This article presents the current land administration system (LAS) in Switzerland including (i) the land information component, (ii) the land policy component, and (iii) the land administration functions within the areas of land tenure, land value, land-use, and land development. It further identifies the challenges and problems within (i) policy level, (ii) managerial level, and (iii) operational level.

COUNTRY CONTEXT AND A SHORT HISTORICAL PATH TOWARDS SUSTAINABLE LAND MANAGEMENT

The Swiss Federal Constitution supports a confederation of cantons and their respective communities. The modern state dates back to 1848. Switzerland's administration is characterised by a high level of autonomy in the cantons and municipalities. Cantons have their own constitutions, parliaments, governments and courts. Additionally some 2900 municipalities exercise local autonomy according to the subsidiarity principle.

Switzerland’s neutrality is perhaps its strongest characteristic. It became a member of the United Nations only in 2002, and cooperates with the European Union without being a member. The role of Switzerland in the activities of the United Nations and international organisations, particularly the Working Party on Land Administration, Eurogeographics and the International Federation of Surveyors has strengthened its international role.

The severance of land administration has encouraged Switzerland into an international leadership role in new GIS and cadastral technologies which supply synergies and efficiencies amid varying data sources and types. As early as 1987, a specific data
description language defining the cadastral core data model has been developed: INTERLIS, a forerunner of the international GML/XML concepts.

The influence of Napoleon is evident both in the design of the cadastres and their establishment in cantons rather than in the national sphere (Steudler and Williamson, 2005). Professional density in Switzerland is high with about 3,100 persons involved in cadastral surveying and approx. 2,000 lawyers and administrative staff in the land registry.

The long history of the cadastral system and the principle of subsidiarity have ensured wide social acceptance and understanding.

Current LAS Institutional Arrangements

(I) LAND INFORMATION

“To fund his conquests, Napoleon had all French properties accurately mapped and registered for taxation, saying “a good cadastre [property map] of the parcels will complement my civil code.” Once annexed, Belgium, the Netherlands and Switzerland received the same system (World Bank, 2005, p 33). Thus during the early 19th century, cadastres were established in many of the cantons for fiscal purposes. The legal cadastre came later to secure land ownership and facilitate land transactions. The Civil Law of 1912 was the basis for the Federal Land Registry System defined in more details in the Instructions for Monumentation and Cadastral Surveying in 1919 and the Ordinance for Land Registration in 1910. The basic principles in these remain cornerstones of the land information system today:

- Definition of the five parts of the land register, based on a cadastral map;
- Basis of cadastral map is cadastral surveying;
- Operational control of cadastral surveying and land registration is with the Cantons;
- Cadastral surveying can be – and to a high degree is – contracted out to private sector land surveyors; and
- Surveyors carrying out cadastral surveying need to hold a federal licence.

The precision of cadastral surveying and the degree of detail vary according to five different levels reflecting the economic value of the land: city centres, settlement areas, intensively used agricultural areas, extensively used agriculture areas and mountain areas. The surveying data are based on a national control system organised in a hierarchy of three orders (Steudler, 2003). At the end of 2004, about 39% of the cadastral survey was digitized, with another 29% in progress. About 16% is maintained in conventional records, 13% is not surveyed or lakes (3%). Cadastral data is captured predominantly by field survey using a total station or electronic theodolite which measures angles and distances to provide a basis for calculating the coordinates of boundary points and house corners. Photogrammetry (using both terrestrial and aerial photogrammetry) is used. Since 1998 a high accuracy satellite-based control point network has been established. An automatic GPS network with 29 permanently operating GPS stations enables accurate determination of planimetric coordinates and heights in real time and is assisting compilation both of the cadastre and geographical information which is both location based and spatially referenced. A growing use of GIS applications is assisting policy makers and administrators dealing with issues such as emergency management, tourism, traffic management, road information systems and aircraft noise analysis.
The Federal Directorate for Cadastral Surveying supervises the cantonal surveying agencies. The cantons are responsible for implementing surveying. Some use internal administrative units, but most contract out the field work and maintenance of surveying data and maps to private land survey offices who act as public agents. The Federal Directorate has about 15 employees working in cadastral surveying, with some 300 at the cantonal level, and approximately 3,000 mostly in private surveying offices. Land regulations, set-up of offices and districts, appointment and compensation of land registrars are the responsibility of the cantons.

