Swiss Cadastre: Cadastre 2014 for Sustainability

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Key words: Cadastral System of Switzerland, Legal Base, Public-Private Co-operation, INTERLIS, Cadastre 2014.

ABSTRACT

The paper shows the legal base and the organization of the cadastral system of Switzerland. It explains the way public and private sectors are working together in the field of cadastral surveying.

The aims and the elements of the cadastral reform in Switzerland are figured out and the impacts of the reform in the fields of mental change and professional and technical development are shown. The way from cadastral maps to well defined digital data models, which proves to be an important mental challenge, and the importance of the tools for model-based, conceptual data modeling, developed in the framework of the reform, is shown. The effects of the reform work within the country and for the work abroad are outlined.

Finally the efforts in the field of Cadastre 2014 taken by the stakeholders in Switzerland to develop the cadastre to be a complete and reliable documentation of rights on land as a basis for sustainable development are discussed.

ZUSAMMENFASSUNG

Das Papier zeigt die Rechtsgrundlagen und die Organisation des Katasters in der Schweiz auf. Es erklärt, wie die amtlichen Stellen und die privaten Vermessungsbetriebe im Bereich der Amtlichen Vermessung zusammenarbeiten.

Die Ziele und die Elemente der Reform des Katasters und die Auswirkungen der Reform in den Bereichen des mentalen Wandels und der beruflichen und technischen Entwicklung werden dem Leser nähergebracht. Der Weg vom Katasterplan zum präzise definierten digitalen Katastermodell, der eine grosse Herausforderung darstellt und die Wichtigkeit der Werkzeuge für eine modell-basierte konzeptionelle Datenmodellierung, die im Rahmen der Reform entwickelt wurden, werden gezeigt. Die Auswirkungen der Reform auf die Arbeit im In- und Ausland werden skizziert.

Schliesslich werden die Anstrengungen aller am Kataster der Schweiz Beteiligten, diskutiert, den Kataster im Sinne der Vision Cadastre 2014 zu einer umfassenden und zuverlässigen Dokumentation aller Rechte am Boden weiter zu entwickeln, als Basis für eine nachhaltige Entwicklung.

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1. INTRODUCTION

Switzerland has a long lasting and successful tradition in cadastre. After the introduction of the federal constitution in 1848 all cantons started implementing cantonal land registers. These cantonal registers were replaced by the Swiss Federal Land Register (Eidgenössisches Grundbuch) with the adoption of the Swiss Civil Code *(Zivilgesetzbuch, ZGB), namely section 4, law of things, and title 25: the land register (Grundbuch)* on 10.12.1907 (Figure 1) and the following years when the Ordnance concerning land registration, 23.11.1910 *(Grund-buchverordnung, GBV) and the* Ordnance of Cadastral Surveying, 18.11.1912 *(Verordnung über die Grundbuchvermessung, VAV)* were introduced.

Swiss Civil Law
(in force since 1.1.1912, up-dated up to 1.1.1997)

Art. 942

[1] All rights on real estates have to be registered in the **land registry**.
[2] The **land registry consists of the main book with its associated maps**, the auxiliary registers (in particular the list of property owners), the deeds (records and evidences), the description of properties, and the day book.

Art. 950

[1] Registration and description of the properties in the land register have to be done **on the basis of a map, which as a rule, has to be the result of an official surveying**.
[2] The Federal Council decides on which principles these maps have to be based upon.

Figure 1, The legal basis of the Swiss Cadastral System in the Civil Code

According this legal base the land registration is declared a joint task of the authorities for the land registration and the cadastral surveying (Figure 2). Cantons work under the supervision of the federal authorities, the Federal Office of Land Registration and Land Law and the Federal Directorate of Cadastral Surveying. Both authorities were then subordinated to the Department of Justice.

Due to the technical developments in particular the information technology coming up about 1960 both ordinances became the objects of a reform in the mid of the seventies. The reform work lasted until 1993/94. While the Ordnance concerning Land Registration released on 23.11.1994 was changed in the sense that it allowed the cantons the introduction of IT-based solutions, the cadastral surveying was essentially remodeled and the new Ordnance of Official Surveying, 18.11.1993 resulted from this process. As we can see the name was changed from cadastral surveying to official surveying.

