A Cadastral Domain Model

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Abstract

The National Land Survey of Sweden has developed an information model describing real property information. The model is an object-orientated description of real property information stored in the Swedish cadastre.

The work has been initiated due to a general need for an object-orientated description of real property information to create an application independent model of cadastral information, not limited to technical storage solutions.

The project is also a part of a greater task describing all information handled by the National Land Survey in an object-orientated way, not focussing on the technical storage of the information, but the information itself. A non-technical modelling approach is the foundation for more cost-efficient construction and development of new software managing and processing cadastral information in the future.

Introduction

The National Survey of Sweden has a central role in the Swedish information infrastructure. The National Land Survey is e.g. responsible for the administration and maintenance of the Land Data Bank System, which contains the Swedish cadastre, which include the real property register, the land-, the building-, the address- and the tax-assessment register, and other registers.

The National Land Survey has taken a strategic decision 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 cadastral domain model

The cadastral domain model can be described as an information model, which is an application independent description of information. The aim is to focus on the information itself and not the technical environment where it is stored.

The main focus for the cadastral domain model has been to concentrate on the different parts of real property information, including real property rights, and especially the

relations between the different kinds of real property information, not limited to where the information is physically stored and managed today. 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 legislation and cadastral ordinances.

The model is a central part of the digital infrastructure at the National Land Survey and a central tool for developing e.g. geo-spatial applications processing and analysing real property information.

The cadastral domain model is very complex and contain several hundreds classes and attributes (March 2004). The model consists of two parts; class diagrams and definitions of each object and attribute described in the model. The model is object orientated. The information is structured as objects and the relation between these objects are described in the model. The class-diagrams are constructed in UML, Unified Modelling Language. See e.g. Booch et al. (1999) and ISO (2004) for an introduction in object-orientation and UML.

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*.

Property and *Person* are objects along with several hundred objects and attributes described, according to the Swedish real property legislation. The relation between *Property* and *Person* is illustrated in Figure 1.

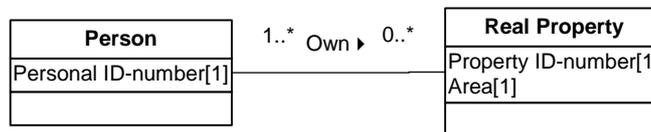| Person	1..* Own ▶ 0..*	Real Property
Personal ID-number[1]		Property ID-number[1] Area[1]

Figure 1. A simplified model of a relation between person and real property.

The objects 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 does not have to. 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 defined to avoid any misunderstanding.

The model is not limited to any computer or software application. It simply states the relationships between the two objects. In other words, the model is system independent.

The model has been developed in two phases, the first phase describing the legal content in most of the main part of the real property register and a second phase describing the information stored in the land register and information about planning regulations, which are part of the Swedish cadastre.

The model does not describe the possible geo-spatial representation of the objects, but does only describe if an object can be represented by geometry (point, line or polygon). The geo-spatial relationships between the information are described as rules in the descriptions of each class. A relation to a separate geometry model, developed by The National Land survey, describes the geographical representation(s) of each object.

Part of the modelled real property information is not maintained by the National Land Survey, only stored in the Land Data Bank System. Parts of the model have therefore been conducted as a joint venture between the National Land Survey and other national and local authorities that are responsible for the information stored but not managed by the national land survey, e.g. planning regulations.

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 useful 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. The digital index map is part of The Real Property Register. 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 limited production resources. 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
The modelling of cadastral information has two purposes: first; creating an application-independent description of real property information not limited to any technical storage and second; to be the first step in a system development process. 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 can be used as a basis for the construction of an application dependent data model. A simplified system development process is illustrated in Figure 2.

Information model → **Data model** → **System construction**

Figure 2. Model based system development.

The model is also being used as a basis for the development of an interface 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 understanding 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 only standardised approach regarding Swedish real property information is a report on cadastral information produced by The Swedish Standards Institute (SIS 1998). The model is currently being adapted to the ISO-19100 series describing geographical information (ISO 2004).

Summary
The cadastral domain model illustrates a 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 that are responsible for the information not managed by the national land survey, e.g. planning regulations.

The cadastral domain model can be seen as the first step of an "in-house" standardisation approach of cadastral information by the National Land Survey and might be part of a larger standardisation process in the future. A standardisation process must be conducted in co-operation with The Swedish Standards Institute and other national and local authorities that are responsible for the information with the cadastral domain. The model is not complete yet, but a preliminary version showing selected parts (in Swedish only) can be seen on LMV (2004).

References
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