The New Land Information System in Finland

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SUMMARY

On June 1, 2005 a new land information system (the LIS) was launched in Finland as a result of collaboration between 86 municipalities and the National Land Survey of Finland (the NLS). To provide a legal framework for the development of the LIS, an Act had been passed about two years earlier declaring the planned LIS the official real estate register, which meant that it would replace the 87 separate cadastres used at the time. Accordingly, the new LIS holds attribute and spatial data on all real estates in Finland. Prior to 2005, attribute data maintained by the NLS and the municipalities were copied into and maintained in the old LIS, whereas spatial data were exclusively stored in the separate systems maintained by the NLS and the municipalities.

The loading of the real estate data from the municipalities was carried out at a swift pace in the spring of 2005, and the maintenance of the data commenced separately in each municipality once the loading was completed. A maintenance application is used for recording any changes in the cadastral data that have resulted from cadastral surveys carried out and related decisions made throughout Finland. The register-keeping application used in connection with the maintenance is based on Smallworld software originally used for building a system – introduced in 1998 – for maintaining cadastral data at the NLS. In the new LIS, the municipalities are able to transfer data from their own systems to the register-keeping application via an XML interface for use as initial data. The terminal server technology allows the municipalities to use the application.
The system provides data services in three different ways: Various customer service points and authorities have access to a web application with a map interface; the municipalities are able to update data in their own systems through a data service application, which supplies changed cadastral data; and the cadastral data in the LIS are accessible to external systems through a software interface. The data service applications rely heavily on XML- and Java-based interface technology.

The introduction of the new system brought about improvements in many fields. As a result, the real estate data maintained by the NLS and municipalities are more uniform, data quality has improved and the applied procedures no longer differ to such a great extent. All real estate data (including the related spatial data) are now stored in one coherent database and available nationwide through an information service.

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1. GENERAL

At the beginning of 2003, the Act on the Land Information System and Related Information Service came into force in Finland. The purpose of the Act was to provide a legal basis for organising a national information service concerning real estates and other units of land and water areas based on information technology. To this end, a nationwide cadastre with spatial and attribute data, where data integrity was adequately ensured, needed to be established, and a suitable system for updating the stored data developed. When the Act took effect, the Land Information System (LIS) became the official cadastre in Finland, and thus replaced the separate registers previously kept by 86 municipalities and the NLS. This ended a system, where attribute data on real estates from the NLS and municipal cadastres were copied into the old LIS, and spatial data were only available from the data systems maintained by the NLS and the municipalities.

The LIS is one of the base registers in Finland. Other base registers are the various registers that hold information on individuals, buildings and apartments, and make up the population information system, and the registers that contain data on corporations and non-profit institutions (Kokkonen, A., Vahala, M.: The Cadastre as a Cornerstone in the Information Society Infrastructure). The cadastre holds data on all independent land ownership units, i.e. real estates. A total of 86 cadastre-keeping municipalities are responsible for recording data on real estates in their town plan areas. These areas constitute approximately 2 per cent of the Finnish territory. The NLS District Survey Offices record cadastral data on all other areas. Also, the District Courts under the Ministry of Justice keep the Land Register, which contains data on the ownership of real estates (titles) and on any mortgages and encumbrances that burden the real estates.

The cadastral system is currently composed of both the new and old LIS, as the old LIS still contains the Land Register, which is used by the Ministry of Justice. The Land Register must be updated with data from the cadastre in order to be valid, and this takes place at night time (Figure 1). For the time being, the old LIS is run in the old IBM/IDMS environment. When it is overhauled, the real estate and land register data will be more closely integrated.

