Cadastre 2014 and the Initiatives Making the Vision Reality

Abstract #196

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1. INTRODUCTION

The world, its different cultures, and its political and economic systems are in a permanent development process. This process is driven primarily by the activity and the creativity of humankind. New medical and technical possibilities have impacts on life, on the way of living, and on the way of doing business. One effect of this development is the growth of the world's population.

This development leads to an increase in the consumption of natural resources, particularly of land. It has been acknowledged that disorganized consumption of natural resources will lead to a degradation of nature, of the natural world, of the environment, and finally of humankind. Efforts are being made to encourage sustainable development. That means that development should be undertaken in such a way that a minimum of resources are consumed. It is the main goal of Agenda 21 to improve awareness of and introduce measures for a sustainable development of humankind in harmony with the environment.

As land is an important part of nature and the environment is the basis for nutrition, housing, energy production, resource exploitation, leisure activities, waste disposal, economic activities - in short for the maintenance and survival of humankind - cadastres are a crucial aspect of sustainable development.

Traditional cadastre systems, however, can no longer meet the high standards necessary for a sustainable development. There is a need to adapt the currently successful operating cadastral systems to the new standards and to implement improved cadastral systems where no such infrastructure exists. This is one reason for the many ongoing cadastral reforms and efforts in the world.

Cadastre 2014 shows how modern cadastral systems are to be designed to be able to meet the future requirements. It is based consequently on the possibilities of Information Technology. Cadastral Data Modelling plays an important role to make efficient use of IT and to secure the expensive cadastral information a long life.

2. THE ENVIRONMENT OF MODERN CADASTRAL SYSTEMS

To be able to use land and natural resources in a sustainable manner, a jurisdiction has to define a comprehensive Land Policy. To implement the policy, Land Management is necessary. Land management must base on Land Administration which is defined as 'the processes of determining, recording and disseminating information about the tenure, value and use of land when implementing land management policies'. Land Administration like

Business Administration must be able to fall back on a reliable bookkeeping system, which provides the administrators with correct, complete and up-to date information. The cadastre plays the role of this important bookkeeping system of the land business.

Level	General Business	Land Business
Strategy (goal setting)	**Policy**: Sound economic development	**Land Policy**: Land Market, Sustainable development
Management (measures to meet strategy)	**Company Management**	**Land Management** (ressource management)
Administration (business processes)	**Administrative unit**	**Land Administration**
Accounting (tools for documenting and monitoring)	**Accounting system** • accepted principles of bookkeeping • reliable • complete • appropriate to needs • adaptable to development	**Cadastre** • accepted principles to document rights/restrict. • reliable • systematic • approriate to needs/laws • adaptable to development • public

Figure 1, Land Business

Successful operation and development of a business is based on a well developed administration system. The Land Business is made possible by a land bookkeeping system obeying clearly defined rules that are valid world-wide in principle, and may be adapted in detail to accommodate national and cultural peculiarities. (Figure 1)

Future cadastral systems will provide this bookkeeping function to support decision-making and sustainable development. The principles of a cadastre are acknowledged world-wide. The details can be adapted to meet the needs and traditions of a particular country. Land management needs reliable information about the existing land and its resources and about the legal situation of these items. This information will be provided by future cadastral systems.

3. CADASTRE 2014, THE FLEXIBLE BOOKKEEPING SYSTEM

3.1 Terms of Reference and Result

FIG, aware of the need for change in the cadastral domain and of the efforts in cadastral reform, initiated at the Melbourne 1994 FIG Congress by its Commission 7 the Working Group 7.1. The terms of reference for this Working Group were to:

> Study cadastral reform and procedures as applied in developed countries, take in consideration automation of the cadastre and the role of cadastre as part of a larger land information system, evaluate trends in this field and produce a vision of where cadastral systems will be in the next twenty years, show the

means with which these changes will be achieved and describe the technology to be used in implementing these changes.

The term cadastre 2014 arose from adding 20 years to 1994.

