Employment of the User Interface 2000 for the Development of the New National Cadastral Index Map of Sweden – Some Experiences

Olof OLSSON and Christos PAPADOPOULOS, Sweden

Key words: User Interface 2000 (UI 2000); National Cadastral Index Map (NCIM); National Land Survey of Sweden (NLS); Municipal Cadastral Authorities (MCA)

SUMMARY

In Sweden the Cadastral Index Map has played an important role since the beginning of the century. Today the responsibility for building up and maintaining the National Cadastral Index Map (NCIM) is shared between the National Land Survey of Sweden (NLS) and 38 Municipal Cadastral Authorities (in Sweden there are 290 municipalities in total).

Of course this undertaking was not easy to achieve and implied many problems. Problems that varied from technical ones to others, even more difficult to solve, related to the "cultural" differences among diverse organizations.

A project called "User Interface 2000" was implemented to help us solve the main technical problem which was the interchange of geographical information between the NLS and the Municipal Cadastral Authorities without regard to formats and different technical solutions. UI 2000 is neither a format nor a program but a series of technical principles that can be used with different programs and computer systems for interchanging geographical data.

Apart from the technical aspect of the project there is, as mentioned above, another one that is related to cooperation among different organizations. This part was somehow more difficult to achieve. Reasons such as different "working environments" with their own working procedures, as well as "cultural" differences made the effort not less easy. The use of modern technology and the lack of competence by employees who used to work with more traditional tools put one more barrier. Fortunately, today we have agreements on cooperation with almost all local authorities. This cooperation is not stated by law but it is founded on voluntary agreements. A remarkable decisive factor is a statement in the agreement stating that the MCA as well as the NLS will get revenue from the sales of the data.

The use of UI 2000 within the NCIM-concept is the first big test of its capacity as an effective interface for exchange of geographical information in Sweden. The first results, taking into consideration all the aspects, are considered as positive and encouraging. We already have four MCA into operation and the overall evaluation, after some fluctuations, is that we have a system that is working satisfactory.

Employment of the User Interface 2000 for the Development of the New National Cadastral Index Map of Sweden – Some Experiences

Olof OLSSON and Christos PAPADOPOULOS, Sweden

1. INTRODUCTION

Nowadays there is an increased need for centralized data[1] - data that many users will have access to and information that will be used for different purposes. A part of this concept is to centralize geographical information in Sweden as well as internationally. Globalization and new Internet services open new possibilities and at the same time facilitate an increased demand for geographical data or data related to the cadastral information.

New concepts and terms as GIS-Geographical Information System and LIS-Land Information System have been introduced and are being used on a daily basis and in many different aspects and professions.

In Sweden all land is divided into real property units - approximately 3.2 millions. The Cadastral Index Map is a part of the Real Property Register and gives the geographical representation of the properties. Traditionally the cadastral index map has played an important role since many years. It has evolved from an old type of cartographic map to a map based on more modern techniques and further to a completely digital version. Today the NCIM has passed in another phase with "cooperation and integration" being the concepts that are describing it in the best way. From the last stages - the digital version, cooperation and integration - we already have some important experiences. This article is a brief description of the historical development and of our experiences in developing the new NCIM of Sweden.

2. BACKGROUND

2.1 Cadastral Index Map, before introducing digital techniques

About a hundred years ago the first modern real property register was established in Sweden and soon afterwards the production of cadastral index maps started in the cities (urban areas). There was a need for official, updated information about properties, rights and physical plans etc. for larger areas and the first generation of cadastral index maps were produced from around 1920 until World War II. The maps were quite simple from a geometric standpoint and some of them lacked a coordinate system. However they were produced with a unique and standardized legend and were updated by the registration offices in cities and counties.

[1] Centralized data: data that are referring to a National level and are stored according to some specific standards and information models.

In rural areas there was an almost greater need for a cadastral index map with good coverage but nothing was produced until the late fifties because until then there was no good base-map available. This situation changed by1957 when the so called "economic map" of Sweden which was based on a photo-mosaic and had a scale of 1:10.000 started to be produced and reached a reasonable good coverage. The "economic map" which actually was intended as a general land-use map for planning purposes in forestry and agriculture contained a good portion – but not all – of the cadastral pattern. Thus, and after completing the information of this map with information about physical plans, regulations, easements and other rights of land we used the "Economic map" as a base to produce a cadastral index map for the rural areas in a period of about 20 years. Furthermore some other developments have been done such as the production of special maps in the scale 1:2000 covering areas of small and medium sized villages where the scale 1:10.000 was unsuitable.

