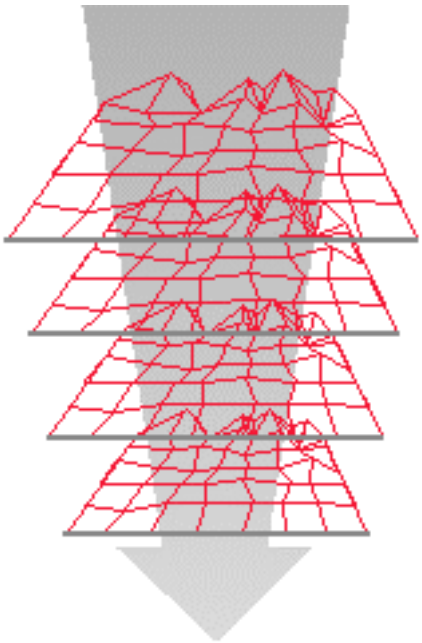

CADASTRE 2014

A VISION FOR A FUTURE CADASTRAL SYSTEM

Jürg Kaufmann • Daniel Steudler
with the Working Group 1 of FIG Commission 7

July 1998

CADASTRE 2014

by Jürg Kaufmann, Daniel Steudler

Jürg Kaufmann, Chairperson, Working Group 7.1 (Modern Cadastral Systems), Commission 7, FIG and owner of Kaufmann Consulting, Concepts and Project Management for Geomatics, Im Hauffeld, CH-8455 Rüdlingen, Switzerland
Electronic Mail: jkcons@swissonline.ch

Daniel Steudler, Secretary, Working Group 7.1 (Modern Cadastral Systems), Commission 7, FIG and Associate at Swiss Federal Directorate of Cadastral Surveying, Einsteinstrasse 2, CH-3003 Berne, Switzerland
Electronic Mail: Daniel.Steudler@ein2.brp.admin.ch

Graphic Layout by
Werbegrafik Bruno Teucher, CH–8055 Rüdlingen, Switzerland

Thanks

This booklet would not have been possible without the help of several friends.

First of all, Prof. Dr. Ian P. Williamson from the University of Melbourne, Australia, was kind enough to provide the foreword. Ms. Wendy Wells from the University of New Brunswick, Canada, edited the English text and made valuable suggestions to improve its readability. Mr. Bruno Teucher, graphics artist in Rüdlingen, Switzerland, designed the graphics and the nice layout of the booklet. Last, but surely not least, printing was made possible by the sponsorship of the Swiss surveying instruments manufacturer Leica Geosystems Ltd.

To all of these kind supporters, we give our most cordial thanks.

Jürg Kaufmann, Daniel Steudler

Foreword

It gives me great pleasure to write the foreword for the excellent publication CADASTRE 2014 produced by Jürg Kaufmann and Daniel Steudler, the Chairperson and Secretary of working group 7.1 of Commission 7. This publication presents a clear vision for cadastral systems in the future as well as being an excellent review of the strengths and weaknesses of current cadastral systems. I believe this report will become a benchmark against which cadastral systems world-wide will measure their development and reform. It will also become essential reading for students of cadastre.

Commission 7 set Jürg and Daniel a difficult task in 1994 to develop a vision for a modern cadastre 20 years into the future. They have undertaken the task with commitment and energy. They developed a work plan and systematically pursued the tasks they set themselves. The excellent seminar on 'Modern Cadastres and Cadastral Innovations' held as part of the Commission 7 annual meeting in Delft, The Netherlands in 1995 set the scene for the scope and innovation of their working group. Subsequent annual meetings of the Commission in Budapest and Penang strengthened and extended their work.

The outcomes of their working group has far exceeded my expectations. The resulting research and publication is an important document which will have an impact on cadastral reform world-wide for many years. The cadastral vision developed by the working group fully recognises the changing role of governments in society, recognises the changing relationship of humankind to land, recognises the dramatic influence of technology on cadastral reform, recognises the changing role of surveyors in society and recognises the growing role of the private sector in the operation of the cadastre.

As well as completing this publication, the working group also produced an excellent publication titled 'Benchmarking Cadastral Systems' published in *The Australian Surveyor* (Vol. 42, No. 3, 87-106, 1997). The research on benchmarking has already had a significant impact on the development of many cadastral systems world-wide.