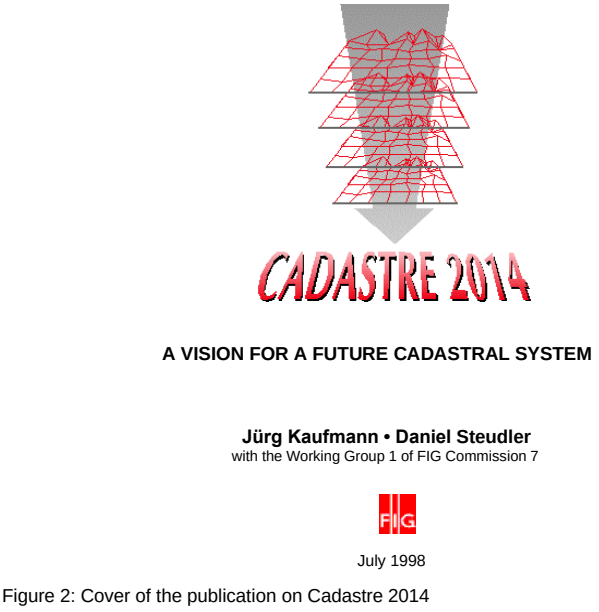

Figure 2: Cover of the publication on Cadastre 2014

The result of this work was published as a brochure with the title 'Cadastre 2014, A Vision for a Future Cadastral System' [Kaufmann, Steudler, 1998]. (Figure 2). It was presented 1998 at the FIG Congress in Brighton.

Since 1998, the brochure was translated into more than 20 different languages. In 2001 FIG had to provide a second edition because the first was sold out.

3.2 Need for new Cadastral Systems

Investigations carried out during the work made clear that the documentation and registration of private land rights referring to land parcels does not provide enough information to assemble a complete picture of the legal situation of land. The legal environment has changed remarkably in the last few decades. Societies introduced new laws concerning physical planning, protection of the environment, and the exploitation of limited natural resources.

This process is going on and it can be considered as a fact that further legal regulations will and must be implemented.

All these regulations on one hand touch the absolute rule of the land owner, on the other hand create an unclear legal situation of land. This may in a medium term threaten the land market and hinder a sustainable development. Cadastral systems provide economies with credits secured by mortgages. In Switzerland for example more than 60% of loans in a value of

about 500 billion Swiss Francs are secured by land. Legal uncertainty can change this important role of land for the economies.

In view of the new possibilities of information and sensor technology services cadastral systems can become more efficient and comprehensive as they normally use to be.

Modern cadastral systems must therefore be designed to be able to:

- give reliable and complete information on the legal situation of land by taking into consideration all legal impacts on land;
- adapt to the changing needs of societies by flexible organizations and well defined information structures and data models;
- work straight forward and efficiently by making use of appropriate technology;
- achieve best practice and flexibility by bundling the strengths of the public and private stakeholders;
- be run at minimum cost for citizens and communities.

To meet these requirements the principles for modern cadastral systems were developed.

4. PRINCIPLES OF CADASTRE 2014

4.1 Principle of Land Objects

Cadastre 2014 applies the proven principles of the traditional cadastre but enlarges the objects to be processed by the cadastre and the content of cadastral systems.

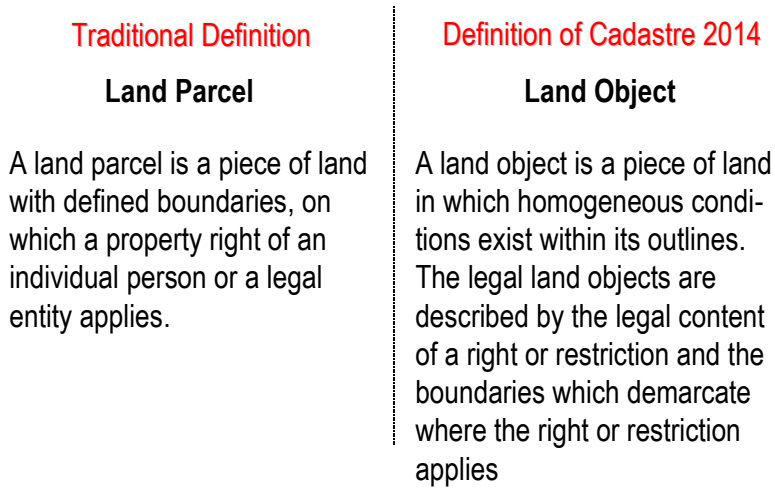

Figure 3: New Definition Land Object

The new objects to be processed are the land objects. Land parcels are one category of land objects (Figure 3).