The organization of the cadastral system was not changed in principle by the reform. Neither was the allocation of responsibilities to the different political levels. However during the reform process the Directorate of Cadastral Surveying was subordinated to the Federal Office of Topography.

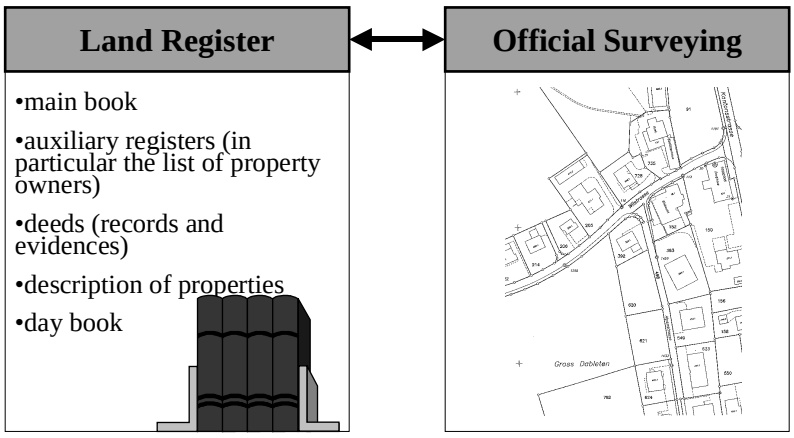


Figure 2, Cooperation of registration and surveying authorities

In our presentation we will give an overview on the cadastral system in Switzerland and then concentrate on the aspect of official surveying.

2. THE PRESENT-DAY CADASTRAL SYSTEM OF SWITZERLAND

2.1 Structure and Organization

The political and administrative structure is influenced by Switzerlands federal structure with the three levels Federation, Cantons and Municipalities. The cantons constitute political and administrative bodies on their own.

Therefore organizations on different political levels are involved in the cadastral system (Figure 4). The responsibility of the federal authorities is the supervision. The cantons have chosen different solutions, however one of their main responsibilities is the implementation of the land registration and the cadastral surveying. On the municipal level we can find private Licensed Surveyors dealing with official surveying besides a small number of municipal surveying offices. In the domain of Land Registration, the private sector is only involved by private notaries preparing the contracts (deeds).

2.2 The Organization of Official Surveying

The surveying part of the cadastral system is organized as shown in figure 5, where the respective tasks are listed as well.

