Designing System Architecture for Cadastral Information Dissemination using Internet
(In the Framework of Korean E-Government Concept)

Park, Jongcheul
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Designing System Architecture for Cadastral Information Dissemination using Internet
(In the Framework of Korean E-Government Concept)

by

Park, Jongcheul

Thesis submitted to the International Institute for Geo-information Science and Earth Observation in partial fulfilment of the requirements for the degree of Master of Science in Geo-Information Management

Degree Assessment Board

Chairman: Prof. Ir. P. van der Molen
External examiner: Prof. Dr. Ir. P. van Oosterom
Supervisors: Dr. M. M. Radwan
Ir. C.H.J. Lemmen

INTERNATIONAL INSTITUTE FOR GEO-INFORMATION SCIENCE AND EARTH OBSERVATION
ENSCHENDE, THE NETHERLANDS
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Abstract

Most of geographic information provision organisations are strongly being pressed to change in order to make it competitive and effective. Monopoly given to cadastral organisations and national mapping agencies in Korea no longer exists, if it does, then to a limited extent, with competition continuing to pose a danger to their continued existence.

Recent development in Geo-ICT, such as information system modeling standards, database technology, global positioning system, Internet technology development, wireless communication and acceptance of geometry standards have given tremendous push to change for cadastral organisations. As well as the Geo-ICT developments, the customers’ requirements, e-government policy and budget constraints are identified as key drivers to change for cadastral organisations. These external environmental factors push cadastral organisations in both the development of new cadastral systems and in the improvement of existing systems.

On the other hand the developments in Geo-ICT is the main supporter enabling organisations to keep pace with the changing environment. Geo-ICT is closely related to most of the working processes in cadastral organisations such as data acquisition, data processing, data retrieval and dissemination of products.

Particularly in Korea, despite the highly developed Internet network infrastructure and availability of a digital cadastral database including both administrative and spatial data, the cadastral information is still delivered through a manual process by visiting the municipality office or by telephone request. This manual process of cadastral information delivery causes many performance problems.

In this thesis dissemination of cadastral information through Internet network is investigated as one of alternatives to increase Korean cadastral organisations’ competitiveness. More particularly the system is proposed to be an extension of current Korean e-government service system (G4C: Government for Citizen) and to make use of the established e-government service infrastructure.

It is proposed that citizens will be able to access a wide range of cadastral information 24 hours a day and to apply for and receive copies of cadastral records at home or working place. From the organisation perspective, the labour intensive manual processes can be replaced by an electronic system. It gives two options for the organisation: reducing staff numbers or redeploying staff to other priorities or more complex work. Both of them will increase cadastral organisations’ operational efficiency.

This research deals with two main subjects. Firstly, an impact analysis of digital cadastral information is conducted in terms of economical, technical, legal (revision of current Cadastral Act) and social aspects. Secondly, cadastral information dissemination system is designed to overcome the performance problems of manual cadastral information delivery processes.
From an economic perspective, an electronic access is expected to increase the demand for products, which will decrease the price of transactions. Increased and improved access to cadastral information will provide support to legal security of rights of persons to land. This improvement in security of tenure will in turn stimulate the land market. Subsequently the stimulated land market could contribute to the development of economy in general.

From a technical perspective, the proposed cadastral information dissemination system will be an extension of the current Korean e-government service system (G4C) and cadastral spatial information will be a first step to accommodate a spatial component in the G4C. Ultimately the spatially enabled e-government service will support the Spatial Decision Support Systems (SDSS), which supports citizens and organisations to take the right decisions.

In order to implement the cadastral information dissemination system using Internet, a revision of current Cadastral Act and review of related legislation is proposed as a first step. On the social impact side, the Internet and communication technologies are expected to have impact on efficient and transparent land administration processes and this improvement will contribute to the reduction in the number of land disputes in Korea.

Data for this research have been collected using a questionnaire on user requirements for a cadastral dissemination system, conducted for three groups: the general public, cadastral public officers and Korea Cadastral Survey Corporation (KCSC) staff members.

Based on the identified user requirements system specifications have been formulated to meet user requirements. However these system specifications from the user requirements are not enough to design a system, which complies with the current e-government service system standards. Thus further system specifications have been formulated from a system designer’s point of view.

A conceptual system architecture has been proposed to meet the identified user requirements and the formulated system specifications and this system is modeled using Unified Modeling Language (UML) diagrams.

For a successful implementation of the e-government service system, making use of the existing public organisation’s national network such as post offices and banks is proposed as an alternative to physically accessing the Certificate Authority (CA). With close collaboration, these organisations will take a responsibility of receiving the authorized certificate applications and checking the applicant’s identification.
Acknowledgements

First of all, I would like to express my gratitude to the Korea Cadastral Survey Corporation (KCSC) for giving me the opportunity to continue my studies at ITC.

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Park, Jongcheul

March, 2004, Enschede
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<td>B2G</td>
<td>Private Company with Government</td>
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<td>C2G</td>
<td>Citizens with Government</td>
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<td>CA</td>
<td>Certification Authority</td>
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<td>CI</td>
<td>Cadastral Information</td>
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<td>CIDS</td>
<td>Cadastral Information Dissemination System</td>
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<td>DEM</td>
<td>Digital Elevation Model</td>
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<td>DTD</td>
<td>Document Type Definition</td>
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<td>E-Commerce</td>
<td>Electronic Commerce</td>
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<td>E-Dissemination</td>
<td>Electronic Dissemination</td>
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<td>E-Government</td>
<td>Electronic Government</td>
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<td>FTP</td>
<td>File Transfer Protocol</td>
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<td>G2G</td>
<td>Among Government Agencies</td>
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<td>G4C</td>
<td>Government for Citizen</td>
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<td>Geo-ICT</td>
<td>Geo-Information and Communication Technology</td>
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<td>GI</td>
<td>Geographic Information</td>
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<td>GII</td>
<td>Geographic Information Infrastructure</td>
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<td>GML</td>
<td>Geography Markup language</td>
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<td>GSDI</td>
<td>Geo-Spatial Data Infrastructure</td>
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<td>ICT</td>
<td>Information and Communication Technology</td>
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<td>KCSC</td>
<td>Korea Cadastral Survey Corporation</td>
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<td>KIEC</td>
<td>Korea Institute for Electronic Commerce</td>
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<td>KNSO</td>
<td>Korea National Statistical Office</td>
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<td>LBS</td>
<td>Location Based Service</td>
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<td>MOGAHA</td>
<td>Ministry of Government Administration and Home Affairs</td>
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<td>NGDI</td>
<td>National Geospatial Data Infrastructure</td>
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<td>NGII</td>
<td>National Geographic Information Institute</td>
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<tr>
<td>NGIS</td>
<td>National Geographic Information System</td>
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<td>NMA</td>
<td>National Mapping Agency</td>
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<tr>
<td>OECD</td>
<td>Organisation for Economic Cooperation and Development</td>
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<tr>
<td>PIN</td>
<td>Personal Identification Number</td>
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<td>SDSS</td>
<td>Spatial Decision Support Systems</td>
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<td>RA</td>
<td>Registration Agency</td>
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<tr>
<td>UML</td>
<td>Unified Modeling Language</td>
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<tr>
<td>W3C</td>
<td>World Wide Web Consortium</td>
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<td>WWW</td>
<td>World Wide Web</td>
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<tr>
<td>XML</td>
<td>eXtensible Markup Language</td>
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1. Introduction

1.1. Background

Recent developments in Geo-Information and Communication Technology (Geo-ICT) have given tremendous push toward the development of cadastral systems and geo-spatial data infrastructure (GSDI). This has created new perspectives in both the development of new cadastral systems and in the improvement of or extension of existing cadastral systems. Owing to a cadastral market pull, new requirements that satisfy users have emerged due not only the changes in Geo-ICT technology but also the changes in government policies, legislation, emerging new tasks of the organisations and users (Oosterom and Lemmen, 2001).

Most of Geographic Information (GI) provision organisations are strongly being pressed to change in order to make it competitive and effective. Monopoly given to cadastral organisations and National Mapping Agencies (NMAs) in Korea no longer exists, if it does, then to a limited extent, with competition continuing to pose a danger to their continued existence.

Historically, in many parts of the world, geo-spatial information such as cadastral maps, attribute information from registers such as title and valuation, has traditionally been gathered from isolated systems of surveying, title registrations and valuation assessments. As a result, getting complete and up to date parcel information is often time consuming and difficult. However, the development of Internet technology has allowed Geographic Information (GI) providers an unprecedented opportunity to disseminate data, and conversely, has allowed users an unprecedented access to volumes of GI (Williamson, 1999).

The access to cadastral information is very important because the information has to serve the land market, credit facilities, urban and rural planning and development, land taxation and management of natural resources, thereby enabling citizens and organisations to take the right decisions.

1.2. Research problems

Cadastral information usually consists of two parts, one is spatially referenced spatial data (cadastral map) and the other is land attribute data (cadastral register). In the recent past the Korean government initiated a six years (1996-2003) cadastral digitization project as one of the important National Geospatial Data Infrastructure (NGDI) components. As of December 2002, digitization of 613,000 maps out of a total of 748,000 maps (representing 82%) was completed. It is expected that a digital cadastral database will be available by the end of 2003.
The recent Network Readiness Index (2001 – 2002) shows that Korea marked 4.86 networked readiness index which means the Information and Communication Technology (ICT) infrastructure ranks 20th in the world (Kirkman, 2002).

However at present the cadastral information is still delivered through a manual process by visiting municipality office or by telephone requests. The manual process of cadastral information delivery has caused the following performance problems:

- High transaction cost (in both money and time)
- Restricted access period (office hours)
- Poor allocation of skilled resources (cadastral public officers)
- Out of date information (updating and disseminating time)

Therefore there has been an increased demand for up-to-date cadastral information from a large number of users. Thus there is a need for an efficient mechanism for making the cadastral information accessible through the Internet network to the majority of the users.

1.3. Research context

Korean government has recognized the importance of e-government early and has started building key national databases such as resident, taxation, and vehicle registration since mid 1980s. As Korean society became more information oriented and nation-wide digital networks were firmly established, the efforts to construct an integrated e-government system gained a significant attention.

Currently, the major tasks of Korean e-government can be classified into three categories: services for citizens, services for government, and infrastructure building. In particular, Government for Citizens (G4C) has been established as one of the core projects of the Korean e-government. Services are provided in the five most frequently used fields: residents, real estate, vehicle, business and taxation.

The e-government services are in the course of continuous upgrading and updating to achieve a complete and full-fledged stage of development, which will include digital information distribution, full-scale electronic commerce, and Internet banking and financing.

However the current e-government activities are primarily focused on text format information provision. That is mainly because of the availability of spatial database and complexity of handling spatial information compared to text format information.

Thus, this research focuses on how to improve the cadastral information dissemination by means of the current Korean e-government service infrastructure and to ascertain the impact of digital cadastral information is in terms of economical, technical, legal (revision of current Cadastral Act) and social aspects.
1.4. **Scope of this research**

This research deals with two main subjects. Firstly, an impact analysis of digital cadastral information dissemination is conducted in terms of economical, technical, legal (revision of current Cadastral Act) and social aspects. Secondly, a conceptual cadastral information dissemination system is designed in order to extend the Korean e-government services and overcome the performance problems of manual cadastral information delivery processes.

In this thesis dissemination of cadastral information through Internet network is investigated as one of alternatives to increase Korean cadastral organisations’ competitiveness. More particularly the system is proposed to be an extension of current Korean e-government service system (G4C: Government for citizen) to make use of the established e-government service infrastructure.

For designing the system Unified Modeling Language (UML), which is one of the most powerful object-oriented modeling tools, is used in this thesis. It is not intended to result in a fully functional system, but to show the UML usage in the development process from analysis to a proposed solution.

Recently the Korean government has identified the five most frequently applied and used civil service fields: residents, real estate, vehicle, business and taxation. In the field of real estate information e-government service the real estate register information, which is mainly real estate ownership information, is provided through the e-government service system. Thus in this thesis the cadastral information dissemination system is proposed to be an extension of current Korean e-government service system (G4C: Government for citizen) to make use of the established e-government service infrastructure in the field of real estate information provision.

Since the Korean e-government service system has been primarily focused on text format information provision service, the extension of cadastral information will be the first step to accommodate a spatial component in Korean e-government service system. The diagram below shows the scope of this research.
1.5. Research objectives

The main objective of this research is to analyze the impact of digital cadastral information dissemination in Korea and develop a conceptual system architecture and model the system based on identified user requirements.

In order to achieve the main objective, several specific-objectives have to be achieved. These are listed below.

1. Identification of key drivers to change for cadastral organisations and analysis of current cadastral information dissemination in Korea.
2. To analyze the impacts digital cadastral information dissemination in Korea in terms of economical, technical, legal (revision of current Cadastral Act) and social aspects.
3. Identification of the cadastral information user requirements in designing of dissemination system using Internet network.
4. To develop a conceptual system architecture for cadastral information dissemination.
5. To verify the proposed system design based on the identified user requirements and system specifications.

1.6. Research questions

In order to achieve research objectives, the following questions need to be addressed.

1. What are the key drivers to change for cadastral organisations and what is the current situation of cadastral information dissemination in Korea?
2. What are the impacts of digital cadastral information dissemination in Korea?
3. What are the strengths and weakness of different Internet data viewing and transfer tools?
4. What are the current cadastral information users, providers and administrators requirements for designing of cadastral dissemination system in Korea?
5. How can a conceptual system architecture for digital cadastral information system using Internet network be developed?
6. How can the proposed system be verified?

1.7. Research methodology

This research has been carried out under the following five components: problem definition, user requirements analysis, conceptual system design, verification and drawing conclusions.
Several tasks have been executed; each of the research questions shown above corresponds to each task.

**Task 1. Investigating the key drivers to change for cadastral organisations (Descriptive)**
This task helps to answer the research question 1. Comprehensive literature review will be carried out in order to investigate the key drivers to change for cadastral organisation and the recent Geo-ITC development.

**Task 2. Impact analysis of digital cadastral information dissemination (Analytical)**
This task is to answer the research question 2. The impacts of digital cadastral information dissemination in terms of economical, technical, legal (revision of current Cadastral Act) and social aspects will be addressed.

**Task 3. Identification of user requirements (Analytical)**
This task contributes to answering the question 4. Structured questionnaire method will be used to identify cadastral information users, providers and administrators’ requirements for the designing of a dissemination system using Internet network in Korea.
Task 4. Development of a conceptual system design
This task will answer the question 5. Based on the identified user requirements, and analysis of different Internet data viewing and transfer technologies, a conceptual system architecture and a conceptual cadastral information dissemination system will be developed by Unified Modeling Language (UML) modeling.

Task 5. Verification of the proposed system
This task will answer the question 6. The proposed system will be verified based on the identified user requirements and system specifications.

1.8. Prior research
This research is within the framework of improvement of cadastral information dissemination with the help of Geo-ICT development, some of the prior researches carried out within this framework and have been found relevant to the study include:

(Molen, 2001) in his paper highlighted a growing importance of data communication as a supporting tool focusing on land administration’s determining, recording and disseminating processes. A data communication technology is playing an important role in each land administration process.

(Koh, 1998) in his MSc thesis produced structured guidelines for access to government held geoinformation and proposed the cost recovery policy as a Korean model.

(Polley, 1998) in his MSc thesis focused on the study how the Internet can be applied to enable use of cadastral digital data, given current technical capabilities, and the needs of cadastral data users and providers.

1.9. Structure of thesis
The thesis is organized into seven chapters and they are organized as follows:

Chapter 1. Introduction
This chapter gives a glance over the research that includes background, research problems, objectives and methodology.

Chapter 2. Challenges of cadastral organisations and situation analysis
This chapter gives a description of the key drivers to change for cadastral organisation and current situation of cadastral information delivery system in Korea.

Chapter 3. Impact analysis of digital cadastral information dissemination
This chapter analyzes the impacts of digital cadastral information dissemination in the view of economical, technical, legal (revision of current Cadastral Act) and social aspects.

Chapter 4. User requirements analysis
This chapter analyzes the cadastral information users, providers and administrators requirements for designing of cadastral information dissemination system using Internet network in Korea.

Chapter 5. Cadastral information dissemination system modeling
In this chapter, a conceptual system architecture and a conceptual cadastral information dissemination system design have been developed by Unified Modeling Language (UML) modeling.

Chapter 6. Verification of the proposed system
The proposed system will be verified in this chapter based on the identified user requirements and system specifications.

Chapter 7. Conclusions and recommendations.
Conclusions and further research recommendations have been given in this chapter.

1.10. Operational plan

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2. Challenges of cadastral organisations and situation analysis

2.1. Introduction

The access to cadastral information is important because the information serves the land market, credit facilities, urban and rural planning and development, land taxation and management of natural resources, thereby enabling citizens and organisations to take the right decisions.

Many organisations for mapping and cadastre face similar problems. First of all there is tension between the organisational principles of the public administration and the requirements of an executive organisation. The aim for serving customers impact heavily on organisations for mapping and cadastre because they need continuity in investments in ICT and organisational development (Molen, 2003).

The objective of this chapter is to identify key drivers to change for cadastral organisations and to analyze current situation of cadastral information delivery system in Korea. In the first section of this chapter, key drivers to change for cadastral organisations are described. In the next section, the situation of Korean cadastre is analyzed in terms of geo-information provision organisation and cadastral information delivery system.

2.2. Key drivers to change

Most of geographic information (GI) provision organisations are strongly being pressed to change in order to make it competitive and effective. Monopoly given to cadastral organisations and National Mapping Agencies (NMAs) in Korea no longer exists if it does, then to a limited extent and still face competition.

Paul Van der Molen (2003) states that mapping agencies and cadastral organisations which do not develop a strategic view to the development of geo-information in society, and which cannot invest in adequate product development and service attitude, will face hard times and may possibly not survive. Insufficiently performing cadastral organisations supplying incomplete, incorrect, out of date, not timely information on ownership, value and use of land and real estate, cannot serve land tenure security, the land market, and government functions like land taxation, land use planning and development, and management of natural resources. The government might create new organisations in an attempt to neglect existing cadastres or if the government does not take action, an illegal land market and land use will come into existence.
Therefore, cadastral organisations have to adopt new strategies to cope with the new environment. When defining strategy, sound analysis of external environment should be the first priority. The question of who plays what role should be answered before defining how to achieve an organisation’s goal. The introduction of Information and Communication Technology (ICT) and the political factors such as governmental innovation and reformation, new legislation, etc. have forced NMAs to critically review their mandates and how the biggest return on the investment in national surveying and mapping by society can be realized (Groot, 1999).

John Meadows and John Formby (2003) states that government organisations are no longer immune to these changes and, like other organisations have had to react in order to prosper and survive and identifies the following external factors influencing HM Land Registry England and Wales renewal strategy.

- **Political factors**: Political change has taken the form of central government initiatives aimed at increasing the efficiency and accountability of government departments.
- **Economic factors**: Period of sustained economic growth, relatively high employment, low interest rates and de-regulation of the mortgage market making it easier to obtain secured loans.
- **Social factors**: Increased customer awareness, greater public demand for information and increased level of private home ownership.
- **Technical factors**: The digital revolution, growth in the use and ownership of personal computers, and the growth of e-business and on-line services.

Below is the overall picture of the context that contains cadastral organisations and key drivers to change.

![Figure 2.1 Key drivers to change for cadastral organisations](image-url)
2.2.1. Customers’ requirements

As consumers we have daily contact with efficient private sector business, which are making full use of recent technologies to improve the convenience of doing business with them. The convenient business interface provided by the private sector contrasts strongly with the bureaucratic government environment still prevalent in many land agencies and other government departments (Roux, 1999).

Citizens are becoming used to ever-faster response times and higher quality of products and services from the private sector. They expect the same performance from public administrations too. Obscure procedures, long queues, having to re-enter information that is already held by the administration, and “one size fits all” approaches are all practices that are increasingly criticized.

With the Internet becoming available in more locations and accessible to more people, the demand for online access to cadastral information is increasing. Kjellson (2003) identified the following number of cadastral trends relating to growing customer requirements on cadastral information dissemination.

- Market driven and increased interest in information means that there will be less focus on traditional activities such as mapping, surveying and registration.
- More non-professional usage of services, increase in public access to data through Internet services, 24 hours in a day and 7 days in a week service.
- Growing demand for integrated information services: i.e., cadastral and topographic mapping.
- Integration of data maintenance in order to make better use of technology, organisational resources and to cut maintenance cost.
- More global thinking, due to international demands for access to information, which will ultimately lead to more harmonization.