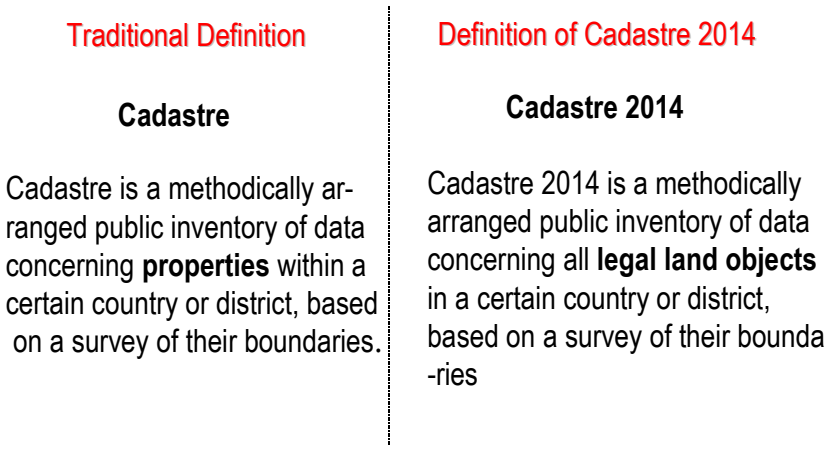

Figure 4: New definition of a modern Cadastre

The new cadastre shall comprise not only the land parcels but all land objects in a defined area (Figure 4).

4.2 Principle of relating rights to Land Objects

Cadastre 2014 works consequently with the geographically located land objects and relates the rights of physical or juridical persons to these objects. (Figure 5)

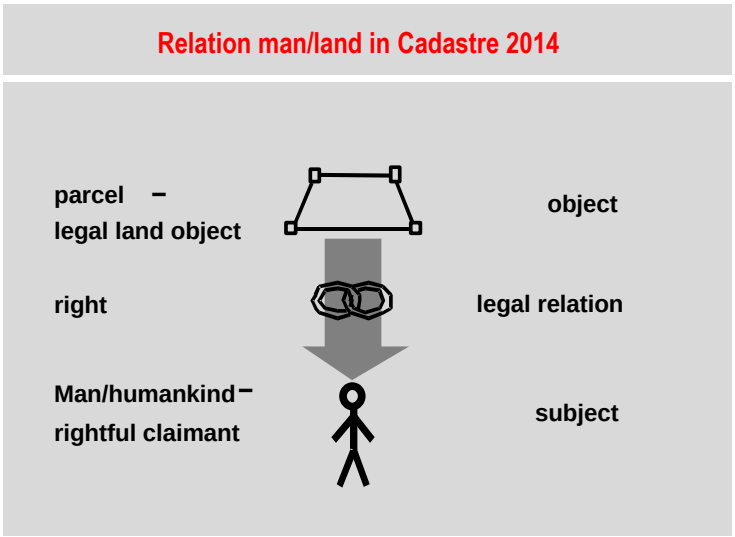

Figure 5 Relation Land <-> Man

Cadastre 2014 is therefore title-oriented. The intake of a land object in Cadastre 2014 means that a title is created describing the object and the related rights and/or restrictions.

4.3 Principle of the documentation of private and public rights and restrictions

The most important statement on Cadastre 2014 is :

Cadastre 2014 will show the complete legal situation of land including public rights and restrictions!

All land objects emerging from a law – and not only the land parcels as objects describing the property right - are to be carefully defined, verified, and kept in a public documentation.

The actual situation in the traditional parcel-based cadastres is characterized in figure 6.

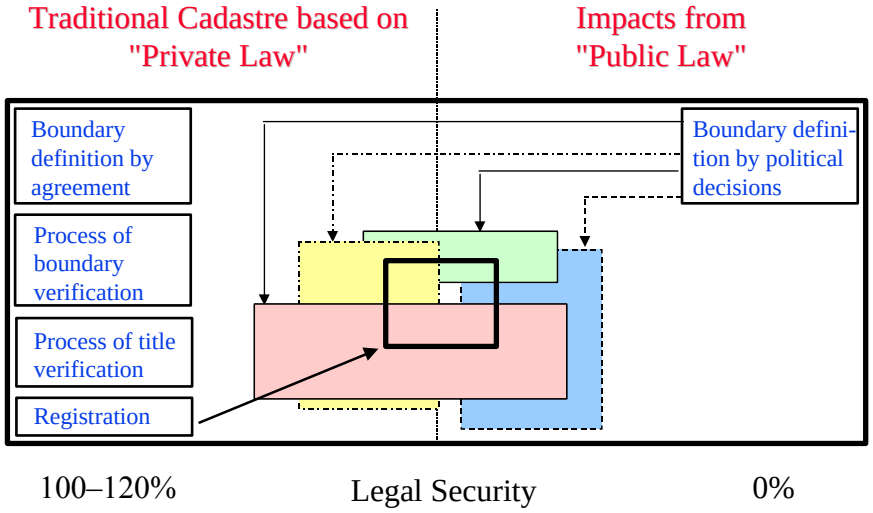

Figure 6: Lack of legal Security

Future cadastres shall correct this dangerous situation by applying the principles of cadastral systems on all legal land objects (Figure 7).