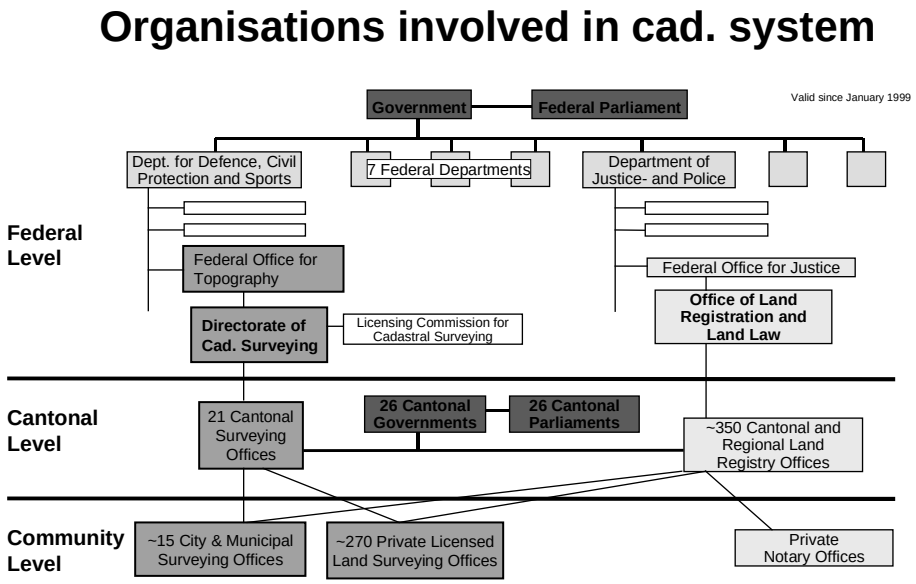


Figure 4, Organizations involved

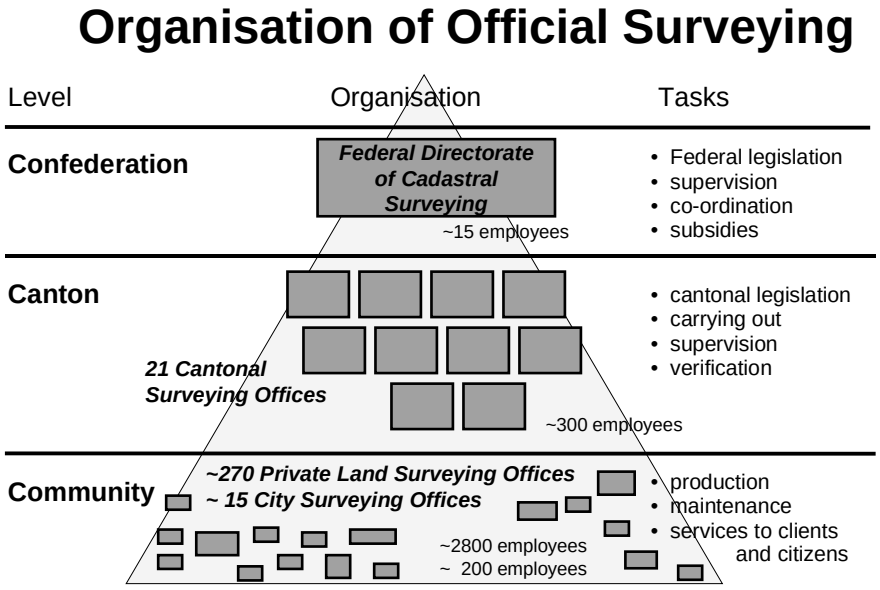


Figure 5, Organization of Official Surveying

2.3 The Contents of the Reform of Cadastral Surveying

An overview of the reasons for and the principles and the result of the reform is shown in figure 6.

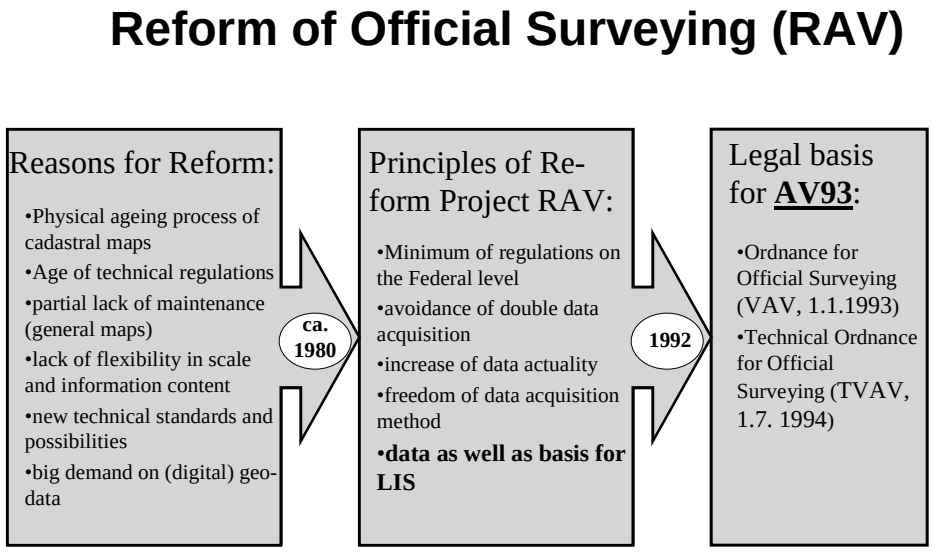


Figure 6, Reasons, principles and result of the reform

The result of the reform is a new legislation for Official Surveying (AV93). The two ordinances define the responsibilities, tasks, procedures and results required from cadastral surveying work.