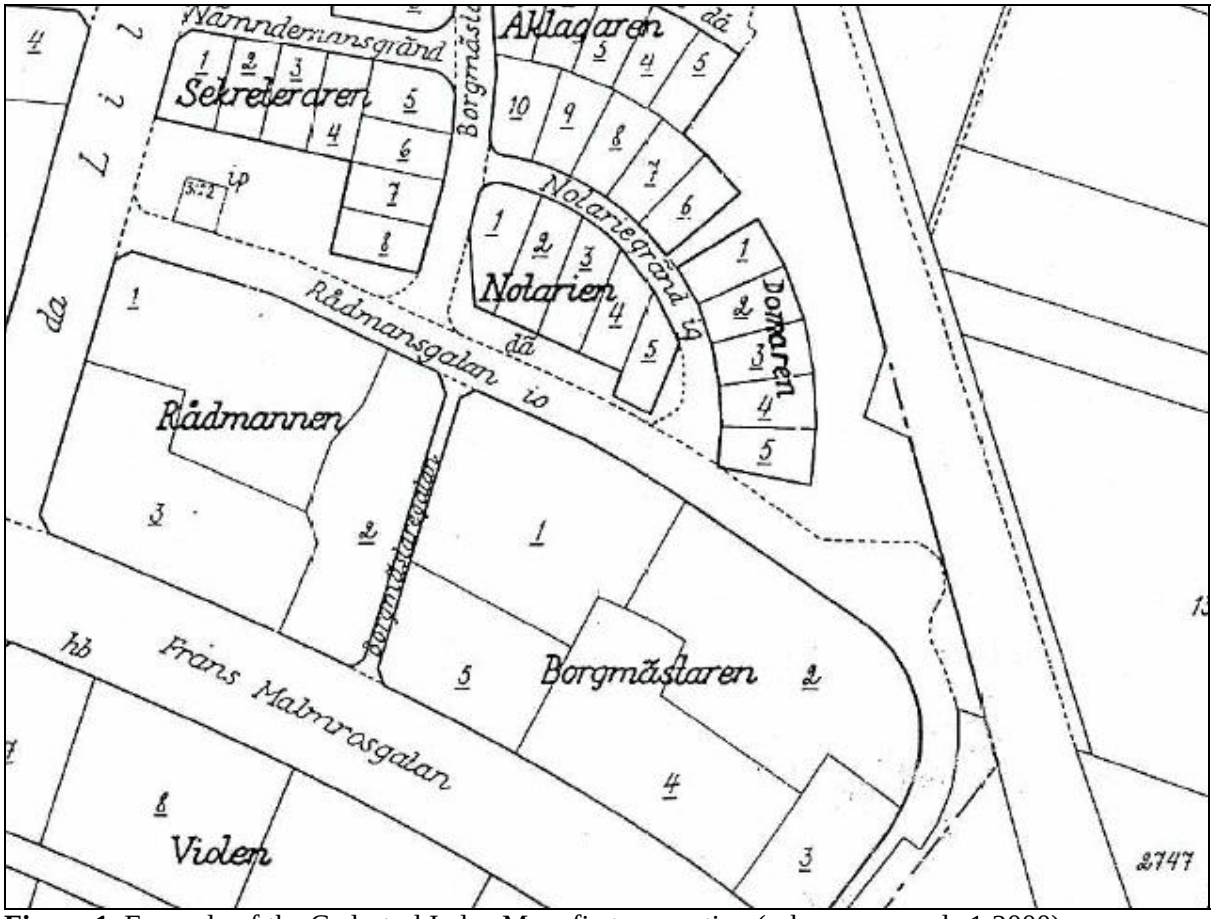

Figure 1. Example of the Cadastral Index Map, first generation (urban area, scale 1:2000).