As Chairperson of Commission 7, I want to thank Jürg and Daniel for their commitment and excellent work. I also want to thank the members of their working group who have assisted them. They can all feel proud that they have made a significant contribution to the way that we will manage land for the benefit of all in the next millennium.

Ian Williamson

Chairperson

Commission 7 (Cadastre and Land Management)

International Federation of Surveyors

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Preface

At the XX FIG Congress 1994 in Melbourne, Australia, Commission 7 decided to initiate three working groups for the four-year period until the next congress in 1998. According to the Commission's goals, the working groups were to study different aspects of cadastre and land management.

Working group 7.1 was given the task to study cadastral reform projects in developed countries. Two elements had to be considered in detail: the on-going automation of the cadastres and the increasing importance of the cadastre as part of a larger land information system. Based on trend analysis, the working group produced a vision of where cadastral systems might be in twenty years, of the changes that might take place, of the means by which these changes can be achieved, and of the technology to be used to implement these changes. The mission of the working group was named "Vision Cadastre 2014" to underpin the task to create a vision of how cadastres might work and look like twenty years from the outlook of 1994.

Commission 7 mandated Jürg Kaufmann with the leadership of this working group. With his secretary, Daniel Steudler, he established a concept of how to tackle the task together with the working group participants, which numbered about 40 people participating in at least one annual meeting. A complete list of all participants is given in the appendix.

The working group met regularly at the four annual meetings of Commission 7: 1994 in Fredericton, Canada; 1995 in Delft, The Netherlands; 1996 in Budapest, Hungary; and 1997 in Penang, Malaysia. A one-day seminar on 'Modern Cadastres and Cadastral Innovations' was organized in 1995 during the Delft meeting. Cadastral systems of developed countries in Europe and Australia and on-going reform projects were presented.

Between the annual meetings the chairman and the secretary prepared the work for the next meeting, sent out and compiled questionnaires, and prepared drafts and statements for discussion. The working group members filled in the questionnaires and took positions to drafts and statements.

The Chairman and the secretary wish to thank very much all working group members for their input, their many good suggestions, and their always motivating and active support of the work. A very special thanks is due to three persons – Prof. Jo Henssen who in his function as president of OICRF helped to establish the sound basis of this work; Prof. Ian Williamson for his never ending and always active willingness to strongly support our work, and Prof. Don Grant for his incomparable sense of confirming that we were on the right track. We also would like to thank FIG for enabling us to work in such a formidable international context; we have enjoyed the last four years.

INTRODUCTION

For many decades, traditional cadastral systems have tended to enjoy a reputation for reliability, well defined processes, and a well recognized guarantee of security of private land ownership. Tremendous technological progress, social change, globalization, and the increasing interconnection of business relations with their legal and environmental consequences, however, have put a strain on the traditional systems. They cannot adapt to all the new developments. An obvious indication of this is the many reforms that cadastral systems are going through.

The need for reform is the main reason why Commission 7 of FIG is looking very carefully at the developments in this field and why in 1994 it set up a working group to follow the trends and develop visions. The working group first formulated a questionnaire to get a trend analysis. Many important suggestions came out of this questionnaire, and six statements were devised. The term 'Cadastre 2014' was coined and used in relation to the six statements.

At the annual FIG meeting in 1995 in Delft, a one-day seminar about 'Modern Cadastres and Cadastral Innovations' was organized where further trends were detected. The trends arising from the first questionnaire of the working group were presented, and the six basic statements on Cadastre 2014 were discussed.

During the Budapest meeting in 1996, the working group discussed the summary of the first questionnaire and initiated a second one, which concentrated more on the cost recovery aspects and on the privatization of the cadastral systems. The six statements on Cadastre 2014 were again discussed and verified. At the Penang meeting in 1997 the working group dealt with the results of the second questionnaire and approved the contents of the final report.

The major results of the work of the last four years can be summarized as follows:

- The cadastral systems in developed countries attempt to be too perfect. This perfectionism results in weighty procedures and slow and expensive services.
- In consequence, one aim of cadastral reform projects is to improve services of the cadastral systems.
- The automation of cadastral systems is widely seen as an appropriate tool to improve the performance of cadastral systems. Automation, however, of the traditional perfectible systems without re-engineering the procedure aspects may result in performance failure.
- The innovation of cadastral systems tends to be in the direction that cadastral systems will be embedded in land information systems.
- Cost recovery and privatization issues are increasingly important within the context of cadastres.
- 'Cadastre 2014' will be a complete documentation of public and private rights and restrictions for land owners and land users. It will be embedded in a broader land information system, fully co-ordinated and automated, without separation of land registration and cadastral mapping. It will remain a public task, although operational work will be done by private organizations, and it will have a 100% cost recovery.
- 'Cadastre 2014' can provide optimal services to the different societies at a lower cost than today's systems. It will not only concentrate on private rights, but increasingly on public rights and restrictions as well.