In organisations for mapping and cadastre traditionally a lot of attention is dedicated to the production processes, as daily maintenance and updating are major operational tasks. The risk is that managers pay insufficient attention to customers. On the pretext that customer disturbs the production process. Creation of a special customer unit therefore is recommendable. In fact the organisation is divided in two: the factory and the shop. All the contacts with the customer are channelled through the front shop. The creation of such a front shop/factory model requires appropriate strategy, planning and management as the organisation pursues for the production processes (Molen, 2003)

As government moves towards the implementation of online services, “one-stop shopping”, and integrated service delivery, consumer choice and accessibility should still be key concerns. The possibilities afforded by the available Internet and interoperability technologies are placing pressure on outdated practices, methods, and structures where they still exist within a cadastral organisation.

However some customers may choose not to transact business online or may not have access to the Internet, a telephone or a computer. These customers should not be ignored in the evolution of government service delivery and the re-engineering or modernization of a land management infrastructure.
2.2.2. Geo-ICT development

Recent developments in Geo-ICT, such as information system modeling standards, database technology, global poisoning system, Internet technology development, wireless communication and acceptance of geometry standards have given push toward both the development of new cadastral systems and in the improvement of or extension of existing cadastral system (Van Oosterom, 2002).

The combination of changes in government policy and regulations and technology presents a major driving force to changes in cadastral organisations. To achieve objectives of affordable, effective production and delivering the appropriate information product to the desired point of consumption at the required time, the cadastral organisation continues to drive suppliers of technology to deliver technology and solutions that enable better achievement of objectives (Roux, 1999).

As described in the previous section the developments in Geo-ICT has been key drivers to change in cadastral organisations. On the other hand the developments in Geo-ICT is the main supporter enabling cadastral organisations to keep pace with the changing environment. Geo-ICT is closely related to most of the working processes in cadastral organisations i.e. data acquisition, data processing, data retrieval and dissemination of products. Introduction of new Geo-ICT into cadastral organisation causes significant operational changes.

Oosterom and Lemmen (2002) points out the following Geo-ICT, which tremendously impact cadastral organisations:

- Geo-data infrastructure
- OpenGIS standards
- Unified Modeling language (UML)
- Geography Markup language (GML) and eXtensible Markup Language (XML)
- Developments in database technology
- Location based service (LBS)

2.2.3. E-government policy

The UN/DPEPA benchmarking e-government report (UN/DPEPA, 2002) defines e-government as utilization of the Internet and the world-wide-web for delivering government information and services to citizens. But in the broad sense e-government can include virtually all information and present a straightforward benchmark for information communication technology (ICT) platforms and applications in use by the public sector. However Kainz (2001) emphasizes the role of facilitating interaction between the citizens and the government, he defines e-government as a service infrastructure to facilitate the interaction of the citizens with the government and to increase the efficiency of information exchange and sharing among government organisations.

Since the mid 1990s governments around the world have been executing major initiatives in order to tap the vast potential of the Internet for the distinct purpose of improving the governing process.
Changes in government policy and regulations are a critical driving force to change in cadastral organisations. Roux (1999) underlined the following e-government drivers for change:

- The need to generate more non-tax revenue in order to fund required government operations without tax increase.
- Process reform and improvement, driven by demand for increased efficiency and speed in handling volumes of transactions.
- Public demand for integrated service delivery and improved front-end customer interfaces and services.

Especially the Korean government has been active in establishing e-government. According to the recent UN report (UN/DPEPA, 2002) Republic of Korea is classified into the “High e-government capacity counties” and marked 2.30 which is 15th highest e-government index points among the all UN member countries. Recently Korean government has released the “Strategy report for E-government” which has officially announced the 11 key tasks to complete the framework for e-government by 2002 (Table 2.1).

<table>
<thead>
<tr>
<th>Key tasks</th>
<th>Description</th>
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<tbody>
<tr>
<td><strong>Innovative and better services public and businesses</strong></td>
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<tr>
<td>1. Public-oriented service through a Single Window (G4C: Government for Citizen)</td>
<td>Establishing portal site and public information sharing system for five major databases in the areas of resident registration, real estate, vehicles, corporate and tax</td>
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<tr>
<td>2. Linking four major social insurance information systems</td>
<td>Linking medical, national pension, employment, and accident compensation insurances and activating information sharing</td>
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<td>3. Home tax service via the Internet</td>
<td>24 hour online service such as tax declaration and payment, affairs document issuance and tax counseling</td>
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<tr>
<td>4. G2B: Integrated e-procurement system</td>
<td>Establishing a single procurement window and making all procurement related processes electronic such as registration, tender, contract and payment</td>
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<tr>
<td><strong>Productivity and efficiency government</strong></td>
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<tr>
<td>5. Integrated national finance management system</td>
<td>Establishing a system for information sharing and linkage for finance related institutions</td>
</tr>
<tr>
<td>6. Integrated administration information system in local government</td>
<td>Completing information for all administrative affairs such as resident registration and real estate, finance, tax, etc. in 21 cities</td>
</tr>
<tr>
<td>7. Nation-wide education administration information system</td>
<td>Establishing an online logistics system for school affairs and education administration material connecting schools, Office of Education and Ministry of Education and Human Resources Development</td>
</tr>
<tr>
<td>8. Personnel policy management system</td>
<td>Developing and diffusing a standardized system for the whole human resources including recruitment, promotion, payment and training of public service personnel</td>
</tr>
<tr>
<td>9. Government e-document exchange</td>
<td>E-processing of preparation, approval, distribution and storage of all governmental documents</td>
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<tr>
<td><strong>Building an infrastructure for e-government</strong></td>
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<tr>
<td>10. Government e-signature and e-seal system</td>
<td>Securing reliability for information distribution and e-administration such as private information protection and security</td>
</tr>
<tr>
<td>11. Consolidation of government computing centers</td>
<td>Protecting 24 hour working, professional service, and secure information resources by managing computing environment in an integrated manner</td>
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Key national database systems and online public services based on these were already made available in the early 1990s. One of the recent developments towards e-government is the *Electronic Government Act* enacted in July 2001. As prescribed in the E-Government Act, the Korean government views an integrated government portal as a key instrument and pre-requisite for better and more customer-oriented information provision and government services. For this reason, like many other countries, the Korean government has been making consistent efforts for establishing integrated e-government service portal.

Korean government takes a two-way approach to implementing e-government service: on one hand the government information-sharing portal and on the other hand the e-government service portal. The former, which has a longer history, is focused on mainly providing government information and the latter on e-government services portal, the functionality of on-line transactions between government and the citizen as well as the business was included. The two e-government portals, information sharing and e-government service portal have been linked together and integrated into a single government portal.

In particular, Government for Citizens (G4C) has been established as one of the core projects of the Korean e-government. Services are provided in the five most frequently used fields: residents, real estate, vehicle, business and taxation. Service consists of 12 areas based on user convenience. Guides are provided for the 4,000 services that appear in the Civil Service Standards List. A total of 393 services can be accessed online. Some examples of services are listed in the following table.

<table>
<thead>
<tr>
<th>Category</th>
<th>Service coverage</th>
<th>Related agencies &amp; systems</th>
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<tbody>
<tr>
<td>Real Estate</td>
<td>Land/ Housing/ Construction/ Farmland/ Real Estate Brokerage/ Development/ Registry</td>
<td>Ministry of Construction &amp; Transportation (MOCT) Court Auction System Korea Housing Association</td>
</tr>
<tr>
<td>Vehicle &amp; Transportation</td>
<td>Cars/ Driver's licenses/ Bus lanes/ Used cars</td>
<td>Road Traffic Safety Authority MOCT Traffic Information Center Korea Highway Corporation</td>
</tr>
<tr>
<td>Tax</td>
<td>Income/ Local/ Corporation/ National/ Property/ Traffic taxes</td>
<td>National Tax Service Korea Federation of Taxpayers</td>
</tr>
<tr>
<td>Business &amp; Economy</td>
<td>Corporations in general (profit/non-profit)/ Wholesale &amp; Retail, Agriculture/ Mining</td>
<td>Ministry of Finance and Economy Ministry of Planning and budget</td>
</tr>
<tr>
<td>Travel &amp; Immigration</td>
<td>Travel abroad/ National tourist attractions/ Special local Products</td>
<td>Ministry of Culture &amp; Tourism Immigration Bureau</td>
</tr>
<tr>
<td>Defense &amp; Inter-Korea relations</td>
<td>Unification/ Inter-Korea exchange visits</td>
<td>Defense Security Command Emergency Planning Commission</td>
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<tr>
<td>Education &amp; employment</td>
<td>School/ Job search/ Certificates a qualification/ Employment insurance</td>
<td>Educational Statistics System The Homepage of CareerNet</td>
</tr>
<tr>
<td>Social security &amp; Health</td>
<td>Meritorious Awards/ Food hygiene/ Worker services/ Insurance/ Livelihood welfare protection</td>
<td>Communicable Disease Information System Ministry of Patriots &amp; Veterans Affairs</td>
</tr>
<tr>
<td>Arts &amp; Culture</td>
<td>Cultural properties/ Cultural facilities/ Movie industry/ Copyrights/ Libraries/ Museums</td>
<td>Ministry of Culture &amp; Tourism National Institute of Korean History</td>
</tr>
<tr>
<td>Recreation &amp; Sports</td>
<td>Sports facility business/ Youth training facilities</td>
<td>Ministry of Culture &amp; Tourism National Institute of Korean History</td>
</tr>
<tr>
<td>Environment</td>
<td>Environment/ Conservation/ Improvement of water</td>
<td>The National Fitness Center Korea Sports Training Association</td>
</tr>
</tbody>
</table>
2.2.4. Budget constraints

Paul van der Molen (2003) points out that many organisations for mapping and cadastre are facing the following challenges:

- First of all there is tension between the organisational principles of the public administration and the requirements of an executive organisation. The aim for serving customers impact heavily on organisations for mapping and cadastre. Because they need continuous investments in ICT and organisational development. The government however is restricted to its annual budget, which can differ from year to year because of the endorsement of Parliament, the inflexible labour conditions, changing political priorities, apart from political instability and lack of money.

- Secondly, governments tend to impose some kind of cost recovery regime on this kind of executive organisations, causing decrease of legitimacy because customers are not satisfied in their desire to receive value.

- Thirdly executive organisations are almost everywhere on top of the list for staff and budget reductions because this kind of going concern activities seldom are politician's favorite priority.

- Fourthly, under investments in mapping and cadastre have the potential to cause backlogs, which never can be overcome in the future.

Due to the serious governmental deficits, most countries have been trying to reduce the size of government and funds. Many governmental organisations have been privatized or independent from governmental intervention. Cadastral organisations are also confronted with the pressure of being independent organisations. It means that some portion of cost should be recovered by its own income. This situation however requires a new business paradigm.

Governments are under pressure to deliver more value for taxpayers’ money. Administrations have to deliver more and better services with equal or fewer resources. Public expenditure is severely constrained in many countries due to slow economic growth and the need to reduce budget deficits. The challenge is to achieve productivity growth in the public sector in order to create more opportunity for service improvement at equal cost (COEC, 2003).

Dutch Kadaster (The Cadastre and Public Registers Agency of the Netherlands) is one of the significant successful cadastral organisations. In 1982, the Dutch Government decided to improve the efficiency of government departments and the Dutch Kadastre undertook a series of reform. The goal of the Dutch Kadastre reform was to achieve cost-effectiveness by providing excellent services using advanced information technology, remaining a cost-effective operation, cooperating well with universities and private companies, and providing international consultancy. The organisation moved towards the direction of a self-supporting agency with large scale of contracting out of survey and mapping services.

Westerbeek (2001) states that Dutch Kadaster is focusing on the development of the following value added services:
• Peaceful conveyancing and peaceful access to credit
• Independent role in rural land development
• Basic geometry and maps
• Support to reliable valuation and taxation
• Supporting private and public business processes

2.3. Situation analysis of cadastral information dissemination in Korea

In this section three main government organisations, which provide topographic and cadastral information in Korea are analyzed in terms of main activities and challenges. The current cadastral information delivery system is analyzed in terms of the number of cadastral public officers handling this task and the volume of annual cadastral information delivery transactions in the following section.

2.3.1. Geo-information provision organisations in Korea

In Korea, there are a number of organisations supplying geographic information. There are three main government organisations, which provide topographic and cadastral information, and are identified as the most important producers of geo-information in the country in terms of main operations, activities, and information flow. These are the followings:

• Ministry of Government Administration and Home Affairs (MOGAHA, cadastral information).
• National Geographic Information Institute (NGII, topographic information)
• Supreme Court (real estate information)

2.3.1.1 MOGAHA (cadastral information)

Korean cadastral and real estate registration systems are administered by the executive and the judicial bodies respectively. Cadastral registration is based on the Cadastral Act, which governs the activities of the Korea Cadastral Survey Corporation (KCSC) and Cadastral Division while the legal registration is based on the Real Estate Registration Act, which gives guidelines to real estate registry offices. In general, the cadastral system can be grouped into the following three categories:

• Ministry of Government Administration and Home Affairs (MOGAHA) is responsible for the administration of Cadastral Divisions at the city, county, district and provincial levels. At each level, the local cadastral division stores and maintains cadastral registers and maps.
• MOGAHA also oversees the work and issues guidelines to Korea Cadastral Survey Corporation (KCSC) on all surveying activities. Whenever surveying activities are carried out, the KCSC provides new information to municipality by its local survey offices.
• Local real estate registry offices under the direction of the Supreme Court are responsible for real estate ownership registration.

The Cadastral Act governs all the process of cadastral work. Cadastral records both registers and maps are archived in municipality Cadastral Divisions’ offices. Automation of the cadastral register, which became operational in 1992, contains about 17 items of data for every parcel such as parcel...
identification number, location, land category, boundary, area, yield class, owner’s name, address, civic number, map scale, land use, control points, and so on. However, information about buildings, public utilities, mortgage, easement, and other rights on land are not included in the cadastral records.

2.3.1.2 National Geographic Information Institute (topographic information)
National Geographic information Institute (NGII) originated from the Survey and Cartography Division of the National Construction Research Institute of the Land Development Agency in 1961. It is now the central surveying and mapping organisation under the Ministry of Construction & Transportation. It has long been Korea’s topographic map authority and as such gives case-by-case permission to private map producers makers to produce various maps. It has a comprehensive in-house map production system serving other government entities such as government departments, municipalities, government-invested companies, individuals, etc. In response to these user requirements, its main tasks are as follows:

- Geodetic work, ground control surveys and precise levelling to establish fundamental survey networks.
- Geographical work such as the survey and compilation of topographic and facility maps at larger scales
- Information service for geodetic data, aerial photographs, maps and national land information;

The NGII is producing topographic maps at scale 1/5000, 1/10000, 1/25000, 1/50000, 1/250000, 1/1000000 and a 1/25000 scale land use map which cover the whole country. Since 1993, small-scale maps have been converted into digital form. With such great experience in mapping it was natural that the NGII was put in charge of establishing the national topographic information database which includes 1/1000, 1/5000, and 1/25000 scale maps. However, due to the extensive number of maps, NGII is awarding sub-contracts to private firms with sufficient expertise.

2.3.1.3 Supreme Court (real estate information)
The Korean land registration system was established in 1912. The Real Estate Registration Act governs all real estate registry activities. It consists of 193 city, county, and district real estate registry offices and 2,334 government employees who manage and provide property registry information based on the cadastral records under the guidance and supervision of Supreme Court. Its main tasks are to maintain and provide the land register, building register, shipping register, and to maintain and update registration on right and subjects.

The local registry offices manage land register, building register, ship register, etc. including the information of ownership, leasehold, easement, and mortgage in paper form under the control of Local Courts. The Supreme Court has started the “Project of Land Registration Computerization” since 1994 in order to realize epoch-making improvements for registry application and issue, to support the following objectives:

- Information provision for capturing all types of tax sources according to deals with real estate
- Information provision for policy-making and for eradicating real estate speculation
- Information provision in digital form to reduce issuing time
The project began with the development of an on-line system, which stores and manages real estate information in the Central Center, 12 local centers, and 240 land register offices including future extension of installations with advanced systems. Secondly, the conversion of the conventional land registers into digital form until 2003. As a result of this long-term project, a reduction of waiting-time for issuing (from 30 minutes to 5 minutes) can be expected regardless of “when, where and who” in Korea. Another benefit is that citizens who need relevant information do not have to visit the registry office, it will be possible to view and obtain land register and other related information at home or office at anytime.

2.3.2. Current cadastral information delivery system in Korea

In the recent past the Korean government initiated a six years (1996-2003) cadastral digitization project as one of National Geospatial Data Infrastructure (NGDI) components. As of December 2002, digitization of 613,000 maps out of a total of 748,000 maps (representing 82%) was completed. It is expected that a digital cadastral database will be available by the end of 2003.

The recent Network Readiness Index (2001 – 2002) shows that Korea marked 4.86 networked readiness index which means the Information and Communication Technology (ICT) infrastructure ranks 20th in the world (Kirkman, 2002). An OECD (Organisation of Economic Cooperation and Development) report (OECD, 2001) states that Korea is the one of the most advanced country in the world in terms of broadband Internet network connections.

However in spite of highly developed Internet network infrastructure and availability of a digital cadastral database both administrative and spatial data, the cadastral information is still delivered through a manual process by visiting municipality office or by telephone request. This manual process of cadastral information delivery has caused the following performance problems:

- High transaction cost (in both money and time)
- Restricted access period (office hours)
- Poor allocation of skilled resources (cadastral public officers)
- Out of date information (long updating and disseminating time)

According to the annual cadastre statistics (MOGAHA, 2003) the number of cadastral information application is gradually increasing. During the year 2002 over 46 millions of cadastral information applications which are mostly from the general public and government organisations have been handled by cadastral public officers at municipality offices. Figure 2.2 shows the number of annual cadastral information applications.
Figure 2.2 Number of annual cadastral information applications (MOGAHA, 2003)

Issuing copies of cadastral register and cadastral map is time consuming but simple work process. If this labour-intensive manual process is replaced by an electronic system, it will give two options for the organisation: reducing staff numbers or redeploying staff to other priorities or more complex work. But both of options will increase organisations’ operational efficiency. Then how many cadastral public officers are involved with this work process and what is the annual volume of the transactions?

According to the responses from the questionnaire, of which 20 cadastral public officers replied, the average number of employees handling this task is 2.7. There are about 260 municipality/ district/ county offices, which are responsible for maintenance cadastral records in Korea. From the information, we can conclude that there are approximately 700 cadastral public officers involved in issuing cadastral information.

The service fee is varies from 0.4 € to 0.6 € per one parcel but in this calculation 0.5 € per one parcel single service fee is applied. Based on this assumption the monetary value of annual cadastral information transaction in the year 2002 was approximately 23 million €. Table 2.3 shows the volume of annual cadastral information delivery transactions in terms of application numbers and monetary value.

Table 2.3 Volume of annual cadastral information delivery transactions (MOGAHA, 2003)

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<tbody>
<tr>
<td>Cadastral register (Number of application)</td>
<td>34,008,783</td>
<td>27,806,115</td>
<td>26,257,484</td>
<td>29,991,854</td>
<td>27,217,167</td>
</tr>
<tr>
<td>Cadastral map (Number of application)</td>
<td>12,632,990</td>
<td>10,538,549</td>
<td>11,607,792</td>
<td>14,502,385</td>
<td>13,229,412</td>
</tr>
<tr>
<td>Total</td>
<td>46,641,773</td>
<td>38,344,664</td>
<td>37,865,276</td>
<td>44,494,239</td>
<td>40,446,579</td>
</tr>
<tr>
<td>Estimated transaction volume (Euro)</td>
<td>23,320,887€</td>
<td>19,172,332€</td>
<td>18,932,638€</td>
<td>22,247,120€</td>
<td>20,223,289€</td>
</tr>
</tbody>
</table>
In summary, the Internet infrastructure is highly developed in Korea and digital cadastral database both administrative and spatial data will be available by the end of 2003. This new environment provides many opportunities to cadastral organisations. However at present the cadastral information is still delivered through a manual process by visiting municipality offices or by telephone requests.

In this section the volume of annual cadastral information delivery transaction is estimated in terms of application numbers and transaction volume. From an economic point of view, the extension of cadastral information in e-government service is already big enough. The volume of annual cadastral information transaction in the year 2002 was approximately 23 million €.

2.4. Concluding remarks

Cadastral organisations are strongly being pressed to change in order to make it competitive and effective. The customers’ requirements, recent development in Geo-ICT, e-government policy and budget constraints are identified as key drivers to change. These external environment factors push cadastral organisations in both the development of new cadastral systems and in the improvement existing cadastral system.

Particularly in Korea, despite the highly developed Internet network infrastructure and availability of a digital cadastral database including both administrative and spatial data, the cadastral information is still delivered through a manual process by visiting the municipality office or by telephone request. This manual process of cadastral information delivery causes many performance problems.

In this research dissemination of cadastral information through Internet network is investigated as one of alternatives to increase Korean cadastral organisations performance. More particularly the system is proposed as an extension of current Korean e-government service system (G4C: Government for citizen) and to make use of the established e-government service infrastructure. If this labour-intensive manual process is replaced by an electronic system, it will give two options for cadastral organisations: reducing staff numbers or redeploying staff to other priorities or more complex work.

