicity and education

To promote the land and housing big data platform, it is important to publicize the achievements of the development of contents and services built on the platform. In other words, the MOLIT should support the new services that use the database and analytical tools provided by the platform, business model development, and the marketing for the products. To achieve this, consulting services and professional training can be provided regarding the utilization of the land and housing big data platform. In addition, the MOLIT can introduce various cases of big data convergence and utilization in sectors other than land and housing such as national territorial, urban, and regional sectors as well as support the marketing activities, for example, the organization and operation of cyber show rooms for the promotion of new services and products.

In addition, the MOLIT can act as a specialized accelerator for fostering the startups that utilize land and housing big data. For this, it can provide general support for the successful promotion of startup businesses such as the development of unicorn companies for real estate and provision of customized technology consulting, S/W, human resource information, and linkages to investments. Furthermore, the MOLIT can also provide business matching support to create business opportunities based on land and housing big data.

2) Institutional restructuring

Among the laws and regulations for the utilization of land and housing big data, there is a need to reduce duplicate regulations and relax the regulations for application through the improvement of the legal system related to personal location information. In other words, it is important to review the laws related to personal location information such as the Personal Information Protection Act, the Act on the Protection, Use, etc. of Location Information, and the Act on Promotion of Information and Communications Network Utilization and Information Protection, etc. In addition, for the smooth utilization of location information, the system should be unified into the Personal Information Act and should be revised to enable data disclosure after making the personal information unidentifiable using pseudonyms or anonymized information.

Furthermore, the Act on the Promotion of Real Estate Services Industry should outline the basis for platform construction and operation to promote the land and housing big data and the creation of new industries.

CHAPTER V.

Conclusion

In the land and housing sector, an information system is being built and operated for the efficiency of administrative work and convenience of citizen services. However, different data are being provided for the same contents because the linkage among data is not smooth and similar data have been developed in duplication by different institutions. These problems are hindering the promotion of the real estate industry and the private market.

Therefore, it is essential to build a basis to establish the master data that are commonly used in land and housing and to standardize and provide various data in the land and housing sector. In addition, a land and housing big data platform should be built to store, collect, process and analyze the data to then create new services.

Creation of a base environment is essential such as the institutions and public relations to be able to smoothly build and operate the land and housing big data and platform. Furthermore, it is important to improve the institutions related to personal information to enable diverse utilization of data as well as the institutions related to real estate market promotion to invigorate the market.

The land and housing big data platform will play an important role in creating various new industries in the future by acting as the seed of data-based policy decision making in the public sector and the creation of new industries in the private sector.

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INDEX

Figures

- Figure 1. Investment into Real Estate Tech is Growing (unit : USD billion) **05**
- Figure 2. Implementation of the basic plans for informatization **08**
- Figure 3. Housing Site Information System (left) and Architectural Information System (right) **09**
- Figure 4. Real Estate Trade Management System (left) and Apartment Housing Management Information System (right) **09**
- Figure 5. Korea Real Estate Administration Intelligence System **10**
- Figure 6. National Spatial Data Infrastructure Portal **11**
- Figure 7. The government's big data promotion policy **12**
- Figure 8. Development direction for the land and housing big data platform **17**
- Figure 9. Vision and strategies **18**
- Figure 10. Composition of the functions of the land and urban big data platform **21**
- Figure 11. Types of services to be provided by the land and housing big data platform **23**

Tables

- Table 1. Current status of information systems in the field of land and housing **08**
- Table 2. Land and housing related data (example) **20**
- Table 3. Analytical techniques required (example) **22**

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