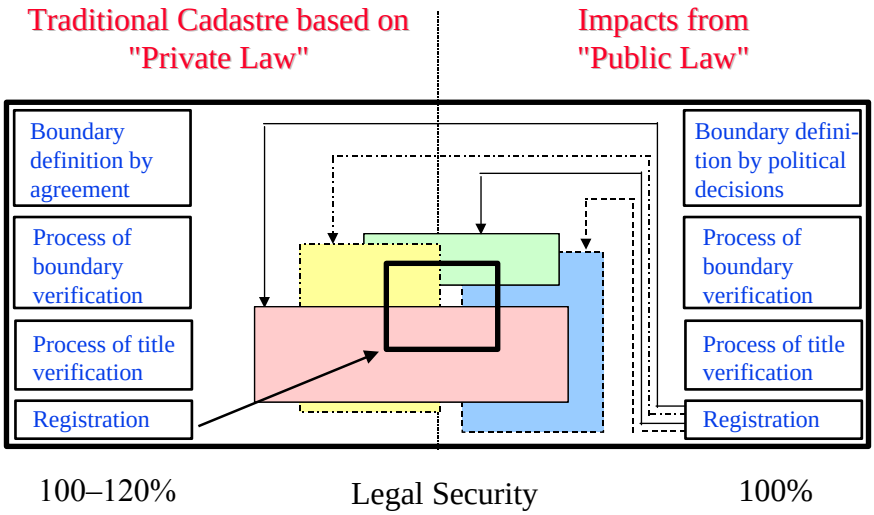

Figure 7: Cadastre 2014 documenting properly land objects defined by private **and** public law

4.4 Principle of legal independence

The future complete documentation of the legal situation of land must respect the principle of legal independence, which is shown in figure 8.

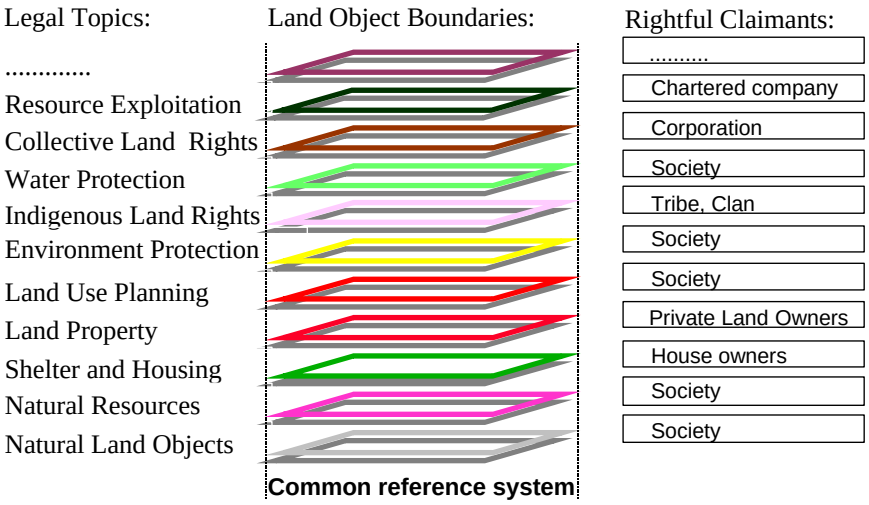

Figure 8: The principle of legal independence

The different legal land objects are to be arranged according to the laws by which they are defined. This structure allows the immediate adaptation of the cadastre to the development of

the legislation. It is not necessary to rearrange the information. New legal topics can simply be added by including a further information layer.

This process can be compared with the adaptation of the chart of accounts in a bookkeeping system. A new account for the administration of the new land objects is introduced because a law defines a new category of assets being part of the land business. An abrogation of a law would mean the removal of an account in the system. This happens unfortunately not to often.

4.5 Principle of independent topics

The realisation of the principle of legal independence results in a structure of independent topics. Land objects are arranged in legal topics. There is no link between land objects in different topics. Links between land objects are not stored in the system but created when needed using the fact that the land lbjects are located in the same area.

Figure 9 shows how polygon overlaying techniques help to create links between land objects.

Cadastre 2014 helps to resolve the problem when land and houses are not an immovable unit. This situation occurs often in the countries in transition, where the land used to belong to the state and the houses belong to the citizens. Even when land privatisation is intended, this situation last for years. Cadastre 2014 documents the rightful claimant of the land parcel independently from the rightful claimant of the house. If both objects have the same owner the parcel and the house may be considered to be a immovable property.

This technique is very favourable from the point of view of updating. There are no links to be administered. Links are created when needed comparing the positions of the land objects.