It is estimated that currently about 700 cadastral public officers are involved in issuing cadastral information in 260 municipality offices in Korea. The volume of annual cadastral information delivery transactions in the year 2002 was approximately 23 million €. From an economic point of view, the extension of cadastral information in e-government service is already big enough.

Many pieces of literature on the system development stress the importance of user requirements identification when designing a system. Thus the following chapter will focus on the analysis of user requirements and impact analysis of digital cadastral information dissemination in Korea.
3. Impact analysis of digital cadastral information dissemination

3.1. Introduction

The cadastral information dissemination system is proposed to be an extension of the current Korean e-government service system (Government for Citizen: G4C). On the customer side, citizens will be able to access a wide range of cadastral information 24 hours a day and to apply for and receive copies of cadastral records at home or working place. On the organisation side, the labour-intensive manual process can be replaced by an electronic system.

The objective of this chapter is to identify impacts of digital cadastral information dissemination in Korea. This chapter analyzes the impacts of digital cadastral information dissemination in terms of economic, technical, legal (revision of current Cadastral Act) and social aspects. In the first section of this chapter, general background of this research area is described. In the next section, economical, technical, legal and social impacts of digital cadastral information dissemination are analyzed respectively.

3.2. The study area

The study area of this research is the Republic of Korea (ROK), which is located on a peninsula between China and Japan as shown in Figure 3.1. Total area of the Republic of Korea is 99,268 square kilometres, slightly larger than Hungary or Portugal. The population of Korea was 48 million in 2002 and Republic of Korea is one of the world’s most densely populated countries, with an estimated 425 people per square kilometre. Another notable trend in the population structure is that it is getting increasingly older in average.

Korea developed rapidly from the 1960s, fuelled by high savings and investment rates, and a strong emphasis on education. The nation became the 29th member country of the Organisation for Economic Cooperation and Development (OECD) in 1996.

Figure 3.1 Map of Republic of Korea
3.3. Economic impact

From an economic perspective, an electronic access is expected to increase the demand for products, which will decrease the price of transactions. Increased and improved access to cadastral information will provide support to legal security of rights of persons to land. This improvement in security of tenure will in turn stimulate the land market. Subsequently the stimulated land market could contribute to the development of economy in general.

Van der Molen (2002) states that as land administration systems have to serve society on a long-term basis and normally have a long-term return on investment. In this section the economic impacts of cadastral information dissemination using Internet network are analyzed focusing on transaction cost, land market and e-government vs. e-commerce.

3.3.1. Transaction cost

An economic definition of transaction costs is the costs of measuring what is being exchanged and enforcing agreements. In the larger context of societal evolution they are all the costs involved in human interaction over time. However in this research mainly focuses on in both money and time cost to get cadastral information: for instance, if a citizen has to visit a municipality office only during working hours to get cadastral information, it will require a lot of travelling time and money.

The competitiveness of business is strongly influenced by the transaction costs incurred in dealing with administrations. As international competition becomes fiercer, governments are also responsible for many of the inputs to production processes. Firms therefore expect cheaper and better public services in order that they may stay competitive (COEC, 2003).

Bourn (2002) identifies the following five key benefits of e-government service:

- *Greater choice*: Providing citizens with a greater range of services and delivery channels such as the Internet, telephone call services, and face-to-face contacts, which better meets their individual needs and preferences.
- *Better accessibility*: Giving citizens greater access to the range of services delivered by departments by providing better, easier to use information on-line and joining up services at the point of delivery.
- *More convenience*: Providing services in a way, which suits citizens and businesses needs for example, by providing services on-line, 24 hours a day seven days a week, enabling people to obtain information and carry out transactions with departments when it is convenient for them to do so
- *Faster delivery*: Providing faster and more accurate services for example, on-line services which enable citizens to obtain information more quickly than by post or by visiting a government office; and by electronic data interchange which enables businesses to transmit large amounts of data quickly and easily to departments.
- *Improved efficiency*: Replacing manual processing of routine high volume work by IT systems should reduce staff requirements and deliver financial savings or allow staff to be redeployed.
to other priority areas. It can also be used to make the purchasing of goods and services more efficient.

From a customer’s point of view, travelling to the municipality office only during the working hours to get copies of cadastral records (cadastral register and cadastral map), it costs a lot of travelling time and money. From an organisation’s point of view, the issuing of copies of cadastral records is time consuming but simple work process. If this labour-intensive manual process is replaced by an electronic system, it will give two options for the organisation: reducing staff numbers or redeploying staff to other priorities or more complex work. But both of options will increase organisations’ operational efficiency.

3.3.2. Land market

Land markets, including purchase, lease and other transactions with land, have been vital to the successful development of all the advanced market economies. Land has also been regarded as the best kind of collateral in developed market economies. System for enabling land to be used for this purpose, and thereby laying the foundation for a well functioning land market, are necessary ingredients in a functioning market economy (UN/ECE/WPLA, 1996)

It further states that the land market shows many similarities with the stock market. In most of countries, the stock market have been established quite rapidly, while the land markets lag far behind. Those are mainly because of the lack of information about real estate such as annual reports from the cadastral or land registration authorities, in contrast to information more readily available on the stock exchange. Thus the land market needs access to cadastral information.

De Soto (2000) argues that poor people without title are unable to raise capital even though they possess assets such as land and buildings, he terms this situation “dead capital.” How can one encourage raising capital processes in this situation? The standard model argues that the principal contributor to the process is improving security of tenure: more secure property rights for owners and users of land.

Baldwin (2000) considered the land market to be composed of the following elements: the land registry and cadastre (legal basis), the land valuation (market based), the financial service (capital and credit), the participants, the goods and services and the financial institutions. In this three-pillar model, land registry and cadastre is one of the essential pillars, which provides a legal relationship between land and the people.

Thus increased and improved access to cadastral information by an electronic access is expected to increase the demand for products, which will decrease the price of transactions. Increased and improved access to cadastral information will provide support to legal security of rights of persons to land. This improvement in security of tenure will in turn stimulate the land market. Subsequently the stimulated land market could contribute to the development of economy in general.
3.3.3. E-government vs. E-commerce

Though one may think that e-government has little to do with e-commerce, Markus (2001) points out the similarities between e-government and e-commerce from a legal, contractual, stakeholders, and fulfilment perspective. He suggests that due to structural similarities between the two types of Internet-based activities, when implementing e-government strategies and solutions, it is essential to refer to experiences from the former to avoid wasted efforts and missed targets. Table 3.1 shows the structural similarities between e-government and e-commerce. The first column describes the type or category of the similarity. The second and third column is the actual characteristic of the similarity for e-government and e-commerce.

<table>
<thead>
<tr>
<th>Category</th>
<th>E-government</th>
<th>E-commerce</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multi-step process to come to a mutual agreement</td>
<td>- Application for permit</td>
<td>- Simple and fast to implement</td>
</tr>
<tr>
<td>Highly distributed stakeholder</td>
<td>- Several government agencies</td>
<td>- Enterprises</td>
</tr>
<tr>
<td></td>
<td>- Citizens</td>
<td>- Customers</td>
</tr>
<tr>
<td></td>
<td>- Enterprises</td>
<td></td>
</tr>
<tr>
<td>Result is a legally binding document</td>
<td>- Notifications</td>
<td>- Contracts</td>
</tr>
<tr>
<td></td>
<td>- Contracts</td>
<td></td>
</tr>
<tr>
<td>Heterogeneous platforms</td>
<td>- Each agency, enterprise and customer runs different platforms to support the internal communication and data processing</td>
<td>- Each enterprise and customer runs different e-business platforms, which are integrated through data exchange formats</td>
</tr>
<tr>
<td>Communication via structured compound documents</td>
<td>- Structured data for internal data processing</td>
<td>- Structured data within a contract in order to facilitate backend integration of legacy systems</td>
</tr>
<tr>
<td></td>
<td>- Multimedia data for evidence reasons</td>
<td>- Unstructured multimedia data within a contract</td>
</tr>
<tr>
<td>Control of the fulfilment</td>
<td>- Monitoring and controlling of payment</td>
<td>- Monitoring and controlling of the payment</td>
</tr>
<tr>
<td></td>
<td>- Monitoring and controlling of the constraints defined by the government agency</td>
<td></td>
</tr>
</tbody>
</table>

This analysis led us to the assumption, that the structural characteristics of e-government and e-commerce are the same, and therefore the requirements on e-government enabling infrastructure, which arise from the stakeholders’ needs and the enabling technologies, are basically the same as for e-commerce.

E-commerce can be among businesses or between businesses and consumers. But the Internet also encompasses a wider spectrum of potential commercial activities and information exchanges. For instance, it offers firms, individuals and governments an electronic infrastructure, which enables the creation of virtual auction markets for goods, and services where previously they did not exist (Coppel, 2000). Table 3.2 shows possible network connectivity and new service areas. E-government service mainly focuses on C2G (citizens with government), B2G (private company with government) and G2G (among government agencies).
Table 3.2 Network connectivity and new services (adopted from Coppel, 2000)

<table>
<thead>
<tr>
<th>Category</th>
<th>Government (G)</th>
<th>Firms (B)</th>
<th>Consumers (C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Government</td>
<td>G2G e.g., coordination</td>
<td>G2B e.g., information</td>
<td>G2C e.g., information</td>
</tr>
<tr>
<td>Firms</td>
<td>B2G e.g., public market</td>
<td>B2B e.g., e-commerce</td>
<td>B2C e.g., e-commerce</td>
</tr>
<tr>
<td>Consumers</td>
<td>C2G e.g., tax procedures</td>
<td>C2B e.g., price comparison</td>
<td>C2C e.g., auctions</td>
</tr>
</tbody>
</table>

According to the Korea National Statistical Office (KNSO), the total volume of e-commerce in Korea increased from $47.93 billion in 2000 to $99.15 billion in 2001, up more than 250% in just one year. B2B has emerged as the major type of e-commerce and the growth of B2C has been particularly remarkable. Thanks to the increasing public awareness of the benefits of e-commerce and government policies to facilitate e-commerce, this trend is expected to continue (KNSO, 2002). Figure 3.2 shows the volume of e-commerce market in Korea.

![Figure 3.2 Volume of e-commerce market in Korea (from KNSO, 2002)](image)

3.4. Technical impact

From a technical perspective, the proposed cadastral information dissemination system to be an extension of the current Korean e-government service system (Government for Citizen: G4C). The G4C is highly integrated web based system. Thus the appropriate technologies and Internet infrastructure are an essential part for a successful e-government service. In this section current Internet infrastructure,
Internet GIS, Internet security technologies and National Geospatial Data Infrastructure (NGDI) issues are addressed.

### 3.4.1. Internet infrastructure

The appropriate technologies and Internet infrastructure are essential part for a successful e-government service. As of December 2000, there were 18,615,000 personal computers being used in Korea. Of these, 11,060,000 (59%) PCs were used in the home, 5,152,000 (28%) by private enterprise, and 2,403,000 (13%) by the public sector (KNSO, 2002). Figure 3.3 shows the status of PC usages by different groups. Among the three different groups, household group is using 59% of total PC in Korea.

![Figure 3.3 Status of PC usages by different sector](from National Computerization Agency, 2000)

In 1993, there were only 612 websites in the Korea domain. The number peaked at the end of 2000 at 517,354 and then began to decline. Because of the economic recovery, the number of Korea websites has begun to slowly rise again (KNSO, 2002).

The number of hosts is widely regarded as a reliable index of the level of Internet usage. In Korea, the number grew from over 460,000 in 1999 to approximately 690,000 in 2001. In addition, Korea succeeded in building a broadband Internet network covering 144 regions around the country in 2000. As a result of this project, more than 8 million households, which are more than half of all households in the country, are now using broadband Internet service. An OECD (Organisation of Economic Co-operation and Development) report dated October 2001 states that Korea is the one of the most advanced country in the world in terms of broadband Internet network connections. Although Internet access via cable was the most common form of high-speed access until 1999, xDSL service has now become the most widely used means of Internet access since 2000. Figure 3.4 shows the increasing number of hosts in Korea by year.
A recent survey poll (KIEC, 2002), which was conducted by Korea Institute for Electronic Commerce (KIEC) identified the following impediments for implementation of e-commerce. As shown in the diagram below (figure 3.5), companies, which have not adopted e-commerce answered that the primary reason for the relatively slow growth of e-commerce is a lack of standardization. On the other hand companies, which already have adopted e-commerce, answered that a system implementation cost and lack of expert manpower are the major problems.

![Figure 3.4 Number of hosts in Korea by year (from KNSO, 2002)](image)

![Figure 3.5 Impediments to the growth of e-commerce (KIEC, 2002)](image)
3.4.2. Internet GIS technology

Internet GIS is a special tool that uses Internet as a means to access and transfer remote data, conduct analysis and make GIS presentation. In addition Internet GIS should have additional functions that take advantage of the Internet and its associated protocols such as the World Wide Web (WWW) and the File Transfer Protocol (FTP). These additional functions include exchanging remote data and application programs, presenting interactive maps and data on the Internet.

There are various tools and technologies that could implement a data viewing and update service on the Internet network. Each has strengths and weaknesses, and some are more suitable than others in a particular situation. Analysis of each data viewing and transfer tools’ strengths and weaknesses is a crucial step for further designing of an information system.

In this section various Internet GIS technologies focusing on main functionalities, strengths and weakness are investigated. Table 3.3 shows a summary of different Internet data viewing and transfer tools.

<table>
<thead>
<tr>
<th>Category</th>
<th>Main functionalities</th>
<th>Strengths</th>
<th>Weakness</th>
</tr>
</thead>
<tbody>
<tr>
<td>HTML</td>
<td>- Provide only for single click operation on image</td>
<td>- Simple and fast to implement</td>
<td>- It was not designed for spatial data - Supports only raster image (GIF and JPEG)</td>
</tr>
<tr>
<td>Java</td>
<td>- Object-oriented programming language - Security measures were built from its beginning</td>
<td>- From a security point of view, Java is ideal</td>
<td>- Can not access to remote computer’s hard drive or memory stacks</td>
</tr>
<tr>
<td>ActiveX</td>
<td>- Development of Microsoft’s Object Linking and Exchange (OLE) technology</td>
<td>- Provide access remote computer’s hard drive or memory stacks - Existing applications can be converted to ActiveX controls without new programming languages</td>
<td>- Currently only operable on MS Windows platforms - Security was not original design considerations</td>
</tr>
<tr>
<td>Plug-ins</td>
<td>- When a browser detects a particular type of content, it redirects that content to the plug-in</td>
<td>- If a type of special content is common, then having the plug-in already loaded prevents the download time</td>
<td>- It has to be installed before download pages with special content - It is considerable task to have them all installed</td>
</tr>
<tr>
<td>GML/XML</td>
<td>- Transport and storage of geographic information - Spatial and non-spatial properties of geographic features</td>
<td>- Provide a better quality maps - Works on a browser, without the client-side software - Custom map styling - Editable maps - Better query capability - Control over content - Service chaining</td>
<td>- It creates large volume of data file thus handing this increased data load burdens networks and storage infrastructures - Slowing the Web’s move to XML compare to other markup language</td>
</tr>
</tbody>
</table>
The Geography Markup Language (GML) is an XML encoding for the transport and storage of geographic information, including both the spatial and non-spatial properties of geographic features (Simon Cox, 2002). GML uses the W3C XML Schema Definition Language to define and constrain the contents of its XML documents.

Recently the eXtensible Markup Language (XML) was developed by an XML Working Group (originally known as the SGML Editorial Review Board) formed under the auspices of the World Wide Web Consortium (W3C) in 1996 (Tim Bray, 2000). The W3C approved the first version in 1998. Now XML is the standard for the exchange of structured information and plays an important role in the Internet. It emerged as a new generation language for data description and exchange for Internet use. Data models may be described either within a Document Type Description (DTD) or a more advanced XML Schema document (W3C, 2000a; W3C, 2000b).

Jim Costello (2002) explains the fundamental difference between HTML and XML as follows: HTML tags do not really describe the data itself. While it tells a web browser how to display the data, it does not define the type of data it contains. However XML employs markup in a fundamentally different way: if used properly, XML tags do not just identify data, they describe it. In short, unlike HTML, the XML tags do not contain any information about how the data will be displayed, thus making it possible to separate content from format.

XML is not a programming language but it is a set of rules for designing text formats to structure data. XML is defined by the following several related specifications.

- XML (eXtensible Markup Language): defines the syntax of XML
- XSL (eXtensible Stylesheet Language): a language for expressing stylesheet. An XSL stylesheet is a file that describes how to display and XML document of a given type. It consists of three documents:
  1. XSLT (Transformation): a language for transformation one XML document into another: e.g., to generate HTML web page from XML data.
  2. Xpath (XML Path Language): a language used by XSLT to access or refer to parts of an XML document.
  3. XML-FO (Formatting Object): an XML vocabulary for specifying formatting semantics and advanced styling features: e.g., produce a PDF document from an XML file.

### 3.4.3 Internet security

The Internet offers unprecedented opportunities for enterprises to provide convenience, increase revenues, reduce costs, and keep ahead of competitors. Government agencies can harness convenience of the Internet to reduce costs and improve the efficiency of delivering services to citizens and businesses. To fully realize these benefits, enterprises, governments, and other entities require an affordable solution that enables them to efficiently and securely exchange strategic information anywhere, anytime, while providing customer convenience and personalization (VerisignInc, 2001). Data protection, network and information security, the fight against cyber crime and dependability are prerequisites for a properly functioning information society, and consequently core policy issues in many countries.
Early computer security solutions started with user IDs and passwords and then evolved to include PINs, digital certificates, and smart cards. As technology becomes more advanced, security solutions provide not only stronger security, but also greater customer convenience. The most secure, convenient, and practical solution today comes from combining PKI technology and digital certificates into smart cards.

Significant developments in electronic identity and authentication systems have taken place over the past few years in Korea. Access to citizens’ data must be in full compliance legislation, where the choice of technology should empower citizens as much as possible to retain control of their personal data. However, it is still in a relatively early stage and experience is being built up. This is therefore the right time to enhance cooperation in this area.

The current Korean e-government system has adapted digital certificates security technology. The certificate contains vital user information including the user’s public key, which is encrypted by Certification Authority’s (CA) private key. A CA is a reputed organisation that registers users and their public keys and generates digital certificates. The general process for issuing authorized certificates is as follows:

1. Users (individual/corporate) who wish to register for an authorized certificate should visit the Certification Authority (CA) or Registration Agency (RA) in person to apply for the issue of certificate. Proof of identification must be submitted at this time.
2. CA or RA verifies the identity of the applicant and forwards a registration confirmation to the user, with a reference number and permission code.
3. Users access the website of CA/RA, download relevant application programs (plug-ins) to be installed on their personal computers.
4. Users access the website of CA/RA, download relevant application programs (plug-ins) to be installed on their personal computers.
However there is one more thing that needs to be addressed in the authorized certificate issuing procedures. The CA/RA should take care of maintenance of an authorized certificate-issuing database whenever the database needs to be updated. For instance, when a new person applies for an authorized certificate or a person applies for cancellation of his/her authorized certificate or a person’s authorized certificate is not valid for any particular reasons.

Since an issuing authorized certificate procedure is similar to Internet banking transaction application, then in this case a CA/RA sends e-mail to users regularly (every 6 months or every year) to inform them that for security reasons and for purpose of updating customers information database they have to revise their authorized certificate otherwise it will expire. On the customer side, it may cause some inconvenience, however this process improves the on-line transaction security and a CA/RA maintains the certificate-issuing database at low cost. Subsequently, it can contribute to reduce the final products price.

3.4.4. National Geospatial Data Infrastructure (NGDI)

Groot R. & McLaughlin J. (2000) states that the National Geospatial Data Infrastructure (NGDI) seeks to support the sharing of data in the national context by means of a set of standards, such as: national spatial reference systems, a national topographic template, a national elevation model, any other standardized data set of national scope such as geographical names, administrative boundaries, certain thematic data sets (soils, hydrology, vegetation population, etc.), and meta data standards to describe in a consistent manner each of the GDI holdings.

The Korean government has recognised that a National Geographic Information System (NGIS) is one of the most fundamental infrastructures required to promote national competitiveness and productivity. Government has provided substantial funding for the development of the NGIS, based on the fact that the public sector will be the major user of the NGIS and recognising that geographic information is a basic asset of the nation (MOCT, 1995).

The overall objectives of the NGIS are i) to establish a geographic information infrastructure in Korea, and ii) to eliminate unnecessary duplicate investment for GIS. To achieve the objectives of NGIS, the NGIS Steering Committee developed phase-by-phase strategies, which are shown in figure 3.7.

