The Development Strategy for Cadastre and Land Register in Finland

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Key words: Development strategy, Cadastre, Land Register, Land Administration, Land In formation System, Base Registers

SUMMARY

Land Administration is based in Finland on the Cadastre and Land Register. The National Land Survey (NLS) and 86 municipalities maintain the Cadastre. The Ministry of Justice is responsible for the Land Register as a system and district courts update the register. The distribution of duties between the NLS and municipalities is based on city-planned areas: the municipalities can be registrar of the Cadastre on their own city-planned areas. The city-planned area accounts for around 2 % of the whole area of Finland. In the past it was compulsory for municipalities to be the registrar on these areas but from the beginning of 2000 it became voluntary. As one can consider the city-planned areas are the most important and expensive area of the country, although a small part of the country.

Conveyances of land are mostly carried out by sales. Notaries public must attest the sales. Notaries send data about the transactions made to the NLS by forms that contain in addition to the data on parties also the price of the purchase and a lot of a data that describes the purchased object. Based on that data the NLS transfers all that data to the Purchase Price Register that contains all purchases of real estates in Finland since 1982. A part of the data is also recorded into the Cadastre if the transfer is a part of a real estate, i.e. transfer of part. It will have an identifier that is a derivation of the real estate ID.

In the Land Register all data is related to the units found in the Cadastre. Transfers are recorded as conveyances and that data comes from the NLS who records that data into the Purchase Price Register. For the conveyances the new owner(s) are obliged to apply for a title in a period of six months. Also transfers of part must be titled. Titling is a precondition for mortgaging. When a transfer of part has been titled the legal survey starts automatically.

In the 2000´s ongoing development is directed to introduce a renewed Land Information System (LIS). It will contain map and new information services that spatial data processing can provide will benefited. The data procedures of the LIS are great in number. The updating procedures when the aim is to carry out the updating from different systems without human intervention have appeared to be a great challenge. The processes are to be investigated as well. The introduction of map into the data contents of the LIS provides the description of land use rights and restrictions as spatial objects. Relations between different objects can be solved by GIS technology. This would improve information services considerably compared with the existing situation.

The role of the LIS will be strengthened as a cornerstone of information society's data infrastructure. As the same time data contents of the Base Registers can be rationalised because there exists no need any more duplicate e.g. person data in many registers.

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1. ORGANISATIONS AND CHARACTERISTICS OF LAND ADMINISTRATION IN FINLAND

The present Finnish Land Information System is comprised of the Cadastre and the Land Register. The existing system is hosted by the National Land Survey of Finland and the Ministry of Justice in cooperation. The responsibility to update the Cadastre lies to a big party at the National Land Survey (98 % of total area) and at a number of cities (86) in their city-planned areas. Local courts update the Land Register and the Ministry of Justice is responsible for the information of the Land Register.

The diagram below describes schematically the parties in land transactions, different tasks, as well as the legal consequences of different stages in the process.