Based on the questionnaire, Chapter 1 gives an overview of the existing cadastral systems, and Chapter 2 of the on-going reform projects and trends in the cadastral field. The six statements and the vision for a Cadastre 2014 are presented in Chapter 3, while the justifications for it are given in Chapter 4. Chapter 5 suggests what role the surveyor should be playing in Cadastre 2014. Chapter 6 makes recommendations about what surveyors should do to play an important role, and what FIG and national member organizations can contribute to Cadastre 2014.

1. EXISTING CADASTRAL SYSTEMS

As a first step in investigating trends and developing visions, the working group looked at existing cadastral systems. For this purpose, it was agreed at the first annual meeting to develop a questionnaire that would provide insights into the current developments of cadastres around the world.

The questionnaire looked at four basic aspects of cadastral systems and their strengths and weaknesses. It furthermore looked at on-going reforms and trends that are happening or might happen in the next few years. Some 70 copies were sent out in February 1995 to delegates and corresponding members of the Commission. The working group received responses from 31 jurisdictions, among them 7 Australian states.

Sections 1.1 and 1.2 summarize some results of the questionnaire characterizing existing cadastral systems. The completed questionnaires with all responses are available from the authors.

1.1 Four Basic Aspects

The following four basic aspects were part of the questionnaire and give an overview of the existing cadastral systems: legal and organizational characteristics, levels of planning and control, aspects of multipurpose cadastres, and responsibilities of the public and the private sectors.

A) Legal and Organizational Characteristics

The basic elements of the cadastral systems are presented in Table 1.1. Cadastral systems can be based on titles, deeds, or both. Out of 31 responses, 23 jurisdictions indicated that their cadastral system is based on titles. The parcel is the basic unit in 26 jurisdictions. A civil law system is the legal basis in 23 instances. Registration of property rights is compulsory in 24 cases.

Basic elements of cadastral systems

Questions	Answers		
Registration is based on:	titles: 23	deeds: 5	both: 5
Unit of Cadastre is:	parcel: 26	property: 4	name: 1
Legal basis is:	common law: 7	civil law: 23	statutory law: 2
Registration of property rights is:	optional: 4	compulsory: 24	both: 3
Registration is based on adjudication process ?	yes: 10	no: 17	

Table 1.1

The legal aspects arising from the questionnaire are summarized in Table 1.2. In the average cadastral system, legal protection of the registered rights seems to be very good. The legal force of a property registration, however, has at the same time both a positive (registered rights are assumed to

be correct) and a negative effect (unregistered rights are assumed to be non-existent). Furthermore, the state is in most cases liable for any damage that was caused by faulty registration.

In most jurisdictions, the cadastral systems include land registration and cadastral mapping. In many jurisdictions the cadastral maps are part of the register, but not, for example, in most of the Australian states, and in Hong Kong, Greece, and Latvia.

Land registration includes interests in land that are rights, but which are also restrictions and responsibilities.

Basic legal aspects of the cadastral systems

Questions	Answers		
Legal force of registration has negative effect (unregistered rights are assumed to be non-existent) ?	yes: 21	no: 7	both: 1
Legal force of registration has positive effect (regis tered rights are assumed to be correct) ?	yes: 27	no: 3	both: 1
Protection of a persons rights by the registration ?	yes: 28	no: 2	both: 1
Liability of state for damage caused by faulty registration ?	yes: 23	no: 5	both: 1
Extent of Cadastre:	land registration: 29	cadastral mapping: 28	other:10
Are the cadastral maps part of the register ?	yes: 20	no: 9	both: 1
Included interests in land:	rights: 31 special rights: 10	restrictions: 26 mortgages: 4	responsibilities: 20 others: 4
Boundary concept:	fixed boundaries: 27	unfixed boundaries: 5	
Legal value of boundaries lies on:	monuments:19 measurements: 16	cadastral maps: 13	coordinates: 14 other: 5

Table 1.2

As indicated in Table 1.3, in most jurisdictions, there are legal, technical, or organizational links to topographic mapping. In 9 jurisdictions, cadastral and topographic mapping are the responsibility of the same organization.