So, by the end of the 70:ies Sweden had a nationwide cadastral index map that was updated on a daily basis by the registration (cadastral) offices and could be used effectively at least for some official duties. This was good, but at the same time there was a growing feeling that this mapping system was obsolete, hard to use for others but the involved offices, and that the updating process started to show some serious problems. It was obvious that the cadastral

index map was in a new turning point and had to be modernized otherwise the whole investment could deteriorate.

2.2 Cadastral Index Map, after introducing digital techniques

In parallel with this development a new digital real property register was being built up. This register was one of the first of its kind in the world. There was also a discussion of how a new cadastral index map should be constructed in order to match this new digital register and a special committee was organized to answer this question.

Their proposal was a completely new map covering the whole country where its production could partially be supported with digital techniques but, unfortunately, the result still was a conventional map on a plastic film. This map should be better suited for updating activities and for copying than the maps in the old system.

- In rural areas a new set of cadastral index maps should be closely integrated with the new land-use map (So called "economic map") that was on the way in Sweden. This map was in main scale 1:10.000, based on orthophoto, and technically divided into layers that could be combined in different ways. This was almost perfect for the cadastral index map. The map system was quite large and consisted of about 13.000 sheets covering most rural areas in Sweden except from the mountain region in the north.
- In the urban areas the proposal was a close cooperation with the local municipalities and their production of modern base maps for planning purposes, water supply, sewage system, etc. After World War II the municipalities had to invest a lot in urban infrastructure and almost all of them invested in large-scale high quality base maps that also included cadastral information. This was a good base for cadastral index maps as well but there was some work ahead consisting of agreements and coordination if this should be realized.