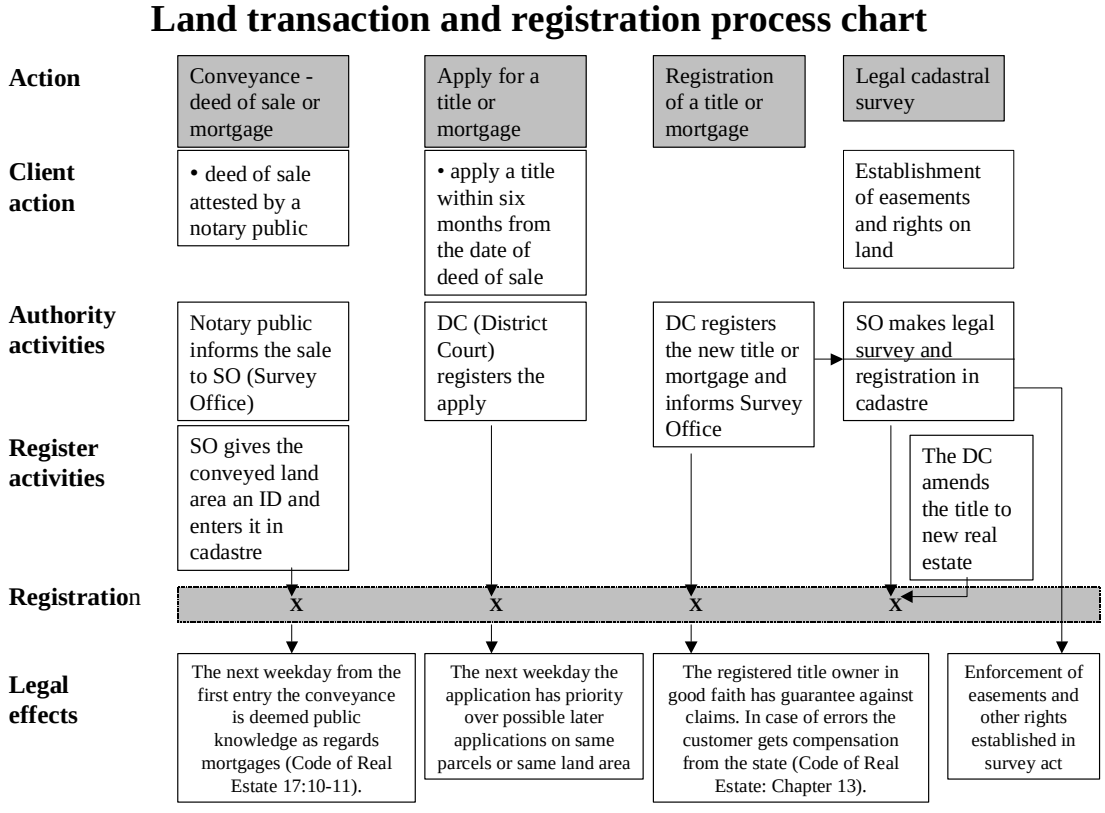

Figure 1

The data contents of the Cadastre include data as follows:

- identification code,
- register unit origin,

- area,
- interest in common areas,
- easements,
- transfers of part,
- land use rights and restrictions and
- references to documents.

It is worth mentioning that buildings and taxation value of properties are not included in the data contents of the Cadastre.

The data contents of the Land Register are as follows:

- applications for titles, easements, mortgages, or other decision
- decisions on titles, easements, mortgages, and other related decisions
- reminders on recovery, bankrupt, restrictions of use, rights of pre-emption or expropriation and liens fixed by law
- conveyances

2. INTRODUCTION INTO THE LAND ADMINISTRATION

2.1 Registers Containing Real Estate Information

The National Land Survey began transferring its alphanumeric cadastral data onto a computer in the late 1970s; the transfer was complete in 1994. Since 1985 the NLS has collected data for the Digital Cadastral Index Map from the existing register maps by digitising and carrying out new mapping. Mapping is based on targeting boundary monuments and photogrammetry. In order to get a full coverage in a reasonable timeframe, digitising of the existing analogue maps was used. In 2000 full coverage was reached and then about half of the coverage was produced by a new mapping. Now Finland continues the mapping and according to plans the whole of country will be mapped in 2010.

To improve the information service, a centralised data system - the Land Information System (LIS) - was introduced in 1984. Data was transferred from the Cadastres of the NLS and cities. Register for titles and mortgages – the Land Register - are also integrated into the same system. Contrary to the Cadastre there is only one centralised Land Register.

2.2 Development of Cadastral Applications at the NLS

Systems have been developed to support legal survey processes since the 1960s by developing software for certain stages of the process. It was not the intention, nor even possible, to design the system on an integrated basis.

The updating of attribute and map data was not synchronised by software. The links between items in these two registers are the identification codes of real estate units. Guaranteeing the intersystem consistency must be managed by administration.

2.3 Digital Cadastral Index Map

The NLS began producing a digital cadastral index map in the mid 1980s.