In most cases, the cadastre covers the complete territory of the jurisdictions. The exceptions are low priority areas which may not always be covered. The cadastres are mainly of a complete character which means that parcels are introduced into the systems in a systematic way.

Link to topographic mapping and completeness of cadastre

Questions	Answers	
Is there a technical, legal, or organizational link between cadastral and topographic mapping ?	yes: 25 same organization: 9	no: 6
Does the cadastre cover the whole territory of the jurisdiction ?	yes: 25	no: 6
Is the cadastre of complete character (i.e. are the parcels or land units introduced in the cadastre in a systematic, or in a sporadic, piecewise way) ?	yes (systematic): 28	no (sporadic): 4

Table 1.3

B) Levels of Planning and Control

Strategic planning, management, and operational control for both components of the cadastral system – land registration and cadastral mapping – are done in about half the jurisdictions within the same organization which is, in all cases, from the public sector. In other jurisdictions, the tasks of strategic planning and management control are separated among different organizations, some of which are even in the private sector. However, as Table 1.4 shows, the strategic responsibility for the cadastral systems, i.e., strategic planning, is always kept in the hands of the public sector.

Responsibilities of planning and control in the cadastral system

S = Strategic Planning
M = Management Control
O = Operational Control

	Land Registration	Cadastral Mapping
SMO in 1 public organization	15	16
SMO in 1 semi-public organization	1	1
SM in 1 public org. / **O** in a public org.	7	1
S in a public org. / **MO** in 1 public org.	3	4
S in a public org. / **M** in a public org. / **O** in a public org.	5	6
S in a public org. / **M** in a public org. / **O** in a private org.	–	2

Table 1.4

C) Aspects of Multipurpose Cadastre

Cadastral systems were mainly established to serve a legal and/or a fiscal purpose [1]. The questionnaire confirmed this fact, as 27 out of 31 jurisdictions indicated these two purposes. Nearly as many jurisdictions (Table 1.5) indicated that the data of the cadastral systems are used as well for facilities management, base mapping, value assessment, land use planning, and environmental impact assessment. A legal basis, however, does not exist everywhere for all of these other purposes.

Purposes served by the cadastre

The Cadastre serves the following purposes:		legal basis exists: **yes**	**no**
legal purpose	27	27	2
fiscal purpose	27	19	7
facilities management	24	17	11
base mapping	26	17	10
value assessment	23	16	7
land use planning	25	14	11
environmental impact assessment	26	10	9
other	3	2	–

Table 1.5

D) Responsibilities of Public and Private Sectors

In the era of New Public Management, the questionnaire also looked at the separation of the responsibilities between the public and the private sectors (Table 1.6). Originally the cadastral systems were very much in the hands of the state which held all the responsibilities and which carried out all the tasks that were involved.

The responses to the questionnaire showed that this is still the case today, although there have been developments going on in recent years which has led to some tasks being taken over by the private sector (Table 1.7). In particular, the financing part of land registration and cadastral surveying has to be carried also by the private sector (Table 1.8).

[1] Larsson [1991], p.15: Historically, land records have been established to serve two main purposes. First, as 'fiscal' records, primarily for the public sector, they have served as the basis for the full and accurate taxation of land. Second, as 'legal' records, primarily for the private sector, they have served as registers of ownership and other land rights.