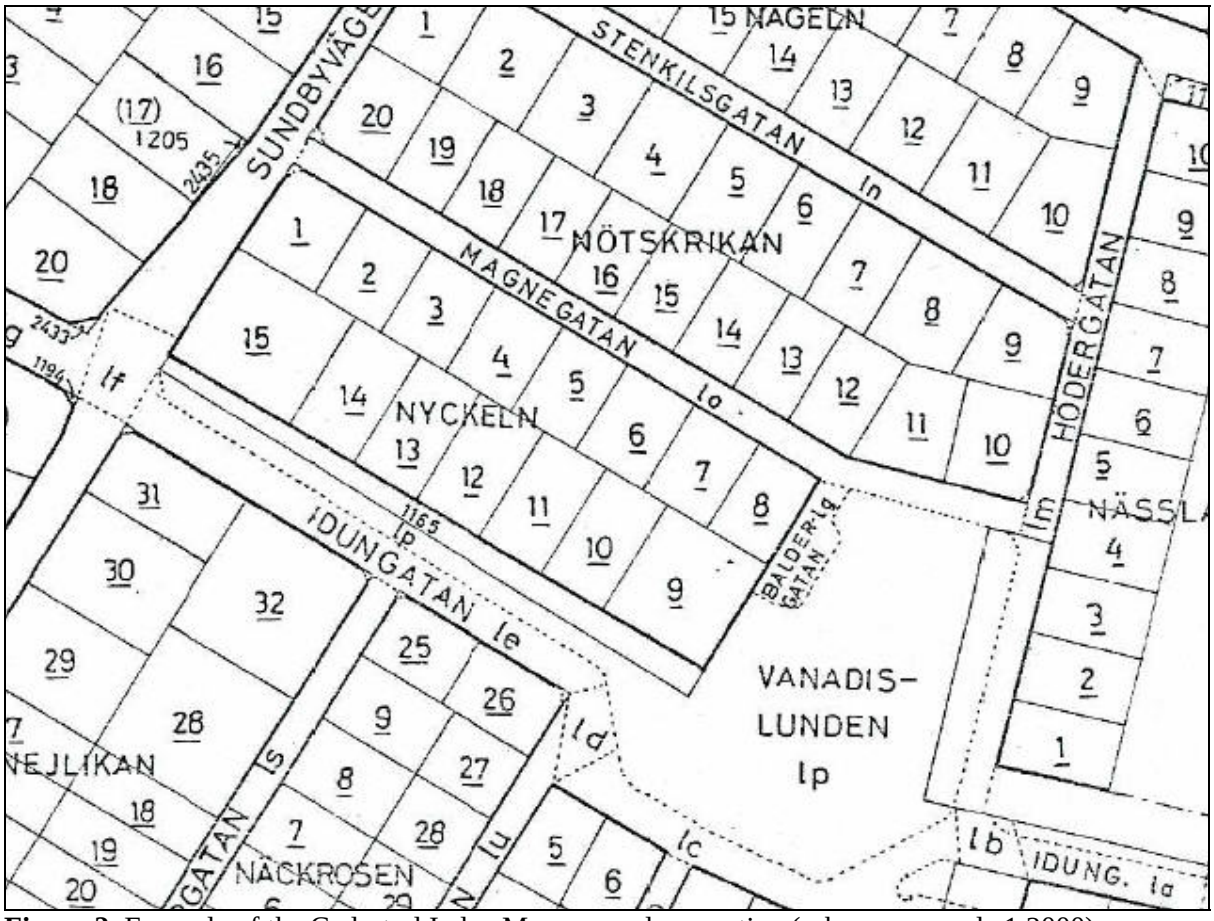

Figure 2. Example of the Cadastral Index Map, second generation (urban area, scale 1:2000).

The process to create this new mapping system according to the proposal started immediately even if the funding only partially could be solved. But during a period of about 15 years a new map system gradually was built up. The main focus in this production was the integration with two other big and important maps systems in society and the close cooperation with the local communities. It took of course some time until all follow-up-discussions and agreements were made. However this should be a good investment in itself because both the technical integration and the cooperation with other parties should emerge as cornerstones when later on the process towards digital handling of the information started.

Unfortunately the time for a completely digitally stored map had not yet come or at least the committee was not so radical to propose a completely digitally stored map. However it should appear that the proposal still was very foresighted and in the late 70:ies laid the foundation for a digital development that would be discussed intensively just a decade later.

2.3 Cadastral Index Map, the digital era

In the middle of the 80:ies techniques that enabled maps to be updated interactively had emerged. As a consequence, discussion started quite intensely of how to build up and use a

truly digital cadastral index map. Some basic studies and pilot projects were started, but it took another 10 years until the whole project started to proceed.

By 1995 the organization of surveying and cadastral activities was renewed and as a result 38 of the bigger cities in Sweden got their own municipal cadastral authorities. In the rest of the country, cadastral activities should be handled by governmental cadastral authorities within the organization of the NLS.

The concept for the new digital cadastral index map was that data from all parts of the country should be gathered and stored in a central database within the NLS. Up-building of the database should be financed mainly by governmental grants to the NLS and updating should be done from both governmental and municipal cadastral authorities (MCA).
There was a big investment but also big possibilities ahead.
.
In March 2000 an agreement was made between the NLS and the local authorities. This agreement included the important goal to develop a National Cadastral Index Map (NCIM) covering the whole country. A key factor in the agreement was that the local authorities would receive economic revenue from sales of data by the NLS.

Technically, data capture should, as much as possible, rely on already existing databases and with some modification, complementation and standardization should a new nationwide database be constructed under a period of about 10 years.

Even if we had the vision there were still some big and unsolved problems. The biggest obstacle was the fact that the NLS and most of the municipalities worked in different technical systems. The national land Survey had a system named AutoKa that was developed within the organization. The municipalities used different systems available in the market and even if some used AutoKa, many used others such as Intergraph, AutoCad, MapInfo etc.

Therefore by 1997 a special project ("Målbild 2000" in Swedish) with the aim to propose solutions and develop routines etc was established. Results from the project should be ready by the year 2000 and actually were.

3. INTRODUCING THE USER INTERFACE 2000 FOR USE WITH THE NCIM

A project called "User Interface 2000" was implemented to help us solve the main technical problem that was the interchange of geographical information between the different organisations (MCA and NLS). The biggest barrier in the project, as it is mentioned above, was that different MCA as well as the NLS have different technical solutions to store and maintain their geographical information. For this reason it was imperative need to find a way of interchanging data without regard to diverse technical solutions and formats.

This was achieved with the help of the "UI 2000" which is neither a format nor a program but a series of technical principles that can be used with different programs and computer systems for interchanging geographical data.

The interface is made up of three main components:

- The Information Models which are closely connected to the Data Models.
- An application for interchanging of data.
- A transfer file in XML/GML format for interchanging geographical information via Internet.