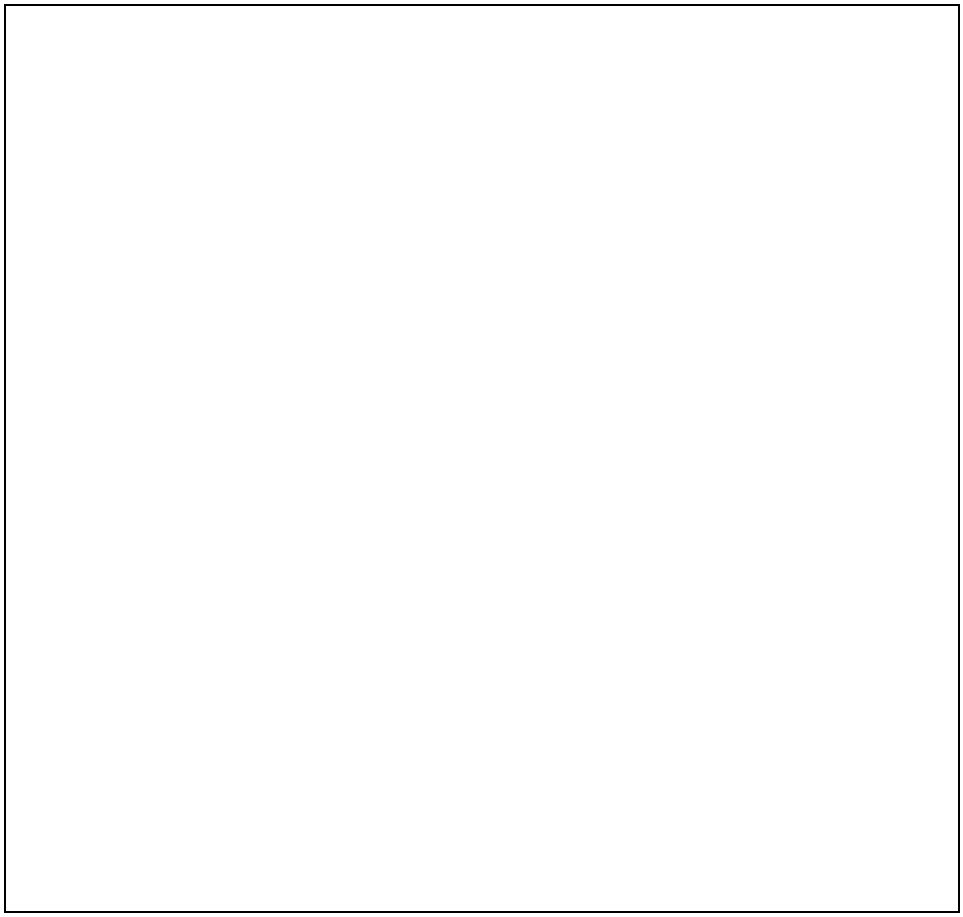

Figure 2. Extract of the Cadastral Index Map

2.4 Legal Survey Work Processes in Use until 1998

Common trends have deeply affected the work processes used in legal surveys. The legal survey work became organised according to methods used in industry, i.e. production-line work, often involving several people of various educational backgrounds. Typical education levels have been: M.Sc. in surveying, surveying engineer, cartographer and topographer.

A survey is divided into many stages each of which has a person in charge. The use of EDP applications has increased the number of stages due to the greater number of applications and complicated user interfaces, and is carried out by `specialists´. The large number of stages in the workflow requires sound management of the production line, since problems always occur involving resource balance between various work stages.

2.5 Problems with the Old Data Systems

There were many problems with the old system, the most significant being:

- cadastral unit's attribute and map data were stored in different systems and the only factor common between them were Ids and the user. This significantly increased the possibility of errors during registration.
- the possibility of making information service inquiries using the efficient spatial predicates (inside, touches, neighbouring) provided by modern GIS software were not available.
- many separate application programs operating with different hardware platforms were used in cadastral surveys, making it difficult to learn and manage all of them. Consequently, work processes were divided amongst different employees, and application users had become specialised into their own sub-groups. The survey proceeded in phases, i.e. after one work phase the survey had to wait for the next phase, which was carried out by another person. This resulted in even simple surveys taking a long time to be completed.
- it was laborious and expensive to maintain several hardware platforms and many types of application software.

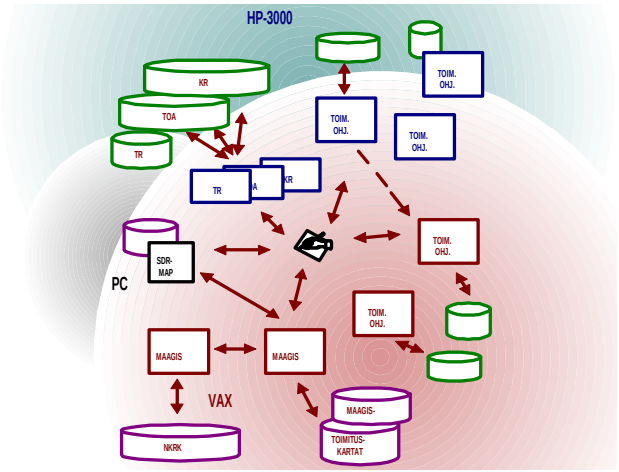

Figure 3

Municipalities developed their own systems that were directed to support the municipal administration. The systems were developed as at the NLS systems for management of attribute data of the Cadastre and a different system for map data.

3. DEVELOPMENT OF NATIONAL LAND INFORMATION SYSTEM (LIS)

In the 70's it was evident that there is a need for a nation wide Land Information System that would contain both data of the Cadastre but also data of the Land Register. The computerisation of the Land Register had not started. The implementation of the LIS system started in 1984. It took till 1994 when cadastral alpha/numerical data covered the whole of Finland. The

data collection was made in the decentralised systems of the NLS and municipalities. For the Land Register no parallel system was developed. The LIS was the first and only realisation of the Land Register. The computerisation of the Land Register took place after the computerisation of the Cadastre because all data in the Land register must be linked to the units of the Cadastre. The Land Register computerisation was completed in 1999.

