

A Strategy for developing the cadastral system of Cadastral Resurvey Project based on International Standard(LADM) in South Korea

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Key words: Land Administration Domain Model, cadastral resurvey project, Land Registration, Standard Model, Cadaster Standard

SUMMARY

ISO19152 international standard, led by ISO/TC211 in the meantime, has been published as an international standard at the end of 2012. It does not necessarily mean a simple document published. The FIG having the initiative in international standards-based technology is actively promoting overseas business in developing countries through developing a system based on international standards such as STDM. Developing a standard model based on international standards for Korea environment is no longer an option. In this paper, we analyzed the current cadastral resurvey project. Then we analyzed the proposed model in the field of cadastre up to now in Korea. We presented the future-oriented model of land registration for cadastral resurvey project which embraced both kind of standardized target for “Product” and “Process” perspective. This study was mainly carried out the existing literature research about the presented specific model. Therefore it is needed further development for technical model to verify the validity of the practical application.

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1. Introduction

Spatial Information Standard is the concept that includes standardization base, institution organization, laws necessary for acquisition, processing, storage, and distribution of spatial information. To enhance interoperability among information and bring about cost reduction, the Korean government has promoted standardization initiatives from 1st NGIS (National Geographic Information System) projects in 1995. Through existing policies centering on development and enactment, 105 national standards and 49 organizational standards have been developed, but less than 35% of GIS projects actually applied those standards.

To improve this, policy direction was shifted from “development of standards” to “compliance with standards” from the NSDI (National Spatial Data Infrastructure) project that started in 2010. Research on how to put the standards into practical use through the annual “National Spatial Information Standardization Project” has been done in order to enable the standards to actually be applied to work. In addition, to utilize the International Organization for Standardization as the base for globalization of Korean spatial information technologies, efforts have been made on the establishment of standard commercialization direction and coming up with a systemic foundation that allows automatic monitoring of standard compliance.

In the Cadaster area, “ISO19152 LADM” was published as international standard in late 2012. The enactment of LADM as international standard has big significance in that it is not only the first standard for a specific domain (cadaster) but also the first global standard for this field. By taking advantage of this environment, related industries at home and abroad are racing to launch new businesses. In particular, the Netherlands is actively implementing overseas projects by capitalizing on the LADM-based Social Tenure Domain Model (STDM). Against this backdrop, national efforts are required to continuously monitor overseas spatial information industry trends at the national level and to come up with countermeasure policies.

The Korean government is currently promoting policies to bring about integrated construction of DB and systems through the national spatial information integration system & cadastral system advancement project (previously the cadaster reinvestigation project) and the administration information unification system. To secure synergy through effective information linkage and integration, standards should come first. In addition, considering that those systems are built on cadastral information but it is not easy to share that information due to its own unique characteristics, reduction of technology gap should be preceded through

development of related standards in order to enable interoperability between cadastral information and other basic spatial information.

Taking a close look at related studies in Korea shows that a variety of studies are being carried out and suggestions are being made on how each country utilizes and respond to the LADM enactment. However, few studies are being done on the construction of models that apply LADM, and if any, they just emphasize the necessity of practical application at a theoretical level.

In this regard, this study aims to analyze domestic and international standardization trends of the cadaster area after the enactment of LADM and present ways to design an international standard-based model for land registration. To meet these purposes, the study 1) analyzes the current cadastral resurvey project in South Korea, 2) establishes the concept of the land registration standard model, and then 3) presents the direction of designing a Korean land registration standard model for cadastral resurvey project.

The study is focused on designing a standard model and putting it into practical use so as to utilize it through actual application. In this regard, by centering studying methods on case studies and literature research, the study was divided into analysis of LADM-related research, analysis of standard applied overseas cases, and analysis of international standards in the spatial information area and these analyses were conducted in consecutive order.

