

A study on PAI (Positional Accuracy Improvement) of the Korea Cadastral Resurveying Pilot Project

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SUMMARY

The fast development and widely expanded applications of satellite positioning technology has made the basic assumption “control systems remain stable and unchanged” no longer necessarily true. Revision survey is a frequent and continued cadastral surveying work. The revision survey of cadastral maps not created with numeric resurvey, no matter its current format is numeric or not, still relies on the use of analogue media.

It inevitably becomes a major obstacle to improve the quality of revision survey. The cadastral surveying authorities have been long ignoring this problem, and even included a detrimental article in the newly promulgated “Operation requirements for executing revision survey on paper cadastral maps”. The quality of future revision survey is certainly open to suspicion. Starting from the practical matters surveyors of the local land offices shall face while executing revision survey, this paper intends to discuss feasible solutions and concrete steps to complete numeric revision survey, so as to meet the challenge of improving current operation models and creating a better management and application environment for revision survey.

Revision survey is a frequent and continued cadastral surveying work with high demands from the public. Consequently it is very common for an individual parcel in the database to be neighboring to parcels determined by other revision surveys. Although there have been many major breakthrough in surveying technology over the years, the essence of revision survey actually remains unchanged. From a technology evolution perspective, how to take advantages of the newly introduced instruments and operating procedures to improve the quality of revision survey, and in the mean time also take the requirements of management and application of revision survey data into consideration have become an issue we can never ignore or escape. When compared with the degree of dedication to the digitization of cadastral maps, it is questionable why revision survey never receives its deserved attention up to now. Despite numerous suggestions regarding the improvement of revision surveys, the cadastral survey authorities still haven't confronted this issue and drafted any affirmative and complete schedules for numeric revision survey.

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1. INTRODUCTION

Cadastral system of Korea was established for the purpose of tax collection and financial problems through initial land survey (1899~1904), pre-land survey (1904~1907) and Cadastral survey (1910~1918). Cadastral information has been operated with various geospatial data as well as contributed to the advancement of national industry and protection of personal property as administrative basic data. Most nations realize that Cadastre plays an important role in innovation of financial issues and sustainable development. However, a number of developing countries are in lacking the will to improve cadastral system. In this paper, new cadastral task was suggested in terms of improving reliability of land information rather than cadastral resurveying. High quality cadastral information means that positional information and attribute data are accessible to user.

2. CADASTRAL DEVELOP MODEL

2.1 Outline

Basic land policy is based on protecting land ownership and land evaluation for most countries. In other words, land management of tasks is divided in three areas, valuation of land according to land price, management of legal ownership and development of land use. A process of Korea Cadastre development, in the same way, initialized national financial problem and progressed relocation parcel boundary as industry develop and reinforced land registry system. By extension, land information was integrated by computer system so that multi-purpose cadastral system was created currently in use. Present Korea cadastral system has the various merits of using integrated information, which is statistical analysis, taxation, public communication, urban planning, housing supply, etc. Moreover, government related to land management carry out indigenous task through developing land policy, land usage management and social infrastructure.

2.2 Reengineering Land Administration System

An important change of land administration is that land information service transition from protection ownership to land transaction and build self-sufficient system. This change has a effect on public institution of land registration, Cadastre, cartography. In order to reduce financial burden by operating administrative organization, public sector will carry out a reshuffle and private sector, especially, will share the role of public sectors. Land administrative task, also, will improve in the way of downsizing and networking in order to lessen labor force. Central government will focus on development of land policy and public

and civil sector will take the area of data acquisition and management. This is another way to realize small government as well as transfer functional or repetitive task to non-government sector. Government concentrates on planning, control, creating service needs while public or civil sector are left in charge of the rest business. Cadastral enhancement need to improve information accuracy and establish integrated land service system based on cadastral information. Land administrative strategy will be structuralized in the frame of a wide scope.