The Korean government is taking a leadership role in developing a public and private national GIS program for the country. Korea initiated “the first national GIS master plan” in 1995 (MOCT, 1995). Based on this plan, several GIS projects and research works have been initiated such as digital topographic and thematic mapping, GIS technology development, GIS standardization and human resource development and GIS application system. "The second national GIS master plan," a five-year master plan that started in 2001 (MOCT, 2000), is actively taking shape.

The Korean NGIS structure was reformed in 2000 with the objective of using GIS in all public and private disciplines if really needed within the next five years. Now under the Ministry of Construction
and Transportation, the NGIS consists of seven subcommittees responsible for areas such as human resource development, development of data distribution technologies, cadastral systems, standards development, surveying, and related technologies. Building on the first master plan, the Korean national GIS effort is fast becoming one of the most visible and progressive national GIS programs worldwide.

One of the serious problems encountered during the first master plan period was that there was no spatial data distribution network and clearinghouse. Therefore, the second master plan aims at maximizing the utilization of the already established spatial information by establishing a national clearinghouse and distribution network for spatial data (Cho, 2001).

The national geographic information clearinghouse was established in 2001. At present 22 different digital maps are accessible such as: digital topographic map (1/1000, 1/5000), land use map, soil map and Digital Elevation Model (DEM) etc. Figure 3.8 shows some samples of digital maps, which are currently accessible at national geographic information clearinghouse web site (http://www.ngic.go.kr).

However, the current e-government service system (G4C) has not reflected the importance of spatial component so far. The Korean e-government service system (G4C) has been primarily focused on text format information provision service. This is mainly because of the availability of spatial database and complexity of handling spatial information compared to text format information. The extension of cadastral information will be a first step to accommodate spatial information in Korean e-government.
service system. Thus the two projects NGIS project, which is mainly focussing on spatial data distribution and e-government project, should be integrated in a more comprehensive perspective.

When GIS and geospatial information becomes an essential component e-government in Korea, the goals of e-government: higher administrative efficiency and higher quality citizen-centered services can be realized. Ultimately the spatially enabled e-government service will support the Spatial Decision Support Systems (SDSS), which supports citizens and organisations to take the right decisions.

![Figure 3.8 Sample of digital map (accessed from Korea national GI clearinghouse)](image)

### 3.5. Legal and social impact

This section investigates the legal and social impacts of the implementation of cadastral information dissemination system using Internet. In this regard, the revision of the current Cadastral Act and review of related legislation is proposed as a first step. Further, from a social perspective land administration and land dispute impacts analyzed.

#### 3.5.1. Current Cadastral Act revision

The Cadastral Act governs cadastral activities in Korea. There is a three hierarchical structure in cadastral legislation, which is Cadastral Act, Enforcement Decree of the Cadastral Act and Enforcement Regulation of the Cadastral Act.

According to the “Open cadastral record to the public principle” cadastral records have to be provided to the general public without any restrictions. Anyone who asks for cadastral records gets copies of
cadastral records subject to the payment of a service fee. The following cadastral legislation revisions are required to implement a cadastral information dissemination system using Internet network.

1. Cadastral Act Article 14. defines the process of applying for cadastral records. In the current Cadastral Act defines one cadastral record applying process. In order for implementation of cadastral information dissemination system using Internet network, another possibility of applying cadastral information through Internet process should be defined.

2. Enforcement Decree of the Cadastral Act Article 10. and Enforcement Regulation of the Cadastral Act 16. describes the fee of getting a copy of cadastral records and defines public organisations which can get cadastral records without any charge. Therefore, the pricing and open access cadastral information for public organisation should be determined based on a sound economic analysis.

3. Under the “Open cadastral record to the public principle” cadastral records should be provided to the general public without any restrictions. But the current Cadastral Act (Enforcement Decree of the Cadastral Act Article 11.) describes an exception for protecting personal information. However the exceptional limitation of cadastral information provision is applied in case of large amount of cadastral information application. The limitation should be extended to one parcel of cadastral information applications.

4. Reliability norms and liability for quality of cadastral spatial data and quality of cadastral spatial data manipulating services are not expressly mentioned in the current Cadastral Act. In general, the liability for cadastral spatial data quality and the level of such responsibility are still technically and legally an open issue.

3.5.2. Privacy and consumer protection

Public services can be offered only within an environment where trust and confidence flourish. Such environment should always guarantee secure interaction and access for citizens and businesses (COEC, 2003). Thus protections of personal data, authentication, and identity management are primary issues where no public services should fail. Public institutions should always ensure that digital transactions and communication are secure and that personal data will remain protected.

The Digital Signature Act (refers to Appendix 3) was enacted on February 5, 1999 and went into force on July 1, 1999. On July 7 of the same year, the Digital Signature Certification Management Center was established within the Korea Information Security Protection Agency to implement the full force of the Act. In recognition of the importance of privacy protection, Korea has set up both a regulatory framework and means for self-regulation. The Korea Information Society Agency (KISA), in particular, has been authorized to oversee privacy protection in the private sector pursuant to the Promotion of Information Communication Network Usage and Information Protection Act (hereinafter referred to as the "Information Communication Network Act").

The Personal Data Dispute Mediation Committee, established within KISA, has established a regulatory framework as a response to the call for strengthened privacy protection measures. The main ob-
jectives are to secure various effective means for addressing privacy infringement and complaints while facilitating the players in the economy and society to take the initiative for privacy protection. The Committee is also pursuing various projects to create the social foundation for better privacy protection in Korea.

Although there are such Acts as the Basic Act on Electronic Commerce, which directly regulate e-business, most existing Acts and regulations are geared to ensure fair trade and consumer protection or define e-commerce as a general form of information communication service.

3.5.3. Pricing policy

In general there are two different approaches for geo-data pricing policy. One is an open access policy which propagates free geo-data for all users and funding for collection and maintenance by government. The other is a cost recovery policy, which stresses that geo-data is a normal commodity like any other and that users should pay a fair price.

Weiss (2002) presents two different geo-data funding pricing model. One is an open access model (sometimes called as US model), which with an unrestricted information access, produces new companies, new jobs, increased sales and new products. Eventually this leads to increased tax revenues. Government agencies fund their data collection with money from the general budget, appropriated to them by Congress. Public sector information is available freely to other agencies. The other is a cost recovery model (sometimes called as European model) which treasuries and legislation force government agencies to recover costs directly from users. This results in limited use and thus leaves limited resources for the government agency to collect the data. The need for direct funding and cross-subsidies should not be eliminated, as other agencies transfer taxpayer money to originating agencies. Figure 3.9 illustrates two different funding and pricing models.

![Figure 3.9 Funding and pricing models (Lemmens, 2003)](image-url)
Many discussions are going on concerning an optimal economic model for funding and pricing of geo-data. However e-government service pricing is not more complicated than other geo-data services. Because Korean e-government service provides e-service to end-users directly, the value adding activities which links the government agencies and end user is not as active as other geo-data provision services.

Currently, the Korean government imposes a minimum service charge for general public users and provides a free access for limited numbers of government organisations, which require cadastral information for doing their tasks. The fee charged to the customer is very sensitive to users’ willingness for using the service. Too high a service charge will drive customers away from using the service. Bourn (2002) further states that introduction of an incentive system is important to encourage citizen to take up of on-line services.

3.5.4. Land administration

The UN ECE Guidelines on Land Administration defines the term land administration as the process of determining, recording, and disseminating information on ownership, value and use of land when implementing land management (UN/ECE/WPLA, 1996). Molen (2001) highlighted a growing importance of data communication as a supporting tool focusing on determining, recording and disseminating processes.

On the determination side of the land administration process (input), strategic objectives such as faster services to the fast moving property market and to the public administration become possible by offering facilities for electronic conveyancing and easy map updating. The recording process (throughput) will be improved through internal data communication offering better integration between centralized and decentralized processes. The integration of work process allows for combining the benefits of centralized IT services and decentralized information management. On the dissemination side (output) the strategic objective of making land administration better, easier and cheaper accessible will be supported by data communication. Internet services can be applied here, which require a reflection on opening hours, data quality, liability, data protection and copyright, privacy issues and pricing policy.

Already today, good practices in many countries show that e-government is a powerful means indeed to deliver better quality public services, reduce waiting times and improve cost effectiveness, raise productivity, and improve transparency and accountability (COEC, 2003). It further states that just like the rest of the economy, the public sector faces the challenge of responding to new technological development, in particular in information and communication technology. For example, the Internet has enabled new forms of involvement in policy-making, such as rapidly forming on-line opinion groups, public on-line consultations or systematic collection of feedback on needs for help and advice from citizens and business. This means that public administrations must review their established ways of decision-making.
E-government is an enabler to realize a better and more efficient administration. It improves the development and implementation of public policies and helps the public sector to cope with the conflicting demands of delivering more and better services with fewer resources.

Ting (2001) underlines the role of the Internet and communication technologies in the operation of land administration and cadastral system. The Internet is seen as an alternative to delivering cadastral information from public bodies to the public. In fact some land administration organisations are seeing their whole delivery strategy based on the Internet network. She concludes that together with distributed database, the Internet and map servers, a multi-purpose cadastre is expected to allow government agencies to overlay cadastral maps, title registers, planning and other vital land resources live and interactively in order to show the complete legal situation of the land to Internet users across the world. In other words it is becoming possible to identify all the rights, restrictions and responsibilities relating to land over the Internet network.

3.5.5. Land dispute

According to the recent statistics (KCSC web site: www.kcsc.co.kr) released by Korea Cadastral Survey Corporation (KCSC) the number of land boundary dispute in Korea increased annually until 1999 and the number drastically decreased during 2001 – 2002. Figure 3.10 shows the number of land boundary dispute during the recent five years (1998 – 2002).

![Figure 3.10 Number of land boundary dispute (from KCSC web site: www.kcsc.co.kr)](image-url)

However the number of land boundary disputes has drastically decreased since 2001. At this time KCSC seriously recognized this problem and put a lot of efforts to reduce the number of land boundary disputes. For example, KCSC emphasized the importance of staff’s working attitude, which is critically influenced to reduce land boundary disputes. Because many land boundary dispute cases have been raised due to staff’s bureaucratic working attitude as well as technical constraints. This statistical number implies a very impor-
tant message to all personnel involved in cadastral surveying activity that technology itself is not sufficient to resolve land boundary disputes. Beyond the technology, special attention should be paid to regular customer satisfaction surveys which enable an organisation to measure the level of customers satisfaction as well as a continuous staff re-education programme focusing on their service mind and professionalism.

The electronic access to cadastral information is expected to increase the demand for products. Increased and improved access to cadastral information will provide support to legal security of rights of persons to land. Although this is not a direct technical improvement, which can serve to improve cadastral surveying accuracy, better accessibility to cadastral information will increase transparency in provision of cadastral information to the public. It is expected that a continuing staff service mind and a professional re-education with improved accessibility to cadastral information, will eventually contribute to the reduction in the number of land boundary disputes in Korea.

### 3.6. Concluding remarks

In this chapter the impacts of digital cadastral information dissemination were analyzed in terms of economical, technological and legal (revision of current Cadastral Act) and social impacts.

From an economic perspective, an electronic access is expected to increase the demand for products, which will decrease the price of transactions. Increased and improved access to cadastral information will support to legal security of rights of persons to land. This improvement in security of tenure will in turn stimulate the land market. Subsequently the stimulated land market will contribute to the development of economy in general.

From a technical perspective, the proposed cadastral information dissemination system to be an extension of the current Korean e-government service system (Government for Citizen: G4C). The G4C is highly integrated web based system, thus it requires a broadband Internet network connection to transfer large volume of data.

However, the current e-government service system (G4C) has not reflected the importance of spatial component so far. The extension of cadastral information will be a first step to accommodate spatial information in Korean e-government service system. When GIS and geospatial information becomes an essential component e-government in Korea, the goals of e-government: higher administrative efficiency and higher quality citizen-centered services can be realized. Ultimately the spatially enabled e-government service will support the Spatial Decision Support Systems (SDSS), which supports citizens and organisations to take the right decisions.

In order to implement the cadastral information dissemination system using Internet, a revision of current Cadastral Act and review of related legislation is proposed as a first step. On the social impact side, the Internet and communication technologies are expected to have impact on efficient and transparent land administration processes and this improvement will contribute to the reduction in the number of land disputes in Korea.
4. User requirements analysis

4.1. Introduction

The essential purpose of the user requirements analysis aims at developing a system, which is accepted and supported by its users. This is achieved by describing the system requirements (i.e., conditions or capabilities to which the system must conform) well enough so that an agreement can be reached between the customer (including users) and the system developers on what the system should and should not do. A major challenge is that a customer, who is assumed to be primarily a non-computer specialist, must be able to read and understand the results of requirements analysis. To meet this challenge the language of the customer has to be used to describe these results (Ivar Jacobson et al., 1999).

The objective of this chapter is to identify user requirements based on the analysis of collected questionnaire data. The purpose of the questionnaire and methodology for data collection is described in the first section. In the following section, user requirements are analyzed from three different perspectives: the general public, cadastral information provider and cadastral information administrator. In the last section a list of system specification is formulated based on the identified user requirements in the previous section.

4.2. Methodology for data collection

Data for this research have been collected using a questionnaire on user requirements for a cadastral information dissemination system, conducted for three different groups: the general public, cadastral public officers and Korea Cadastral Survey Corporation (KCSC) staff members. A questionnaire containing about 18 questions was distributed by e-mail from 6th November 2003 to 18th November 2003. It was decided to electronically disseminate the questionnaire in order to avoid delays with mailing printed versions. However the limitation of a questionnaire methodology is that it is difficult to ask in depth questions. The questionnaire was also translated into the Korean language. The final version of the questionnaire is included in Appendix A.

In general the response rate in this questionnaire was high. A total of 60 answers to the questionnaire were collected by e-mail from each group: the general public (20), cadastral public officers (20) and Korea Cadastral Survey Corporation (KCSC) staff members (20).

The questionnaire was organized based on the group. Some questions are modified for the specific group but general structure of the questionnaire is as follows:

- Introduction to the cadastral information dissemination system and objectives
• Internet infrastructure readiness (2 questions)
• Current cadastral information issuing system (5 questions)
  - Purpose, method and frequency of getting cadastral information
  - Degree of satisfaction with current system
  - Most inconvenient factor of current system
  - How many public officers are dealing with it
• On-line cadastral information dissemination system (11 questions)
  - Necessity of on-line service
  - Expecting direct benefits and service fee
  - User education method
  - Expecting further services
  - Most important consideration in designing the system
  - General requirements
  - Functional requirements

4.3. Purpose of the questionnaire
Structured questionnaire was used to identify user requirements for designing of cadastral information dissemination system using Internet network in Korea. The purposes of this questionnaire are the following:
  • To identify the general requirements
  • To identify the functional requirements
  • To formulate the system specifications based on the identified user requirements

4.4. User requirements analysis
Based on the collected questionnaire data from the general public group, the following points are identified (for detailed questionnaire data refers to table 4.1, Appendix 1 and 2):
1. Large numbers of the general public are not satisfied with the current cadastral records issuing system in Korea.
2. The most inconvenient factors of the current system turned out to be the travelling time to municipality office and the limited service time.
3. All citizens who answered this questionnaire believe that the on-line cadastral information delivery service is necessary at this moment.
4. Most of the general public are expecting less than the current service fee or same as the current service fee.
5. Most of the general public (90%) answered that they are willing to use this service of this service available at 1,000 won per one parcel (1,000 won is slightly increased service fee and equivalent of 0.7 Euro). These high numbers represent the general public’s high expectation of this service.
From the general public perspective the following requirements have been drawn as general requirements and functional requirements respectively. Figure 4.1 shows the general and functional requirements from the general public perspective.

4.4.1. **Cadastral information provider perspective**

According to the collected questionnaire data from the Korea Cadastral Survey Corporation (KCSC) staff members group, the following points are identified:

1. Checking parcel area and parcel subdivision history are the main purposes to access the administrative cadastral database, which is currently available in Korea.
2. Large numbers of KCSC staff members believe that the on-line cadastral information delivery service is necessary at this moment.
3. All KCSC staff members who answered this questionnaire believe that the on-line cadastral information delivery service will contribute to improve their working environment.
4. A checking cadastral map through the Internet network is a main expecting improvement.
5. On the appropriate service fee, many KCSC staff members (60%) believe that less than the current service fee or same as the current service fee would be appropriate.
6. On the provision of the parcel coordinates, more than half of KCSC staff members (60%) answered that it should not be provided to the public because of the cadastral map’s digitisation accuracy problem. For this reason, if the general public believe that the digitised cadastral map coordinates are their parcel boundaries, there will be a lot of confusions on parcel boundary. A provision of the parcel coordinates will eventually increase the land boundary disputes.

From the cadastral information providers perspective the flowing requirements have been drawn as general requirements and functional requirements respectively as shown in figure 4.2.
4.4.2. Cadastral information administrator perspective

Based on the collected questionnaire data from the cadastral public officers group, the following points are identified:

1. The average number of accessing time to administrative cadastral database is 14.1 times in a day.
2. A checking parcel subdivision history and parcel area are the main purposes to access administrative cadastral database.
3. Large numbers of cadastral public officers (95%) believe that the on-line cadastral information delivery service is necessary at this moment.
4. Many cadastral public officers are expecting that the on-line cadastral information delivery service will contribute to improve their working environment. The main improvement will be a cadastral record issuing task and a cadastral map-updating task.
5. On the appropriate service fee, many officers answered that more than the current service fee should be applied. It means that the public cadastral organisations are facing pressure to recover a part of the investment cost because of the government’s budget constrains.
6. On the provision of the parcel coordinates, more than half of cadastral public officers (65%) answered that it should not be provided to the public because of the cadastral map’s digitisation accuracy problem. A provision of the parcel coordinates will eventually increase the land boundary disputes.
Below table 4.1 shows the summary of collected questionnaire results.

<table>
<thead>
<tr>
<th>Questions</th>
<th>General public (20)</th>
<th>KCSC staff members (CI provider: 20)</th>
<th>Cadastral public officer (CI administrator: 20)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Status of Internet connection</td>
<td>- Having an internet connected PC at home (18)</td>
<td>- Working with an internet connected PC at the office (20)</td>
<td>- Working with an internet connected PC at the office (20)</td>
</tr>
<tr>
<td>2. Frequency of getting CI</td>
<td>- Once in 6 months</td>
<td>- 2.6 times in a day</td>
<td>- 14.1 times in a day</td>
</tr>
<tr>
<td>3. Main purpose of getting CI</td>
<td>- Checking parcel location (10)</td>
<td>- Checking parcel area (9)</td>
<td>- Checking parcel area (8)</td>
</tr>
<tr>
<td>4. Current application methods and degree of satisfaction</td>
<td>Visiting municipality (18)</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>5. Necessity of on-line CI delivery service</td>
<td>- It is necessary at this moment (100%: 20)</td>
<td>- It is necessary at this moment (90%: 18)</td>
<td>- It is necessary at this moment (95%: 19)</td>
</tr>
<tr>
<td>6. Expecting benefits</td>
<td>- Saving time and cost (16)</td>
<td>- Saving time and cost (15)</td>
<td>NA</td>
</tr>
<tr>
<td>7. Appropriate service fee</td>
<td>- Same as current fee (12)</td>
<td>- Same as current fee (9)</td>
<td>- More than the current fee (11)</td>
</tr>
<tr>
<td>8. Scurrility of the current e-commerce payment</td>
<td>Secure (12)</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>9. Provision of parcel boundary coordinates</td>
<td>NA</td>
<td>- Should not be provided because it will increase land disputes due to the accuracy problem (12)</td>
<td>- Should not be provided because it will increase land disputes due to the accuracy problem (13)</td>
</tr>
<tr>
<td>10. Expecting further service</td>
<td>- Provision of integrated information (cadastre and land register information: 12)</td>
<td>- Provision of integrated information (cadastre and land register information: 7)</td>
<td>- Provision of integrated information (cadastre register and map: 8)</td>
</tr>
<tr>
<td>11. Important consideration in designing the system</td>
<td>- Personal information security (12)</td>
<td>- Original cadastral DB security (9)</td>
<td>- Provision of integrated information (cadastre and land register information: 7)</td>
</tr>
<tr>
<td>12. General requirements</td>
<td>- Personal information security (6)</td>
<td>- Personal information security (5)</td>
<td>- Original cadastral DB security (6)</td>
</tr>
<tr>
<td>13. Functional requirements</td>
<td>- Integrated information provision</td>
<td>- Integrated information provision</td>
<td>- Personal information security</td>
</tr>
<tr>
<td>11. Important consideration in designing the system</td>
<td>- Original cadastral DB security (9)</td>
<td>- Provision of topographic map</td>
<td>- Original cadastral DB security</td>
</tr>
<tr>
<td>12. General requirements</td>
<td>- Reliable information provision</td>
<td>- Simple application</td>
<td>- Personal information security</td>
</tr>
<tr>
<td>13. Functional requirements</td>
<td>- User friendly interface (easy to use)</td>
<td>- Minimum number of moving screens</td>
<td>- More than the current service fee</td>
</tr>
<tr>
<td></td>
<td>- Minimum service fee</td>
<td>- Standardisation for further extension</td>
<td>- Simple system architecture for maintenance</td>
</tr>
</tbody>
</table>

1) The cadastral information applying frequency in this group is very high; for this could be that the questionnaires have been sent to the general public who have cadastral knowledge.
4.5. System specification

The identified user requirements are used to produce a system specification, which has the same purpose as a house plan, to specify how the future information system will satisfy user requirements. A system specification is preceded by defining a broad conceptual solution. Ultimately, the conceptual solution must be expanded into the system specification, which clearly defines what the implemented system will look like, what it must do and how it fits into the business process (Ivar Jacobson, 1999). As shown in the figure 4.4 a system specification is placed in the middle of business process and implementation.