2. Outline of Korea Cadastral Resurvey Project

2.1 Summary

"Cadastral Resurvey basic plan" published in February 2013 based on the result of the preliminary feasibility study (2012.9.13) of Korea Development Institute is committed a massive national financial budget, 1.3 trillion won till 2030. And aims is realize transparent and effective government by increasing people's happiness through the completion of a Korean smart cadastre

Cadastral Resurvey basic plan is divided into 4 steps: Total project implementation period is 19 years. And Basic plan is modified every 5 years by considering the change in circumstances. 1st step as the initial phase of this project is performed for 4 years and to reflect the new policy paradigm. Total project revenue is 1.3 trillion won for control survey, resurvey, conversion of world Geodetic system coordinates, information system construction, reserve, etc.

Cadastral Resurvey project is invested massive budget, so the government is preparing a variety of ways in order to minimize the financial burden. As part of the plan, business budget cuts through the conjunction with other projects, such as SOC projects and to create a foundation for improve the public welfare

2.2 Standard research trends related to Cadastral Resurvey Project

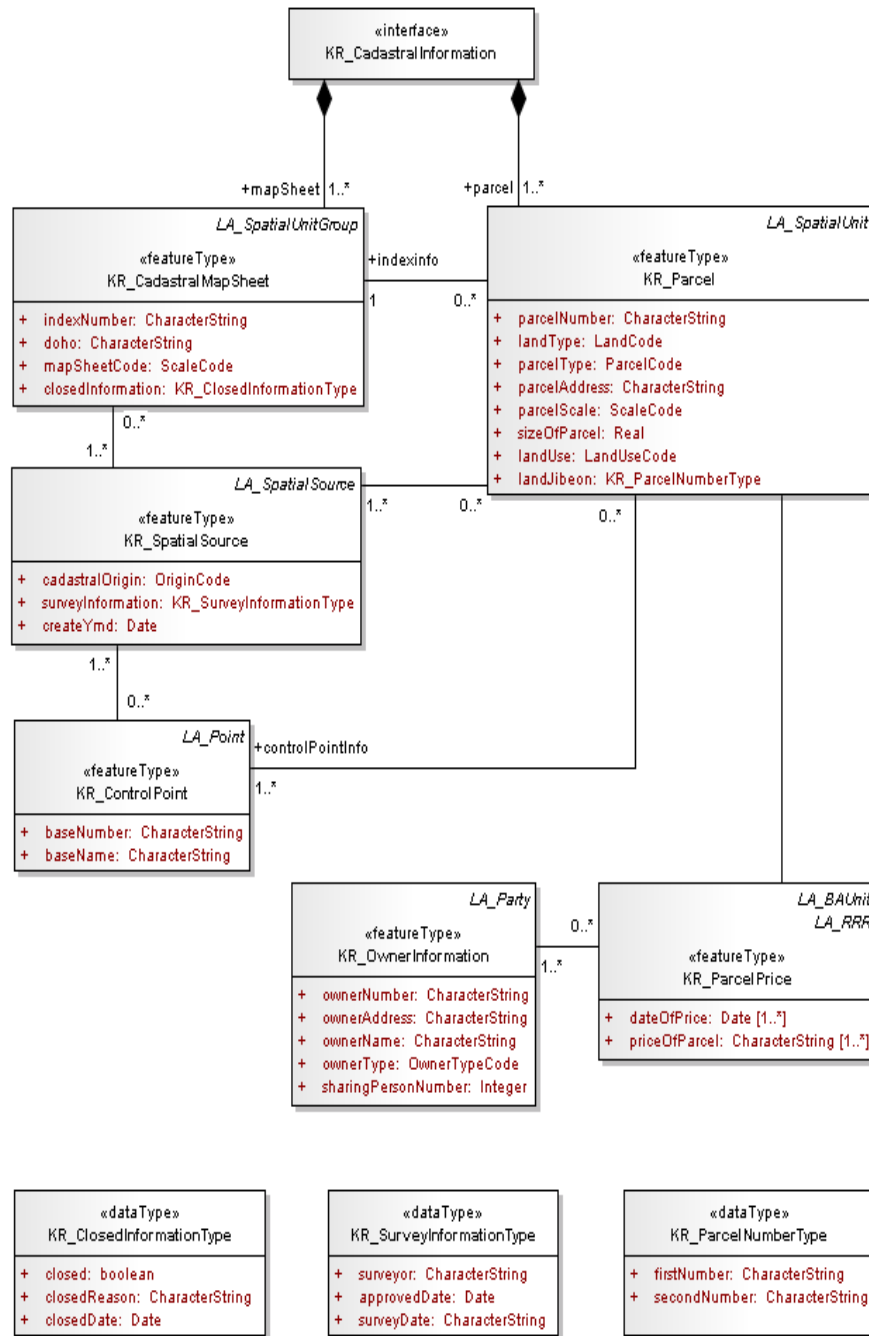
Since taking full charge of research on standards for cadastral and address areas in 2009, the government has continuously engaged in and expanded R&D on standards. Building on this, the government is conducting standard research projects on all spatial information-related areas in 2013. In 2010, the government presented 3 cadastral standards through “Study on Spatial Cadastral Information Data Model and Metadata Standard Development” and “Study on Cadastral Information Standard Development and Establishment of International Cooperation System.” Of the three, 2 standards (TTAK.KO-10.0503:Data Model, TTAK.KO-10.0504 : Production Specification) were adopted as TTA standards in 2011.