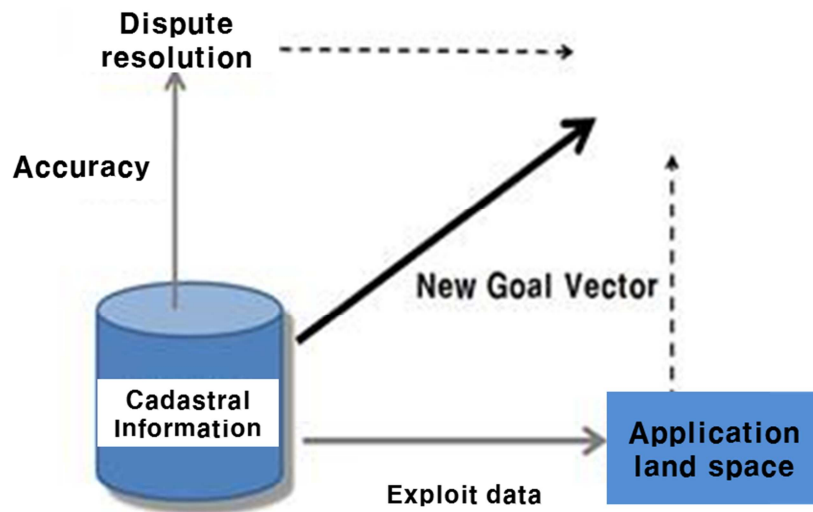


Figure 1. Cadastral Enhancement Goal

2.3 Innovation of cadastral technology and land administration

Cadastral information will be efficiently processed and managed, cartographic area in particularly will make rapid progress. Technology is very important in establishing land administrative system. Moreover, cadastral survey will be engrafted on GPS, GIS and numerical Cadastre so that cadastral information changes parcel based type. As land information system will be build, it is possible to search, inform surveying result in real-time and construct mobile survey system which are able to work at home. This technology reduces field worker's burden and costs, improve work efficient, accuracy, and propriety.

2.4 Cadastral innovation and enhancement

The world suggests new vision through management innovation and each country develops various land policy in order to achieve balanced development between regions. Especially, as critical land administration, innovation of cadastral system is the basis for new land management. Korea government adopted world geodetic system in order to easy to use of satellite navigation system, standardize spatial information and geodetic positional expression. Meanwhile, several ways of cadastral transition has been tried to create 3D cadastral system, resolution of non-coincidence and carry out cadastral reform. It is the time to propose new cadastral model and vision. In addition, it is necessary to suggest development

of service area contributing to the society at large rather than internal need such social needs, publicity and enhancement of performance organization. In order to achieve new model and vision, technological inefficient will be resolved and amend ordinance after establishing basis of cadastral reform using information technology.

3. DIRECTION OF CADASTRAL PROGRESS

3.1 Current state

Cadastral administrative is developing in direction of fusion service system since computerization which able to reduce simple management tasks. That is meaning of emphasizing aspect of data usage than data management. That is stand for change of traditional paradigm of cadastral concept. In other words, E-Cadastre and Smart- Cadastre comes to the fore as technology development of GPS and communication device so that basic paradigm changes from boundary management to land information exploitation. However, most important in using cadastral information is providing accurate data and updating in real-time. Initial Cadastre was operated for searching and indexing land information. On the other hand, current system combines cadastral map and books so that there is no difference between them.

3.2 Technical reform and PAI (Positional Accuracy Improvement)

Development of survey technique enables cadastral system to improve accuracy, reduce complicate survey process and decide rapidly parcel boundary using satellite positioning system. Cadastral reform project need to study in aspect of ordinance as well as survey technique. Recently, auto matching algorithm achieves improve field process by using statistical analysis based on existing cadastral map and real ground status.