![Figure 4.4 Role of system specification (adapted from Ivar Jacobson, 1999)](image)

In the following section firstly, system specifications, which are based on the identified user requirements, have been formulated. Then secondly, further system specifications, which comply with the current e-government service system standards, have been formulated.

4.5.1. System specifications from the user requirements

The following system specifications are formulated to meet the identified user requirements. The system specifications are structured into four categories: general system specification, technical system specification, new service system specification and institutional system specification. Table 4.2 shows system specification from the user requirements.
Table 4.2 System specifications from the user requirements

<table>
<thead>
<tr>
<th>System specifications</th>
<th>Description</th>
</tr>
</thead>
</table>
| General system specification| 1. The interface of this system should be designed as easy and simple as possible.  
2. The application procedure should not be complicated and the number of moving screens should be minimized.  
3. On-line transaction process should be dealt with by a reliable professional authority to secure the transaction.  
4. Various payment methods should be provided for users convenience: e.g. with a credit card, bank transfer and e-money etc. |
| Technical system specification| 5. The capacity of server and other communication facilities should be considered based on the highest number of applications to minimize the response (waiting) time.  
6. Digital certificates security technology or more advanced security technology should be adopted to protect the personal information and original cadastral database.  
7. A separate production database should be built and maintained from original cadastral database for on-line cadastral information dissemination in order for the original cadastral database security.  
8. An automatic production database updating process should be accommodated to avoid entering error and to reduce cadastral public officers workload.  
9. Manipulation prevention measures should be accommodated. |
| New service system specification| 10. A new service, which integrates cadastral map and cadastral register, should be designed and provided.  
11. A new service, which integrates cadastral information and real estate ownership information, should be designed. However this requires more than technologies: e.g. agreements between two organisations, which belongs to different ministry, new legislation, coordination of the service income, and standardisations etc.  
12. Provision of topographic map, which included the street names and the major building names to assist users in finding parcel location should be accommodated. |
| Institutional system specification| 13. Same as current fee or less than the current fee (pricing)  
14. Personal information security. |

4.5.2. Further system specifications

In this section the further system specifications, which is not included in the user requirements but significant for complying with Korean e-government system standards, are formulated.

Since the Korean government selected XML as a standard for electronic documentation and digital certificate as a security technology standard for e-government service project (Yang, 2002) many of system specifications are related with these technologies.

The further system specifications are structured under the following categories: general system specification, creation of digital documents and transferring technology, security technology, manipulation prevention technology and institutional system specification. Table 4.3 shows the further system specifications.
### Table 4.3 Further system specifications

<table>
<thead>
<tr>
<th>System specifications</th>
<th>Description</th>
</tr>
</thead>
</table>
| **General system specification**                  | 1. 24 hours in a day and 7 days in a week service.  
2. One stop shopping.  
3. Data back up device and storage.  
4. Statistical data provision function: the system keeps records about all necessary statistics e.g. how many applications have been received in a certain period for one particular service. |
| **Creation of digital documents and transferring technology** | 5. Develop a standardized DTD (Document Type Definition) for each service.  
6. Encrypt the application XML form.  
7. Transform the service production XML form into HTML to transfer to the web server.  
8. XML server: managing XSL forms and transferring the applied XSL form file.  
9. DB server: saving the apply form XML and the service production XML.  
10. Connection server: transferring the application XML to the service provision organisation server (municipality cadastre division) and transferring the service production XML that received from the service provision organisation server to DB server.  
11. Authentication/registration server: encrypting application XML form and the service production XML and transferring the authentication information. |
| **Security technology**                            | 12. A firewall/intrusion detection system should be accommodated for network security.  
14. The Certification Authority (CA) maintains an authorized certificate-issuing database by sending e-mail to the users to inform revising the authorized certificate.  
15. Encryption technologies (SSL, PKI) protect the information transaction in the information sharing system.  
16. Limiting the time or period of use to prevent illegal distribution of issued documents. |
| **Manipulation prevention technology**             | 17. Creating copy prevention code.  
18. Inserting digital watermark feature.  
19. Limiting the number of printing and printing time.  
20. Creating the checking reference number for enabling the recipient public officers to check the e-document by checking the reference number at the G4C web site  
| **Institutional system specification**             | 22. Using a digital signature to empower the e-document same as the official paper document (Electronic Government Act Article 17-2).  
23. Privacy: the information obtained by this channel should be protected in accordance with the Act on privacy protection by public institutions and should not be used for commercial purposes.  
24. Pricing: the service charge should be determined based on an economic analysis and an introduction of incentive system to encourage citizens to take up of on-line service should be considered. |
4.6. Concluding remarks

In this chapter, user requirements on the cadastral information dissemination system using Internet have been identified based on the analysis of collected questionnaire data, which from the general public, cadastral public officers and Korea Cadastral Survey Corporation (KCSC) staff members. From the analysis of collected questionnaire data general and functional requirements are formulated in the perspective of the general public, cadastral information provider, and cadastral information administrator. Table 4.4 shows the summary of general and functional requirements from different perspectives.

<table>
<thead>
<tr>
<th>Perspectives</th>
<th>General requirements</th>
<th>Functional requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>The general public</td>
<td>- Personal information security</td>
<td>- Provision of integrated information</td>
</tr>
<tr>
<td></td>
<td>- Original cadastral database security</td>
<td>- Various payment methods</td>
</tr>
<tr>
<td></td>
<td>- Reliable information provision</td>
<td>- Short response (waiting) time</td>
</tr>
<tr>
<td></td>
<td>- User-friendly interface (easy to use)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Secure on-line transaction</td>
<td></td>
</tr>
<tr>
<td>Cadastral information provider</td>
<td>- Original cadastral database security</td>
<td>- Provision of integrated information</td>
</tr>
<tr>
<td>(KCSC staff members)</td>
<td>- Personal information security</td>
<td>- Should not provide parcel coordinates</td>
</tr>
<tr>
<td></td>
<td>- Simple application procedure</td>
<td>- Provision of topographic map</td>
</tr>
<tr>
<td></td>
<td>- Minimum number of moving screens</td>
<td>- Manipulation prevention measures</td>
</tr>
<tr>
<td></td>
<td>- Standardisation for further extension</td>
<td></td>
</tr>
<tr>
<td>Cadastral information administrator</td>
<td>- Original cadastral database security</td>
<td>- Automatic production database updating process</td>
</tr>
<tr>
<td>(Cadastral public officers)</td>
<td>- Personal information security</td>
<td>- Should not provide parcel coordinates</td>
</tr>
<tr>
<td></td>
<td>- Simple system architecture for maintenance</td>
<td>- Provision of integrated information</td>
</tr>
<tr>
<td></td>
<td>- More than the current service fee</td>
<td>- Short response (waiting) time</td>
</tr>
</tbody>
</table>

For the formulation of system specification firstly, system specifications from user requirements, which are based on the identified user requirements, are formulated. Then secondly, further system specifications, which are not included in the user requirements but significant for complying with the Korean e-government system standards, are formulated.

Since the Korean government selected XML as a standard for electronic documentation and digital certificate as a security technology standard for e-government service project many of further system specifications are related with these technologies.
5. Cadastral information dissemination system modeling

5.1. Introduction

A model is an abstraction of a system, specifying the modeled system from a certain viewpoint and at a certain level of abstraction. For instance, the workers modeling the functional requirements think of the system as having users outside the system and having use cases inside the system. They do not care about what the system looks like from the inside; only what it can do for its users (Ivar Jacobson, 1999). The objective of this chapter is to develop a conceptual system architecture for cadastral information dissemination using Internet network and model the system to meet the identified system specifications using UML (Unified Modeling Language).

This chapter begins with the components and general processes of e-dissemination system, and continues with a conceptual architecture of cadastral information dissemination system, which is proposed in section 5.3. Finally, in section 5.4 the cadastral information dissemination system using Internet network is modeled with the UML.

5.2. Components and general processes of the e-dissemination system

Web based systems have a different structure in comparison to classic information systems. The main difference is in the number of participants-users. This fact demands bigger automation and efficiency. This has a consequence that the demand response time is shorter and the level of end-users satisfaction is higher. Senegacnik (2002) points out the following basic components in web-based systems as follows:

1. **E-users**: These users access data through network. In general, there are two types of e-user groups based on the level of GIS processing knowledge and identification of their demands.
   - **Thin clients**: A group of users, who do not know their exact demands or do not have enough GIS processing knowledge.
   - **Thick clients**: A group of users, who know their demands and also have knowledge how to satisfy their demands as well as GIS processing knowledge.
2. **E-partners**: E-partners provide certain e-services like Internet service providers, e-payment authority and certification authority.
3. **E-network**: The entry point of the system is based on WEB server, FTP server, Wireless Application Protocol (WAP) and different formats.
4. **Physical level**: Consist of network, supporting lookup tables, services for users authentication and data security, order entry systems, data preparation and data dissemination.
Kim (2003) states that to implement a desirable e-government, fundamental infrastructure is required. He has identified the following components of the infrastructure for e-government: data, organization, law/institution, standard and technology.

1. **Data**: For seamless on-line portal service, inter governmental data sharing and utilization is required. Also, metadata is a prerequisite for data acquisition, access and integration.
2. **Organization**: To encourage e-government portal, inter governmental partnership and collaboration between and across governmental lines are required.
3. **Law/Institution**: The policy will support e-government, such as control and assignment of governmental agency’s role, preparation of regulations, coordination between privacy and open government policy, and licensing.
4. **Standard**: E-government standards are fundamental for a consistent seamless one-line e-government portal.
5. **Technology**: In implemented practices, technologies and infrastructure are mandatory for e-government, an electronic service delivery tool and enterprise technology can be included.

For Internet users the dissemination system may be seen as one entry point Internet address called Spatial Portal. This address contains links to different services of the portal for instance, e-payment process and user authentication process. The general processes of the e-dissemination system are as follows (Senegacnik, 2002):

1. **Registration**: This process provides the authentication of portal users. All new users that want to access services with restricted access must first register and they are automatically redirected to the registration process.
2. **Data dissemination process**: Data browsing services for browsing the spatial data, metadata, and data ordering service.
3. **Services for the internal users**: The spatial portal also provides the services for activities that are not directly related with the dissemination process but are part of the internal procedures of the data providers.
4. **Billing and payment system**: This is a general service used for preparing the necessary documents for the billing process.
5. **Statistics**: The system keeps records about all necessary statistics about all accesses to the system and data requests.
6. **Auditing system**: The purpose of the auditing system is to keep the track off accesses to the data especially to the data with defined attribute of privacy. The audit records should be periodically archived and proper analysis of these records should be made in regular time intervals.
7. **Data transformation**: Data transformation process is used for transformation of the production data into the dissemination data and properly updating all the overview layers and metadata database.
8. **Help system**: The purpose of the help system is in providing context and technical help to the users.
5.3. System architecture

Ivar Jacobson (1999) explains that the role of software architecture is similar in nature to the role architecture plays in building construction. The building is looked at from various viewpoints: structure, services, heat condition, plumbing, electricity, and so on. This allows a builder to see a complete picture before construction begins. Similarly, architecture in a software system is described by different view of the system being built.

There are several ways to organize computers so that they can perform their tasks properly. Computer systems may be arranged as individual stand-alone machines, or co-operate in computer networks. Today, computer network is an indispensable component of any system. In this section, the proposed system has been viewed at top-level and at implementation level respectively.

5.3.1. Conceptual system architecture of Korean e-government system (top-level)

The Korean e-government system in this research can be divided into three main components: users, G4C application processing system and participating public administration organisations. The system is supported and evolved by users requirements, information technology developments and legal framework as shown in figure 5.1. As shown in the system architecture below, cadastral information provision organisations (Municipality Cadastre Division) are not yet participating in the process.

![Figure 5.1 Conceptual system architecture of Korean e-government system (top-level)](image-url)
5.3.2. Conceptual system architecture of proposed system (implementation level)

The architectural view of implementation level is the view of a system’s architecture encompassing the components that are used to assemble and release the physical system (Ivar Jacobson, 1999).

The main idea of proposed system architecture is to link cadastral information to the current Korean e-government service system. In order to realize this idea the proposed system should fully comply with the e-government system standards. The Korean government selected XML as the standard for electronic documentation and digital certificates security technology for e-government service project (G4C\textsuperscript{2}): Government for Citizen) in 1999. Currently, about 70\% of XML demands are created by the government and public sectors (Yang, 2002).

Kiril Simov (1999) states that XML-based process representation for e-government service is a promising application oriented approach, which enables governmental actors to enter the network age without high investment burdens, but with many options for creating the service oriented government of the future. Schmid (2001) presented the following general system architecture for XML based web system.

![Figure 5.2 XML based web system architecture (Schmid, 2001)](image)

The proposed system architecture in this research mainly focused on the cadastral information provision process. The system can be divided into four main components: user interface, G4C application processing system, participating public administration organisations and municipality cadastre divisions. The public administrations’ form managers are responsible for managing forms using XML Editor. The municipality cadastre divisions’ cadastral records managers are responsible for updating original cadastral database. Figure 5.3 shows a conceptual implementation level system architecture of proposed cadastral information dissemination system.

\textsuperscript{2} The Government for Citizens (G4C) is a recently developed integrated e-government web service portal by the Korean government (for more information:https://www.egov.go.kr/default.html).
From the system perspective the processes of the proposed cadastral information dissemination system are as follows:

1. The public administrations’ form managers are managing XML form using XML Editor.
2. The created XML form will be sent to the G4C XML repository and these forms will be shared with all public administration organisations.
3. The users can view on-line application forms.
4. Select a service that requires identification. Enter the name and password and fill out the online application form. This application information will be stored into the XML DB and application DB separately. The XML DB will send a message to the XML server.
5. After receiving a message, XML server will retrieve the required data from the production DB and retrieve the right XML forms from the XML form repository. Then create the required e-document and send it to the issuing DB.
6. The issuing DB will transform the XML format document into HTML format. The HTML document will be sent to user interface web site.
7. The users can view the final product through the computer screen or download the file for printing the e-document.
Figure 5.4 Application procedures from the user perspective

From the user perspective, the application procedures are as follows (Figure 5.4):
1. Select a service that requires identification.
2. Enter name, resident registration number, address, and other personal information.
3. Fill out the online application form.
4. Select method of receipt (either postal or online service) and check out the service charge.
5. After a security program is installed on your web browser, a screen will appear to confirm your authorized certificate. Select a certificate to use and enter password.
6. The program will connect to the relevant CA and verify the digital signature used for the e-service and identity of the customer.
7. When the certificate is verified, you will have to enter your payment information.
8. When the payment is done, your application will be received by G4C.

5.4. Cadastral information dissemination system modeling

The cadastral information dissemination system is proposed to be an extension of the current Korean e-government service system (G4C: Government for Citizen). In this section, based on the identified user requirements, system specifications, and proposed a conceptual system architecture, cadastral information dissemination system is modeled using UML diagrams. In the following sections, the use case model, activity model for cadastral information dissemination system is developed. For data modeling, out of four identified use cases (Figure 5.5), the issuing authorized certificate use case is modeled.

5.4.1. Use case model for cadastral information dissemination

The use case model includes the actors, the system, and the use cases themselves. The set of functionality of a given system is determined through the study of the functional requirements of each actor, expressed in the use cases in the form of ‘families’ of interactions (Muller, 1997).
Use case diagram describes external perspective of the system by identifying actors and use cases. From the proposed system architecture (section 5.3) the cadastral information dissemination system use case model is produced as shown in figure 5.5. Identifying actors and use case is the first step to model the system. An actor represents a role that someone or something in the external environment can play in relation to the business process (Jacobson, 1994). In this use case diagram (figure 5.4) the following six actors are identified: Internet users, public administration organisations’ XML form manager, cadastral records manager (cadastral public officer), cadastral records provider (KCSC staff), Certificate Authority (CA) and e-payment authority.

1. **Internet users**: Internet users represent the general public who have access to the G4C e-government web site for applying and receiving cadastral information products.
2. **Public administration organisations’ XML form manager**: The public administrations’ form manager represents public officers who are managing XML form using XML Editor and send it to the XML form repository.
3. **Cadastral records manager**: Cadastral records manager represents cadastral public officers who are responsible for updating the original cadastral database.
4. **Cadastral records provider**: Cadastral records provider represents the KCSC staff members who are responsible for provision of new cadastral records to the cadastral records manager.
5. **Certificate authority**: Certificate authority represents an authority, which provides an authorized certificate when the general public applies for it.
6. **E-payment authority**: E-payment authority represents an authority, which takes care of online transaction process.

![Use case models for cadastral information dissemination system](image-url)
5.4.2. Activity model for cadastral information dissemination

This activity diagram shows the roles and responsibilities of each actor in the business process, which is documented as a business workflow. The identified actors in the previous section and one more actor, which is G4C application processing system, are participating in the cadastral information dissemination process. The whole processes of cadastral information dissemination using Internet network are described in the activity diagram (figure 5.6).

![Activity Diagram of Cadastral Information Dissemination System]

*Figure 5.6 Activity diagram of cadastral information dissemination system*
The Internet users initiate the process visiting Certificate Authority (CA) and apply for an authorized certificate. The CA checks the applicant’s identification and if it is acceptable, issues the authorized certificate to the applicant. The applicant confirms the authorized certificate and downloads the security program at the CA web site and installs the program on the computers. The above activity diagram (figure 5.5) shows each actor’s role and responsibility in the of cadastral information dissemination through Internet network.

5.4.3. Data model for issuing authorized certificate use case

The purpose of a class diagram is to document the relationships between workers and entities. It provides a way to visualize who interacts with who and who is responsible for what. The class diagram is used for two main purposes: a) to show how workers and entities are collaborating to implement business process b) to show static structure and relationships among entities (A.Tuladhar, 2003).

In this section, among the identified four use cases (figure 5.5) the issuing authorized certificate use case is modeled as shown in figure 5.7.
In the UML class diagram above the OR constraint relationship is used between the application entity and the Authorized Certificate (AC) handler or the AC manager. The purpose of this relationship is to represent the customer’s application can be received either by the post offices and banks or Certificate Authority to make use of the existing public organisation’s national network.

For a successful implementation of the e-government service system, accessibility of Certificate Authority (CA) is very important, because every citizen who wants to use this service has to visit the CA at the first time. If it takes too long time to access CA physically, then, many of them would not use this service. Therefore, one alternative is to make use of the existing public organisations’ national network such as post offices and banks. With close collaboration, these organisations will take a responsibility of receiving the authorized certificate applications and checking the applicant’s identification. After this process forward the application to the CA. Then CA will be able to register and manage this information into the database. Finally send confirmation e-mail to the applicants.

5.5. Concluding remarks

In this chapter, two tasks have been discussed, the first being the proposal of a system architecture and the second being the development of models for the proposed system. To this end, a conceptual system architecture has been proposed to meet the identified user requirements and system specifications.

In the use case model six actors: Internet users, public administration organisations’ XML form managers, cadastral records managers (cadastral public officers), cadastral records provider (KCSC staff members), Certificate Authority (CA) and e-payment authority have been identified. In the activity model six actors and one additional actor, G4C application processing system, are participating in the cadastral information dissemination process. For data modeling among the identified four use cases (user interface, XML repository, cadastral records updating and issuing authorized certificate and online transaction), the issuing authorized certificate use case is modeled.

The cadastral information dissemination system is proposed to be an extension of the current Korean e-government service system. The Korean government selected XML as the standard for electronic documentation for e-government service project (G4C: Government for Citizen) in 1999. Thus the XML based web system architecture was proposed for extension of the existing system. The system is highly integrated and is composed of a database management system, public document form repository, XML server and cadastral database. This system highly requires a broadband Internet network connections to transfer large volume of data.

Making use of the existing public organisations national network such as post office and banks is proposed as an alternative to physically accessing the Certificate Authority (CA). With close collaboration, these organisations will take a responsibility of receiving the authorized certificate applications and checking the applicant’s identification.
6. Verification of proposed system

6.1. Introduction

In the previous chapter 5, a conceptual architecture of cadastral information dissemination system is proposed. The proposed system is modeled by using UML consisting a series of different models such as use case model, activity model and data model. Due to the iterative nature of the development effort, it is natural to maintain the test model throughout the complete software life cycle (Ivar Jacobson, 1999).