In land registration, federal supervision is carried out by approximately five employees at the Federal Office of Land Registration and Land Law. Some of the smaller cantons have a single land registry office. In others offices exist in several districts and municipalities, making up approximately 350 land registry offices.

The cadastral surveying system was renovated in 1993 to introduce a digital data format, allowing the surveying data – which mainly serve the land register – to also underpin land information systems of any kind. The invention of the independent data description language INTERLIS was a crucial element in this flexibility.

Cadastral data is structured in eight information layers, each of which can be acquired independently: control points, land cover, single objects, heights, local names, ownership, pipelines, and administrative subdivisions. The land cover (including buildings) and ownership layers cover the whole territory without overlaps or gaps, while other layers have various definitions.

Each of the eight information layers is defined by an object-oriented entity-relationship diagram, providing a basis for translation of the data into an interoperable INTERLIS data exchange format.

Land registry information is not available to the public and is restricted to those determined by information protection officers to “have an interest” in the information.

(II) LAND POLICY

The localization of administration is counteracted by the efforts of the federal agencies, and by organised meetings of the cantonal agencies (at least twice a year in the Conference of Cantonal Cadastral Surveying Agencies). Introduction in technology has resulted in more coordination, especially to retrieve the benefits available from modelling and GIS.

Between 1912 and 1993, the cadastral system was mainly used for legal purposes to secure land ownership. Survey data was also used for utility mapping and municipal planning and management. Conversion of the data to digital form in 1993 has extended its use. By contrast, the land registries are variously digitized with some fully computerized and others remaining manual. The federal office is carrying out a project for a central data base for land registration data (eGRIS).

In contrast to the land registries which did not require complete coverage for spatial data, land information systems need complete data over the whole territory to be operational and useful. However, some cadastral data is still in old data formats; conversion is planned to be finished by the end of 2007.
In common with many countries, public restrictions and responsibilities are increasing but without sufficient transparency yet. A new law on geoinformation prepares the field to also deal with this issue in the not too distant future.

The declared objective of the cadastral system is to support land market activities and provide security of ownership. Digitisation extended the capacity of spatial data to service land information systems. There is a weak relationship between the academic and administrative sectors, limiting the opportunities for cross-fertilisation.

(iii) Land Administration

a) Land tenure

The land registry manages registration of properties – real estate being land parcels and their buildings, condominiums, servitudes and easements, and mines. The titling system is derived from the French Napoleonic code with standard features of ownership, leaseholds, mortgages and servitudes. Transactions require notarised documents that are registered in the land registry.

The cadastral map is based on a folio principle, with each land parcel on the ground related to one ownership title registered in the land registry. Every land parcel has a unique parcel identifier to which all parcel relevant information is linked. Buildings are integral parts of land parcels and cannot cross parcel boundaries. Land parcels are sold as complete entities. While the land registry deals with private owners, the cadastre covers every parcel and identifies each owner. Roads and public areas are owned either by the municipalities, cantons or federal organisations.

The federal system in cadastral surveying and its reliance on individual cantons led to the introduction of a data modelling concept in description of cadastral surveying data in 1993. The basic building block is the data description language INTERLIS which allows spatial data to be defined, modelled and exchanged without information loss, independent of system restrictions. The system encouraged the definition of more than 100 other spatial data domains so far using the same data exchange mechanisms. Cadastral surveying is the forerunner for SDI development in Switzerland.

In 2000 a new agency (COSIG) was established to foster coordination, acquisition and use of spatial data within the federal administration. COSIG also based its coordination activities on the INTERLIS concept, nowadays assisted by the world wide interest in modelling languages, particularly XML and GML.

b) Land value

Land ownership is taxed at the canton level according to various conditions and amounts. Land valuation data are kept to support tax collection.

c) Land use

Land use management and records are required for both taxation and agricultural subsidies which depend on size of
areas and identification of transitional zones between forest and agricultural uses.

d) Land development

If part of a parcel is sold, a subdivision process is required to create the new parcel and the new boundaries defined by survey.

STANDARD OF SURVEYING

The digital cadastral map is based on eight layers of information with land cover and ownership covering the whole territory without overlaps or gaps (Figure 1). Each information layer is object-oriented and defined by an entity-relationship diagram which is the data model and the basis for translation of the data into an INTERLIS data exchange format (Steudler, 2004b).

