The Swiss Cadastral System in the Digital Age

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SUMMARY

The Swiss cadastral surveying system is operational since 1912 and is the basis for land registration. In 1993, a new legislation was put in force defining the digital format of the cadastral surveying system, which at the same time extended the purpose of the data to be the basis for "any other land information system" as well, thus establishing the foundation of the upcoming spatial data infrastructures.

This paper describes the basic conceptual elements of the digital format of cadastral surveying in Switzerland.

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1. COUNTRY CONTEXT

Switzerland is situated in the centre of Western Europe, bordering with Germany, Austria, Liechtenstein, Italy and France. Its territory covers an area of 41,290 sq km and is dominated by mountain ranges with a central plateau and large lakes. The total population is 8.2 million, of which 68% are living in urban areas.

The federal constitution defines Switzerland as a "league of the peoples of 23 sovereign Cantons" (three Cantons are subdivided into half-cantons) making it a federative country with largely decentralized structures. The Constitution also defines the separation of the three powers – legislative, executive, and judiciary. The Confederation, however, has only limited power. The 26 Cantons and the approx. 2,300 municipalities exercise a large degree of autonomy according to the subsidiarity principle. The Cantons are autonomous and have their own constitutions, parliaments, governments and courts. Also the municipalities enjoy certain autonomy with their own constitutions and communal statutes, although being under the supervision of their respective Cantons.

During the early 19th century under Napoleonic influence, cadastres were established in many of the 26 Cantons; however mainly for fiscal purposes. With the putting in force of the federal constitution in 1847, a modern state with a stable rule of the law developed, and with the industrial developments, the need for a legal cadastre emerged, securing land ownership rights and enabling land transactions. The Civil Law from 1912 constitutes the basis of the cadastral system with the two main elements of land registration and cadastral surveying. Several principles have been defined at that time, which are still valid today:

- the land register has five main parts and is based on a cadastral map;
- the cadastral map has to be based on cadastral surveying;
- according to the political and administrative structure of the country, the operational control of cadastral surveying and land registration is with the Cantons;
- the Confederation is supervising and subsidizing the Cantons;
- cadastral surveying can be contracted to private sector land surveyors;
- surveyors carrying out cadastral surveying need to hold a federal licence.

2. INSTITUTIONAL FRAMEWORK

According to the political and administrative structure of Switzerland, the organizations involved in the cadastre are situated on the different administrative levels – federal and cantonal – and have different tasks and functions. For cadastral surveying, the Federal Directorate for Cadastral Surveying (V+D) has mainly the responsibility of supervising the cantonal surveying agencies. Those have the responsibility to implement cadastral surveying within their jurisdiction and territory. There are different, although similar solutions in each Canton, but most of them contract the fieldwork as well as the maintenance of surveying data and cadastral maps to private land surveyor offices, which then are acting as public agents on behalf of the Cantons. On the federal level, there are approx. 15 employees working for cadastral surveying, while there are approx. 300 on the cantonal level, and approx. 3,000 on the municipal level – most of them in the private surveying offices (compare Figure 1).