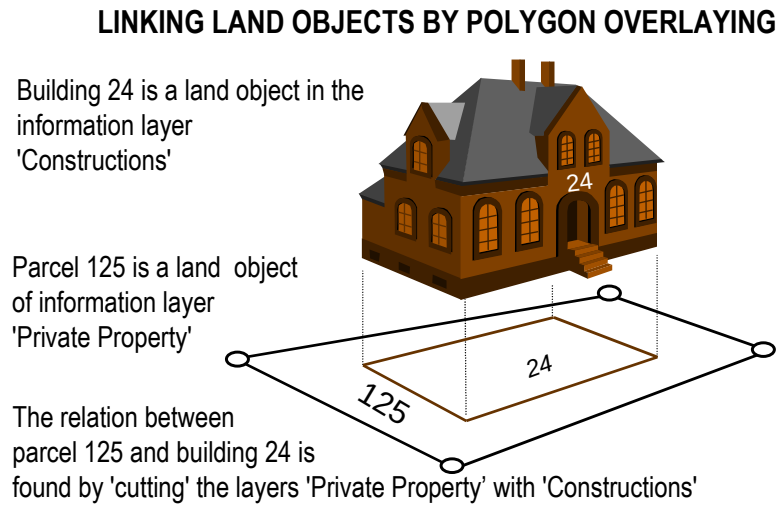

Figure 9: Finding relations between Land Objects by the ‚Overlay Technique‘

Using this principle means to say good by to the parcel-based cadastral systems of the past, where all the information is linked to the land parcel. Future cadastral systems are no longer parcel-based, they are based on land objects located in a common reference system.

4.6 The principle of unified Cadastre and Land Registry

A second statement of Cadastre 2014 says:

The separation between 'maps' and 'registers' will be abolished!

The establishment of separate organisations for map production and land registration was often necessary because the two operations used to require different skills, and the available technology did not allow for other solutions. With modern technology (IT) it is possible to link land objects with the information about ownership and owners, mortages and emcumbrances. The often practised separation of the physical and organisational structure will become unnecessary.

4.7 The principle of Cadastral Modelling

'Cadastral mapping' will be dead! Long live modelling!

The idea to replace the good old maps by virtual models is a mental challenge for the professionals used to think in graphical categories. Information technology works with digital data and provides the ability to model objects of the real and legal world. Maps as analogue representations will lose their function as information storehouses; their only purpose will be the representation of information. In future we will have increasingly different graphic representations as extracts of the cadastral model tailored to the needs of the individual customer. To store maps as a picture on a computer is therefore an archaic operation.

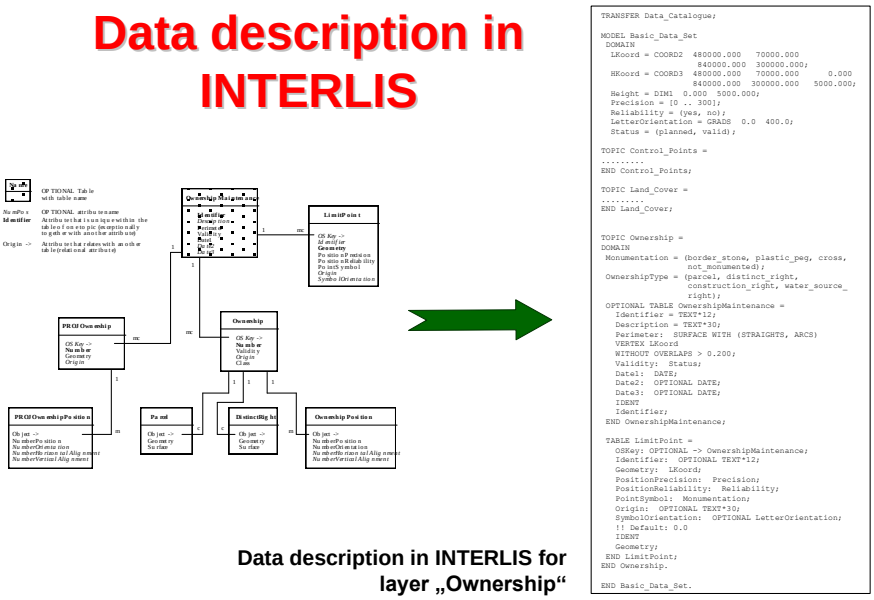

Figure 10 Modelling with INTERLIS

When working with models, the data models are to be described precisely and there is also a need for a description of representations of data. In Switzerland such a data modelling language called INTERLIS has been developed during the reform of the cadastral surveying laws in the years 1975 to 1993. INTERLIS1 was the first operational GeoInformation Standard and it is broadly used for precise data modelling (Figure 10), secure data exchange

and sustainable insurance of long term data availability. INTERLIS1 creates automatically an ASCI data exchange format and respective files.