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 data description language INTERLIS was the basic building block for that, with which spatial data can be defined, modelled, and exchanged without information loss and independent from any system restrictions. The object-oriented approach and the separation of the data into logically independent information layers offers two substantial benefits: the data models became considerably less complex and the data can be queried by objects (compare Figures 2 and 3).

Cadastral surveying data are based on a national control point system organised in a hierarchy of three orders. Like the majority of geographic data in Switzerland, they are based on a national geodetic reference framework (oblique Merkator projection) which is in process of being adapted to modern GPS requirements.
INSTITUTIONAL ARRANGEMENTS AND LAND INFORMATION

Competency in the private sector surveyors is essential. Traditional surveying methods need to change to incorporate the move to GPS, and to address the new uses of digital land and spatial information available through geographic information systems (GIS), new modelling languages and the capacity of the web to facilitate highly sophisticated use of spatial information. The training of surveyors can no longer afford to concentrate only on cadastral surveying. The two campuses of the Federal Institute of Technology (ETH) in Zurich and Lausanne offer programs equivalent to Masters degrees focusing on rural and environmental engineering with optional courses in geomatics. Two technical schools offer bachelor degrees in surveying.

CHALLENGES AND BARRIERS

Federal agencies include Swisstopo – the Federal Office of Topography including the Directorate of Cadastral Surveying, which undertakes licensing – in the Department for Defence, Civil Protection and Sports, and the Interdepartmental GIS Coordination Group (COSIG, www.cogis.ch). In the Department of Justice and Police lies the Federal Office for Justice including the Office for Land Registry and Real Estate Law.

The cantonal level is the most significant, with each canton organizing its activities according to its needs, without a universal model. There are 21 Cantonal Surveying Offices among the 26 Cantonal Governments running up to 350 Cantonal and Regional Land Registry Offices. The result is a highly decentralized land administration system, with the cadastral surveying system separated from the registry functions, while topographic surveying is done centrally on the federal level by Swisstopo.

a) Policy level

The predominant political principle is the principle of subsidiarity that requires problems to be solved at the level closest to the local level. While this principle services Swiss society, and is set aside to provide national infrastructure of roads, defence, water supply, sewerage and so on, in the context of land administration it is an impediment. Along with other federal systems, the constitutional structures were devised before a national LAS became feasible or needed. Now the creation of the political opportunities and the will to develop a land administration infrastructure is a major difficulty involving creating and developing means for accessing information through nationally devised metadata and modelling standards. Without a clear, funded and supported political will to create a national land administration infrastructure, Switzerland risks to end up with subordinate technical and cooperative solutions. If they are well implemented, these may work; certainly the achievements to date are remarkable.

Organisational structure impedes informational flows necessary for government information about land in general. Accumulation of cross canton, broad scale and generic information about land (for example, average parcel size according to activities, ownership patterns, cross canton ownership) is difficult and in some cases impossible. While data sharing is greatly assisted by digitization and improved interoperability, data levels remain inadequate to fully inform government policy making.
In the context of introducing a new funding scheme for tasks between the federal and cantonal levels, the federal parliament proposed an amendment to the federal constitution. One of the amended articles refers to national surveying giving cadastral surveying a national character and providing the basis for introducing regulations for the harmonization of official land information with legal character.

b) Management level

Decentralised administration occurs in all federated states. The capacity of the national agencies to work in this context needs to be negotiated in the context of constitutional silence. Switzerland is improving coverage of digital data. However for purposes of a land information system, large-scale data coverage is still not available in all areas, and there are few coherent user-driven web enabled applications.

c) Operational level

Switzerland's administrations are working on solutions, and are assisted a well-suited system design and neutral software within which land objects can be identified and information relating to them shared.

Comparing with international trends and developments, it is felt that more attention would need to be given to the creation of land and spatial information commodities, especially access to data and information itself and sale price information.

Funding for cadastral surveying follows the administrative structures: involvement of all three administrative levels can lead to difficulties in initiating projects. However, once established, results of projects are available to all levels. Though the land market transaction duties and land taxes produce high revenues for the cantons, generic statistics are not available, nor is funding for cadastral surveying infrastructure (dependent on the non-earning federal level) easily attracted.

REFERENCES


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