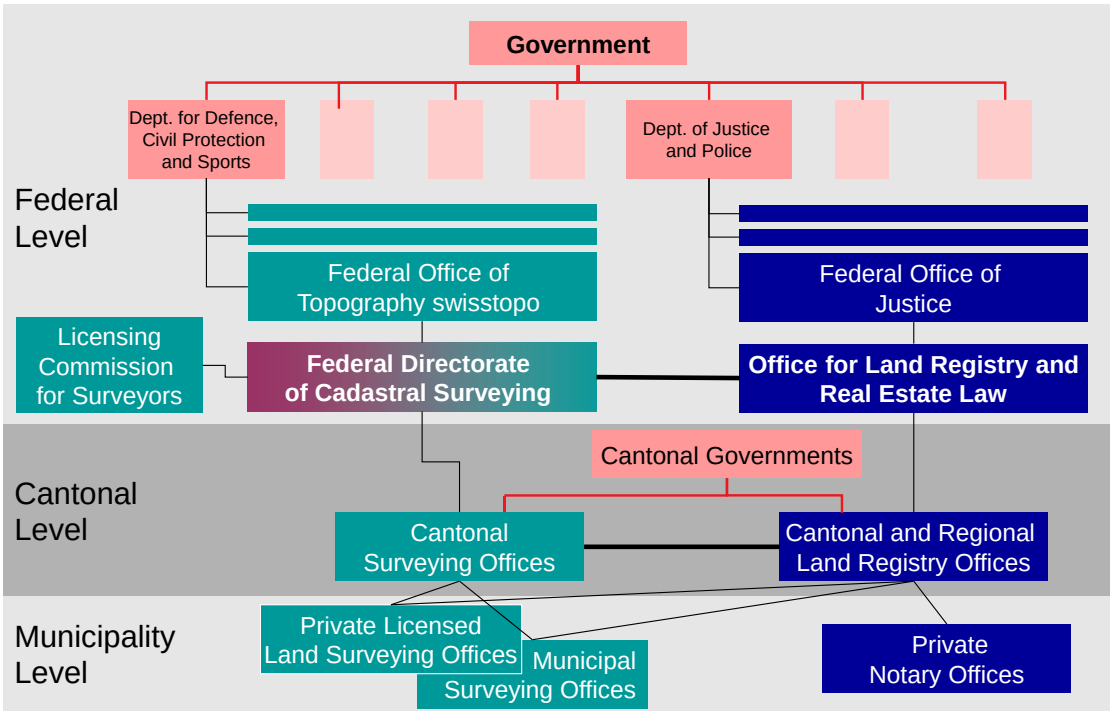

Figure 1: Organizations involved in the Swiss cadastral system.

For land registration, the regulations, set-up of offices and districts, the appointment and the compensation of land registrars lie in the competence of the Cantons. The Confederation supervises the Cantons through the "Federal Office of Land Registration and Land Law" with approx. 5 employees. Some of the smaller Cantons maintain a single cantonal land registry office, while in 18 Cantons, there are offices per one or several districts, or even per municipality resulting in a total of approx. 350 cantonal or regional land registry offices.

The involvement of the private sector in cadastral surveying is a normal practice since the establishment of the cadastral system in the early 1900's; it carries out 80-90% of the total work. The private sector is commissioned with projects – through a tendering process – for data acquisition, upgrading, and updating. There is a long established and accepted system, through which the private sector is mandated with data updating and maintenance procedures. As such, the private surveyors are acting as public agents providing decentralized services close to customers. With the availability of digital data, Cantons and municipalities are introducing their own land information systems and private surveying offices quite often support such projects either by contract or by consulting.

With the introduction of the land registration system in 1910, the Confederation also introduced a regulation for the licensing of cadastral surveyors. Only licensed land surveyors can carry out cadastral surveying. Although they are mostly operating in the private sector, they are public agents, bound by regulations and contracts.

On the university level, there are education programs in surveying on both campuses of the Federal Institute of Technology (ETH), one in Zurich and the other in Lausanne. Both offer programs equivalent to Masters degrees, which focus more on rural and environmental engineering with mostly optional courses in geomatics. The tendency towards environmental engineering over the last few years is actually a big challenge for geomatics. Around 50-60 students graduate from both ETH's combined each year. There are also two technicums that offer bachelor degrees in surveying, which have both combined some 20-30 graduates annually.

3. CADASTRAL SYSTEM

From 1912 until 1993, the cadastral system had purely a legal purpose and was mainly geared for securing land ownership rights. The cadastral surveying data have however always widely been used as basis for utility mapping and all sorts of municipal and planning and management purposes. Since 1993, in addition to the legal purpose, cadastral surveying data (in digital form) are also intended to serve as basis for any land information systems. Since 2002, there is a growing need to document public law restrictions and responsibilities; working groups have been established to investigate their integration into the cadastral system.