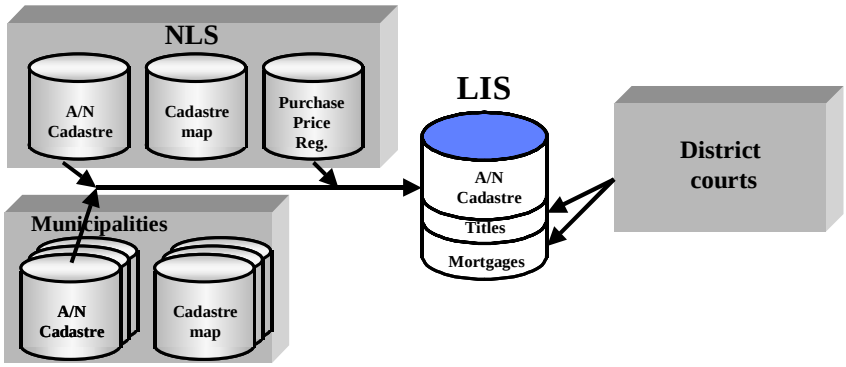

Figure 4. Updating of the Land Information System

4. JAKO - THE SECOND GENERATION CADASTRAL SYSTEM OF THE NLS

The development of a new integrated system of the NLS called JAKO started in the early 90's at the NLS. It was obvious that the integration of separate systems should be achieved. The design of the new system was carried out before 1995 as well as the choice of the GIS platform that was Smallworld GIS. Programming as well as other parts of development were realised in house. The system was implemented in spring 1998. The basic ideas behind the system can be described as follows.

4.1 Functional Improvements in Maintaining the Database

Surveyors employed by the NLS and major cities maintain the cadastre by carrying out cadastral surveys.

The NLS carries out some 25,000 cadastral survey and cities carry out about 5000 surveys annually. But JAKO system is used only by NLS in cadastral surveys. Cities have their own systems.

The JAKO system was developed to include extensive tools for conducting cadastral surveys, involving everything from processing an application for a survey to its registration. This makes it possible for one person to carry out all the work phases of a simple survey (for example subdivision), including final registration.

In terms of register maintenance, it is significant that attribute and spatial data are processed in the same transaction, as this guarantees the consistency of attribute and spatial data in all circumstances.

4.2 Database

Attribute and map data (in vector form) as good as base maps (in raster form) are stored in the same seamless database.

The database includes data on over 4.2 million cadastral units, of which some 1.5 million have ceased to exist. The map data includes data on about five million parcels formed by closed polylines. There is a database join between each parcel and cadastral unit. Spatial data is stored in the seamless database in a uniform co-ordinate system. Co-ordinate calculation must be converted and output presented using Gauss-Krüger projection with five projection zones.

The database also includes raster data of Base Map at scale of 1:20 000 covering the whole of Finland.

4.3 Distribution of the Data

All data in the new cadastral system is stored in a database on a UNIX server in Helsinki. The distribution is based on Smallworld technology in which a cache server including a Persistent Cache is installed in all 13 NLS District Survey Offices and their sub-units. Only if the required data have been changed it is necessary to use WAN connection to get the updated data from the main server.

4.4 Updating the Cadastre with Cadastral Surveys

The data in the cadastral system is maintained and updated with data derived from cadastral surveys. Managing the long transaction forms the most significant element of the updating process. A long transaction means an action in which the updating of database items takes several hours, even weeks or months before the updated data can be registered. Cadastral surveys are a typical example of a long transaction.
In this way, the surveyor updates the Cadastre at the same time as he or she produces the cadastral survey document. When all items in the survey document have been dealt with, the cadastral survey can be pre-registered. This procedure allows the surveyor to register the survey himself and there is no need to restore the decisions and matters resolved during the survey at the registration phase.

4.5 Improvements in the Information Service

The need for efficient and versatile information service functions was given special attention in the design and implementation of the new system. The new system allows an efficient information service with versatile attribute predicates (name, date, area, owner etc.) as well as spatial predicates on a map.

4.6 Experiments of the JAKO System

Now after six years and full-scale production man can summarise experiments:

- From a technical point of view the system has functioned satisfactorily. It has been reliable and the throughput has been sufficient.

- The surveys can be conducted using the new system from correspondence to production of all documents and finally registration.

- The new system has led to a very large training task. All personnel involved in surveys has had to learn to use system. The introduction such a system requires re-engineering of the whole process. The earlier style of processes had been based on production line principle. Personnel was expertise in small phase of the whole process. Now that there is no need to divide the process into small phases it is possible to complete the whole survey by one person only. This is reasonable especially in small surveys such as subdivisions. The JAKO system is quite large one and there is a need for rather deep understanding of EDP, however. Without that knowledge the user will find difficulties.

- The JAKO system was introduced in the whole NLS organisation simultaneously. All the units had the agreed result objectives for that and following years that could not be jeopardised. The organisation culture in the NLS is based on steering by results i.e. local offices can make decisions on the methods used. Re-engineering was the aim in the renewal but it has reached only partially. Implementation of new processes is still going on.