The elements of the new official surveying are listed in figure 7.

Elements of AV93

- Information content has not been changed compared with traditional cadastral surveying
- Definition of a data model with 8 information layers
- Data description with INTERLIS
- Possibility for the setting up of general land information systems LIS

Figure 7, Elements of AV93

The main result of an official surveying is not a cadastral map as it used to be but a well defined set of objects described by their digital data. This data is arranged in 8 different information layers each describing a certain aspect of the reality (Figure 8).

AV93-layers according to VAV

(1.1.1993)

8 Information Layers:

Control points

Land cover

Single objects / line elements

Heights

Local names

Ownership

Pipelines >5bar

Administrative subdivisions

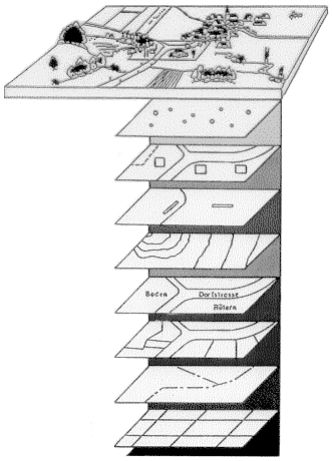
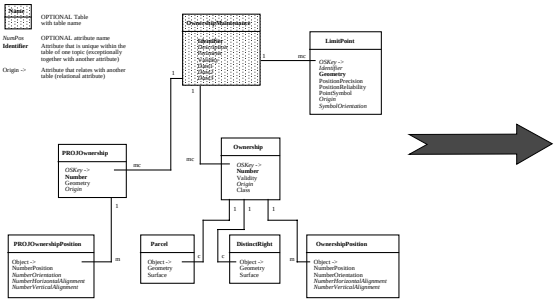


Figure 8, The information layers of Av93

Data description in INTERLIS



Data description in INTERLIS for layer „Ownership“

```
TRANSFER Data_Catalogue;

MODEL Basic_Data_Set
 DOMAIN
  LKoord = COORD2  480000.000   70000.000
                    840000.000  300000.000;
  HKoord = COORD3  480000.000   70000.000      0.000
                    840000.000  300000.000   5000.000;
  Height = DIM1  0.000  5000.000;
  Precision = [0 .. 300];
  Reliability = (yes, no);
  LetterOrientation = GRADS  0.0  400.0;
  Status = (planned, valid);

TOPIC Control_Points =
  .........
END Control_Points;

TOPIC Land_Cover =
  .........
END Land_Cover;


TOPIC Ownership =
DOMAIN
 Monumentation = (border_stone, plastic_peg, cross,
                  not_monumented);
 OwnershipType = (parcel, distinct_right,
                  construction_right, water_source_
                  right);
 OPTIONAL TABLE OwnershipMaintenance =
   Identifier = TEXT*12;
   Description = TEXT*30;
   Perimeter:  SURFACE WITH (STRAIGHTS, ARCS)
   VERTEX LKoord
   WITHOUT OVERLAPS > 0.200;
   Validity:  Status;
   Date1:  DATE;
   Date2:  OPTIONAL DATE;
   Date3:  OPTIONAL DATE;
   IDENT
   Identifier;
 END OwnershipMaintenance;

 TABLE LimitPoint =
   OSKey: OPTIONAL -> OwnershipMaintenance;
   Identifier:  OPTIONAL TEXT*12;
   Geometry:  LKoord;
   PositionPrecision:  Precision;
   PositionReliability:  Reliability;
   PointSymbol:  Monumentation;
   Origin:  OPTIONAL TEXT*30;
   SymbolOrientation:  OPTIONAL LetterOrientation;
   !! Default: 0.0
   IDENT
   Geometry;
 END LimitPoint;
END Ownership.

END Basic_Data_Set.
```

Figure 9, Interlis-Description for the information layer 'Ownership'

The objects to be acquired and managed are the same as in the traditional cadastral surveying. The data is defined precisely in the data definition language INTERLIS, which was developed in the framework of the reform project. Starting from an Entity-Relationship-Diagram, a precise data description is defined in the INTERLIS language (Figure 9).