These three components are independent of each other and each can be replaced or further developed individually.

UI 2000 was presented during the spring 2000 and the National Land Survey of Sweden in consultation with the Swedish Association of Municipal Authorities decided to introduce the interface as soon as possible in the up building and maintenance of NCIM.

3.1 Some technical aspects

3.1.1 Information models

The information models are formal descriptions or a series of technical principles that are describing the data as well as their interaction. The models are written in UML (Unified Modelling Language); they form the core of the interface and are its conceptual basis. A basic characteristic of the information models is that they will remain unchanged and stable for a long time whereas the other two parts, format of the transfer file and technical solutions for data interchange will be subject to more frequent changes.

The models contain links between the geographical information represented in the CIM and the RPR via common identifiers. They can handle both the transfer of complete databases or changes of individual objects and require nationally unique identifiers.

Models have been created for real properties, rights, plans, regulations and ancient monuments. In addition, there are models for geometry, data quality, map representation, text and changes in individual objects (i.e. parcels). There are nine models in total and they are described schematically below:

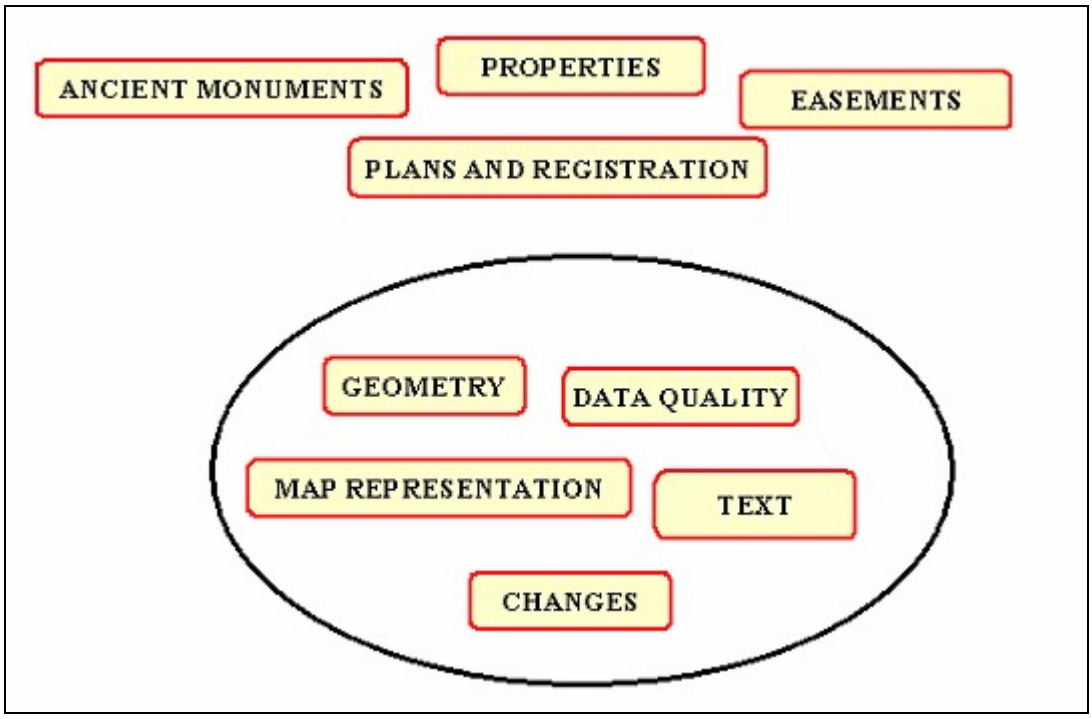

Figure 3. Information models.

3.1.2 Format

After an unsuccessful trial to introduce Express/STEP Part 21 as the format for the transfer file, GML format was introduced and is used today for interchanging of geographical information. This decision has been taken with the help of the local authorities and system developers and their suggestion that was in favour of GML. GML (Geography Markup Language) is an XML based encoding designed for transfer (via the Internet) and storage of geographical data including both the geometry and properties of geographical features. GML is developed by the OGC (Open GIS Consortium, www.opengis.org). GML as XML makes use of syntax tags to describe various types of data in a file in the form of text. The use of tags that conform to information models makes it easy for various programs to extract data and easy for people to understand the written information even without having advanced programming knowledge.