In this chapter, the designed system architecture and models are verified by answering to assessment questions (or indicators). The assessment questions are formulated to assess how many user requirements have been fulfilled with the proposed system. The theoretical background of assessment questions is based on principles of Verification, Validation and Accreditation (VV&A) developed by Balci O. (1998).

6.2. The role of testing in the system development life cycle

Some initial test planning may occur during inception when the system is scoped. However, testing is primarily employed when each phase (as an implementation result) is integrated and system tested. This means that testing is a focus both during elaboration, when the executable architectural baseline is tested and during construction when the bulk of the system is implemented (Ivar Jacobson, 1999).

During the transition phase, the focus shifts toward fixing defects detected during early usage and toward regression testing. Figure 6.1 shows the iteration phase of testing in a general system development life cycle.

![Figure 6.1 Iteration phase of testing in system development life cycle (Ivar Jacobson, 1999).](image)
6.3. Test case

A test case specifies one way of testing the system, including what to test with which input or result and under which conditions. In practice, what to test can be any system requirement or collection of requirements whose implementation justifies a test that is possible to perform and that is not too expensive to perform (Ivar Jacobson, 1999).

In general the test model primary describes how executable components in the implementation model are tested by integration and system test. The test model can also describe how specific aspects or the system of the system are to be tested (e.g., whether the user interface is usable and consistent or whether the system’s user manual fulfils its purpose). Due to the time limitation in this research, the verification of the proposed system is carried out only for non-functional user requirement perspective. Figure 6.2 shows a conceptual framework of non-functional requirement verification process.

![Figure 6.2 Conceptual framework of non-functional requirements verification process](image_url)

6.4. Assessment question (or indicator) formulation

The following assessment questions are formulated to check how many user requirements, which mainly focused on non-functional requirements, have been fulfilled with the proposed system. Answering the assessment question has been done based on which system specification or system design concept described or proposed for particular user requirement. Table 6.1 shows the assessment question and results.
Table 6.1 Assessment questions and results

<table>
<thead>
<tr>
<th>No.</th>
<th>General requirements</th>
<th>Related system specification or design concept</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Personal information security?</td>
<td>- Digital certificate security technology&lt;br&gt;- Management of issuing authorized certificate information&lt;br&gt;- A firewall/intrusion detection system accommodated for network security</td>
</tr>
<tr>
<td>2</td>
<td>Original cadastral database security?</td>
<td>- A separate production database was designed&lt;br&gt;- For security of original database a back up device was accommodated&lt;br&gt;- A firewall/intrusion detection system accommodated for network security</td>
</tr>
<tr>
<td>3</td>
<td>Reliable information provision?</td>
<td>- A cadastral surveying inspection system was introduced to increase the reliability&lt;br&gt;- Current cadastral Act revision was proposed to deal with digital cadastral data reliability</td>
</tr>
<tr>
<td>4</td>
<td>User-friendly interface (easy to use)?</td>
<td>- HTML user interface was proposed to provide user-friendly environment</td>
</tr>
<tr>
<td>5</td>
<td>Simple application procedure?</td>
<td>- For user convenience making use of the existing public organisations national network (e.g., post office and banks) was proposed as an alternative to physically accessing the Certificate Authority (CA).</td>
</tr>
<tr>
<td>6</td>
<td>Standardisation for further exten- sion?</td>
<td>- Comply with current e-government service system (XML and digital certificate technology)</td>
</tr>
<tr>
<td>7</td>
<td>Less or same as the current service fee?</td>
<td>- Making use of the current Korean e-government service infrastructure&lt;br&gt;- Inexpensive authorized certificate issuing information management was proposed</td>
</tr>
<tr>
<td>8</td>
<td>Secure on-line transaction?</td>
<td>- For on-line transaction link with a reliable professional authority was proposed</td>
</tr>
</tbody>
</table>

6.5. Results of the assessment

Since all of identified non-functional requirements (8) were addressed in designing system architecture or UML modeling, this result gives the impression that the designs of system architecture and models produced in this research have met user requirements. However this evaluation is mainly focused on the non-functional requirements. Functional testing is also very important component for finding defects and possibly sent back to other core workflows, such as design and implementation, so that the significant defects can be fixed (Ivar Jacobson, 1999).

6.6. concluding remarks

In this chapter the designed system architecture and models are verified by answering to assessment questions (or indicators). The assessment questions are formulated to check how many user requirements, which mainly focused on non-functional requirements, have been fulfilled with the proposed system. In general the designed system architectures and models have fulfilled most of the identified user requirements. However the evaluation in this research is only dealt with non-functional requirement perspective due to time constraints and the required basic knowledge in programming. Functional testing can be carried out by prototyping one of executable components in the system.
7. Conclusions and recommendations

This chapter summarizes the conclusions of the research and makes recommendations for further study and implementation of the proposed cadastral information dissemination system.

7.1. Conclusions

The main objective of this research is to analyze the impact of digital cadastral information dissemination in Korea and to develop a conceptual system architecture and model the system based on identified user requirements.

In order to achieve the research objectives, an impact analysis of digital cadastral information is conducted in terms of economical, technical, legal (revision of current Cadastral ACT) and social aspects. Secondly, cadastral information dissemination system is designed to overcome the performance problems of manual cadastral information delivery processes. The system is proposed to be an extension of current Korean e-government service system (G4C: Government for citizen) to make use of the established e-government service infrastructure. From this research the following conclusions are made.

1. Recent development in Geo-ICT, such as information system modeling standards, database technology, global positioning system and Internet technology development etc., customers’ requirements, e-government policy and budget constraints are identified as key drivers to change for cadastral organisations. These external environmental factors push cadastral organisations in both the development of new cadastral systems and in the improvement of existing systems.

2. An impact analysis of digital cadastral information is conducted in terms of economical, technical, legal (revision of current Cadastral ACT) and social aspects.

On the economic impact side, an electronic access is expected to increase the demand for products, which will decrease the price of transactions. Increased and improved access to cadastral information will provide support to legal security of rights of persons to land. This improvement in security of tenure will in turn stimulate in turn the land market. Subsequently the stimulated land market could contribute to the development of economy in general.

From a technical perspective, the cadastral information dissemination system is proposed to be an extension of the current Korean e-government service system (G4C) and cadastral spatial information will be a first step to accommodate a spatial component in the G4C. Ultimately the spatially enabled e-government service will support the Spatial Decision Support Systems (SDSS), which supports citizens and organisations to take the right decisions.
On the social impact side, the Internet and communication technologies are expected to have impact on efficient and transparent land administration processes and this improvement is expected to contribute to the reduction of the number of land disputes in Korea. In order to implement the proposed system, a revision of current Cadastral Act and a review of related legislation is proposed as a first step.

3. Particularly in Korea, despite the highly developed Internet network infrastructure and availability of a digital cadastral database including both administrative and spatial data, the cadastral information is still delivered through a manual process by visiting the municipality office or by telephone request. This manual process of cadastral information delivery causes many performance problems. According to the responses from the questionnaire, it is estimated that currently about 700 public officers are involved in issuing copies of cadastral records in 260 municipality offices in Korea. The volume of annual cadastral information delivery transactions in the year 2002 was approximately 23 million €. From an economic point of view, the extension of cadastral information in e-government service system already has a big market.

4. User requirements are identified from three groups: the general public, cadastral public officers and Korea Cadastral Survey Corporation (KCSC) staff members. Based on the identified user requirements system specifications have been formulated to meet user requirements. However these system specifications from the user requirements are not enough to design a system, which complies with the current e-government service system standards. Thus further system specifications have been formulated from a system designer’s point of view.

5. A conceptual system architecture has been proposed to meet the identified user requirements and the formulated system specifications and this system is modeled using Unified Modeling Language (UML) diagrams. In the use case model six actors: Internet users, public administration organisations’ XML form managers, cadastral records managers (cadastral public officers), cadastral records provider (KCSC staff members), Certificate Authority (CA) and e-payment authority have been identified.

6. In the activity model six actors and one additional actor, G4C application processing system, are participating in the cadastral information dissemination process. For data modeling among the identified four use cases (user interface, XML repository, cadastral records updating and issuing authorized certificate and on-line transaction), the issuing authorized certificate use case is modeled.

7. For a successful implementation of the e-government service system, making use of the existing public organisation’s national network such as post offices and banks is proposed as an alternative to physically accessing the Certificate Authority (CA). With close collaboration, these organisations will take a responsibility of receiving the authorized certificate applications and checking the applicant’s identification.
7.2. Recommendations

The main areas of further study directly relevant to this work and recommendations for implementation of the proposed cadastral information dissemination system are the following:

1. The prototype of the proposed system has not been fully implemented due to time constraints and the required basic knowledge in programming. The provided design can be adopted for implementation and testing.

2. An integrated information provision service, which integrates cadastral information and real estate register information, has been identified as a main expected further service. However this requires not only technologies but also other institutional issues such as: agreements between two organisations, which belong to different ministry, new legislation, coordination of the service income, and standardisations. Creating a new information service with cadastral information can be recommended as a related study area.

3. The Korean e-government service system has been primarily focused on text format information provision service. The extension of cadastral information will be the first step to accommodate a spatial component in Korean e-government service system. However there are large numbers of other spatial information, which can be extended in the e-government service. Thus extension of Korean e-government service system with other spatial information, which will make the current e-government system as a spatially enabled e-government service system and ultimately will support Spatial Decision Support Systems (SDSS), is recommended as a further study area.

4. One of the current Korean e-government service system objectives is to realize a paperless government, which emphasize the efforts to reduce paper documents for prompt and precise public administrative procedures. To realize this objective a comprehensive analysis on redesigning public administrative working process in digital environment should be carried out.

5. For a successful implementation of the proposed cadastral information dissemination system the following tasks could be addressed:
   - Revision of the current Cadastral Act and review of related legislations.
   - Creation of a separated cadastral information dissemination production database from original database.
   - Development of a standard XML form for cadastral information dissemination service.
   - Define the cadastral information service delivery condition including liability, intellectual property right, limitation in use, customer complaints and cancellation.
   - Economic analysis for pricing the service charge and consideration of an incentive system introduction.
   - Development of evaluation indicators for further assessment.
   - Comply with the current Korean e-government service system standards.
Reference and bibliography


Appendix 1. Questionnaire

1.1 Questionnaire for the general public

<table>
<thead>
<tr>
<th>Question</th>
<th>Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Do you have an Internet connected PC at home?</td>
<td>Yes, No</td>
</tr>
<tr>
<td>2. If you have any purchasing plans, please indicate the time.</td>
<td>Within 1 year, Within 2 years, Within 3 years, Don't have any particular plan</td>
</tr>
<tr>
<td>3. How often do you take cadastral information in municipality office?</td>
<td>Once in a week, Once in a month, Once in 3 months, Once in 6 months, Less than once in a year</td>
</tr>
<tr>
<td>4. What is the main purpose of taking cadastral information?</td>
<td>Submission to other public department, Checking parcel subdivision, Checking parcel location on the map, Checking registered parcel price, Checking ownership information, Others</td>
</tr>
<tr>
<td>5. How do you get the cadastral information at present?</td>
<td>By telephone request, By visiting municipality office, Others</td>
</tr>
<tr>
<td>6. How do you think of the current cadastral map and cadastral register issuing system?</td>
<td>I am satisfied, I am not satisfied, Others</td>
</tr>
<tr>
<td>7. If you have an inconvenience experience to get cadastral information, please indicate the number according to the priority.</td>
<td>Travelling time to municipality office, Travelling cost, Limited opening office hours, Slow process of updating subdivision, Attitude of public officers, Others</td>
</tr>
<tr>
<td>8. Do you think the on-line cadastral information delivery service system is necessary at this time?</td>
<td>Yes, It is necessary, No, It is not necessary</td>
</tr>
<tr>
<td>9. If you think this service is necessary, what is your expecting direct benefit from the on-line cadastral information delivery service system? (Please indicate the number according to the priority)</td>
<td>Saving time, Saving travel cost, Unlimited accessing time, Fast updating subdivision process, Reduce the public agency budget, Others</td>
</tr>
<tr>
<td>10. Is your parcel number in cadastral register is same as your address number?</td>
<td>Yes, It is same, No, It is different</td>
</tr>
<tr>
<td>11. Are you aware of your land parcel number exactly?</td>
<td>Yes, Yes, No, I am not</td>
</tr>
<tr>
<td>12. If you think this service is necessary, how much of service fee would be appropriate?</td>
<td>Same as the current fee, Less than the current fee, More than the current fee, Cost recovery basis, Free of charge</td>
</tr>
<tr>
<td>13. If this service available at 1,000 won to get parcel information either map or register, are you willing to use this service?</td>
<td>Yes, I am willing to use, No, I will not use</td>
</tr>
<tr>
<td>14. What do you think of the security of current e-commerce payment system?</td>
<td>I feel safe all the time, Generally, it's fine, Sometimes I feel insecure, Mostly I feel insecure</td>
</tr>
<tr>
<td>15. Currently you have to visit municipality office and land registration office separately to get cadastral information and land registration information, how do you think of current separated system?</td>
<td>It is very inconvenient, It is inconvenient, It is not inconvenient, It is not inconvenient at all</td>
</tr>
<tr>
<td>16. Which services are you interested in among the below future service list? Please indicate the number according to the priority.</td>
<td>Registration buildings on the cadastral map, Provision of an outline map for finding parcel location, Provision of integrated land information (Cadastral information + Land registration information)</td>
</tr>
<tr>
<td>17. Which user education method do you prefer?</td>
<td>Remote education (Internet), Organize a user education forum regularly, User guide book, Others</td>
</tr>
<tr>
<td>18. What is the most important specification for the development of on-line cadastral information delivery service system? Please indicate the number according to the priority.</td>
<td>Original cadastral DB security, Data consistency, Updating time interval between original DB and dissemination DB, Integrated land information providing (cadastral info. and land registration info.), Short response time, Personal information security, User friendly interface, Others</td>
</tr>
</tbody>
</table>
### 1.2 Questionnaire for cadastral public officers

1. Do you have an Internet connected PC at the office? ( )
   - Yes
   - No

2. (Only for whom replied “No” in first question) If you have any purchasing plan, please indicate the time. ( )
   - Within 1 year
   - Within 2 years
   - Within 3 years
   - Don’t have any particular plan

3. How often do you access to current cadastral information system (administrative cadastral database) for your work? ( )
   - Less than 1 times in a day
   - 1 – 10 times in a day
   - 10 – 20 times in a day
   - More than 20 times in a day

4. What is the main purpose of accessing cadastral information system? Please indicate the number according to the priority. ( )
   - Submission to other public department
   - Checking parcel subdivision history
   - Checking parcel area
   - Checking registered parcel price
   - Checking ownership information
   - Others ( )

5. How many employees are working on issuing copies of cadastral map and cadastral register? ( )
   - One
   - Two
   - Three
   - More than three

6. Do you think the on-line cadastral information delivery service to the public is necessary at this time? ( )
   - Yes
   - It is necessary
   - No
   - It is not necessary at this time
   - If you replied “No”, please indicate the reason ( )

7. Do you expect that the on-line cadastral information delivery service system will contribute to improve your working environment? ( )
   - Yes
   - It will contribute
   - No
   - It will not contribute

8. If the new system will contribute to improve your working environment, which working process will be significantly improved? ( )
   - Issuing cadastral map process
   - Cadastral map updating process
   - Human resource allocation
   - Others ( )

9. If you think this service is necessary, how much of service fee to the general public would be appropriate? ( )
   - Same as the current fee
   - Less than the current fee
   - More than the current fee
   - Cost recovery basis
   - Free of charge
   - Others ( )

10. How much this new system will contribute to reduce land disputes? ( )
    - It will contribute very much
    - It will contribute much
    - It will contribute somehow
    - Not contribute at all

11. Do you think that a new integrated service, providing cadastral information and land registration information together will contribute to improve the general public service? ( )
    - Yes, It will contribute
    - No, It will not contribute

12. If you think a new integrated service will contribute to the general public service, which way is best to realize? ( )
    - Integration of two different databases
    - Developing online dissemination system separately (Separate web portal)
    - Developing system separately, but provide information on the common web portal
    - Designing a new database for dissemination of integrated land information

13. How do you think of providing each parcel boundary coordinate to the general public in the new system? ( )
    - It should be provided
    - It should not be provided
    - There is no much difference
    - Others ( )

14. If you answered the parcel boundary should not be provided to the public, what is the main reason for that? ( )
    - It will increase land disputes because of the digital cadastral map’s accuracy problem
    - It will create more confusion about parcel boundary position to the public
    - The parcel boundary coordinate is not necessary to the public
    - The parcel boundary coordinates can be abused

15. Which service should be addressed first, among the below future service list? Please indicate the number according to the priority. ( )
    - Registration buildings on the cadastral map
    - Provision of an outline map for finding parcel location
    - Provision of integrated land information (Cadastral information and land registration information)
    - Provision of consistent information (Cadastral information and land registration information)

16. What is the most important specification for the development of on-line cadastral information delivery service system? Please indicate the number according to the priority. ( )
    - Original cadastral DB security
    - Data consistency
    - Updating time interval between original DB and dissemination (production) DB
    - Integrated land information providing (cadastral info. and land registration info.)
    - Short response time
    - Personal information security
    - User friendly interface
    - Others ( )
1.3 Questionnaire for Korea Cadastral Survey Corporation (KCSC) staff members

<table>
<thead>
<tr>
<th>Question</th>
<th>Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Do you have an internet connected PC at the office?</td>
<td>Yes, No</td>
</tr>
<tr>
<td>2. (Only for whom replied “No” in first question) If you have any purchasing plan, please indicate the time.</td>
<td>Within 1 year, Within 2 years, Don’t have any particular plan</td>
</tr>
<tr>
<td>3. How often do you access to current the cadastral information system (administrative cadastral database) for your work?</td>
<td>Less than 1 times in a week, 1 – 5 times in a week, 5 – 10 times in a week, More than 5 times in a day</td>
</tr>
<tr>
<td>4. What is the main purpose of accessing cadastral information system? Please indicate the number according to the priority.</td>
<td>Checking parcel subdivision history, Checking parcel area, Checking registered parcel price, Checking ownership information, Others</td>
</tr>
<tr>
<td>5. Do you think the on-line cadastral information delivery service to the public is necessary at this time?</td>
<td>Yes, It is necessary, No, It is not necessary at this time</td>
</tr>
<tr>
<td>6. How much this new system will contribute to reduce land disputes?</td>
<td>It will contribute very much, It will contribute much, It will contribute somehow, Not contribute at all</td>
</tr>
<tr>
<td>7. Do you expect that the on-line cadastral information delivery service system will contribute to improve your working environment?</td>
<td>Yes, It will contribute, No, It will not contribute</td>
</tr>
<tr>
<td>8. If the new system will contribute to improve your working environment, which working process will be significantly improved?</td>
<td>Submission to public department, Checking parcel information both cadastre register and map, Cadastral survey mapping process, Others</td>
</tr>
<tr>
<td>9. If you think this service is necessary, how much of service fee to the general public would be appropriate?</td>
<td>Same as the current fee, Less than the current fee, More than the current fee, Cost recovery basis, Free of charge, Others</td>
</tr>
<tr>
<td>10. Do you think that a new integrated service, providing cadastral information and land register information together will contribute to improve the general public service?</td>
<td>Yes, It will contribute, No, It will not contribute</td>
</tr>
<tr>
<td>11. If you think a new integrated service will contribute to the general public service, which way is best to realize?</td>
<td>Integration of two different databases, Developing on-line dissemination system separately (Separate web portal), Developing system separately, but provide information on the common web portal, Designing a new database for dissemination of integrated land information</td>
</tr>
<tr>
<td>12. How do you think of providing each parcel boundary coordinate to the general public in the new system?</td>
<td>It should be provided, It should not be provided, There is no much difference, Others</td>
</tr>
<tr>
<td>13. If you answered the parcel boundary should not be provided to the public, what is the main reason for that?</td>
<td>It will increase land disputes because of the digital cadastral map’s accuracy problem, It will create more confusion about parcel boundary position to the public, The parcel boundary coordinate is not necessary to the public, The parcel boundary coordinates can be abused</td>
</tr>
<tr>
<td>14. Which service should be addressed first, among the below future service list? Please indicate the number according to the priority.</td>
<td>Registration buildings on the cadastral map, Provision of an outline map for finding parcel location, Provision of integrated land information (Cadastral information and land registration information)</td>
</tr>
<tr>
<td>15. What is the most important specification for the development of on-line cadastral information delivery service system?</td>
<td>Original cadastral DB security, Separation of dissemination DB from original DB, Updating time interval between original DB and dissemination (production) DB, Integrated land information providing (cadastral info. and land registration info.), Short response time, User friendly interface, Others</td>
</tr>
</tbody>
</table>
Appendix 2. The results of questionnaire analysis

1. The general public questionnaire

1.1 Status of Internet connection
The status of Internet connection in this group is 90%.

1.2 Frequency and main purpose of getting cadastral information
10 citizens answered that they get cadastral information once in 6 months. 6 citizens replied once in one year. 10 citizens answered that a checking parcel location on the map and 7 citizens answered a submission to public department is main purpose.