The reasons for the application of a model-based data definition language are listed in Figure 10.

Reasons for a data description language
▪ flexible instrument for the definition of the data model
▪ protection of the investment in the data and long-term security
▪ data transfer without information loss
▪ guarantee of freedom of methods and systems
▪ quality assurance
▪ unified interface for facilitating data exchange between different systems

Figure 10, Reasons for application of INTERLIS

According to the new regulations, the AV93 data shall serve as a basis to set up general land information systems.

The necessary maps are produced when needed from these reliable data.

2.4 The Implementation of AV93

The implementation of AV93 is a still ongoing process taking several years to be completed. Due to this process different standards exist in parallel at the moment as figure 12 shows.

Technical standards			
Since	**Designation**	**Technical characteristics**	**Legal Force**
1993	AV93 Official Surveying	Digital, data model, layer principle, topology	Digital Data
1993	PN Provisionally digitised	Transitional standard, does not fulfil all requirements of AV93	Paper maps
1985	VN Completely numerical	Digital, attributes	Paper maps
1970	TN Partially numerical	List of Co-ordinates	Paper maps
1912	HG Semi- graphic	Traverse points with calculated co-ordinates, co-ordinatograph	Paper maps

Figure 12, Different technical standards

The new law defined two procedures to get from the traditional situation to the new standard defined by AV93. In areas where no cadastral maps exist, an 'initial data acquisition' in which the objects are identified and surveyed has to be carried out. Areas with existing cadastral information are subject to a 'cadastral renovation', where the existing material is used and if necessary completed to get the required information in the new digital form. As the regulation states the free choice of methods, more and more often a combination of terrestrial, GPS and photogrammetry is used to get the required results.

The strategy of the Directorate of Cadastral Surveying is to reach a total area coverage by AV93 as soon as possible because more and more public and private sector organizations are interested to use the data for their own work.

2.5 The Role of the Private Sector in Official Surveying

In view of the trends towards New public management and deregulation, the traditional model of the involvement of the private sector in the execution of official surveying work proved to be the right strategy.

Main Tasks of Private Land Surveyors:

Cadastral Surveying:

- contracts with communities/cantons for the maintenance and updating of cadastral surveying data
- carrying out of projects for acquisition of AV93 data and renovation of old existing cadastral surveys

LIS:

- service to clients (public bodies of all levels, facilities companies, etc.)

Figure 13, Tasks of the private sector

The private sector has the main tasks on municipal and regional level (Figure 13). In the earlier mutual agreement on work and prices, bidding processes are executed. The distribution of responsibilities between the public and the private sector are shown in figure 14.