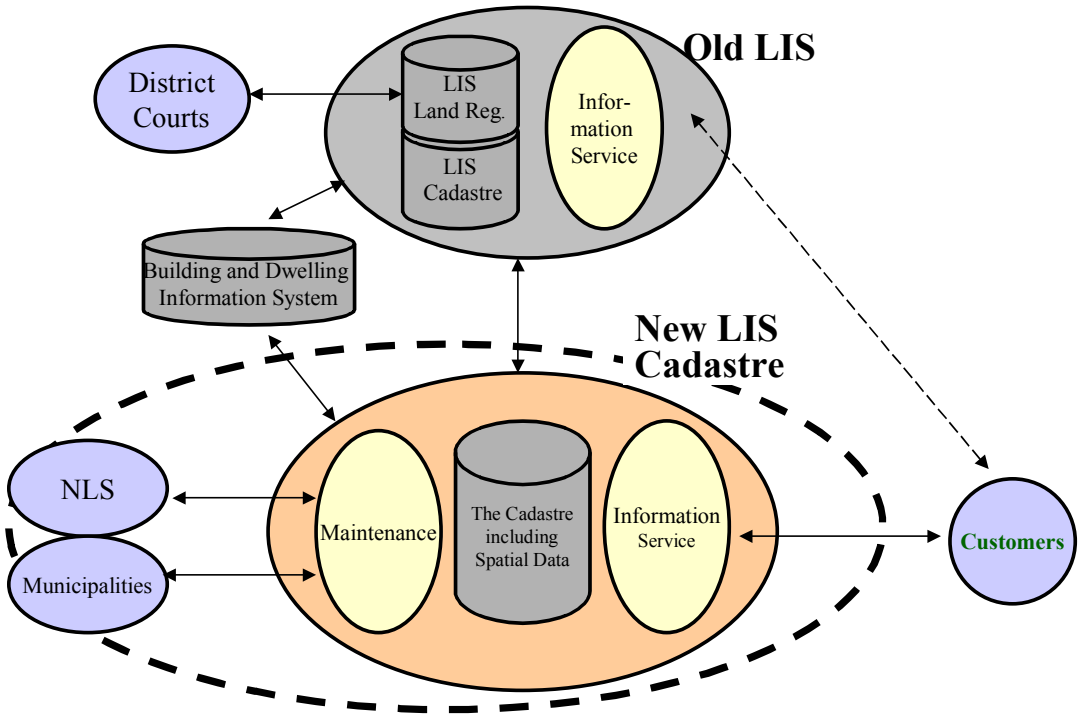

Figure 1

The new LIS was up and running on June 1, 2005, when it was available for use at the national level, after having been launched at the NLS in February 2005, and then, over the course of the spring, separately in the each municipality once the loading was completed. The municipalities thus started to maintain the new LIS one by one in spring 2005.

The Development Centre at the NLS was delegated the task of building the system. When the maintenance application for the new LIS was developed, the NLS JAKO cadastral system introduced in 1998 was used. JAKO is based on the Smallworld software by GE, which was extended at the NLS with application software and databases to enable the maintenance of topographic data. The NLS MapSite application was in turn used, when the new online information service application was built.

The development of the system required approximately 70 man-years between 2001 and 2005 at the NLS and, at its peak, the contribution of 40 experts and application developers full time, whereas 50 man-years or so were spent on launching the system. The NLS is responsible for administering the LIS, which entails not only development and maintenance but also the management of financial matters. The development of the new LIS cost the NLS approximately 8 million euros and the municipalities about 4 million euros. Proceeds from the sale of data will be used to cover the investments, and shared among the parties involved in maintaining the data in the LIS, i.e. the NLS, the municipalities and the Ministry of Justice.

In 2005 about 1.7 million searches were conducted in the LIS, and the revenue from the searches are in the order of 10 million a year.

2. JOINT EFFORTS AND COLLABORATION

The development of the new LIS required close cooperation between the NLS, the Association of Finnish Local and Regional Authorities and the Ministry of Justice. The LIS advisory board composed of the above organisations and a few other organisations functioned as a cooperation body and was responsible for the overall coordination and supervision of the project. Three project teams were entrusted with the actual realisation of the LIS project: A project team tasked to build the system, a project team responsible for launching the new LIS – both consisting of NLS employees – and, as the third party, a project team responsible for those parts of the project that specifically concerned the municipalities. The LIS project was overseen by a steering group with representatives from both the NLS and the municipalities, and the two NLS subprojects mentioned above by the NLS management team.