- When new processes have been applied in subdivisions NLS has reached an increase of productivity by 30 %.

5. DEVELOPMENT OF THE NEXT GENERATION LIS

The existing LIS was implemented as a technical system in 1984. In 1995 it was apparent that the renewal of the system should be done at least in ten years or so. Especially the existing technical platform does not support the implementation of map data into the system.

The development of the next generation system started in 1995. The work was done in a working group that consisted in addition to the NLS' member's representatives from the Ministry of Justice and municipalities, i.e. those sectors that are responsible for the data in the LIS. The basis of the work was realisation of questionnaire for the users of the LIS in order to highlight the needs for the new system. The outcome of the questionnaire revealed that map is the most wanted new element in the service. Other features to be improved or added were:

- a better description of land use rights and restrictions,
- a better updated data on ownership (the existing system does not know about conveyances happened by heritages and divorces earlier than the titles have been applied),
- access to building data (now in a separate system run by the Population Register Centre) and
- an easy access of data by the Internet

The aims of the new system were accepted by all parties involved in the working group.

While the technical solutions on data updating caused problems. When a new system will include map data that must be in consistence with attribute data, updating from distributed systems from different suppliers will be a real challenge. That has been solved nowhere according to Finnish awareness. One solution would be to use the same system in municipalities as at the NLS. The most cities could not accept such a solution, as they like to keep their existing systems that are integrated with many other systems in the municipal administration.

In the meantime new investigations on desired features of the new system were performed. They all gave the same results as earlier but more weight was put on data actuality. Reason behind this was a reform of the law on construction and land use.

The start of renewal activity was postponed because no consensus was achieved about how data update from municipal systems should be solved. Two new working groups were established on a high level to make proposals for the technical solution and draft for a law on LIS and its information services. The parties involved in data production of the LIS were represented. The works of these two working groups were completed in spring 2000.

The working group on technical matters outlined the development of the system for a longer period. Those development stages included completion of data contents of the LIS with land use rights and restrictions with more detailed level than for the time being.

5.1 Development of Legislation

The most serious defect in the current Land Information System was the fact that it is based on an agreement between the producers of information only. From the perspective of the information service the situation is poor when we consider the high socio-economic significance of the data included in the system and the legal protection of those using the information. There was an obvious need to set up a clear legal basis for arranging a national information service concerning real estate and other units of land and water areas as well as to secure the updating and quality improvement of the information.

5.2 Objectives of the Law on LIS

Legislation is needed to turn the current Land Information System into a statutory national register and information service system. The purpose of the legislation is to establish the obligations and rights which can be approved by the society, for both the producers and users of the information. Legislation was also seen to provide the necessary social and political approval for the information service, because the act will be passed in the Parliament and approved by the President of the Republic. The following objectives were set for the new Land Information System Act:

- the State is responsible for the implementation and maintenance of the system;
- the act must contribute to the reliability of the data in the Land Information System; the act must take account of the objective concerning the organisation of the maintenance

and availability of data on real estate by means of automatic data processing so that information on both real estate and other units of land and water areas, the rights and restrictions concerning these and their owners and possessors can be obtained from a single, uniform national information service system, the Land Information System;
- data included in the Land Information System must be public and personal data must be protected so that the legal protection of citizens is not compromised;
- by the act a system must be set up to secure the updating of the data included in the Land Information System, and
- the act must contribute to the efforts to improve the quality of the data included in the Land Information System and the efficiency of the information services.

The law has been valid from January 1, 2003. Also the law on the Cadastre was changed simultaneously but the changes will be effective as from June 1, 2005. The most important changes deal with:

- digital cadastral index map will be a part of the Cadastre and data producers are liable for its errors (now the index map is a separate product that can be analogue or digital and special liabilities on its errors have not been stipulated)
- the cadastral part of the LIS will be the only official Cadastre; the official status of the existing 87 cadastres will disappear.

Law now provides the short-term strategy of development of the Cadastre and the LIS. The law stipulates unambiguous the result that shall be achieved in 2005.

6. AIMS AND SOLUTIONS OF THE NEW LIS

The objectives of the development of next generation LIS are to renew the existing system stepwise. The first step is to renew the cadastral part and later the land register part. The renewal of the cadastral part is more radical both from technical and information service points of view. By renewal of the cadastral part new types of information services can be realised. There are not very radical needs to renew the land register part's functionality but the renewal is rational mainly because of the old technique of the computer and software platform. The figure below illustrates the solution after the renewal of the cadastral part.

The idea of adding of a new cadastral part as a parallel system with the existing one is reasonable because the integration of the land register part directly with the new cadastral part would be very difficult and expensive. In any cases the duration of that solution would be limited to some few years only. The planned solution is based on two parallel systems that are synchronised. The updating of cadastral data is carried out in the new system. The update shall consist of both map and cadastral parts. The new cadastral system employs a version management database. When a new version has been created, during the next night changed attribute data will be send to the old cadastral part. A message will be received from the old part indicating whether the update has succeeded. After the succeeded update of the old cadastral system the new version of the new cadastral system will be taken as the updated register contents.