In 2012, it designed a next generation cadastral spatial information system based on international standards through a study on “Spatial Information Social Platform Construction and Spatial Information Utilization Policy Development,” and as an extension of the study, research on cadastral spatial information exchange and distribution standardization strategy is being carried out in 2013.

In particular, the data model standard completed in 2012 is the first cadastral standard based on ISO19152 (LADM). It is regarded as a big achievement since it has incorporated the international standard.

The cadastral information data model (TTAK.KO-10.0503), a domestic organizational standard, is redesigned to produce Korean Country Profile as shown in [Figure 4] by linking it to international standards. Its conceptual data model consists of 9 classes such as parcel, map sheet, spatial source, control point, owner information, parcel price, cadastral information, closed information type, surveyor information type, and parcel number type. The most essential information is parcel (KR Parcel). Parcel attributes include parcel number, land type, parcel type, parcel address, parcel scale, size of parcel, land use, and land parcel number. Detailed information on each class is described in [Table 2].

Korean Country Profile consists of minimal information that is considered core information required for cadastral system implementation. Therefore, it has the flexibility that allows it to be applied to all related systems.



Source: ISO, Korean Country Profile from Annex D, Figure D.9 of ISO(2012).
 This was created by the ISO LADM editors together with Bo-Mi Lee and Young-Ho Lee in consultation with
 Taik-jin Kim(ISO19152 EC member)

[Figure 1] Korean Country Profile (Korea Cadastral Data Conceptual Data Model)