INTERLIS2 with additional possibilities for incremental actualisation of data and the description of representation models will replace INTERLIS1 in the near future. INTERLIS2 works with UML and creates XML-files.

4.8 The principle of IT application

'The paper and pencil cadastre' will be gone!

This statement implies that the best technical tool for bookkeeping is IT. You can see the automation of business processes all over the world and you cannot find any cadastre project in the world where information technology is not involved. IT makes work easier and is the only way to achieve, what nowadays is called a low-cost cadastre.

4.9 The principle of privatisation

The trend to privatise the operational work to be executed in the field of cadastre is reflected in statement five:

Cadastre 2014 will be highly privatised! Public and private sectors are working closely together!

This is a fundamental trend. The public domain will nevertheless have to provide secure land titles but it will outsource most operational work and concentrate on supervision.

4.10 The principle of cost recovery

Finally, in statement six the aspect of cost recovery which is also an international trend, is expressed:

The cost of Cadastre 2014 will be recoverable!

A functioning cadastral system represent a considerable value for a society. The awareness that public and private sectors have to cover their cost, leads to efforts to implement cost covering fees in the field of cadastre. Because cadastre is a long-term investment the depreciation period for the initial investment can be longer than for normal goods.

5. INITIATIVES MAKING THE VISION A REALITY

5.1 Overview

After the publication the brochure was translated into more than 20 languages (Figure 12). In different countries the ideas of Cadastre 2014 are discussed and first steps in view of a new cadastral system are undertaken.

The Australian and New Zealand professional organizations have printed 5000 copies that were distributed to every member and seminars were held all over the country.

New Zealand's Surveyor General indicated 1999 that New Zealand will implement Cadastre 2014 until the year 2004.

Figure 12 Translations in different Languages

Cadastre 2014 was a topic at several occasions.

- The ideas of Cadastre 2014 were taken into consideration, when FIG and UN were elaborating the Bathurst Declaration in 1999.
- Cadastre 2014 was a topic in different conferences and venues:
- FIG Congress Brighton 1998 and Washington 2002;
- FIG Working Weeks South Africa 1999, Korea 2001 and France 2003;
- Meetings of the UNECE Working Party on Land Administration in Warsaw 1998, London 1999, Sweden 2001;
- Austrian Geodätentag in Bregenz 2000;
- International Cadastral Conference in Bogota 2001;
- First Congress on Cadastre in the European Union in Spain 2002;
- INTERGEO Frankfurt 2002;
- Workshop on Cadastral Modelling in The Netherlands 2003;
- etc.

5.2 Initiatives Switzerland

The first ideas for Cadastre 2014 arose during the Swiss Cadastral Reform project in the time from 1975 to 1993. The legislation was changed mainly to allow the application of IC-Technology. The reform introduced a data model based on the principle of thematic independent topics as shown in figure 13.

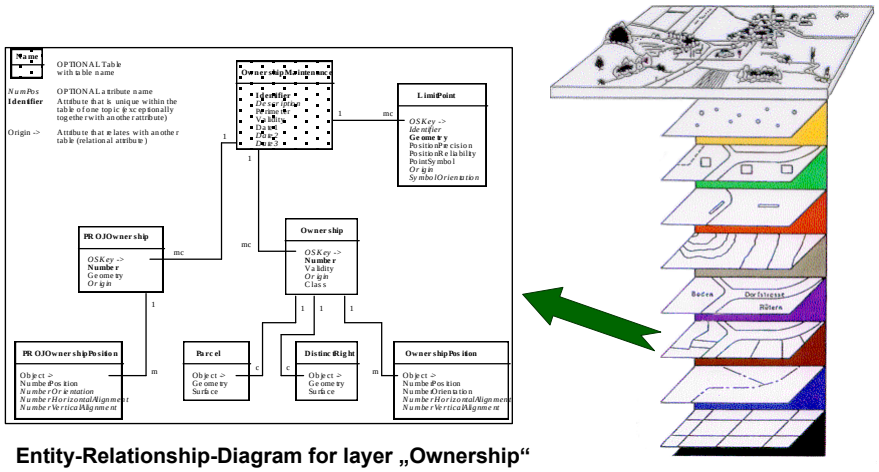

Figure 13 The Swiss cadastral data model with independent topics

This data model is described precisely with the help of a system-independent data definition language called INTERLIS. INTERLIS is a legal prescription in the surveying law but also a Swiss national standard SNV 612010 used to model room-related objects.