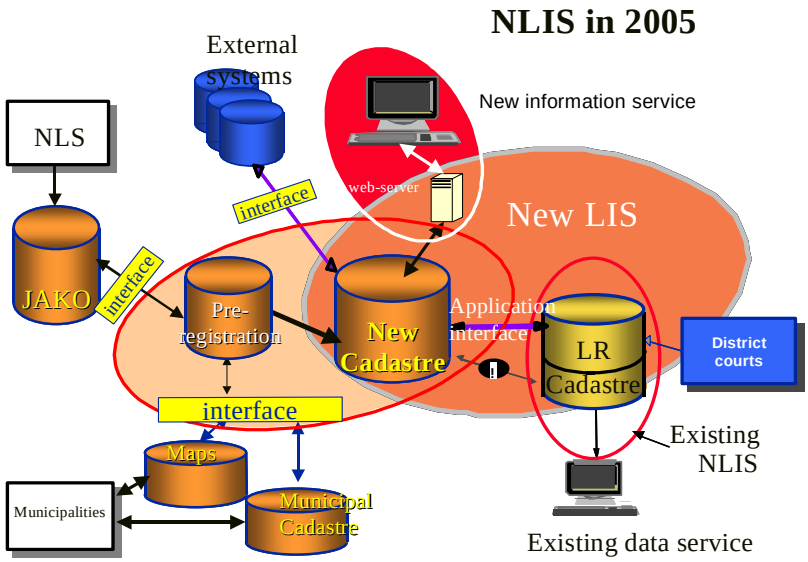

Figure 5

Because the new cadastral part of the LIS is being built on the application developed at the NLS, updating with data born at the NLS is no problem. Whereas updating with data born in municipalities is problematic. Municipalities use several systems for legal surveys. They all are consisted of two parts: a system for managing attribute data and another for managing map data. Updating of attribute data can be solved as an automatic procedure whereas updating of map data provides a lot of problems. They can be listed as follows:

- municipalities use usually their own coordinate system.
- surveys last typically from days to several months. There are many open surveys simultaneously made by different authority organisations (state/municipality, municipality/municipality), there may be conflicts that must be managed.
- the most difficult problem deals with the updating of topology. Updating the map data automatically from municipal systems by messages without human intervention is a difficult problem to solve. Probably it cannot be solved before June 1, 2005 and consequently updating must be made by using more or less human interaction.

7. LAND USE PLANS AND RESTRICTIONS

Land-use rights and restrictions have so far been minimally described in the Cadastre. Real estate units indicate which decisions concern them, but not the actual contents of these decisions; those data must be collected from other sources. When spatial description of real estate units (parcels) has been realized, and land-use rights and restrictions are also described as spatial objects in addition to the attribute data attached to them, relationships of these areas and real estate units can be determined using GIS technology. In this regard, preparatory inventories have been made and development decisions will hopefully be taken in the near future on the political level. By widening the data contents of the cadastre with the spatial description and by depicting land-use rights and restrictions as spatial objects, the feasibilities

of making spatial analysis and of integrating geographical databases are considerably improved.

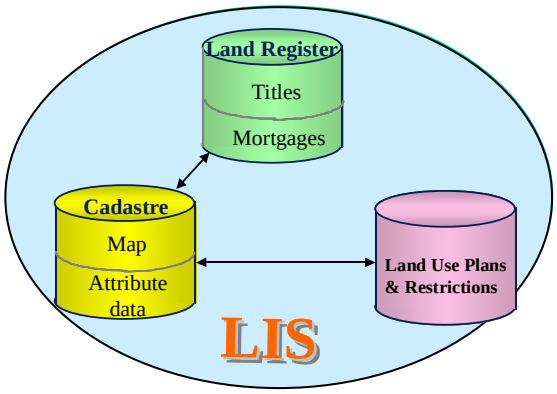

Figure 6

8. LIS IN THE SOCIETY'S DATA INFRASTRUCTURE

The Base Registers in Finland are national information systems that identify the basic units of society. These basic units include **persons, corporations, buildings, and real estate**. The Base Registers contain information about these basic units, information that is of vital importance to individuals and to society at large. Each register describes the state of the basic unit, as well as events, which may have caused this state to change. Characteristics of the Base Registers include broad coverage, reliability, versatility and data protection. Another characteristic is that they have been prescribed by law.