The experts in the so-called municipality project team worked in close cooperation with the NLS project teams. The team responsible for the system tools alone arranged more than one hundred meetings to discuss the requirements to be met by the joint system and the specifics of the development work. The members of the municipality project team also participated, as experts, in the development of the municipal systems. The expertise of the municipal project team was of vital importance for the development of the system, as the NLS did not have prior knowledge of the real estate formation and cadastre-keeping procedures in the municipalities – i.e. to the extent required. The main tasks of the project team responsible for launching the system was to issue instructions at the different stages of the LIS project, carry out the loading of the data and provide user training in the different components of the system (Lauhkonen H.: What Challenges You Face When Taking in Use a Wide LIS System). The District Survey Offices assisted the cadastre-keeping municipalities in making the data compatible with the new system.

The NLS project team responsible for the system tools built the required databases and applications for maintaining data and for the information service. In order for the system to meet the requirements that had been identified at the planning stage, five different applications needed to be built: an application for loading data, a register-keeping application for maintaining data, an information service application for online customer service, a data service application for updating the data maintained by the municipalities and, last but not least, a software interface for the data needs of external systems.

3. THE LOADING APPLICATION

In the new LIS, spatial and attribute data on real estates are stored using a database technology called the Version Managed Data Store (VMDS), which is included in Smallworld and is seamless. The database was created in two stages: In the first stage, NLS spatial and attribute data were converted into a database according to the data model for the new LIS, and in the second stage, the attribute data of the municipalities were loaded from the old LIS, and the spatial data from the systems used by the municipalities. Prior to the

loading, the spatial data of the municipalities were checked, as were the compatibility of the spatial and attribute data. Compatibility checks were necessary due to fact that many municipalities have their own systems for maintaining spatial and attribute data. Also, it was ensured, by use of various programs, that the attribute data on real estates stored in the old LIS, which had been used for years, corresponded to the attribute data stored in the municipalities. In all the stages described above, the municipalities supplemented, where necessary, their own data to ensure the successful completion of the loading. Attribute data on real estates in the municipalities are stored in four separate systems built by system suppliers.

A loading application was used for loading the municipal data. Here the challenge lay in storing data from the registers kept by the 86 municipalities – which differed in detail – and the NLS cadastral data in one database. The attribute data were largely uniform, since in their case the data models had been harmonized in the 1990ies to meet the requirements of the old LIS. The loading application was, however, not finalized until the test loading of data from all the municipalities had been carried out at the end of 2004. By then, all the distinct features of the municipal systems had been identified. Combining data from different registers, e.g. data on one and the same usufruct, by means of a program presented a further challenge, and, in fact, the database still contains a small amount of overlapping data, where any deletions require user interpretation.

The objective of creating a uniform nationwide cadastral index map from the separately maintained and disparate spatial data also presented a challenge, which needed to be addressed when planning the loading of the data. There is in a sense an "ideological difference" between the NLS and the municipalities evident in the differences in the type of spatial data recorded. The coordinates of boundary marks included on the cadastre index maps of the municipalities have been arrived at through calculations based on the town and subdivision plans. In the municipalities, the real property formation relies directly on the calculations of the location of boundary marks, whereas spatial data on the NLS cadastral index map are based on cadastral surveys conducted over the centuries. In the latter case, the digital map data still partly originate from paper maps, which have been digitised. However, a more accurate cadastral index map based on image and GPS measurements will be available from whole country at the beginning of the next decade. The coordinates of the boundary marks are not officially valid in spite of their increased accuracy: in the event of doubt, the demarcated boundary in the field and the related documents drafted in connection with the cadastral surveys are referred to.