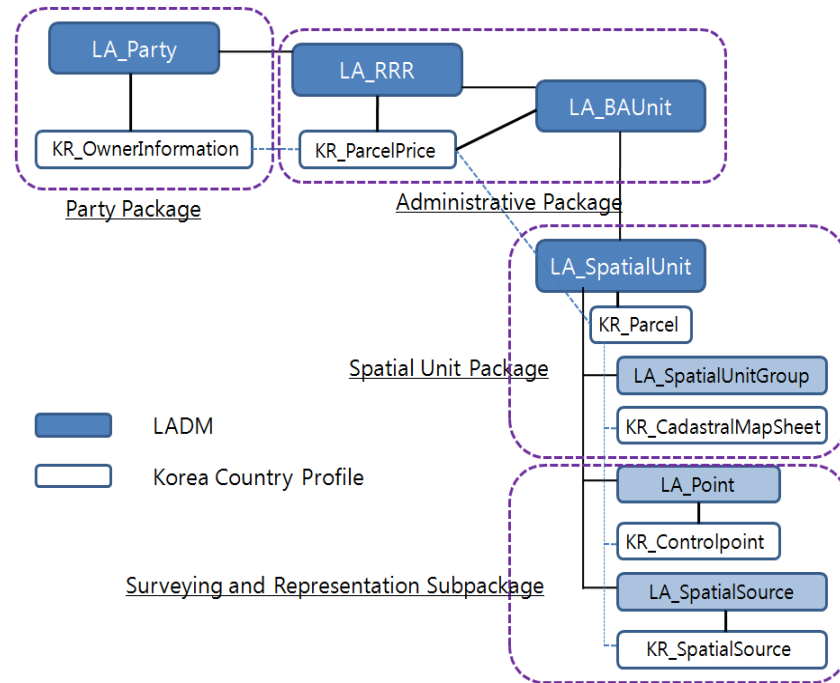
Class	Description
Cadastral Information (KR_Cadastral Information)	- The highest class including all information about parcel and cadastral map sheet classes
Parcel (KR_Parcel)	- The core class containing information on parcels. This includes attributes of parcel number, land type, parcel type, parcel address, parcel scale, size of parcel, land use, and land parcel number.
Cadastral Map Sheet (KR_CadastralMapSheet)	- Information about cadastral map sheets including map sheet index number, map sheet number, map sheet scale, and map sheet closed information.
Spatial Source (KR_SpatialSource)	- Attribute information shared by cadastral map sheet and control point classes. This includes attributes of cadastral origin, surveyor information, and creation date.
Control Point (KR_ControlPoint)	- Attribute information about control points. This includes base number and base name.
Owner Information (KR_OwnerInformation)	- Information about parcel owners including attributes of owner registration number, owner address, owner name, owner type and the number of sharing persons.
Parcel Price (KR_ParcelPrice)	- Parcel price information including attributes of parcel price and parcel price calculation date.
Closed Information Type (KR_ClosedInformationType)	- This data is generated if map sheet is closed due to parcel relocation. Attributes include map sheet closure Y/N, reason for closure, and closed date.
Survey Information Type (KR_SurveyInformationType)	- Information about parcel surveyors. Attributes include surveyor, approved date, and survey date.
Parcel Number Type (KR_ParcelNumberType)	- Information about parcel number types. Attributes includes first number and second number.

2.3 LADM Overview and Comparison with Other Models

LADM, the first ISO international standard in the cadastral sector, consists of 4 packages: Party Package, Administrative Package, Spatial Unit Package and the sub package of Surveying and Representation Package. Class makeup of each package is as follows.

- Party Package: LA_Party
- Administrative Package: LA_RRR, LA_BAUnit
- Spatial Unit Package: LA_SpatialUnit, LA_SpatialGroup
- Surveying and Representation Package: LA_Point, LA_SpatialSource

LA_Party is land owner information, and LA_RRR includes information about rights. LA_SpatialUnit involves information about spatial objects, and information of plural objects is separately defined in LA_SpatialGroup. LA_Point and LA_SpatialSource classes contain other surveying information. LA_Point stores point data gathered through conventional surveys and GNSS on the ground while LA_SpatialSource is the document containing surveying information such as distances, angles, and GPS coordinates.



If the Korean cadastral conceptual data model is matched with LADM classes, a relational map described in [Figure 5] is produced. Spatial Unit Package contains both spatial data and surveying information. In particular, surveying information is arranged as a separate sub package.

- LA_Party - KR_OwnerInformation
- LA_RRR - ParcelPrice
- LA_SpatialUnit - KR_Parcel
- LA_SpatialUnitGroup - KR_CadastralMapSheet
- LA_Point - KR_ControlPoint
- LA_SpatialSource - KR_SpatialSource

If a spatial system is designed based on the spatial conceptual model suggested in this study, the system can be considered an international standard-based one that enables interoperability with other systems since each class of the system is properly matched with LADM's relevant classes.

3. Setting up the Concept of the Standard Model of Cadastral Resurvey System

3.1 Definition of a Model of Cadastral Resurvey System

Land registration is an administrative act conducted by a state agency that involves stocking of land records for public announcement of registration details and provision of necessary information to land owners or interested parties. In addition, land records that register land by land parcel plays the role of public registries for the achievement of the government's financial and administrative objectives and at the same time the role of legal registries that help secure rights of land owners and conduct land transactions in a safe and speedy manner.

In "Cadastral Standardization Strategies in Accordance with Land Administration Domain Model Enactment" published by the Spatial Information Research Institute in 2012, Korea Cadastral Domain Model (KCDM) was presented as an international standard-based land registration model. As shown in [Table 3], the functions of the model include the three fields of spatial information design, management and renewal, and service.