1.3 Current application methods and degree of satisfaction
18 citizens answered that they visit the municipality office to apply copies of cadastral register and map. Only 2 citizens replied that they apply by fax. 18 citizens answered that they are not satisfy with the current cadastral records issuing system. 14 citizens replied that the travelling time to municipality office and 6 citizens answered that the limited opening office hours are the most inconvenient factors.

1.4 Necessity of on-line cadastral information delivery service
All citizens who answered this questionnaire replied that the on-line cadastral information delivery service is necessary at this moment.

1.5 Expecting benefit
16 citizens answered that the saving travel time the most important benefit of this system. 4 citizens replied that an unlimited service time is the most important benefit.

1.6 How much of service fee would be appropriate?
12 citizens answered that same as the current fee and 6 citizens answered less than the current fee and would be appropriate.

1.7 Are you willing to use this service if this service is available at 1,000 won? (1,000 won is slightly increased service fee and equivalent of 0.7 €)
18 citizens answered that they are willing to use this service. This high number represents the general public’s high expectation on the on-line cadastral information dissemination system.

1.8 Do you feel safe with the current e-commerce payment system?
12 citizens answered that they feel safe with the current e-commerce payment system in general. 6 citizens replied that sometimes they feel insecure with it.

1.9 Expected further services
12 citizens replied that provisions of integrated information which combines cadastre and land register information are the expected further services. 7 citizens answered that a provision of topographic map, which contains building names and street names to assist citizens for finding parcel location, are expected further services.

1.10 User education methods
14 citizens answered that they prefer to remote education through Internet. 5 citizens replied that they prefer to provide user guidebooks.

1.11 Most important consideration in designing the system
12 citizens answered that a personal information security and 6 citizens answered the original cadastral DB security is the most important consideration.

1.12 General requirements
- Personal information security
- Original database security
- Reliable information provision
- User friendly interface (easy to use)

1.13 Functional requirements
- Provision of integrated information, which combines cadastral map and cadastral register information
- Various payment methods
- Secure on-line transaction
- Short response (waiting) time

3) The cadastral information applying frequency in this group is very high; for this could be that the questionnaires have been sent to the general public who have cadastral knowledge.
Korea Cadastral Survey Corporation (KCSC) staff members questionnaire

2.1 Status of Internet connection
The status of Internet connection in this group is 100%. All of KCSC staff who answered this questionnaire are able to access Internet network for doing their tasks.

2.2 Frequency and main purpose of access to administrative cadastral database
The average number of accessing time to administrative cadastral database is 2.6 times in a day. The number of accessing time is various from less than once in a week to more than five times in a day. 17 KCSC staff answered that a checking parcel area and parcel subdivision history is main purpose to access administrative cadastral database.

2.3 Necessity of on-line cadastral information delivery service
18 KCSC staff answered the on-line cadastral information delivery service is necessary at this moment. Most of KCSC staff members believe that providing this service to the general public is an urgent task.

2.4 Expected benefit
15 KCSC staff answered that the saving travel cost and time is the most important benefit of this system. 4 staff replied an unlimited service time is the most important benefit.

2.5 Which working process would be improved by this on-line system?
All of KCSC staff member who replied this questionnaire answered that the on-line cadastral information delivery service will contribute to improve working environment. 19 staff members answered that checking the cadastral map through the Internet network will be the main improvement.

2.6 How much this on-line system contributes to reduce land disputes?
15 KCSC staff members answered that the on-line cadastral information delivery service will contribute to reduce land disputes. On the other hand 4 staff members replied that providing this service may not help to reduce the land disputes because an improved access to cadastral information itself is not enough for reducing land disputes.

2.7 How much of service fee would be appropriate?
12 KCSC Staff members answered that less than the current fee and same as the current fee would be appropriate. 5 staff members answered free of charge and only 2 staff members answered that more than the current fee would be appropriate.

2.8 Provision of each parcel boundary coordinate in the system
12 KCSC staff members answered that parcel coordinates should not be provided because it will increase land disputes due to the digital cadastral map’s accuracy problem.

2.9 Expected further services
7 KCSC staff members answered that a provision of integrated information which combines cadastre and land register information is the expected further service. 5 staff answered that a provision of topographic map, which contains building names and street names to assist citizens for finding parcel location, is the expected further service.

2.10 Most important consideration in designing the system
9 KCSC staff members answered that the original cadastral DB security and 5 staff members replied that the personal information security is the most important consideration. 5 staff members answered that the provision of integrated information service, which combines cadastre and land register information.

2.11 General requirements
- Original database security
- Personal information security
- Simple application procedure
- Minimum number of moving screens
- Standardisation for further extension

2.12 Functional requirements
- Provision of integrated information, which combines cadastral map and cadastral register information
- Should not provide parcel coordinates
- Provision of topographic map to assist citizens for finding parcel location
- Manipulation prevention measures
3. Cadastral public officers questionnaire

3.1 Status of Internet connection
The status of Internet connection in this group is 100%. All of cadastral public officers who answered this questionnaire replied they are using computers and access Internet network for doing their tasks.

3.2 Frequency and main purpose of access to administrative cadastral database
The average number of accessing time to administrative cadastral database is 14.1 times in a day. This relatively high number means that the access to the administrative cadastral base is essential for doing their daily tasks. 15 public officers answered that a checking parcel subdivision history and parcel area is the main purpose to access administrative cadastral database.

3.3 Necessity of on-line cadastral information delivery service
19 public officers answered that the on-line cadastral information delivery service is necessary at this moment. Most of cadastral public officers believe that providing this service to the general public is an urgent task, which the government should address.

3.4 Which working process would be improved by this on-line system?
15 public officers answered that the on-line cadastral information delivery service will contribute to a cadastral record-issuing task and cadastral map-updating task. According the annual cadastre statistics (MOGAHA, 2003) about 180,000 applications for copies of cadastral records have been received and delivered in 2002. The majority of cadastral public officers expect that this on-line service will be able to reduce the cadastral record issuing workload.

3.5 How much this on-line system contributes to reduce land disputes?
18 public officers replied that the on-line cadastral information delivery service will contribute to reduce land disputes. It means that many cadastral public officers expect that improved access to cadastral information and improved transparency of land administration will lead to reduced land disputes.

3.6 How much of service fee would be appropriate?
11 public officers answered that more than the current fee and 4 officers replied same, as the current fee would be appropriate. Only one officer answered less than the current fee and two officers replied that free of charge would be appropriate.

3.7 Provision of each parcel boundary coordinate in the system
13 public officers answered that parcel coordinates should not be provided because it will increase land disputes due to the digital cadastral map’s accuracy problem.

3.8 Expected further services
8 public officers answered that a provision of integrated information, which combines cadastral map and cadastral register information is a further developed service. 7 officers replied integration cadastral information and land registration information.

3.9 Most important consideration in designing the system
6 public officers answered that the original cadastral DB security and 5 officers replied the personal information security is the most important consideration. 5 officers answered an automatic updating process between original DB and production DB is the most important consideration in designing the system. This results have reflected that the majority of cadastral public officers are concerning about security problems in Internet environment.

3.10 General requirements
- Original database security
- Personal information security
- Simple system architecture for maintenance
- More than the current service fee

3.11 Functional requirements
- Automatic production database updating process
- Should not provide parcel coordinates
- Provision of integrated information, which combines cadastral map and cadastral register information
- Short response (waiting) time
Appendix 3. Digital Signature Act in Korea

From the ASEM TFAP (the Asia-Europe Meeting, Trade Facilitation Action Plan) homepage (http://www.asemec.org/partners/policy.asp?country_id=23&country_name=KOREA)

CHAPTER I. GENERAL PROVISIONS

Article 1 (Purpose)
This Act's purpose is to create the basic framework for the digital signatures system so that the safety and reliability of electronic messages are secured and to encourage their use in so doing stimulating the use of electronic records and communications nationally and promoting social benefit and convenience.

Article 2 (Definitions)
The terms used in this Act are defined as follows:
1. The term "electronic message" is meant to signify some information in digital form that is produced and sent, received, or stored through an information processing system;
2. The term "digital signature" is meant to signify some information in a digital form attached on, or logically combined to, an electronic message so that the signer can be identified and it can be verified that that signer has signed the electronic message;
3. The term "certified digital signature" is meant to signify a digital signature that has been grounded upon an authorized certificate and satisfies the following requirements:
   (a) That the subscriber shall be the only one to hold and know the digital signature-creating key;
   (b) That at the time of signing, the subscriber shall hold and control of the digital signature-creating key;
   (c) That it shall be possible to determine if the digital signature has been altered since it was attached;
   (d) That it shall be possible to determine if the electronic message has been altered since digital signature was attached;
4. The term "digital signature-creating key" is meant to signify a sequence of bits used to attach a digital signature to an electronic message;
5. The term "digital signature-verifying key" is meant to signify a sequence of bits used in digital signature verification;
6. The term "certification" is meant to signify the act of determining and verifying that only the subscriber holds and knows the digital signature-creating key;
7. The "certificate" is meant to signify a computer-based record determining and verifying that only the subscriber holds and knows the digital signature-creating key;
8. The term "authorized certificate" is meant to signify a certificate that a licensed certification authority issues in accordance with Article 15;
9. The term "authorized certification work" is meant to signify the concerns related to offering authorized certification services, such as authorized issuance and related record maintenance;
10. The term "licensed certification authority" is meant to signify a body that is designated to offer authorized certification services in accordance with Article 4.
11. The term "subscriber" is meant to signify a person whose digital signature-creating key has been certified by a licensed certification authority;
12. The term "signer" is meant to signify a person who holds his own digital signature creating key and signs in his own name or on behalf of another person;
13. The term "information on individual" is meant to signify a piece of information that pertains to a living individual, such marks, letters, voice, sound, image, physical characteristics, that could establish the person's identity with the help of a name or resident registration number (including information that cannot identify a person on its own, but could be used with other information to establish identity). [This Article Wholly Amended by Act No. 6585, Dec. 31, 2001]

Article 3 (Effect of a Digital Signature)
(1) It shall be judged that requirements are satisfied when there is a certified digital signature attached on an electronic message and if a signature, signature and seal, or name and seal is necessary on a paper-based document or letter under other Acts and subordinate statutes. <Amended by Act No. 6585, Dec. 31, 2001>
(2) It shall be supposed that a digital signature is the signature, signature and seal, or name and seal of the signer of the electronic message concerned and that there has been no alteration in the contents of such message since it was signed digitally when a certified digital signature is attached on an electronic message. <Amended by Act No. 6585, Dec. 31, 2001>
(3) When agreed upon between parties, a digital signature other than a certified digital signature shall have the same effect as a signature, signature and seal, or name and seal. <Newly Inserted by Act No. 6585, Dec. 31, 2001>

CHAPTER II. LICENSED CERTIFICATION AUTHORITY

Article 4 (Designation of Licensed Certification Authority)
(1) A licensed certification authority may be designated by The Minister of Information and Communication as a body that is judged to be able to perform authorized certification work (hereafter referred to as "certification work") in a
secure and reliable manner. <Amended by Act No. 6585, Dec. 31, 2001>
(2) Only government agencies, local governments and corporations can be designated as a licensed certification authority.
(3) As stipulated by Presidential Decree, the body that wants to be designated as a licensed certification authority shall meet requirements such as technical and financial capabilities, facilities and equipment, and other requisite matters.
(4) Presidential Decree shall determine procedures for the designation of a licensed certification authority and other requisite matters.

Article 5 (Disqualification)
No body that falls under any of the following subparagraphs shall be designated as a licensed certification authority:
1. A corporation whose officers fall under any of the following categories:
   (a) A person whom a court has declared incompetent or quasi-incompetent or whom a court has declared as bankrupt and remains not reinstated;
   (b) A person with less than two years following a term of imprisonment without prison labor or heavier punishment not yet completely executed (including situations where it is deemed to have been executed completely) or exempted from being executed;
   (c) A person who, as declared by a court, is under suspension of the execution of imprisonment without prison labor or heavier punishment;
   (d) A person who has been disqualified, or whose qualification has been suspended by a court decision, or under another Act;
   (e) A person who was an officer of a corporation whose licensed certification authority designation was revoked pursuant to Article 12 (limited to cases where less than two years have gone by since revocation);
2. A corporation where less than two years have gone by since revocation of the licensed certification authority designation pursuant to Article 12.

Article 6 (Rules of Authorized Certification Work)
(1) A licensed certification authority shall make authorized certification work rules (hereafter referred to as the "certification work rules") that contain topics contained within the following subparagraphs and report them to the Minister of Information and Communication before performing certification work begins: <Amended by Act No. 6585, Dec. 31, 2001>
   1. Categories of certification work;
   2. System and measures for performing certification work;
   3. Terms and fees for authorized certification service use (hereafter referred to as "certification services");
   4. Other requisite matters for carrying out certification work.
(2) Within the time period set by the Ordinance of the Ministry of Information and Communication, the licensed certification authority shall report to the Minister of Information and Communication when changing the topics in paragraph <Newly Inserted by Act No. 6585, Dec. 31, 2001>
(3) The Minister of Information and Communication may order the licensed certification authority to change its certification work rules within a set time period when the Minister decides that the contents of the certification work rules reported under paragraph (1) may hinder safety and reliability of certification work or may be harmful to the subscriber's interests. <Amended by Act No. 6585, Dec. 31, 2001>
(4) A licensed certification authority shall follow all the stipulations in the certification work rules. <Newly Inserted by Act No. 6585, Dec. 31, 2001>

Article 7 (Provision of Certification Services)
(1) Unless there is a justifiable reason, licensed certification authority shall not refuse to provide certification services.
(2) No licensed certification authority shall unjustly discriminate against a subscriber or a certification service user.

Article 8 (Performance of Certification Work by Licensed Certification Authority)
The Minister of Information and Communication may design and publicize digital signature certification guidelines on definite matters that shall be obeyed by the licensed certification authority when performing certification work to ensure the safety and reliability. [This Article Wholly Amended by Act No. 6585, Dec. 31, 2001]

Article 9 (Acquisition of Certification Work by Transfer)
(1) Under conditions stipulated by the Ordinance of the Ministry of Information and Communication, a licensed certification authority that wants to obtain the certification work of another licensed certification authority or to merge with another licensed certification authority that is a corporation shall report to the Minister of Information and Communication.
(2) A licensed certification authority that has acquired the certification work as referred to in paragraph (1) or the corporation remaining after the merger shall acquire the status of the former licensed certification authority.

Article 10 (Cessation or Closure of Certification Work)
(1) A licensed certification authority shall set the cessation period and notify its subscribers of said period in no less than 30 days before the cessation date and also report to the Minister of Information and Communication when its
The Minister of Information and Communication may order the Korea Information Security Agency (hereafter referred to as the "Information Security Agency") that was established under Article 52 of the Promotion of Information and Communications Network Utilization and Information Protection Act to take control of the subscriber’s certificates from the licensed certification authority concerned following receipt of the report stipulated in paragraph (3). <Amended by Act No. 6360, Jan. 16, 2001; Act No. 6585, Dec. 31, 2001>

(5) The Ordinance of the Ministry of Information and Communication shall determine requisite matters for the report of the cessation or closure of certification work as well as the transfer and takeover of the subscriber’s certificates as referred to in paragraphs (1) through (4).

Article 11 (Corrective Order)
The Minister of Information and Communication may order a licensed certification authority to take corrective measures within a fixed time period if it falls under any of the following cases: <Amended by Act No. 6585, Dec. 31, 2001>

1. When a licensed certification authority performs its certification work in a way that may hinder ensuring the safety and reliability of certified digital signatures;
2. When a licensed certification authority does not satisfy the requisite matters it should meet under Article 4 (3) following designation as a licensed certification authority;
3. When a licensed certification authority’s officer falls under any of the items of subparagraph 1 of Article 5;
4. When a licensed certification authority does not report to where stipulated here or in other Acts, report alterations under Article 6, or when it does not follow its rules of certification work that have been reported;
5. When a licensed certification authority violates Article 7 by refusing to provide certification services or by unjustly discriminating against subscribers or certification service users;
5-2. When a licensed certification authority violates Article 8 by not following definite matters as determined in the digital signature certification guidelines;
6. When Article 9 (1) is violated because a report was not made concerning the acquisition of a certification work by transfer or on a merger between the licensed certification authorities;
7. When a licensed certification authority violates Article 10 due to a failure to give notice or report on the cessation or closure of its certification work or when there is a failure to transfer its subscriber’s certificates to another certification authority at the time of the its certification work closure;
8. When a licensed certification authority with a revoked designation, violating Article 12 (2), does not transfer its subscriber’s certificates to another certification authority or does not report it is necessary to do when there is no transfer;
9. When the relevant documents and materials are not submitted as stipulated in Article 14 (1);
10. When a licensed certification authority, violating Article 17, does not suspend or reinstate an authorized certificate’s validity or when it does not requisite steps for this information to be publicly accessible at all times;
11. When a licensed certification authority, violating Article 18, does not revoke an authorized certificate or when it does not take requisite steps for this information to be publicly accessible at all times;
11-2. When a licensed certification authority, violating Article 18-3, does not take protective steps to secure the safety of certification work facilities;

Article 12 (Suspension of Certification Work or Revocation of Designation)
(1) The Minister of Information and Communication may suspend all or part of a licensed certification authority’s certification work for a period of 6 months or less or revoke its licensed certification authority designation when a licensed certification authority falls under any of the following subparagraphs: Provided that its designation shall be revoked in situations set forth in subparagraphs 1 and 2: <Amended by Act No. 6585, Dec. 31, 2001>

1. When a designation was obtained through fraud or any other wrongful action as stipulated in Article 4;
2. When a licensed certification authority that has been ordered to suspend its certification work does not suspend said work;
3. When certification work has not started within 6 months following designation as stipulated in Article 4 or when no certification work has taken place for 6 or more consecutive months;
4. When an order to alter the certification work rules as stipulated in Article 6 (3) is violated;
5. When, without any justifiable reason, a corrective order is not implemented as stipulated in Article 11.
6. When a licensed certification authority whose designation was revoked pursuant to paragraph (1) shall transfer its subscriber’s certificates to another licensed certification authority: Provided that the licensed certification authority shall quickly report it to the Minister of Information and Communication if the subscriber’s certificates may not be trans-
ferred due to an inevitable circumstances.
(3) The provisions of Article 10 (4) shall be applied mutatis mutandis to the licensed certification authority whose designation was revoked.
(4) The Ordinance of the Ministry of Information and Communication shall determine requisite concerns regarding standards and procedures for dispositions as referred to in paragraph (1) as well as transfer and takeover under paragraphs (2) and (3).

**Article 13 (Imposition of Penalty Surcharge)**

(1) The Minister of Information and Communication may impose a penalty surcharge of less than 20,000,000 won against an offence falling under any of subparagraphs of Article 12 (1) instead of a certification work suspension if said suspension may cause subscribers serious inconvenience or may be harmful to other public interests.
(2) The Ordinance of the Ministry of Information and Communication shall determine the penalty surcharge amount according to the types and nature of the offences under paragraph (1) as well as other requisite matters.
(3) The Minister of Information and Communication shall collect overdue penalty surcharges by referring to the practices of dispositions on default of national taxes.

**Article 14 (Inspection)**

(1) If it is deemed necessary for securing the safety and reliability of certification work or protection of subscribers, the Minister of Information and Communication may order a licensed certification authority to submit the relevant documents and materials, and order the relevant public official to enter its office, work site, or any other relevant premises to inspect facilities and equipment used in certification work such as books, records and other relevant items. <Amended by Act No. 6585, Dec. 31, 2001>
(2) The public official shall show a certificate verifying his authority to the interested persons when conducting an inspection pursuant to paragraph (1).