3.1.3 Application for data transfer

The application that is into operation today comprises a server part placed at the NLS in the city of Gävle and a client part that is run in a Web browser which is placed at each local authority.

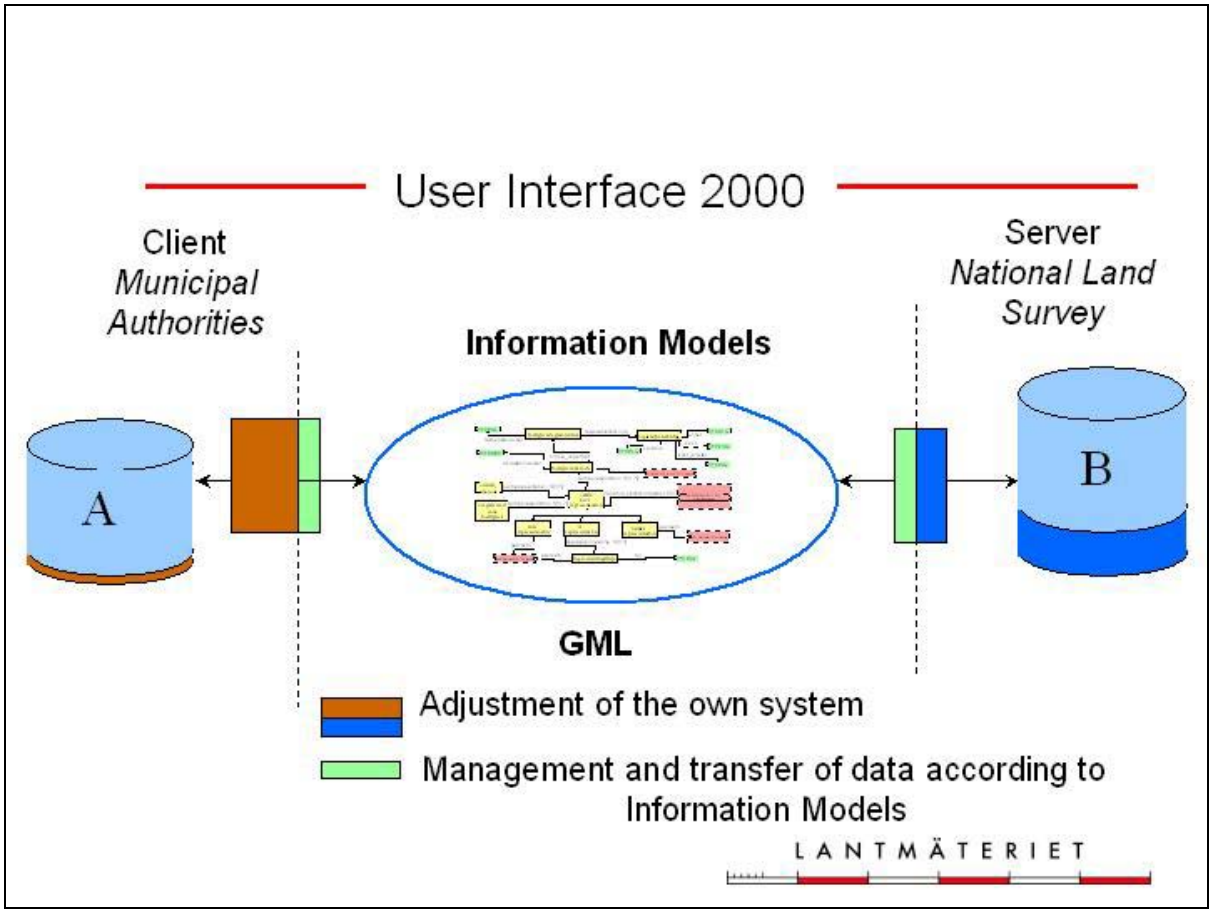

Figure 4. Schematic representation of the system.

Each one of the 38 local authorities has to develop a unique technical solution together with their system supplier. After developing the application, the data transfer is done with the help of files written in GML format and using a Web Browser (i.e. Internet Explorer). The GML files, as mentioned before, are structured according to the information models.