There is only one comprehensive cadastral system, which by definition of land parcels covers the whole territory in a complete way. Every piece of land is a parcel with an assigned owner. Roads or public areas can for example be in the ownership of municipalities, cantons, or federal organizations. Also private companies or cooperatives can be owners of land parcels.

The cadastral system is based on a folio principle, i.e. each "land parcel" on the ground is related to exactly one land ownership title registered in the land registry. Every land parcel has a unique parcel identifier number, to which all parcel-relevant information is linked. Buildings are by definition integral parts of "land parcels" and by default cannot cross parcel

boundaries. In the case of a building sitting on top of a parcel boundary, the boundary would need to be rectified accordingly or the two parcels would need to be merged. Land parcels can be sold only as complete entities.

4. CADASTRAL MAPPING

In 1993, two new ordinances – VAV ("Verordnung für die Amtliche Vermessung" or Ordinance for Cadastral Surveying) and TVAV ("Technische Verordnung für die Amtliche Vermessung" or Technical Ordinance for Cadastral Surveying) – replaced the old instruction for cadastral surveying from 1919. The aim was to renovate the cadastral surveying system and to introduce the digital data format. Due to the versatility of data in digital form, the purpose of the cadastral surveying data has been extended from purely serving the land register to serving land information systems of any kind. The establishment of the system independent data description language INTERLIS was a crucial element in this concept.

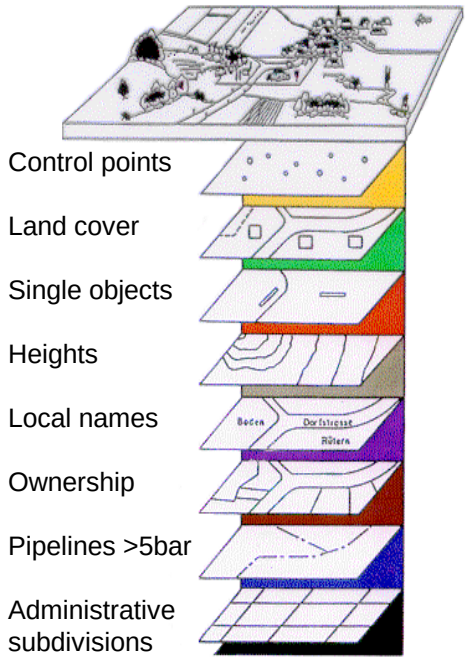

Figure 2: The original eight information layers of Swiss cadastral surveying.

The "digital" cadastral map has originally been defined to consist of eight information layers as illustrated in Figure 2. By definition, the two layers "Land cover" and "Ownership" cover the whole territory in a complete way, i.e. without overlaps and without gaps, while other layers have different structural definitions. Buildings are part of the "land cover" layer. The separation of the data into the eight information layers has the advantage that the layers can be acquired independently from each other. Each of the eight information layers is object-oriented and defined by an entity-relationship diagram, which is the data model and also the basis for the translation of the data into an interoperable INTERLIS data exchange format.

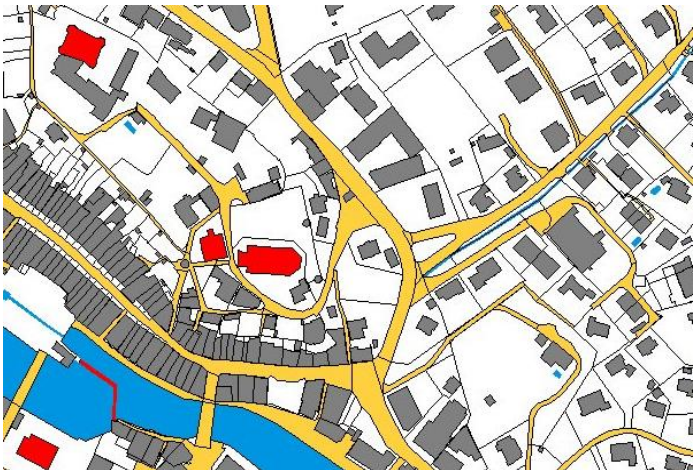

Figure 3: Example of new digital Swiss cadastral map with object-oriented approach.

