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Jesper M. Paasch
MODELLING THE CADASTRAL DOMAIN

Jesper M. Paasch
National Land Survey of Sweden
SE-80182 Gävle
+46 (0)26 63 30 01, +46 (0)26 611880
jesper.paasch@lm.se
and
KTH, Royal Institute of Technology
SE-100 44 Stockholm

ABSTRACT

This paper describes a Swedish approach to constructing a model of the cadastral domain. The National Land Survey of Sweden (Lantmäteriet) has developed an UML-based, object-orientated information model describing real property information stored in the Swedish Real Property Register. The register is part of the Swedish Land Data Bank System.

The work has been initiated due to a general need for an object-orientated and application independent description of real property information. The project is part of a greater task describing all information handled by Lantmäteriet in an object-orientated way, not focusing on the technical storage of the information, but the information itself. A non-technical modelling approach is the foundation for more cost-efficient development of new software and routines managing and processing cadastral information in the future.

The model is the result of cooperation between governmental agencies, describing the Swedish cadastre. The cadastral domain model has been constructed in a project initiated by Lantmäteriet with the purpose to establish a common description of real property information not limited to local, technical solutions. The work has been done in cooperation with national and local agencies handling cadastral information. The model acts as a basis for an increased data and information interchange between governmental and non-governmental agencies and is a part of the Swedish, digital infrastructure. The model is not a Swedish standard, but might be a contribution to a future Swedish standardisation process.

KEYWORDS: Cadastre, standardisation, object-orientation, UML modelling.

INTRODUCTION

The Swedish cadastre incorporates several registers containing real property information: the real property register (including the planning regulations register), the land register, the building register, the address register and the tax assessment register. The registers are referred to as the Swedish Land Data Bank System.

Since 2001, the National Land Survey of Sweden (Lantmäteriet) has been working on a project describing the real property information stored in the Swedish Real Property Register, the Swedish cadastre. The outcome of the project, which was completed in spring 2004, is an object-orientated model describing the Swedish cadastral domain. This paper gives a brief presentation of the model and the present experiences working with complex cadastral information stored and produced by different governmental organisations.

The model is a conceptual schema and is an application independent description of the Swedish cadastral domain. The model has been initiated due to a general need for an object-orientated description, not limited to system-based descriptions of the information stored in the Swedish cadastre.
Generally speaking, the Swedish cadastre can be classified as a multiple cadastre, incorporating the content of a traditional cadastre and land register, among other things. It is not a legal cadastre, meaning that, in a matter of dispute, the original documents, maps and the boundaries on the ground have to be consulted. Nevertheless, the information in the cadastre is of vital importance and frequently used by the Swedish financial and real estate sector. For example, the system had an average of more than 220,000 on-line enquiries per day in 2003 (based on statistics of December 2003). In other words, the Swedish cadastre a central role in the national information infrastructure.

In it’s role of being responsible of operation, maintenance and enhancement of a comprehensive system concerning land information Lantmäteriet works in co-operation with other organisations responsible for their data. Several governmental agencies store their data locally, but the information is copied into the Swedish Land Data Bank System. Examples are the content of the tax assessment register and the land register.

The Lantmäteriet has taken a strategic decision (Lantmäteriet 2001) concerning storage and management of cadastral information and topographical information. The approach is part of a larger scheme describing all information handled by the National Land Survey using object-orientated methods aiming at a new object-orientated storage environment for cadastral and topographical information. The modelling of the cadastral domain is part of an IT-renewal strategy launched by Lantmäteriet, integrating registers with geometric and descriptive information into an integrated land administration system (Ljunggren 2003).

**Integrated Land Administration System in Sweden**

![Figure 1: The integrated Swedish Land Administration System (Ljunggren 2003).](image-url)
The model has been constructed in close co-operation with other national and regional agencies responsible for parts of the information stored in the cadastre.

THE CADASTRAL DOMAIN MODEL

The main reason for constructing the cadastral domain model is to describe the different parts of real property information, including real property rights, and especially the relations between the different kinds of real property information. Great effort has been taken to focus on the information itself and not the technical environment in which the information is stored. The model is dynamic and can be expanded with additional information according to changes in the Swedish real property legislation and ordinances.

The cadastral domain model is a description of a very complex legislation, resulting in 184 classes and 370 attributes (in June 2004). The model consists of two parts; class diagrams and definitions of each object and attribute described in the model. The information is structured as objects and the relation between these objects is described in the model. The class-diagrams are constructed using UML, Unified Modelling Language, which is an object-oriented language which helps you specify, visualise and document models of software, business and process systems (Booch et. al. 1999; ISO 2004).

It is beyond the scope of this paper to give an in-detail presentation of the cadastral information model, but the principle of its construction is described in the following example; describing the relation between property and person.