The Real Estate Unit Identifier (REUI) has the following structure:

REUI = XXX – XXX – XXXX - XXXX

Building identifiers are derived from REUIs as follows:

Building id (BI) = REUI + "D" + nr

Identifiers of flats are derived from BIs as follows:

Flat id (FI) = BI + "N" + nr

Also, identifiers for places of business are derived from BIs as follows:

Place of business id (PBI) = BI + nr

Identifiers for transfers of part and leased land are formed according to the same schema.

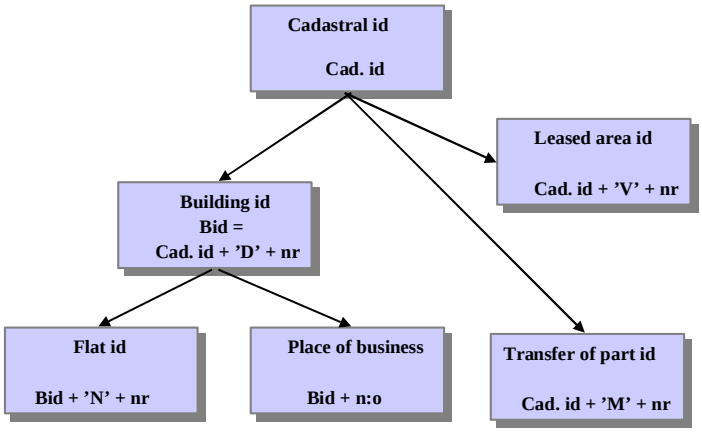

Figure 7. Derivation of new identifiers from real estate identifier

The Personal Information System contains an FI which indicates a person's permanent residence. This includes direct the identifier of the respective building and real estate. The REUI indicates the administrative divisions to which the residence belongs. Integration of these units is straightforward when the identifiers of the units are updated accordingly.

The register of Enterprises and Establishments unfortunately does not include data concerning places of business. Integration of businesses with buildings and real estate can be achieved by using addresses of their locals. The system also includes identifiers of persons belonging to an enterprise or corporation's management and their management role.

The figure below describes the connection possibilities.

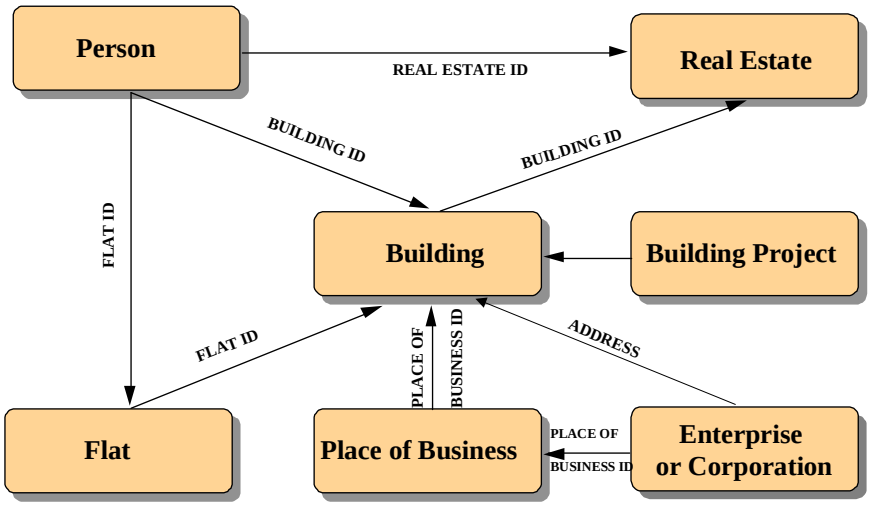

Figure 8. Integration of base register units by identifiers

8.1 Integration of Base Registers with Other Registers

The Base Registers use official identifiers for the basic units (natural persons, juridical persons, real estate, buildings, dwellings, places of business). These identifiers are used in other applications as well. Integration using these identifiers is straightforward: coordinates can be given to natural or juridical persons using relevant building coordinates and data relating to these persons can then be integrated with geographical data. The figure below describes the integration possibilities.