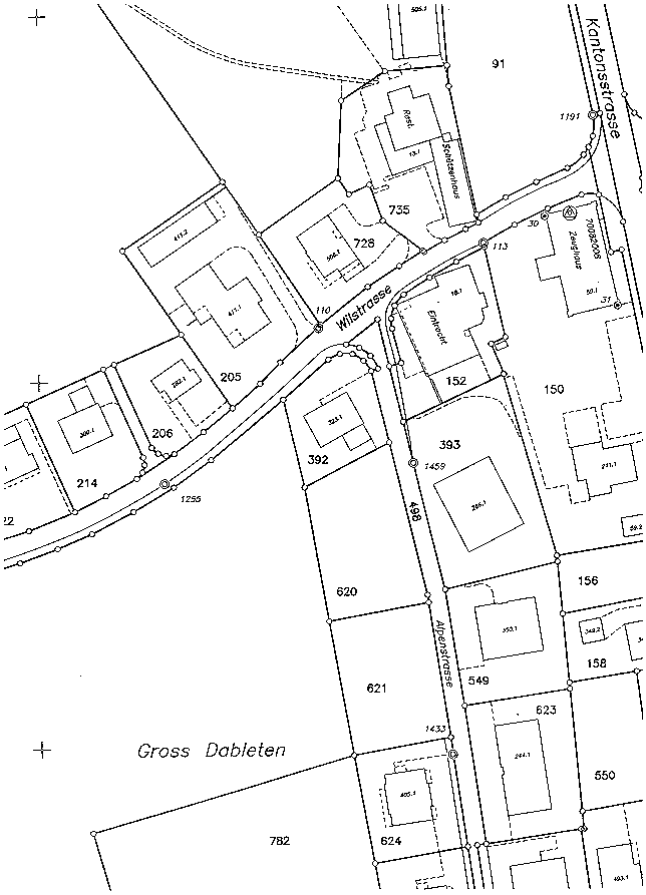

Figure 4: Example of a traditional Swiss cadastral map.

The introduction of the new data-modelling concept for the description of cadastral surveying data in 1993 triggered the development of SDI in Switzerland. The basic building block is the

data description language INTERLIS with which spatial data can be defined, modelled, and exchanged without information loss and independent from any system restrictions. The data model for cadastral surveying has been named AV93, which is defined in the federal TVAV ordinance and legally binding for cadastral surveying in all Cantons. The data-modelling concept with INTERLIS has initiated the definition of more than 100 other spatial data domains since 1995, enabling the use of the same data exchange mechanisms like in cadastral surveying. In 1998, a new agency (COSIG) has been established to foster the coordination, acquisition, and use of spatial data within the federal administration. COSIG promotes the INTERLIS concept for the definition and handling of all spatial data. This concept is also at the core of the e-government project (www.e-geo.ch), which attempts to bring digital spatial data closer to the users.

REFERENCES

Steudler, D. (2006). Swiss Cadastral Core Data Model - Experiences of the last 15 years. Computers, Environment and Urban Systems, Volume 30, Issue 5, September, pp. 600-613.

Steudler, D., Rajabifard, A. and Williamson, I.P. (2005). Evaluation of Land Administration Systems. Journal for Land Use Policy, Volume 21, Issue 4, October, pp. 371-380.

Steudler, D. (2004). A Framework for the Evaluation of Land Administration Systems. PhD thesis, University of Melbourne, Australia, 177 p.

BIOGRAPHICAL NOTES

Daniel Steudler holds a PhD degree from the University of Melbourne, Australia and is a scientific associate with the Swiss Federal Office of Topography swisstopo, working for the Federal Directorate for Cadastral Surveying. He is active in FIG-Commission 7 for many years and was chair of the FIG-Task Force on «Spatially Enabled Society». He published widely in the cadastral field and consulted internationally in land administration and cadastral issues. Since March 2015, he is chair of the EuroGeographics Cadastre & Land Registry Knowledge Exchange Network.