Responsibilities of public and private sectors

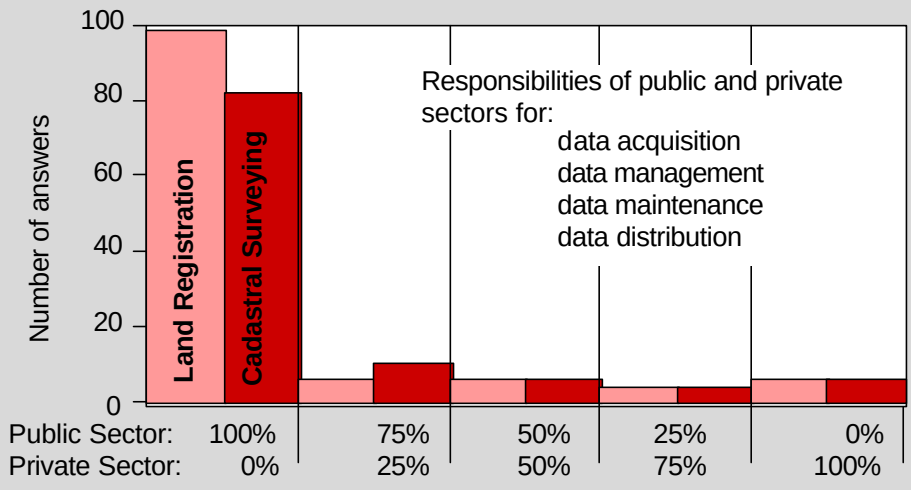


Table 1.6

Level of carrying out: participation of public and private sectors

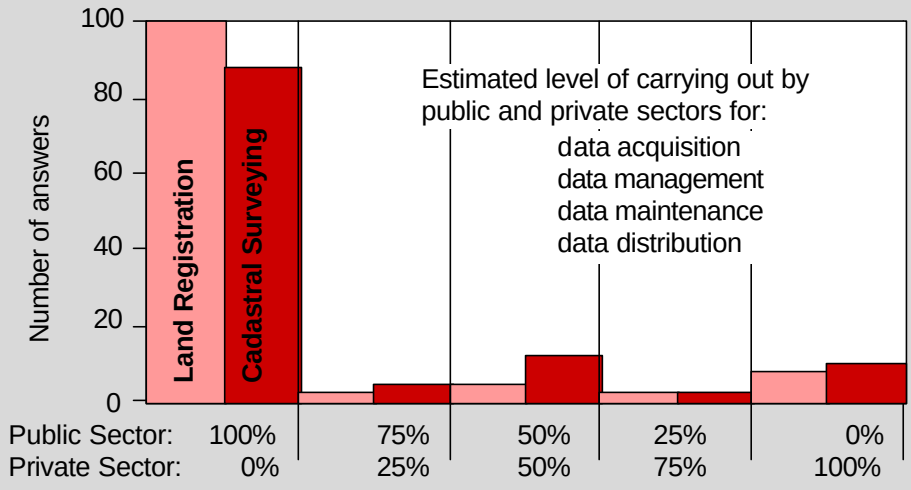


Table 1.7

Level of financial participation of public and private sectors

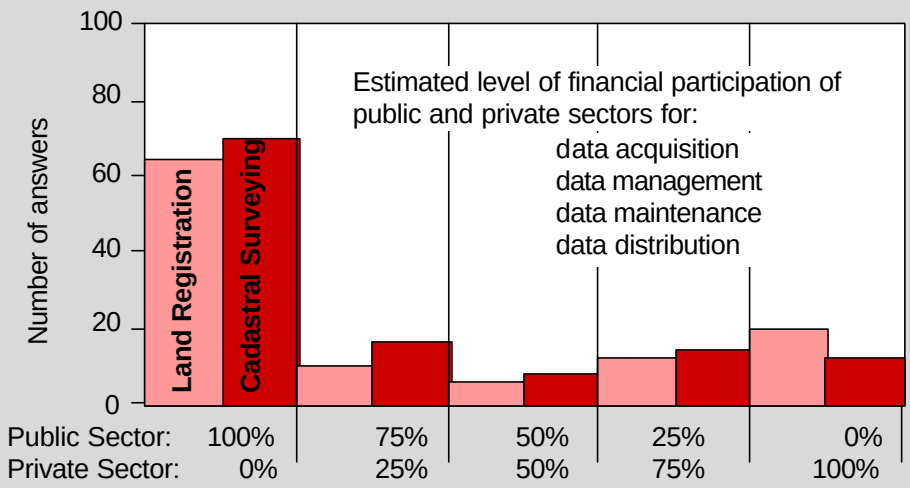


Table 1.8

1.2 Strengths and Weaknesses

In a further section of the questionnaire, respondents were asked to indicate the strengths and weaknesses of their existing cadastral system. There were many indications for both strengths and weaknesses, although quite a few responses were similar to each other. Tables 1.9 and 1.10 list the most frequently indicated strengths and weaknesses as seen by those involved with their systems.

The most frequently named strengths include the state guarantee of title and the legal security of the system. A fast user service, and the complete data coverage were mentioned nearly as often.

The most frequently indicated weaknesses of the systems were the limited computerization, and weak links between the two components of ‘land registration’ and ‘cadastral mapping’. Further indications can be summarized as deficiencies in financial, administrative, and organizational matters.