The basic idea to arrange the data in independent topics according to there legal significance was the first application of land objects. Parcels as land objects are arranged in a topic called private property. Natural objects like forests and rivers and artificial objects like buildings and roads are modelled as individual land objects forming the topic 'Soil Cover'. The named areas are modelled as land objects in the topic 'Local Names'.

The information of the former cadastral map is re-arranged in a topic-structured data model. The cadastral map ceases to exist as an individual long-term object. Maps are produced when needed as a representation of data from the different topics.

When cadastre 2014 came out, the professional organisation of the Swiss Licensed Surveyors (IGS) has investigated the public legislation for land objects creating rights and restrictions on land.

Pilot models of the land objects emerging from the federal law were elaborated. Different system providers among them INTERGRAPH have developed prototype software for cadastre 2014. The new form of information for the land owners and investors is shown as an example in Figure 14.

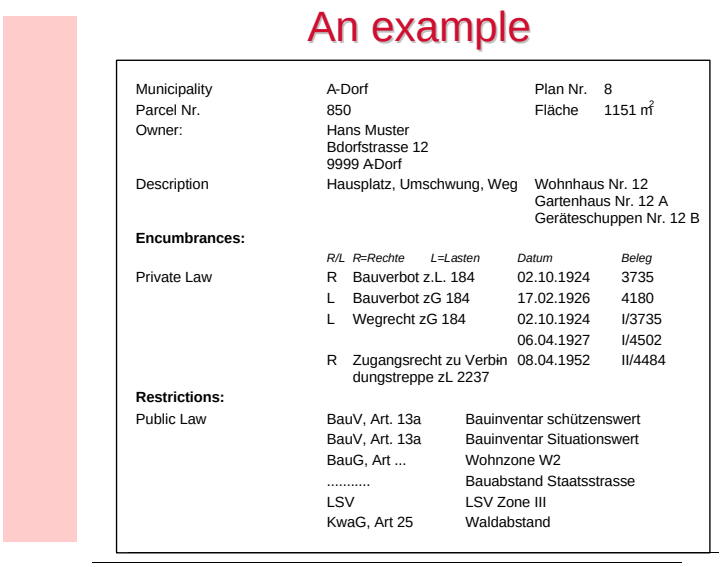

Figure 14 Example for information about private and public law impacts on a land parcel

A cooperative 'c2014' consisting of private surveying companies willing to provide better cadastral services was founded in March 2003.

In parallel the Federal Directorate for Cadastral Surveying has launched a Task Force Cadastre 2014 in cooperation with the Federal Office for Land Rights and Land Registration. The Task Force will study the legal aspects and the necessary improvement of the legal framework for a development of the future Swiss cadastral system.

5.3 First feasibility studies within the Belarus Cadastral system

The implementation of the private land property in Belarus demanded a new cadastral

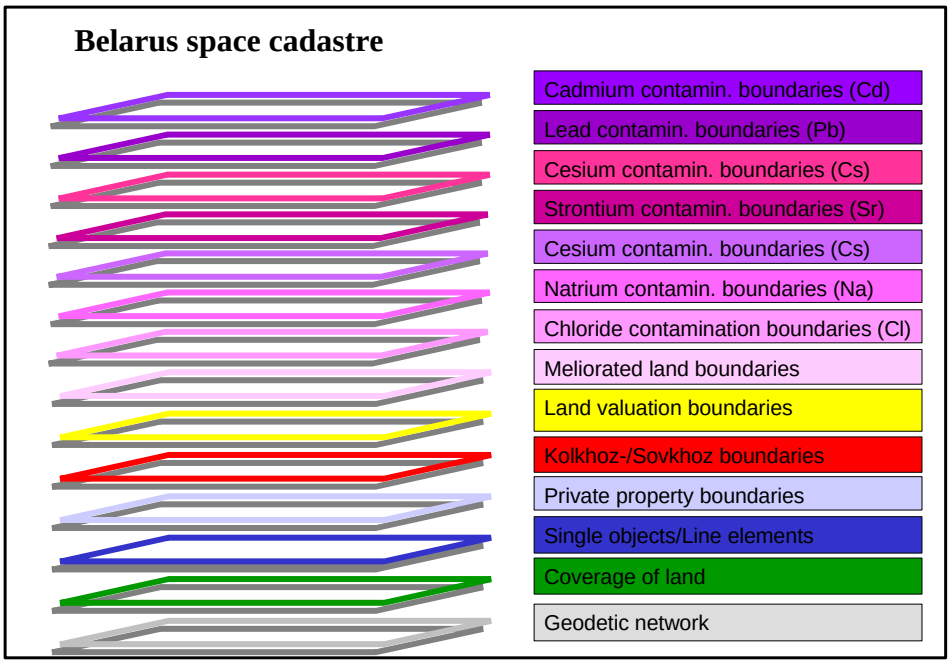

Figure 16 Application of Cadastre 2014 principles in the reformed Belarus space cadastre

system. In view of the needs for reliable data on land, in particular in the zones where heavy environmental damages have been caused by the Chernobyl disaster on one hand and by industrial pollution on the other hand, the cadastre was designed to be able to document other land objects than only the private property parcels. Figure 16 shows the structure and contents of the Belarus spatial cadastre.