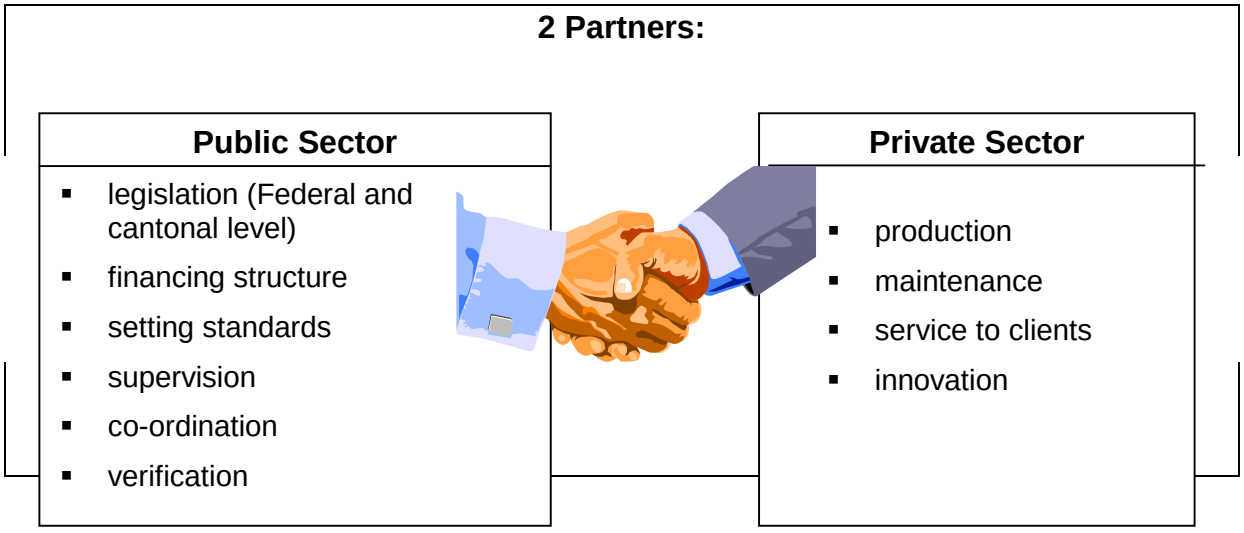


Figure 14, Responsibilities of public and private sectors

3. IMPACTS OF THE REFORM

3.1 Mental Change

The reform created a need for mental change particularly for the professionals. The thinking in objects and data instead of maps proved to be a rather big challenge. It needs a big effort to understand that data quality in terms of integrity, completeness and actuality was now of more importance than the quality of the graphical representation. . This process of mental change is not completed yet.

A further challenge was the dealing with the bidding, which was not known to the profession before. Both sides, the customers in the public sector and the bidders in the private sector had to learn. The prices decreased about 40 to 50%.. This situation supports the strategy of total area coverage on one hand but on the other hand creates the need for more efficient working processes and for co-operation to share resources. Also this process is not consolidated yet.
It is felt strongly that the necessity for mental change strengthens the profession's ability to master the future challenges in the field of geomatics and management of future cadastral systems.

3.2 Dissemination of INTERLIS

The application of the model-based GeoLanguage INTERLIS, developed for the reform and declared mandatory for the official surveying by the new legislation, proved to be very successful. Other domains, e.g. land use planning and utility management adopted this idea and started to describe their data models precisely in INTERLIS. As a consequence INTERLIS was declared a Swiss standard (SN 612030). Based on this success the development of the initial version INTERLIS1 to INTERLIS2 (SN 612031) was initiated and completed in 2001.

INTERLIS was presented in the framework of the normalization work of ISO TC211 and it plays an important role in the tests for the international geostandardization.

3.3 Introduction of Modern Cadastral Systems in Foreign Countries

At the same time, when the reform was implemented in Switzerland, cadastral projects were started in the transition countries of Eastern and Central Europe and the former Soviet Union. Swiss professionals taking the role of consultants in this field disseminated the ideas and the principles of the reform to countries like Lithuania, Czech Republic, Hungary, Russia, Belarus, Moldova, Khirgistan, Armenia and Georgia. The same approach is applied in the re-establishment of the cadastre in Kosovo.

3.4 Development of Cadastre 2014

FIG's successful publication Cadastre 2014 was influenced by the Swiss cadastral reform as well. FIG Commission 7's annual meeting 1992 took place in Switzerland, where the Swiss delegate Jürg Kaufmann, being a member of the reform committee, showed first results of the reform pilot project in the canton of Nidwalden. On the Melbourne FIG Congress 1994 he was given the task to study together with a working group how cadastral systems might look like in about twenty years. This lead first to a working title and later on to something like a trade mark Cadastre 2014 (Figure 15).

Several basic principles of the reform work constituted components of the vision for future cadastral systems developed by Jürg Kaufmann and the working group's secretary Daniel Steudler. The ideas were discussed intensively by the working group during the following annual meetings and finally published.