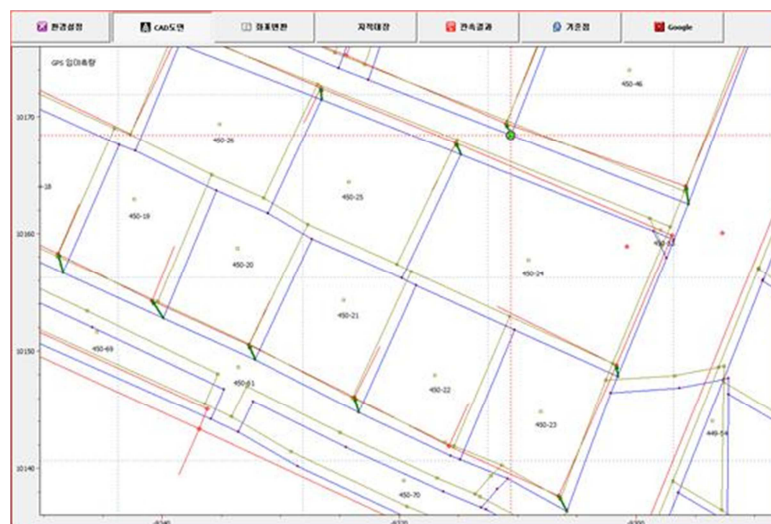


Figure 2. Automatic Parcel Matching

3.3 Improvement of geodetic network (world geodetic system vs. Korea geodetic system)

Geodetic Datum is the Reference of the earth's shape and size. That is divided in two, local and world geodetic system. Local geodetic system is decided based on mean sea level (MSL) in particular region. South Korea has used local geodetic system, Tokyo datum, from 1910 to 2001. Korea Geocentric Datum has difference with 300 meter in a north direction and 75 meter in an east direction. Therefore, geospatial information continuously converts to new world geodetic coordinate system. In the cadastral field, central government plans to finish conversion process by 2020.

Table 1. Korea Geodetic Reference System

Reference System	Korea Geocentric Datum (KGD)
Geographical Coordinate	Korea Geocentric Datum 2002 (KGD2002)
2D Cartesian Coordinate	Korea National Grid 2002 (KNG2002)

4. Model of advanced cadastral tasks

The development of Cadastral work must be advanced in terms of technical and Institutional aspects. It is the improvement of quality and accuracy of land information service. High-quality land information data is modeling to optimize of the service realization and to combine phase relationship between objects refined by the coordinates based on world coordinate system. It has resulted in a database model of land information. Thus, acquisition and management and use of the information aspects of the process to analyze the existing system and should be established the model with new user friendly system. For accurate location information and homogeneity of information, National Geodetic reference point system to be maintained primarily for this integration and technical review for the operation of the device should be made systematic.

4.1 Improvement on administrative system of national spatial information

It is required to improve the systems for data acquisition, management and distribution which make the structure of spatial information open at the stand of the sharing of the data integration and the structure service which owned by central and local governments with private sectors in order to make integration synergy for the function of the (national) land spatial information increased. The government agencies for making public services should supply the private sectors with the survey control information and the imagery information combined with cadastral information as the one of the administrative supporting data for the public benefits. In order to carry out the duty above, the spatial information owned by the National Geographic Information Institute (NGII) should be shared with the information acquired by Land Resurvey Project. Furthermore the handing over the works for instance data supply being accomplished by governments to the private sectors and the merger and

abolition of government agencies doing similar works should be considered as well.

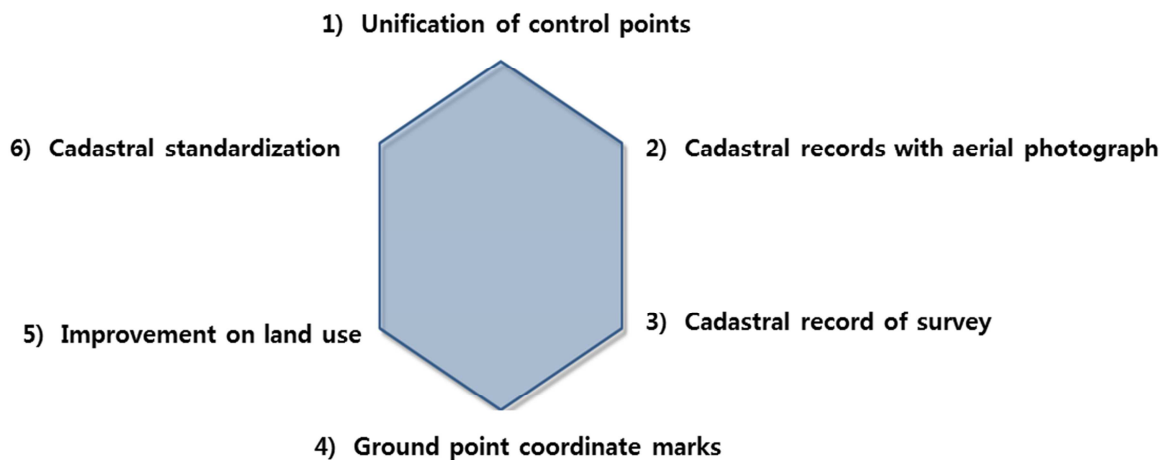


Figure 3. Cadastral Hexa Model

Imagery information with cadastral information based on homogeneous geodetic network enables survey result to improve accuracy so that position and attribute data assist in making decision rapidly.