Spatial data on real estates located within the town plan areas of the cadastre-keeping municipalities were accordingly loaded into the new LIS. The project team responsible for the system tools defined an XML/GML transfer structure to be adhered to by each of the six suppliers providing the required systems for the municipal spatial data when the data extraction program was built. Many of the cadastre-keeping municipalities store cadastral data concerning their town plan area (including spatial data) in their own systems. The municipalities and the local District Survey Office agreed locally in which cases the coordinates of the boundary marks of the NLS were to be adjusted based on data from the municipality. Spatial data from different municipalities also needed to be harmonised as the

town plan areas of various municipalities, particularly in southern Finland, bordered each other. Where necessary, the municipalities checked common boundaries and agreed on common coordinate data.

Through the loading application is was possible to create a coherent set of cadastral data including both spatial and attribute data. After one year of use, no data-related problems have been detected. The database holds data on a total of 5 million real estates, 20 million boundary marks and 25 million boundary lines. The size of the database is approximately 120 Gb.

4. THE REGISTER-KEEPING APPLICATION

At the initial stage of the development project, numerous discussions were held between the NLS and the municipalities on how to provide for the maintenance. For quite some time, the project aimed at a solution enabling the municipal systems to automatically update data in the LIS, but as planning progressed, it became evident that the solution was not viable, particularly not in the case of spatial data. As a result, the project teams set themselves the objective of building a maintenance application to be jointly used by the municipalities and the NLS.

The register-keeping application for the cadastral component of LIS was built around the production application JAKOkii, also developed by the NLS (Tuomaala, J., Uimonen, M.: Introducing the New Object-Oriented Cadastral Information System (JAKO) of Finland). The most significant changes were the incorporation of a register view and a tool for transferring the municipal data. In the register view, cadastral data are given in a tree structure. The tool for transferring municipal data in turn enables the transfer of data through an XML file. In addition, the interface classes, function classes and the database could be technically separated. The so-called conflict management system also underwent a major overhaul and was practically re-built. Drawing on previous experiences, the team decided to improve the maintainability of the tools, and provide the conflict reconciliation system with increased automation.

The Smallworld-based NLS maintenance applications are run in the NLS data network, whereby coherent workstation specifications are used. The workstations used by the municipalities could not, however, be connected to the internal network of the NLS, wherefore the decision was made to use terminal server technology, which allows the application installed on a server at the NLS to be accessed over the Internet. Only the interface image is transferred from the server to the workstation in the municipality and, similarly, only the keyboard and mouse commands from the municipality to the server. The decision to opt for terminal server technology proved to be a good one, as it solved a number of problems relating to data communications, application distribution and data security. Through the technology used it was also ensured that the heavy maintenance application could be used over slower connections.

As mentioned earlier, the NLS did not have prior knowledge of the real estate formation procedures or cadastres used in the municipalities, nor of the applications used for the

maintenance. At the initial stage of the planning of the maintenance application, the new system was simulated in different municipalities maintaining systems of their own, whereby valuable information was gained on what requirements needed to be met by the maintenance application. For instance, one requirement identified was that as much digital data as possible from the system used for cadastral surveys in the municipalities should be available for use in connection with the recording of data with the LIS maintenance application. To satisfy this need, a tool was built for transferring municipal data and provided with the capability of supplying attribute data automatically and spatial data semi-automatically for use as initial data in the maintenance transaction.

The register-keeping application is used by some 600 NLS employees and some 400 municipal employees. The cadastre is updated annually with entries on 25,000 cadastral surveys and decisions at the NLS, and 4,000 cadastral surveys and decisions in the municipalities.