The vision stipulates that the future cadastral system will be a reliable and comprehensive documentation of all rights and restrictions concerning land and the whole living space, managed in close co-operation of surveyors and registrars, working with data models instead of maps, based on information technology, run in common by the public and private sectors and being cost recovering.

Such an efficient documentation can be compared with a book-keeping system being the basis for efficient management. It constitutes the reliable and efficient tool for land management supporting sustainable development of the world and humankind. (Figure 16)

Figure 15, Cover Publication Cadastre 2014

4. ON THE WAY TO CADASTRE 2014

Several initiatives have been taken to develop the existing cadastral system in direction Cadastre 2014.

The co-operation between the Federal Office of Land Registration and Land Law and the Federal Directorate of Cadastral Surveying was reanimated and a basic paper on the future collaboration was published.

Preparing a new legal basis for the official surveying in the Swiss Constitution the Federal Directorate of Cadastral Surveying installed a task force to include the vision of Cadastre 2014 in the further development of the Swiss Cadastral system providing a national reliable and comprehensive cadastral infrastructure for the country.
The organization of the private licensed Surveyors of Switzerland IGS decided to identify all geographical land objects defined by laws and ordinances and to elaborate the respective data models described in INTERLIS.

In several cantons work on systematic documentation of land objects has been started. The important, while economically very strong, canton of Zurich enacted the necessary legal framework in connection with the new legislation on land use planning to make a new system work in the sense of Cadastre 2014.

Level	**General Business**	**Global Development Business**
Strategic (goal setting)	sound economic development	sustainable development
Management (measures to meet strategy)	Company management	Land management (ressource management)
Administrative (business processes)	Administrative unit	Land administration
Operation (tools for documenting and monitoring)	**Accounting system** ▪ accepted principles of bookkeeping ▪ reliable ▪ complete ▪ appropriate to needs ▪ adaptable to development	**Cadastre** ▪ accepted principles of documentation of rights/ restrictions ▪ reliable ▪ systematic ▪ approriate to needs and laws ▪ adaptable to development ▪ public

Figure 16, Cadastre 2014 as a tool for sustainability

All these efforts are coordinated by the Federal Directorate of Cadastral Surveying and it can be expected that Switzerland disposes soon of a most modern cadastral system.

BIOGRAPHICAL NOTES

Jürg Kaufmann, born 1942, is a graduate from the Swiss Federal Institute of Technology and he absolved additional studies in economy and commerce. He runs his own company KAUFMANN CONSULTING working for public and private organizations in the fields of cadastre and geomatics in Switzerland and abroad. Jürg Kaufmann represents Switzerland in FIG's Commission 7 and chaired the working groups producing the publications 'Cadastre 2014' and 'Benchmarking Cadastral Systems'.

Dr. Erich Gubler, born 1941, is the CEO of the Swiss Federal Office of Topography. He graduated from the Swiss Federal Institute of Technology and was awarded a PhD of this University in 1996.

Thomas Glatthard, born 1956, a graduate from Swiss Federal Institute of Technology is a free practicing consultant in Switzerland. As a member of the board of the Swiss professional organization SVVK he is the Editor in Chief of the national professional journal and also responsible for the Swiss FIG activities. Within FIG he is involved in the history of surveying and measuring.

Daniel Steudler graduated from the Swiss Federal Institute of Technology (ETH) in Zurich in 1979, earned the Swiss license for licensed land surveyor in 1985, and did his M.Sc.Eng. degree at the University of New Brunswick, Canada from 1989-91. Since 1991, he is working with the Swiss Federal Directorate of Cadastral Surveying with the responsibilities of supervising and consulting Swiss Cantons in organizational, financial, technical, and operational matters in cadastral surveying. Since 1994, he is involved in the activities of FIG-Commission 7 as a working group secretary, where the topic of the current working group is "Reforming the Cadastre". In April 2000, he started his PhD at the University of Melbourne under the supervision of Prof. Ian P. Williamson. His main research topic is to develop a framework and methodology for evaluating cadastral systems in the larger context of land administration.