Even if it is not strictly defined how the different technical solutions (in the client part) will look like, there are some basic requirements that the system has to fulfil (i.e. the application must handle object oriented data, be able to make controls of data structure and handle changes of objects).

3.1.4 The National Land Survey (NLS)

The database that NLS uses today to store information related to the Cadastral Index Map is a database developed in the 80:ies and data are stored according to the so called "spaghetti model" without any topology. Of course this database is not very well suited for handling data with UI 2000. Therefore an "intermediate system" ("Bryggan" in Swedish) that reads and

administers data in the specification of UI 2000 has been developed using Oracle Spatial – solutions.

Figure 5. Extract from the digital cadastral index map (city of Gävle).

3.1.5 The Municipal Cadastral Authorities (MCA)

As it is mentioned above the MCA use several different systems, thus it was not possible to provide detailed specifications for the adjustments that would be needed in order to build up their applications. This task (development of the technical solution) was mainly left to the system suppliers and for this reason a close co-operation with both municipalities and suppliers was established.

However some basic requirements must be fulfilled by the municipal systems in order to start using the UI2000.

- The developed application must be able to generate data in accordance with the information models.
- The transfer of data is done by using GML files.
- As identifiers and a major part of the attribute data is stored in the Real Property Register; local systems should be integrated with the Real Property Register.
- The systems must be able to handle identifiers and versioning.

– The systems must be able to log changes at the custom objects level in connection with revision

To satisfy the requirements above but for other reasons also some of the 38 MCA are replacing or upgrading their old technical systems. This process runs rather quickly and we believe that in about two years the overwhelming majority of these authorities will have systems that can meet the requirements of UI 2000.

3.1.6 The pilot project in Västerås, now a municipality into operation

The first pilot project for the updating of the NCIM was decided to be the municipality of Västerås (a city with about 130.000 inhabitants). The pilot project started in April 2001 and after some fluctuations finished in June 2004 when the municipality came into operation and started to update the NCIM with information concerning properties on a daily basis.

Today there are four municipalities (Västerås, Uppsala, Örebro, Huddinge) that are into operation and update the NCIM with cadastral information using the UI2000. Unfortunately the updating of the NCIM concerns at the moment only data related to the properties. Some work is at the time under progress at the NLS in order to adjust our system to receive information concerning easements. The municipality of Uppsala has been assigned as a pilot project to update the NCIM with information concerning easements and our aim is that it will be into operation by June 2006.

The work is divided into different stages and after each stage the results are presented for local authorities, system developers and other interested parties. In that way we can start activities in other local authorities before the work is completely done in those that are already into operation. One way of spreading the results is by our homepage www.malbild2000.lm.se The information is until now only presented in Swedish but we plan to give some information in English during this year (2006).

3.2 The "cultural" aspect

Apart from the technical aspect of the project there is another one, more difficult to achieve, that is related to cooperation among different organizations. The concept for the new NCIM in Sweden is quite complex and above all presumes extensive cooperation between the parties concerned. Cooperation is easier to say than to do and in this case there is extensive need for it in different levels, in top-level (general agreements and agreements with individual local authorities) but also in daily work at the "floor" level (cooperation between technicians and others in a wide range of matters). The use of modern technology and the lack of competence by employees who used to work with more traditional tools put one more barrier.

The basis for good cooperation is of course mutual understanding and agreements about goals, technical matters and economics. But the basis must also include what can be called a good general "cooperation climate". Achievement of such a climate between strong organizations with no traditions in the field can be a question of many years. So long before

the concept of NCIM was on hand we had a lot of discussions and other activities that led to improvements in the "working together" concept. This was as it would show essential for the development to come.

Fortunately, today we have agreements on cooperation with almost all local authorities. This cooperation is not stated by law but it is founded on voluntary agreements.

4. FUTURE PLANS

Finally and after some years of continuous efforts and trials we have a system that it is into operation and works satisfactory. Today there are four municipalities that are updating the NCIM using the UI2000. Of course the work doesn't stop here. The success of the project encourages us to continue our hard work. Now a new interesting future has opened up and new aims have to be achieved.