5. THE ONLINE INFORMATION SERVICE APPLICATION

One of the key objectives of the LIS project was to make the real estate data easily accessible, and for this purpose, a map-based information service application was built, allowing the users to browse and print cadastral data online. A real estate can be retrieved by entering the real estate code, the real estate address or the personal identity number of the owner. The service also features a versatile tool for conducting searches by location. The user is able to browse the information on the real estate, which includes an alphanumeric cadastral register extract, a map extract and other documents, and to make printouts. Transfers of parts (unseparated parcels) are also recorded in the LIS, and corresponding data are available on them. In addition to real estates, spatial data on usufructs and building prohibitions can also be displayed on a map, although the stored data are not yet comprehensive. The application is linked to the Land Register, which allows the user to print a certificate of title, an extract from the mortgage register concerning mortgages and an abstract of the mortgage register concerning encumbrances.

Topographic raster maps at various scales from the NLS and large-scale base maps from the municipalities are used as background maps in the map interface of the application. The raster data are also printed in the background of map extracts. See Figure 2 for an example of the user interface of the information service application.

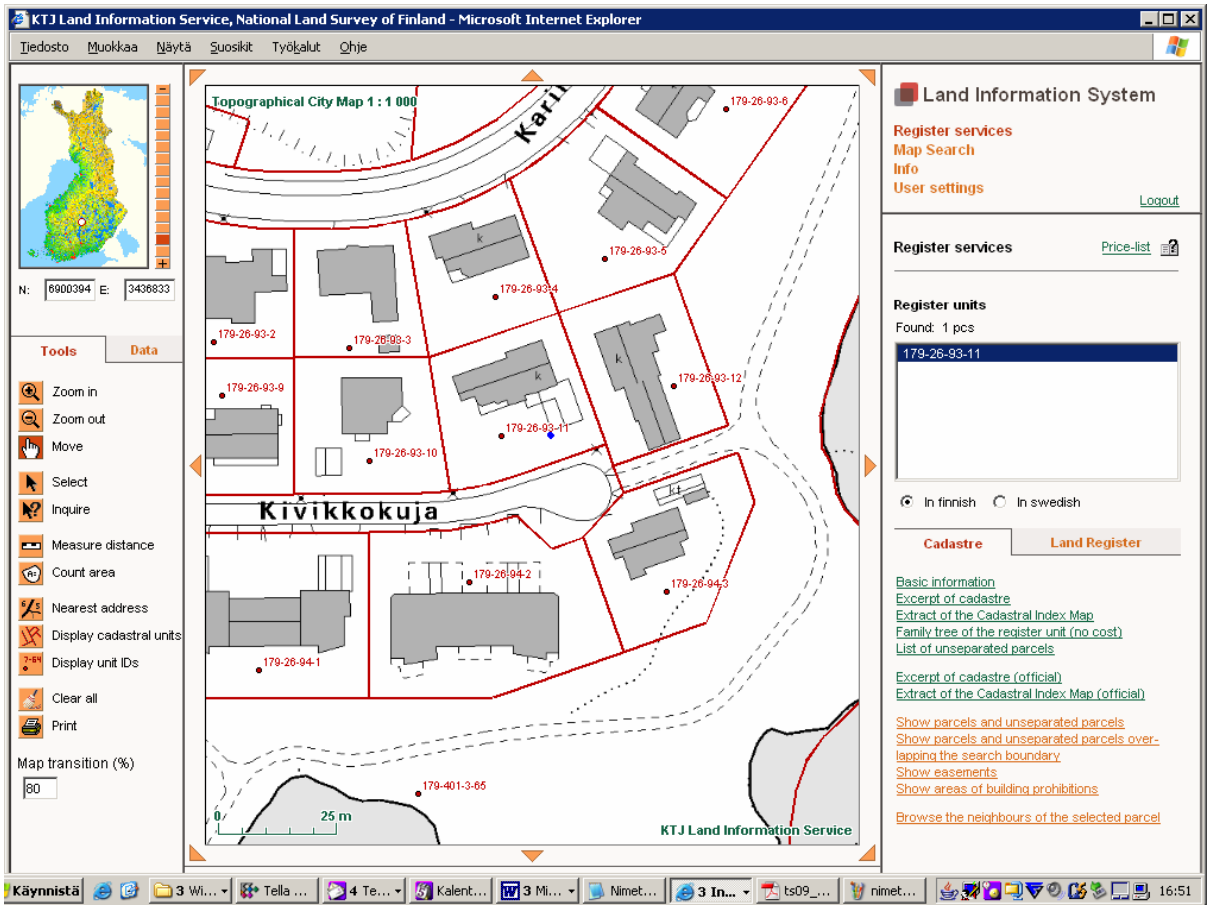

Figure 2

The browser-based LIS information service is an html web application that can be run in all major web browsers. In addition to html, JavaScript and Java applets have been used on the pages sent to the computer at the user end to provide functionality to the forms and map interface, whereas CSS style sheets have been used for the design. The application also offers pdf and text printouts.

The application is based on a technology, where the interface pages and printouts are created in real time in the Apache Cocoon publishing system in response to a request from the user's computer. In accordance with the parameters of the request, the system assembles the required XML descriptions defining the interface and its functions, code and text resources, and the result structures generated by the LIS data retrieval service interface in response to the database queries. Through XSL conversions the page to be sent back to the user is generated from these.

The fundamental idea of the implemented solution is that the application is composed of mutually independent service, interface and design components. The publishing structures of the interface are in turn independent of the internal realization of the database retrieval service. The aim was to come up with a general technical solution, where the applications provided maximum customisability and extensibility, and the components could be easily

used for building other applications. The ideal situation, where the interface and service descriptions and the XSL conversions generating the design of the interface based on these are so universally applicable that the content of the application could be modified or new functions added merely by modifying the XML descriptions, making the need for programming obsolete, was almost achieved.