[Table 3] KCDM Major Functions

Function	Sub Attributes
Spatial Information Design Field	- System management, spatial data inquiry, land transaction management
Management and Renewal Field	- Cadastral file inspection, land relocation readjustment, use zoning area management
Service Field	- Land metadata management, common library management

KCDM was designed based on the Cadastral Records System, the Spatial Data Management System, the Cadastral Surveying Results Recording System, the Land Documents Issue System, and the DB Conversion Management System of the Korean cadastral system KLIS (Korea Land Information System). In addition, the major functions above were drawn not

based on functional classifications but from the perspective of process standardization in order to provide information service from the practical point of view.

3.2 Establishing Functions of the Standard Model

As described above, this study has analyzed the relationship between LADM and the Korean cadastral conceptual model through analyses of overseas and domestic cases [Figure 5]. Comparison with KCDM again will help draw essential elements required for bringing about a future-oriented standard model.

[Table 4] Comparison of Standardization Target by Model

Classification	Standardization Target
LADM	Product
KCDM	Process
Country Profile	Product

The analysis in [Figure 5] took a functional approach from a product perspective while KCDM was classified into spatial information design, management and renewal, and service from a process perspective ([Table 4]). Therefore, a certain function, such as the service field, can be omitted ([Table 5]).

[Table 5] Comparison of Functions by Model (LADM vs. KCDM vs. the Korean Conceptual Model)

LADM	KCDM	Conceptual Model
Party	Spatial Information Design Field	Owner Information
Administration		Parcel Price Information
Spatial Unit	Management and Renewal Field	Parcel, Cadastral Map Sheet
Surveying & Representation		Control Point, Spatial Source
-	Service Field	-

However, the “metadata management and common library” function is an important area for information service. Thus, the establishment of a new land registration standard model that is able to incorporate strengths of both international standards and KCDM is badly needed. The

new land registration standard model should embrace existing standards and at the same time act as a new model that can apply them to domestic systems.

4. Direction to Establish the Cadastral System of Cadastral Resurvey project

The development of a land registration standard model is the task that must be fulfilled. For the development of the model since it is a national project to be utilized for various large-scale government projects including those in 3D cadastral and cadastral reinvestigation fields. This chapter is dedicated to presenting the direction of designing the new standard model that includes the results of previous studies by analyzing ISO191xx series and considering their correlation.

4.1 ISO191xx Series Analysis

To identify the fields to which land administration standards can be applied and define functions for each fields, the analysis of ISO191xx series, the standards for the international spatial information field, is required. To promote the easiness of standard application, in particular, the standards can be divided into three parts spatial information design, management and renewal, and service, and functions of each standard can be analyzed to identify correlation among ISO standards as shown in [Table 6] (the Spatial Information Research Institute, 2012a).

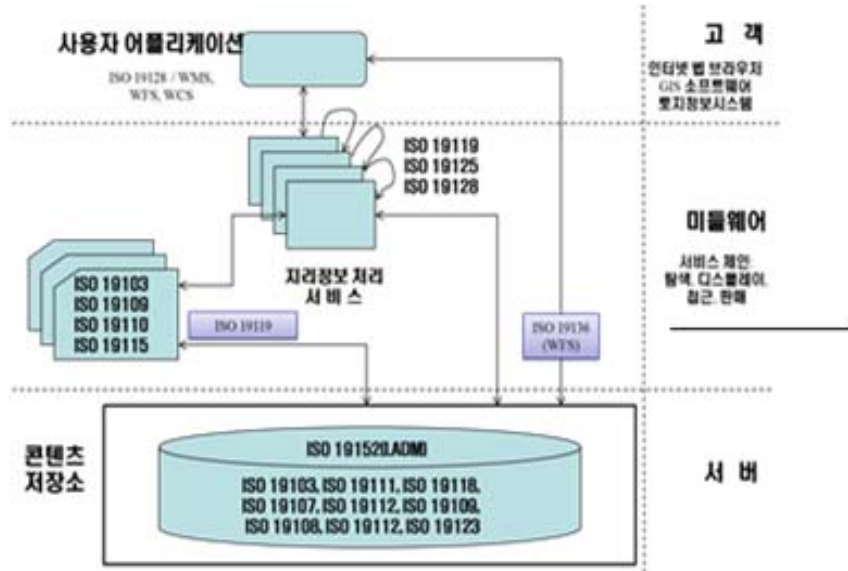
Field	Applied Standards
Spatial Information Design	ISO 19103, ISO 19107, ISO 19108, ISO 19111, ISO 19112, ISO 19123, ISO 19152
Management & Renewal	ISO 19109, ISO 19110, ISO 19115, ISO 19125
Service	ISO 19118, ISO 19119, ISO 19128, ISO 19136