4.2 Strategy of cadastral tasks

The main purpose of the cadastral service improvement is to proceed the cadastral information process to customer-oriented one. In other words, it is to switchover from the current negative systems, the priority order is to protect of the land information, to the positive systems making enlarge the cadastral information ultimate usage along with the refining on cadastral information. There is the necessity for the strategic dissemination of the cadastral-based spatial information using imagery information as the distribution for spatial information industries is low and the amount of information is short. It can be solved by making use of private surveyors in fundamental data acquisition and repeat work under the definite portion of the work and the strict data inspection.

The solution can accelerate the Land Resurvey Project being done currently and make the private sector industries encouraged as well. In order to successfully implement the strategy, several plans can be considered. First, the advanced strategy should be set up focusing on the encouragement of private enterprises in the parts of data acquisition, management and services. At the same time another strategy being linked to lots of service sectors, building management, graveyard survey support, forest resource management, population statistics map, national assets management, military-civil joint system, new addressing system, etc. should be searched as well. Second, new bilateral information system and service model

based on cadastral spatial information in the land information process should be developed. Third, the stage of the Cadastral Advance Project should be established by every 5 year cycle according to the financial and urgent availability. As an example, the refinement of survey control marks should be started preferentially. Fourth, the performers and workloads settled by the business strategy should be managed by public institutes preferentially. While the governments should make plans and prepare business supporting systems. Lastly, location accuracy and system priority including cadastral survey information related to image-based cadastral map should be more improved. And these tasks can be possible after the refinement of survey control being the basic of the Cadastral Advance Project and the acquisition of imagery information are required preferentially.

4.3 Cadastral map with aerial photograph

Cadastral record with aerial photograph is produced by overlapping an original cadastral map, ortho-photograph and satellite image corrected geometrically. The cadastral record with aerial photograph can be used to acquire positional information of areas where is hard to access and areas where buildings are crowded, and understand land use types. It can be also used in order to improve an accuracy of map as support data. The records can prove land use information by monitoring land changes and using these records as important data for follow-up land changes. Therefore, image information has more advantages in terms of practical use and evidential materials than in terms of positional accuracy in informative age.

4.4 Cadastral record of survey

The general information of old cadastral map is geometry locations and parcel boundaries. To make a decision of actual location, it needs control point results and measurement in field. The data quality makes a balance when the cadastral data follows five W's and one H rules. But until now old cadastral map did not have a high quality because of using local situation and local control points.

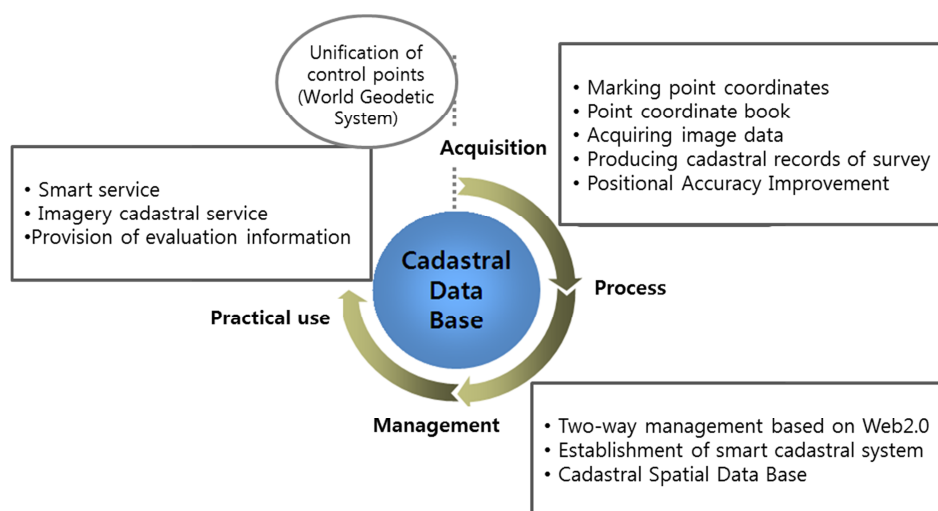


Figure 4. Circulation of Cadastral Information

In order to improve this problem the field sketch should also should be digitized by surveyor and it should contain field measurement information to manage cadastral information. E.g. the field sketches are one of regal documents to maintain high quality of cadastral data in Germany. Construction of digital cadastre project is based on the World Geodetic System in order to join international standard model. In addition, the digital cadastre will bring a reducing cost/conflict between owners. <Figure 5> shows that construction of digital cadastre project schedule until 2030. Recently, development of science improves accuracy of aerial photogrammetry and GPS.