A key component of the application is the mapplet (map applet) embedded in the interface as a Java applet. The mapplet is also an application-independent service component, as the parameters for, for instance, the map data to be displayed, the searched spatial objects to be displayed on the map, the modelling techniques and the texts to be displayed on the map are passed to the applet based on the XML description. The applet is used on the site by means of JavaScript.

Interface technology has also been employed for the printouts offered by the application with the exception of the extracts in pdf format, which are created by publishing services of their own, which are referred to from the interface. Also, calls are made from the application across the application programming interface for text printouts from the Land Register (titles and mortgages) maintained by the Ministry of Justice. These are displayed in the interface in their native format.

The application login is managed by use of the SelectAccess access management software. When the user logs in, a session cookie is stored temporarily on the user's computer and used for collecting information about the user for the creation of the interface pages. According to the application user roles in the user data and rights defined in the service descriptions, products and functions for the specific user role are generated in the interface. For monitoring and invoicing purposes, the transactions are recorded in the case of each user through session management in a service database based on the data retrieval requests made by the application in accordance with the product codes and product-specific processing rules in the requests.

After having been available for a year, the information service application has 450 fee-paying users and 4,000 non fee-paying users. Use is free of charge for the judicial system, the NLS and the cadastre-keeping municipalities. The data are also available for activities connected with the exercise of public authority, such as in the case of the remaining municipalities, which have not undertaken to keep a cadastre (about 320 in total), federations of municipalities, environmental permit authorities, regional environment centres, forest centres and state provincial offices of Finland. Companies engaged in operations requiring cadastral data on a continuous basis, such as banks, real estate agents and notaries, can be granted access to the information service against a fee. The data in the LIS can also be browsed, free of charge, by private citizens at a customer service point.

6. SERVICE BASED ON A SOFTWARE INTERFACE

Frequently, there are instances, where an external system requires up-to-date information, and copying the data through mass transfers into the system's database is not an option. For this purpose, a service interface was built, enabling the client application to retrieve the required cadastral data directly from the LIS database. The service is based on application-to-application communication, where the client program sends a query over the data network to the server at the NLS end. Having received the query, the service retrieves the data required by the customer from the database and sends them to the client application. In the service transaction, the client application sends the demarcated location or real estate code to the service, which responds by sending the basic data on one or, in some cases, more than one real estate. Basic data include, for instance, the real estate code, registration date and area. The real estate found can then be used for searching for further spatial and attribute data.