- There are still many municipalities that are waiting to start using the UI2000.
- Some work is under progress in order to start interchanging information related to the easements.
- Apart from information related to properties and rights there is some more information (i.e. plans and regulations) that it is not completed yet in the system. Our ambition is to continue the hard work until we will create a database containing the whole cadastral information and covering the whole country.
- A new modern, object-oriented environment for storing the cadastral information must be developed. The old environment that has been developed in the 80:ies is considering insufficient for today's needs and technology.
- UI 2000 can also be used for interchanging of other geographical data such as information about buildings and addresses.
- Other local authorities than the 38 mentioned (Sweden has about 290 local authorities) can use UI 2000 for exchanging geographical data.
- The NLS and the MCA want UI 2000 to be accepted as a National Swedish Standard by the standardisation authority.
- Other users, for instance the county administrations, are anxious and will probably quite soon start using UI 2000

Nothing lasts forever but the concept of UI 2000 with three independent parts and probably rather stable information models is at least some guarantee that its lifetime reaches several years ahead.

5. CONCLUSIONS

Today it is more certain than ever that UI 2000 will contribute with a beneficial outcome to the society in many aspects.

The ultimate aim of the project is to create a complete and seamless NCIM with harmonised data and information that follows the same standards and regulations and that is presented in

the same way for all the users. The fact that NLS together with the MCA are responsible for the creation of the NCIM results in some direct economical benefits by avoiding double work.

A positive result from the project is its beneficial effect to the technical development of solutions concerning interchanging and storing of geographical information. The increased demand of an effective exchange of geographical data has some times led us to use the latest "state-of-the art" solutions in the field. This in turn has resulted in a gradual transition to more modern technical systems (object-oriented databases and programming) in the local level. Of course, this development also has some other causes but there is not doubt that the UI 2000 has contributed a lot and is a driving force in the field of interchanging geographical information.

Another important positive effect is that we in practise learn how to cooperate and exchange data on a daily basis. This knowledge can be used in other fields and in a wider sense than only cadastral information. The NLS has started a broad project aiming at renewal of the databases and data communication with other parties and our experiences from the NCIM are very important in this work.

However the most positive effect will come somehow indirectly. Since the information will be easily accessed and used by different stakeholders, this will result in new possibilities and increased demand of geographical information. The project has already led to positive discussions among the NLS, the local authorities, system suppliers and other parties. There is a common sense that we are into the right direction and that is in benefit of all parties to exchange geographical information.

Moreover there are many indications that we move towards a more global and centralized level of the existing geographical information, where interchanging of data is something essential. Some important projects at European level such as INSPIRE, EuroRoadS, EULIS, only certify this trend. The only remaining question is not if but when similar projects will start at a worldwide level and how each country will be best prepared to face the new challenge.

REFERENCES

Olof Olsson, 2002, User Interface 2000 – new standard for the new cadastral index map of Sweden, FIG XXII International Congress, Washington D.C. USA

Lauri Bo, 2001, User Interface and internet approach – important components in the Swedish cadastral system, paper presented at the FIG meeting in Seoul 2001

Målbild 2000 Interface 2000 – Overview, (project report), Lantmäteriet and Svenska kommunförbundet (Swedish Association of Local Authorities), 2000

BIOGRAPHICAL NOTES

Olof Olsson is a licensed surveyor. He has been working within NLS since 1973 and many years with the planning and development of the Cadastral Index Map. Since 2001, he is working as a project manager for the new National Cadastral Index Map of Sweden.

Christos Papadopoulos is a GIS expert. He has been working within NLS since 2001. Since last year he is working as a system manager for the new National Cadastral Index Map of Sweden.

CONTACTS

Olof Olsson
Project Manager
The National Land Survey of Sweden
Department of Cadastral Index Map
Real Property Information
S-801 82 Gävle
SWEDEN
Tel. + 46 26 63 30 00
Fax + 46 26 61 18 88
E-mail: olof.olsson@lm.se
http://www.lantmateriet.se/

Christos Papadopoulos
System Manager
The National Land Survey of Sweden
Department of Cadastral Index Map
Real Property Information
S-801 82 Gävle
SWEDEN
Tel. + 46 26 63 30 00
Fax + 46 26 61 18 88
E-mail: christos.papadopoulos@lm.se
http://www.lantmateriet.se/