From measuring the different pollutions resulted land objects defined by boundaries delimiting areas with similar intensity of impacts. With the combination of the different land objects land protection and use areas were identified and action plans for improvement of the situation elaborated.

This pilot project showed the possibitlities of modern spatial infoprmation systems but also the need for reliable and approved information, which means cadastral information.

5.3 Role of Cadastre 2014 in the Re-establishment of the Cadastre in Kosovo

The international project for the re-establishment of the cadastre in Kosovo is based on the ideas of Cadastre 2014. The traditional cadastre system containing the private land property records is partly missing and is to be reconstructed with the help existing maps and books in the archives. A big problem is the residential property where 100'000's of claims are expected.

The modernized cadastre of Kosovo should be able to provide reliable information about the residential properties besides the information on land property. This information will be important for the Housing and Property Directorate and the Housing and property Claims Commission to settle the disputes. Later on it is expected, that more reliable documented

legal land objects amongst others mined zones, areas where depleted uranium ammunition has been used, etc. must be included in the cadastre. The new Kosovo cadastre is therefore structured according to the rules of Cadastre 2014 and a carefully defined data model in INTERLIS is an important component of the new solution. The basis for the geographic information acquissition and management in the re-established Kosovo cadastre is INTERGRAPH's GeoMedia extended by the Swiss GEOSPro software.

5.4 Core Cadastral Model Initiative

Recently a workshop in The Netherlands was dedicated to investigate and answer the question after a core cadastral model. Cadastre 2014 played a prominent role in these studies. It was considered to be a standard itself and one of the main questions was:

QUESTIONNAIRE

Workshop on 'Cadastral Data Modelling'
organised by ITC and ESRI
March 17 –18, 2003, Enschede, The Netherlands

Section 2

Questions (ESRI):

1. Should we build a generalized cadastre model based on Cadastre 2014?
2. Should we build a Maria Teresa model?
3. Should we build a Napoleonic model?

Section 3

Please list the top 10 features/functions/attributes that you would like to have in the data model.

Figure 17: Questions about core cadastral model

6. CONCLUSION

Cadastre 2014 is an answer to the needs of the world for reliable legal information on land. It makes a consequent use of the modern Information Technology and in the same time keeps the solutions simple with the principles of cadastral modelling and the independent topics.

The principle of independent topics Cadastre 2014 makes the data models very simple and maintenance friendly.

The principle of cadastral modeling makes the solutions comprehensive and secures the rather expensive investment in data over time.

Well structured, flexible and reliable cadastral systems will be the basic tool to achieve a sustainable development of world and humankind.

REFERENCES

Kaufmann J., Steudler D. with Working Group 7.1 FIG Commission 7 (1998) Cadastre 2014, A Vision for A Future Cadastral System

BIOGRAPHICAL NOTES

Date of birth: 22. August 1942
Nationality: Swiss

Education
- Federal Institute of Technology ETH Zürich, Rural Engineering and Surveying, Diploma 1967
- Diploma of Mössinger Business-School, 1965
- Licence as Swiss Federal Licensed Surveyor, 1981

Languages
- German, English, French, Italian

Consulting Experience
- Member Project Management Board of 'Reform of the Swiss Official Cadastral Surveying'
- Consultant GIS/Cadastre/Land Administration to authorities in Switzerland and the Principality of Liechtenstein
- Consultant for Cadastre/LA Projects in Belarus, Ukraine, Georgia and Kosovo

Professional Experience
- since 1988: Independent Consulting Engineer, *KAUFMANN CONSULTING*
- CEO Keller Survey Ltd. and CEO Digital Ltd., Geomatics Services

FIG activities
- Delegate of Switzerland FIG, Commission 7, Cadastre and Land Management
- Member of working group 'Statement on the Cadastre'
- Chair of working group 'Cadastral reform and procedures; Cadastre 2014‘, 1994-1998
- Chair of working group 'Benchmarking Cadastral Systems', 1998-2002

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