The cadastral data interface is based on Web Services technology. The service descriptions are in the form of WSDL documents, and a SOAP protocol allows the systems to communicate through messages, where XML schemas are used for the data descriptions. A SSL secured (Secure Socket Layer, https protocol) connection requiring a user id and password is employed between the cadastral service and the customer (http Basic Authentication).

For access to the service, a contract signed with the NLS is required. Invoicing is based on the number of queries, and a license fee is also charged. LIS information providers, such as the municipalities, are entitled to use the service free of charge provided that the data are used for activities connected with the exercise of public authority. At the moment, the service is used in applications built by three different system suppliers, and there are also a number of cases, where it is used on a trial basis. For further details, see Tarvainen T., Myllymäki T.: Joint Use of Geographic Information – Cadastral Data, General and Topographic Map Data).

7. THE DATA SERVICE APPLICATION

The cadastre-keeping municipalities must be able to update real estate data in the own systems. Within various administrative sectors, the activities are dependent on the availability of comprehensive real estate data for the area administered by the municipality. In practice, this means that the municipal systems also hold data on real estates located outside areas covered by a town plan, where the NLS is responsible for maintaining the data. To ensure that the municipal systems are up to date with the LIS at all times, a data service application was incorporated into the LIS. Cadastral data from the system can be ordered by a municipality in a number of ways. Frequently, the municipality wants its own attribute data changes daily, and the changes in the spatial and attribute data made by the NLS weekly.

If the municipality maintains the data in the LIS directly with the LIS maintenance application, it usually requests all its data at specified intervals, e.g. on a monthly basis. Even when the change is a minor one, the system supplies all the data on the real estate. A database and an application that would have managed and supplied changed data only would have

been difficult to build. It would have required managing changes at the level of data elements and the internal order of the changes in both the extracting and receiving system.

Data according to the limiting criteria are extracted at intervals determined by the municipality, and made available to the user in the municipality or the municipal system, through a data transfer directory created for the purpose, for storage in the municipal system. Some municipal systems update their attribute data automatically and their spatial data semi-automatically. One system supplier has built a functionality that also enables the automatic updating of spatial data; the solution is based on erasing old spatial data and loading new data to replace them.

The data service of the cadastral component of the LIS is a timed service based on batch runs. The batch run service sends a service request for the creation of the files with the results ordered by the customer. In response, the service component, which relies on Java, creates the requested files with the results: it calls for the results of the database queries, which are conducted by means of Smallworld Magik, receives the requested data from the database of the cadastral component and creates a structure of the retrieved data, which is saved in an XML file according to the schema for the data service of the cadastral component. The same service is also used in general for retrieving data from the database, e.g. in connection with the cadastral register extracts and software interface.

Currently, data on real estate changes are supplied to 53 municipalities on a regular basis through the information service. The interval at which data are supplied varies from one day to one week. The comprehensive data for a municipality are supplied once a month to 12 municipalities. A total of 200 users have access rights to the directory used for supplying the data. The use of the service is free of charge for the municipalities. A number of companies have also expressed their interest in using the service.

8. IN CONCLUSION

The solutions opted for when building the new LIS proved to be good ones. Substantial efforts were devoted by the NLS, the municipalities and the system suppliers of the municipalities to building and launching the LIS. The Act on the Land Information System and Related Information Service mentioned earlier obliged the NLS to build the system. Close cooperation between all the parties involved in the LIS project was vital for the successful completion of the LIS project. The system was built and launched in good spirit by the NLS and the municipalities.

The system has now reached the maintenance stage, and additional features are developed at the NLS in cooperation with representatives of the municipalities. The building of the new LIS lay the foundation for the next major projects, such as the overhaul of the land register component, which is currently based on outdated technology, the construction of a component for decisions relating to land use and the development of systems for online customer service.

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