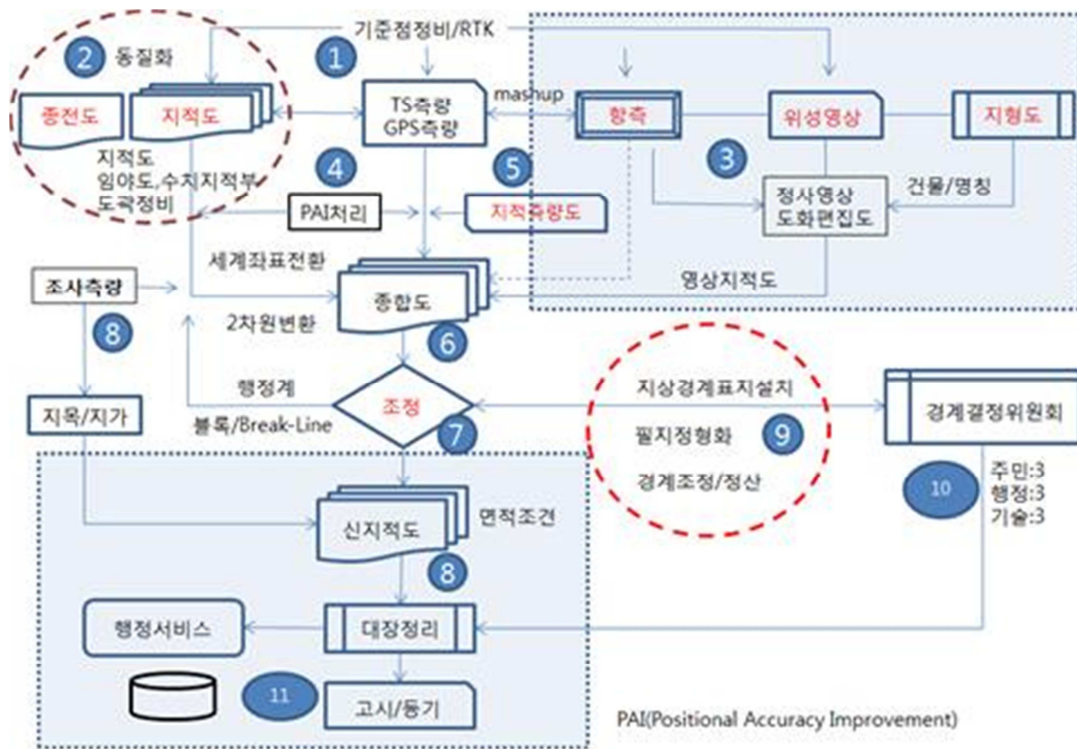


Figure 5. Cadastral Revision Process

Table 2. Main Content of Digital Cadastral System

Sort	Current	Advanced Cadastre Project
Cadastral record system	Cadastral map Cadastral book	Integrated real estate book
Information system	Graphical	Numerical
Accuracy	±36 cm	±3 cm

Reference system	Tokyo Datum	World geodetic system
Registration system	Surface	Above ground, Ground, Underground
Registration of the right	Surface ownership	Surface, Underground, Condominium ownership
Cadastral survey authority	Agency	Open
Registration object	Boundary	Building, Underground facility

5. CONCLUSION

Advanced cadastral project should set up the long term plans and strategies under national policy level. In this case, social/economic effect and cost benefit analysis should be considered in order to implement this project. Furthermore the elimination of redundant investment in this project is also important. To assist this project, the legislation and institution aspect also should be considered and if something is not suitable in long term plans, it should be reorganized. In technical aspect, improvement of the quality and accuracy in the cadastral map, reorganizing control point and transforming geo-reference system, are used for the Cadastre advancement project. Lastly, to have a support of the public, the education and publicity are needed to promote Cadastre advancement project.

The Cadastre is most important infrastructure to implement of land administration in national level. In EU council recommends that the Cadastre should be performed in social, legislation, technical aspect. For the next Cadastre, the accuracy of cadastral map and land information usage will be improved if these aspects are implemented together. Especially the main key point of next Cadastre is fulfilled by secured land ownership, land information usages, land information infrastructure and land development through Cadastre advancement project. To support this project, cadastral map has to be used in a spatial data domain not only in cadastral domain. It can be achieved by continuous map which guaranteed the data quality of accuracy and reliability.

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BIOGRAPHICAL NOTES

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