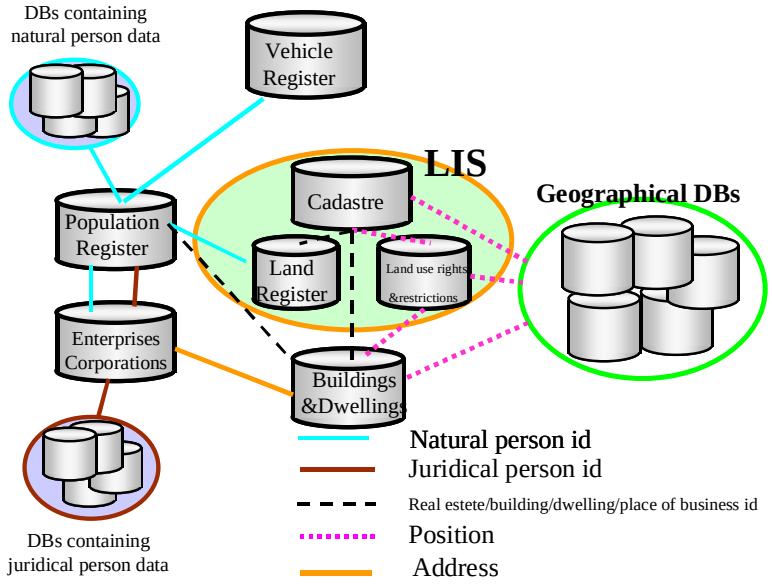

Figure 9. Integration of register data using identifiers and position as links

The Base Registers provide a wide selection of services when their data and services are connected. So far the connection of data has been possible only by batch processing. A project is underway where interfaces for Base Registers are being built. This provides an opportunity to obtain and integrate Base Register data *ad hoc*. The figure below describes the process.

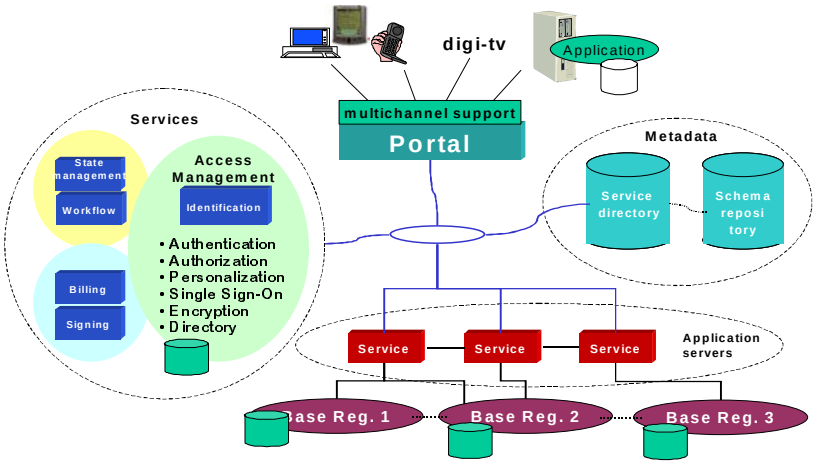

Figure 10. Joint services of the Base Registers

The concept provides possibilities for developing services in which data from several registers are needed. The user does not need to know in which register each piece of information is registered but the service collects all needed data items and provides them accordingly. Such services can be centralized, with licensing, data protection, invoicing etc. managed without duplication. Data protection is a very serious issue in this environment. The Base Registers contain data relating to persons, the use of which requires permission from the relevant register controller. Combining data from several registers becomes more of a threat, from the individual's point of view. Although this paper highlights various uses of Base Register data, the requirements of data protection set strict rules for this use. Data protection is a fundamental principle of the Base Registers.

Tests on a prototype that includes the most of needed technical functionalities are under investigation. So far it seems that all technical problems can be solved. The concept is radical from technical point of view but it is expected that organisational matters will be more difficult to solve. Because parties of the Base Registers belong to different Ministries there is no direct organisational means to reconcile those problems arising from the roles of different actors in a central service like this. Also problems of data protection will be difficult to solve.

9. CONCLUSION

The new technology provides great opportunities to develop data acquisition, registration, integration with other registers, information services, and last but not least to develop the existing processes.

Experiences indicate that reengineering can be more difficult than planned. The aim of using "one man's survey" has been realised partly only. In the NLS case education, the training to manage new skills require more effort than anticipated. That effort is difficult to make simultaneously with normal production.

The concept "Cadastre" includes map as an essential part of its data contents. Traditionally and unequivocally because of earlier techniques map was a separate product and information service. Using the existing GIS technology map and traditional alpha-numerical register can be integrated into one database. That solution guarantees the consistency between these two. Survey can be seen as an update process of the Cadastre. That process can include all necessary phases of the survey from correspondence to final documents and registration.

When map is included in the land administration registers, new era in information service has begun. Map user interfaces are a real improvement for users for data retrieval. In addition all operations provided by the GIS technology improve the service dramatically. Representation of real estates as spatial objects provides the possibility to link them with other spatial objects whether those are included in the LIS or in separate systems.

The NLS has had strategies to develop the system as a technical one but also data contents of registers related to it as well as processes. This operation is not as simple as one could expect. The large number of different actors that belong organisationally to different Ministries and

municipalities as independent organisations causes that the realisation of strategies is demanding. The finding of a consensus requires a long time, at last longer as expected in advance.

The LIS is a vital part of society's data infrastructure. The development of the LIS shall not be seen from land administration's own point of view only. The infrastructure is functional only when different parts cooperate. The NLS has been a protruding member of a pool that has been established to promote the cooperation of Base Registers in Finland. The NLS is according to law responsible for the development of the LIS. The plans made in order to develop the LIS take those aspects into account seriously.

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