Figure 2: Basic principle of the cadastral domain model

The example consists of two classes, Person and Real Property. The classes have certain attributes attached to them, like Personal ID-number and Property ID-number. The legal relation between them is Own and states that a person can own zero or more properties (so-called zero-to-many relationship) and that a property is owned by at least one, or more persons (so called one-to-many relationship). In other words; a person might own a property, but must not have to, and a property must have at least one owner. The next step is to define what is meant with person and property. They have to be properly defined to avoid any misunderstanding. In this example, a person is defined as any living human being, a juridical person (company) or an organisation, which has the right to own real property according to Swedish legislation.

The cadastral domain model primarily focus on the legal aspects of real property information including its representation by multiple geometry in the digital cadastral index map. The model does not deal with geometrical objects in detail. It only states if an object is a polygon, line or point, with reference to a separate model for geometry, based on ISO-standards.

The Swedish cadastre consists of both geometrical information and textual information. The digital cadastral index map is part of the Real Property Register, even if it is (yet) stored in a separate
The cadastral domain model has been constructed in several phases, the first phase describing the legal content in most of the main part of the Swedish real property register and following phases describing the content of the land register, planning and regulations register and the tax assessment register.

The model can be described as a number of sub models describing selected parts of the real property information complex for practical reasons. However, all sub-parts are interconnected and co-ordinated to function as one single model. Parts of the model can be viewed at www.lantmateriet.se/fim (in Swedish only).

The model does neither specify any technical solution for data capture, data interchange or data management, but acts as a basis for the construction of future models for transfer, interchange, capture and management of real property information by the National Land Survey and other governmental agencies.
NON-CADASTRAL ELEMENTS
The model is based on the legal content of the Swedish cadastre and great effort has been made to exclude additional, non-cadastral, strictly database related information. However, the model does contain some non-cadastral elements in order to make it as functional as possible due to the partly incomplete information stored in the registers. An example are “technical boundaries”, which is a geometric feature stored in the digital cadastral index map database. Technical boundaries are used in places where real property boundaries are not registered in the index map, like boundaries in lakes and rivers, as they were omitted in the data capture due to lack of information. The technical boundaries enable the creation of real property polygons in the digital index map and make the map more useful for GIS analysis etc. Even if the additional non-legal objects are not part of the Swedish cadastre, they have to be included in the cadastral domain model in order to make it as useful as possible.

SYSTEM DEVELOPMENT
Before designing new technical storage and database facilities it is necessary to focus on the information that has to be stored, processed, and maintained, in the database system. Selected parts of the information model will be used as a basis for the construction of an application dependent data model. A simplified system development process is illustrated in Figure 5.
The model is also being used as a basis for the development of an interface for updating the digital cadastral index map with spatial real property information maintained by local municipal authorities.

The construction of the cadastral domain model is a dynamic process and parts of the model have already been used in system development at The National Land survey. It has already shown its value as a basis for the development of a data model to be implemented in the Swedish ArcCadastre Software during 2004.

STANDARDISATION
Constructing a cadastral information model is a major step towards spreading the knowledge of the information handled in cadastral registers and land registers. Understanding information is a vital step towards standardisation. However, the model is not a Swedish standard on real property information, but might become input in a process towards standardisation, since there is yet no Swedish standard on real property information.

The cadastral domain model can be seen as the first step of an “in-house” standardisation approach of cadastral information by Lantmäteriet and might be part of a larger standardisation process in the future. Any future national standardisation process must be conducted in co-operation with The Swedish Standards Institute and national and local authorities that are responsible for the information with the cadastral domain.

The model is also a contribution to the on-going discussion aiming at an international cadastral domain model, see e.g. Lemmen et. al. (2003), and improved international harmonisation of cadastral information.

SUMMARY
The cadastral domain model illustrates a for Sweden new, uniform, UML-based and application-independent way of describing Swedish cadastral information. It is important that the model is treated as a dynamic structure. Changes in the cadastral information due to e.g. legislative changes have to be updated continuously in co-operation with national and local authorities.

It is important to notice that parts of the model have been conducted as a joint venture between the national survey and other national and local authorities. This was done to ensure the legal context and most suitable delimitation of the model. The joint venture has been a fruitful experience and the co-operation between the governmental agencies has been very successful. The model does not focus on the actual storage facilities of the cadastral domain. The cadastre can be stored in one single database or in a number of databases located in different locations throughout Sweden. The important issue is that the uniform description of the cadastral domain allows cost-efficient construction of data transfer and data interchange systems between different part of the cadastre, if needed. The decision whether a cadastre should be centralised or decentralised is a political question, which should not interfere with the cadastral information itself.

The next step is the maintenance of the model. The model is dynamic and changes in legislation have to be continuously implemented in the model to make it as updated as possible. Otherwise it would risk to loosen its value as a foundation for future system and information development. Not only for the cadastre, but also for topographical information containing cadastral information. Integrated cadastral and topographical model is the basis for an improved technical integration of cadastral- and topographical data. A non-technical modelling approach is the foundation for more cost-efficient construction of new software managing cadastral information in the future. The construction on a model describing the content of the Swedish Cadastre is also a step towards improved customer service at Lantmäteriet, including being a 24-7 accessible national agency.
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