The spatial information design field needs application of international standards such as rules and methods to store spatial object Data Base systemically. What is required, therefore, is the profiling based on international standards such as conceptual schema language (ISO19103), spatial schema (ISO19107), time schema (ISO19108), spatial referencing by coordinates (ISO19113), spatial referencing by geographic identifiers (ISO19112), schema for coverage geometry and functions (ISO19123), and land administration domain model (ISO19152).

The management and renewal field should manage the lifecycle of designed information and maintain latest information through frequent updates. To achieve this, the new standard should be designed based on rules for application schema (ISO 19109), methodology for feature cataloguing (ISO 19110), metadata (ISO 19115), and simple feature access (ISO 19125).

To provide up-to-dated information efficiently after construction, design should be done by considering encoding (ISO 19118), services (ISO 19119), web map server interface (ISO 19128), and GML (ISO 19136).

The application of ISO19100 analysis results can produce the concept map as shown in [Feature 6].



[Figure 2] Concept Map of Land Registration Standard Model (User Application / Customer / Internet Web Browser GIS Software Land Information System / Middleware Service, Searching Display, / Server / Content Repository / Geographic Information Processing Service)

4.2 Direction of Designing the Standard Model

As described above, the direction of designing the land registration standard model was presented from the 3 perspectives of information design, management and renewal, and service. The integrated standard model that this study wishes to suggest can be drawn by applying process standards of the functional aspect.

Field	Applied Standard	Standard Model Function
Spatial Information Design	ISO 19103, ISO 19107, ISO 19108, ISO 19111, ISO 19112, ISO 19123, ISO 19152	Land administration DB creation function

Management & Renewal	ISO 19109, ISO 19110, ISO 19115, ISO 19125	Spatial data change management function
Service	ISO 19118, ISO 19119, ISO 19128, ISO 19136	Metadata management& common library function

Building on the comparison and analysis of existing land registration models, the direction of the integrated model design this study suggests can come down to the following three points.

- LADM, the ISO international standard, should be complied with.
- The correlation with ISO19100 series should be considered.
- KCDM, the Korean cadastral model, should be included.

5. Conclusion

The study was conducted to present the direction of a Korean land registration model design for cadastral resurvey project. To fulfill this purpose, it studied trends of cadastral standards at home and abroad after the enactment of LADM, 1) analyzed the current cadastral resurvey project, 2) established the concept of the land registration standard model, and then 3) presented the direction of designing a Korean land registration model for cadastral resurvey project.

Using case studies and literature research as main study methodologies, the study conducted analyses of LADM related research, standard applied overseas cases and international standards in the spatial information field in a consecutive manner.

The standard model produced is focused on practicality so that it can be used through actual application.

Korea lacks a national cadastral standard model, so the development of an integrated standard model in the cadastral field is an important project to be promoted at the national level.

A future-oriented land registration standard model should be an integrated one that embraces both the product and process points of view. To give it concrete shape, the following 3 actual models were compared and analyzed.

1. Models from the product point of view: LADM and Korean Country Profile
2. Model from the process point of view: KCDM

The study suggested that the land registration standard model should be based on ISO19152's LA_Party, LA_RRR, LA_BAUnit, LA_SpatialUnit. It applied functions of information design, management and renewal, and service fields, and defined corresponding international standards separately.

This study has its limits in assessing actual applicability since it mainly used literature research targeting already presented particular models. In addition, the study simply presented the functions required to design a standard model and international standards to be applied, so in order to verify actual applicability, the development of a technical model is required to apply it to actual systems.

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BIOGRAPHICAL NOTES

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