**CHAPTER III. AUTHORIZED CERTIFICATE**

**Article 15 (Issuance of Authorized Certificate)**

(1) A licensed certification authority shall issue an authorized certificate to the person who applies for it. The licensed certification authority shall verify the identity of the applicant when this happens. <Amended by Act No. 6585, Dec. 31, 2001>
(2) An authorized certificate issued by a licensed certification authority shall contain information in the following subparagraphs: <Amended by Act No. 6585, Dec. 31, 2001>
1. Subscriber's name (in the case of a corporation, its name or trade name);
2. Subscriber's digital signature verifying key;
3. Description of the subscriber's algorithm and the licensed certification authority who signs the authorized certificate;
4. Serial number of the authorized certificate;
5. Effective period of the authorized certificate;
6. Verification information such as the name of the licensed certification authority and other information that can identify the licensed certification authority;
7. Details of limits, if any, imposed on the scope or purposes of the use of the authorized certificate;
8. Details of the subscriber's proxy to act for another or if he asks his professional title;
9. A mark verifying the authorized certificate.
(3) Deleted. <by Act No. 6585, Dec. 31, 2001>
(4) A licensed certification authority may issue an authorized certificate that has limits on the scope or purposes of its use when a person applies for the issuance of an authorized certificate. <Amended by Act No. 6585, Dec. 31, 2001>
(5) A licensed certification authority shall give an appropriate time period in which an authorized certificate is valid by considering the scope or purposes of its use as well as the safety and reliability of the computing techniques used for its issuance. <Amended by Act No. 6585, Dec. 31, 2001>
(6) The Ordinance of the Ministry of Information and Communication shall determine requisite concerns regarding the identification verification procedures and methods of an applicant for the issuance of an authorized certificate. <Newly Inserted by Act No. 6585, Dec. 31, 2001>

**Article 16 (Termination of Validity of Authorized Certificate)**

(1) The authorized certificate's validity shall end when circumstances arise falling under any of the following subparagraphs with respect to an authorized certificate issued by a licensed certification authority: <Amended by Act No. 6360, Jan. 16, 2001; Act No. 6585, Dec. 31, 2001>
1. When the authorized certificate's validation expires;
2. When a licensed certification authority's designation is revoked pursuant to Article 12 (1);
3. When an authorized certificate's validity is suspended pursuant to Article 17;
4. When an authorized certificate is revoked pursuant to Article 18;
(2) If necessary to ensure the safety and reliability of certification work, the Minister of Information and Communica-
tion may suspend authorized certificates’ validity if they were issued by a licensed certification authority which has ceased or closed its certification work pursuant to Article 10 or the certification work of which has been suspended pursuant to Article 12. <Amended by Act No. 6585, Dec. 31, 2001>

(3) The Minister of Information and Communication shall instruct the Information Security Agency to take requisite steps quickly for this information to publicly accessible at all times when he has suspended an authorized certificate’s validity pursuant to paragraph (2). The same shall also apply when the validity of certificates terminates pursuant to paragraph (1) 2. <Amended by Act No. 6585, Dec. 31, 2001>

Article 17 (Suspension of Validity of Authorized Certificate)

(1) If there is a request by a subscriber or their agent, a licensed certification authority shall suspend the validity of an authorized certificate or restore it by terminating the suspension. When this happens the request for the restoration of validity shall be made within 6 months from the validity suspension date. <Amended by Act No. 6585, Dec. 31, 2001>

(2) A licensed certification authority shall quickly adopt requisite steps for this information to be publicly accessible at all times when it has suspended or restored the an authorized certificate’s validity under paragraph (1). <Amended by Act No. 6585, Dec. 31, 2001>

Article 18 (Revocation of Authorized Certificate)

(1) The licensed certification authority shall revoke an authorized certificate if circumstances occur that fall under any of the following subparagraphs: <Amended by Act No. 6585, Dec. 31, 2001>
1. When a subscriber or his agent requests an authorized certificate to be revoked;
2. When the licensed certification authority learns that a subscriber has been issued an authorized certificate by fraud or other wrongful methods;
3. When the licensed certification authority learns that a subscriber has died or the court has declared their disappearance, or that a subscriber, in the form of a corporation, has been dissolved;
4. When the licensed certification authority learns that a subscriber's digital signature-creating key has been lost, hacked, stolen or disclosed to a third party.

(2) A licensed certification authority shall quickly take requisite steps for this information to be publicly accessible at all times when it has revoked an authorized certificate pursuant to paragraph (1). <Amended by Act No. 6585, Dec. 31, 2001>

Article 18-2 (Personal Identification by Authorized Certificate)

Unless a person's self-identification is restricted or precluded by some other Act, a person may identify himself by way of an authorized certificate issued by a licensed certification authority under this Act. [This Article Newly Inserted by Act No. 6585, Dec. 31, 2001]

CHAPTER IV. THE SECURING OF SAFETY AND RELIABILITY OF CERTIFICATION WORK

Article 18-3 (Securing Safety of Licensed Certification Authority)

As stipulated by the Ordinance of the Ministry of Information and Communication, a licensed certification authority shall take protective steps to secure the safety of certification work facilities. [This Article Newly Inserted by Act No. 6585, Dec. 31, 2001]

Article 19 (Operation of Certification Work System)

(1) A licensed certification authority shall securely operate its certification work facilities and equipment, including a method for at all times allowing the public to know whether or not the authorized certificates it issues are valid.

(2) A licensed certification authority shall be subject to regular inspections by the Information Security Agency to discern whether or not its facilities and equipment as provided in paragraph (1) are securely operated.

(3) A licensed certification authority shall quickly report to the Minister of Information and Communication after it receives its designation and obtains requisite facilities and equipment as provided in paragraph (1). When this happens the Minister of Information and Communication may direct the Information Security Agency to inspect the new facilities and equipment to look for safety problems. [This Article Wholly Amended by Act No. 6585, Dec. 31, 2001]

Article 20 (Time-Stamp of Electronic Messages)

If there is a request on the part of a subscriber or an authorized certificate user (hereafter referred to as the "user"), a licensed certification authority may stamp the time on an electronic message by means of a digital signature when it is presented for its certification. <Amended by Act No. 6585, Dec. 31, 2001>

Article 21 (Control of Digital Signature-creating Key)

(1) A subscriber shall hold and control his digital signature-creating key in a secure and confidential manner and shall notify the licensed certification authority when it is learned that the key has been lost, hacked, stolen, or disclosed to a third person or that it is in danger of being hacked. The subscriber shall quickly inform the users of the contents of the notification that was sent to the licensed certification authority when this happens.
(2) A licensed certification authority shall give its subscribers the computational device they can use to inform or notify such facts referred to in paragraph (1).

(3) A licensed certification authority shall not hold a subscriber's digital signature-creating key unless the subscriber so requests. If the licensed certification authority holds the subscriber’s digital signature-creating key it shall not use or disclose the key without the subscriber’s consent.

(4) A licensed certification authority shall hold and control digital signature-creating keys that it uses in a secure and confidential manner. A licensed certification authority shall quickly notify the Information Security Agency and take requisite steps to ensure the safety and reliability of certification work when it learns that a digital signature-creating key has been lost, hacked, stolen or disclosed outside or that the digital signature-creating key is in danger of being hacked. [This Article Wholly Amended by Act No. 6585, Dec. 31, 2001]

**Article 22 (Keeping Records of Certification Work)**

(1) A licensed certification authority shall keep and control records of authorized certificate issuance for its subscribers and the performance of its certification work in a secure manner. <Amended by Act No. 6585, Dec. 31, 2001>

(2) A licensed certification authority shall keep and control subscriber’s certificates for a period of 10 years after the termination of a certificate’s validity. <Amended by Act No. 6585, Dec. 31, 2001>

**Article 22-2 (Control of Authorized Certificates)**

(1) A licensed certification authority and its subscriber shall carefully maintain the contents of the authorized certificate or the information associated with the authorized certificate while it remains valid.

(2) By using the authorized certificate, a licensed certification authority shall provide the users with an easy to use way to allow them to determine the matters in the following subparagraphs:

1. Name of the licensed certification authority and other information that can be used to verify the licensed certification authority’s identity;
2. The fact that the subscriber held and controlled the digital signature-creating key when the authorized certificate was issued;
3. The fact that the digital signature-creating key was valid prior to the authorized certificate’s issuance.

(3) A licensed certification authority shall provide the users with an easy to use way to allow them to determine the matters in the following subparagraphs:

1. Methods of how the signer’s identity can be verified;
2. Limits on the purpose and scope of the digital signature-creating key or the authorized certificate;
3. The scope or limit of the liability incurred by the licensed certification authority.

[This Article Newly Inserted by Act No. 6585, Dec. 31, 2001]

**Article 23 (Security of Digital Signature-creating Key)**

(1) No person shall use or disclose another person’s digital signature-creating key without permission. <Amended by Act No. 6585, Dec. 31, 2001>

(2) No person shall have an authorized certificate that was issued in another person’s name, or aid in a fraudulent issuance. <Amended by Act No. 6585, Dec. 31, 2001>

(3) No person shall use a mark that leads or may lead others to mistake an unauthorized certificate with an authorized certificate or shall falsely indicate the use of an authorized certificate. <Newly Inserted by Act No. 6585, Dec. 31, 2001>

**Article 24 (Protection of Information on Individual)**

(1) A licensed certification authority shall protect an individual’s information when performing certification work. 

(2) Provisions concerning an individual’s information referred to in Articles 22 through 32, 36 (1), 54, 55, 62, 66, and 67 of the Act on Promotion of Information and Communications Network Utilization and Information Protection shall apply mutatis mutandis with respect to the protection of an individual’s information as stipulated in paragraph (1). The provider of information and communications service shall be judged to be a licensed certification authority and the user to be a subscriber when this happens. [This Article Wholly Amended by Act No. 6585, Dec. 31, 2001]

**Article 25 (Digital Signature Certification Control Service)**

(1) The Information Security Agency shall do the things in the following subparagraphs so that they can help create an environment where the public may use digital signatures with a sense of safety and reliability and to exercise control over licensed certification authorities efficiently:

1. Meeting preparation and help with the inspection of the new facilities and equipment of a designation applicant under Article 4;
2. Help with licensed certification authority inspections as stipulated in Article 14 (1);
3. Inspection and technical assistance of protective steps as stipulated in Article 18-3;
4. Regular inspections to determine whether facilities and equipment are securely operated as stipulated in Article 19 (2);
5. Certification work such as the issuance and control of authorized certificates for the licensed certification authorities;
6. Development, distribution, and research into digital signature certification technology standardization;
7. Help with the promotion of international cooperation, including research into digital signature certification and recognition systems;
8. Other requisite concerns regarding digital signature certification work.

(2) Articles 3, 6, 7, 15 through 18, 18-2, 18-3, 19 (1), and 22 shall apply mutatis mutandis to the Information Security Agency’s digital signature certification control service. The "licensed certification authority" shall be deemed to be the "Information Security Agency" and the "subscriber" to be the "licensed certification authority" when this happens.

(3) The Information Security Agency may impose fees for its digital signature certification control service performance such as examination, technical assistance, inspection, and issuance of authorized certificates referred to in Paragraph (1). [This Article Wholly Amended by Act No. 6585, Dec. 31, 2001]

**Article 25-2 (Obligation of Users)**
The users shall take the following steps so that they can verify whether or not a certified digital signature is true by referring to the details within the authorized certificate as stipulated in Article 15 (2) 1 through 6:
1. A way to determine the authorized certificate’s validity;
2. A way to determine if the authorized certificate has been suspended or revoked; and
3. A way to ascertain matters stipulated in Article 15 (2) 7 and 8.
[This Article Newly Inserted by Act No. 6585, Dec. 31, 2001]

**Article 25-3 (Prohibition from Demand for Specific Authorized Certificate)**
Without a justifiable reason, no one shall demand an authorized certificate issued from a specific licensed certification authority when verifying a digital signature by means of an authorized certificate.
[This Article Newly Inserted by Act No. 6585, Dec. 31, 2001]

**Article 26 (Liability for Damages)**
A licensed certification authority shall be liable for damages that it causes to a subscriber or a user who relied on an authorized certificate that it issued in connection with its performance of certification work: Provided that the licensed certification authority’s liability shall be reduced when the damage was the result of a force majeure or the licensed certification authority shall be exempted from liability if it is verified that the authority was not negligent and therefore not to blame for the damage. <Amended by Act No. 6585, Dec. 31, 2001>
2. Establishment of mutual recognition and common use standards of different digital signature certificates and promotion of the use of these standards;
3. Changes to digital signatures and certification policy for the mutual recognition and common use of different digital signature certificates;
4. Other matters concerning the mutual recognition and common use of different digital signature certificates.

(2) When necessary, the Minister of Information and Communication may delegate a relevant agency or organization to represent him when doing things in subparagraphs of paragraph (1). He may incur requisite expenses under the conditions stipulated by the Ordinance of the Ministry of Information and Communication when this happens.

Article 26-4 (Development of Digital Signature related Techniques and Manpower Training)

The Minister of Information and Communication shall do the things in the following subparagraphs for the purposes of technical development and skilled labor training that are necessary for the promotion of the use of digital signatures:
1. Work related to research on digital signature technical levels, study, development, and application;
2. Work related to cooperation in and transfer of digital signature related techniques;
3. Work related to digital signature related techniques information provision and the promotion of cooperation between relevant agencies and organizations;
4. Work related to research on the supply and demand of skilled labor in digital signatures and assistance for skilled labor training;
5. Such other requisite concerns regarding digital signature related techniques and skilled labor training.

Article 26-5 (Implementation of Digital Signature related Pilot Projects)

(1) Under the conditions stipulated by the Ordinance of the Ministry of Information and Communication, the Minister of Information and Communication may implement pilot projects to promote the wide use of digital signatures.

(2) In order to implement pilot projects referred to in paragraph (1), the Government may give administrative, financial, and technical assistance.

Article 26-6 (Assistance to Promote Use of Digital Signatures)

(1) The State or the local governments may provide financial assistance for the promotion of digital signature extensive and active use.

(2) If authorized digital signatures are used in electronic transactions, the Government may formulate and implement policies to reduce or exempt electronic commerce fees to secure the safety and reliability of electronic commerce.

(3) The Government may incur whole or part of requisite expenses for the implementation of the pilot project within the budgetary limits when a corporation or organization related with digital signatures implements a pilot project to encourage the use of digital signatures.

CHAPTER VI. SUPPLEMENTARY PROVISIONS

Article 27 (Protection of Subscribers and Users)

(1) The Government shall adopt requisite steps to deal quickly and fairly with the complaints or damages of subscribers and users.

(2) The Ordinance of the Ministry of Information and Communication shall determine the details regarding measures stipulated in paragraph (1).

Article 27-2 (Reciprocal Recognition)

(1) The Government may enter into an agreement with a foreign government on digital signatures reciprocal recognition.

(2) As stipulated by the Act, the government may form the agreement’s content to grant a foreign certification authority, or a certificate issued by said authority, the same legal status or effect as the licensed certification authority or the authorized certificate after the agreement under paragraph (1) is signed.

(3) The Minister of Information and Communication shall publicize the agreement’s contents when an agreement on the reciprocal recognition of digital signatures has been signed with a foreign government under paragraph (1).

(4) A foreign digital signature or certificate shall be judged to have the same legal effect as an authorized digital signature or an authorized certificate if an agreement has been signed with a foreign government under paragraph (1).

Article 28 (Imposition of Fees)

A licensed certification authority may charge requisite fees, such as service charges, on those who apply for an authorized certificate’s issuance or receive certification services.

Article 29 (Hearing)
The Minister of Information and Communication shall hold a hearing if he is to revoke a designation in accordance with Article 12 (1).

**Article 30 (Delegation of Authority)**
As stipulated by Presidential Decree, part of this Act’s authority vested in the Minister of Information and Communication may be delegated to the head of a subordinate agency.

**CHAPTER VII PENAL PROVISIONS**

**Article 31 (Penal Provisions)**
Any person who falls under any of the following subparagraphs shall be punished by imprisonment for less than 3 years or by a fine less than 30,000,000 won: <Amended by Act No. 6585, Dec. 31, 2001>
1. A person who holds the subscriber's digital signature-creating key with permission, but uses it without permission, violating Article 21 (3);
2. A person who uses or discloses another person's digital signature-creating key without permission violating Article 23 (1);
3. A person who has an authorized certificate issued in the name of another person or aids said issuance, violating Article 23 (2).

**Article 32 (Penal Provisions)**
Any person who falls under any of the following subparagraphs shall be punished by imprisonment for less than one year or by a fine less 10,000,000 won:
1. A person who does not keep the subscriber’s certificates violating Article 22 (2);
2. A person who demands an authorized certificate be issued from a specific licensed certification authority when verifying a digital signature by means of an authorized certificate violating Article 25-3.
[This Article Wholly Amended by Act No. 6585, Dec. 31, 2001]

**Article 33 (Joint Penal Provisions)**
The representative of a corporation, or an agent, employee, or other hired person of the corporation or an individual shall be punished by a fine as provided in the relevant Article if said corporation or individual has committed an offence as referred to in Article 31 or 32 regarding the business affairs of the corporation or the individual. This is in addition to the punishment of the individual at fault.

**Article 34 (Fine for Negligence)**
(1) Any person who falls under any of the following subparagraphs shall be punished by a fine for negligence less than 5,000,000 won: <Amended by Act No. 6585, Dec. 31, 2001>
1. A person who does not report the certification work rules, or a change in them, violating Article 6 (1) or (2) including situations in which the application is mutatis mutandis as referred to in Article 25 (2). A person who does not carry out an order to change the certification work rules as stipulated in paragraph (3) of the same Article including cases in which the application is mutatis mutandis as referred to in Article 25 (2);
2. A person who refuses to provide certification services without a just reason or who unjustly discriminates against subscribers or users violating Article 7, including cases in which the application is mutatis mutandis as referred to in Article 25 (2);
3. A person who does not make a report under Article 9 (1);
4. A person who does not notify his subscribers or the Minister of Information and Communication of certification work cessation as stipulated by Article 10 (1) or closure as stipulated by paragraph (2);
5. A person who does not transfer the subscriber’s certificates to another licensed certification authority, or who fails without a justifiable reason to report that the transfer is not possible violating Article 10 (3) or 12 (2);
6. A person who, as referred to in Article 14 (1), does not submit the relevant documents and materials, submits false records, or who refuses, hinders, or evades an entrance and inspection by the relevant public officials;
7. A person who does not provide notification as stipulated by Article 21 (4);
8. A person who uses use use a mark that leads or may lead others to mistake an unauthorized certificate with an authorized certificate or falsely indicate the use of an authorized certificate violating Article 23 (3).
(2) Under conditions stipulated by Presidential Decree, the fine for negligence as referred to in paragraph (1) shall be imposed and collected by the Minister of Information and Communication.
(3) Any person who is not satisfied with a disposition of a negligence fine referred to in paragraph (2) may raise an objection with the Minister of Information and Communication before 30 days has passed since the date of disposition notification.
(4) The Minister of Information and Communication shall quickly notify the relevant court and that court shall proceed to trial concerning the negligence fine in accordance with the Non-Contentious Case Litigation Procedure Act when a person who is subject to a disposition negligence fine as referred to in paragraph (2) raises an objection under paragraph (3).
(5) The negligence fine shall be collected by referring to the dispositions on national tax default practices when an objection is not raised within the period stipulated by paragraph (3) nor is a negligence fine paid.
Appendix 4. Sample on-line product (cadastral map from Dutch Kadaster)
Appendix 5. UML Activity diagram symbols

<table>
<thead>
<tr>
<th>Name</th>
<th>Prompt</th>
<th>Symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Action State</td>
<td>Represents an action state whose purpose is to execute an action and then transition to another state.</td>
<td><img src="image" alt="Action State" /></td>
</tr>
<tr>
<td>State</td>
<td>Represents a condition during which an object satisfies some condition, performs an action or waits for an event.</td>
<td><img src="image" alt="State" /></td>
</tr>
<tr>
<td>Initial State</td>
<td>Represents the point at which a newly created object starts.</td>
<td><img src="image" alt="Initial State" /></td>
</tr>
<tr>
<td>Final State</td>
<td>Represents the final occurrence of an event at the enclosing state or the completion of activity in the enclosing state.</td>
<td><img src="image" alt="Final State" /></td>
</tr>
<tr>
<td>Transition (Fork)</td>
<td>Represents a Fork transition requiring one input and two or more output transitions.</td>
<td><img src="image" alt="Transition (Fork)" /></td>
</tr>
<tr>
<td>Transition (Join)</td>
<td>Represents a Join transition requiring two or more input transitions and one output transition.</td>
<td><img src="image" alt="Transition (Join)" /></td>
</tr>
<tr>
<td>Control Flow</td>
<td>Represents a transition from one state to another.</td>
<td><img src="image" alt="Control Flow" /></td>
</tr>
<tr>
<td>Object Flow</td>
<td>Represents the flow of an object to or from an action state.</td>
<td><img src="image" alt="Object Flow" /></td>
</tr>
<tr>
<td>Object In State</td>
<td>Represents an object in a particular state.</td>
<td><img src="image" alt="Object In State" /></td>
</tr>
<tr>
<td>Decision</td>
<td>Represents a decision when guard conditions are used to indicate different possible transitions that are Boolean dependent.</td>
<td><img src="image" alt="Decision" /></td>
</tr>
<tr>
<td>Swimlane</td>
<td>Represents a portion for organizing responsibility for activities.</td>
<td><img src="image" alt="Swimlane" /></td>
</tr>
<tr>
<td>Signal Receive</td>
<td>Represents the receipt of a call for an operation by an object.</td>
<td><img src="image" alt="Signal Receive" /></td>
</tr>
</tbody>
</table>