Strengths of existing cadastral systems

State guarantee of title, legal security	10
fast service for users	9
complete coverage	9
comprehensive, liable, secure system	7
system is computerized and automated, digital data	6
system serves other purposes (i.e. as basis for LIS)	4
integration of different systems	3
land reg. & cad. mapping in **one** organization	3
legal support, legal basis	3
good base mapping	2
meeting local needs / flexibility in market adaptation / decentralized / structures / private sector involvement / cheap system to handle / involvement in economy / centralized management / profession	1

Table 1.9

Weaknesses of existing cadastral systems

limited computerization	9
link land reg.–cad. mapping not efficient enough or inappropriate	9
national consistency could be greater	3
administrative control over land by different organizations	3
low budget funds	3
uncomplete legal framework	3
little accuracy of maps	3
slow updating, slow customer service	3
financing model unsuitable	3
expensive, costly / duplication of data, work / weak def. of parcel	2
system not efficient enough / low degree of coverage / high investment cost / rigid structure, little flexibility / low level of integration with other purposes	1

Table 1.10

2. CADASTRAL REFORMS AND TRENDS

Other questions in the same questionnaire looked at reforms and trends of cadastral systems. The following sections give a summary of the results.

2.1 On-Going Reforms

The questionnaire investigated whether reforms are going on in the different cadastral systems. Out of 31 responses only 2 noted that there are no reforms at all. A great majority answered that there are reforms, either planned (13), in progress (21), or already finished (8).

Asked about the purposes of the reforms, most responses indicated that customer service is a very important goal of the reform project (Table 2.1). Other criteria such as improving the timeliness of the data, improving the efficiency of the system, and the aspect of a multipurpose cadastre seem to confirm the will to provide better and more efficient service to the clients. The economical aspect of the cadastre and the involvement of the private sector were considered slightly less important which gives the impression that they are not the primary purpose but more a by-product of eventual reforms.

Purposes of reforms

Reform Purpose	very important	important	not important
customer service	27	1	–
to improve the quality of data (timeliness)	22	5	1
efficiency of cadastre	20	8	–
to improve the quality of data (accuracy)	18	10	–
aspect of multipurpose cadastre	16	9	2
economical aspect of the cadastre	14	11	1
to involve more the private sector	6	12	8
other	–	–	11

Table 2.1

2.2 Trends

Asked about trends in the technical domain, the responses gave a clear indication that the most obvious trend is the automation of the systems and the digitization of data (Table 2.2). Networking and setting up data bases are basics for the same trend towards the digital age.

Technical trends	
• automation of system, scanning, digitizing	16
• networking, linkeage of different systems	8
• setting-up of data bases	7
• GPS / DGPS	4
• standards for data exchange	2
• orthophoto	1

Table 2.2

The trends from a legal point of view are also dominated by the move towards the digital age by setting up multipurpose cadastres, often called Land Information Systems–LIS (Table 2.3). Defining new legislation and new financing models are further trends in legal respects.

Legal trends	
• setting-up of multipurpose cadastres (LIS)	8
• new legislation	3
• new financing model	2
• privacy aspects	1
• conversion deed to title registration	1
• change of fee structure	1

Table 2.3

The trends from an organizational point of view indicate that the integration of different administrations dealing with land or land data might be undertaken. This is confirmed by another trend that says that the cadastral systems might be linked with environmental data and resources monitoring (Table 2.4).

The age of New Public Management is somehow confirmed by the trends toward deregulation of rigid public structures, and more involvement of the private sector. Other trends such as reduction of personnel and better cost recovery support this statement (Table 2.4).

Organizational trends

• integration of land administration organizations	6
• deregulation of rigid public structures, private sector more involved	5
• reduction of personnel	4
• better or complete cost recovery	3
• link with environmental data, ressources monitoring	3
• decentralization of system	2
• better support for decision-making	2
• blurring of "professional boundaries"	1

Table 2.4

2.3 Cost Recovery Aspects

As cost recovery is to become an important aspect in the era of New Public Management, the questionnaire asked the respondents to estimate how they would judge the degree of cost recovery of their own existing cadastral system after having accomplished data acquisition. The results showed a quite surprising picture in that more than half of the answers indicated a level of cost recovery of 100% or more (Table 2.5).

Estimated level of cost recovery after completion of data acquisition

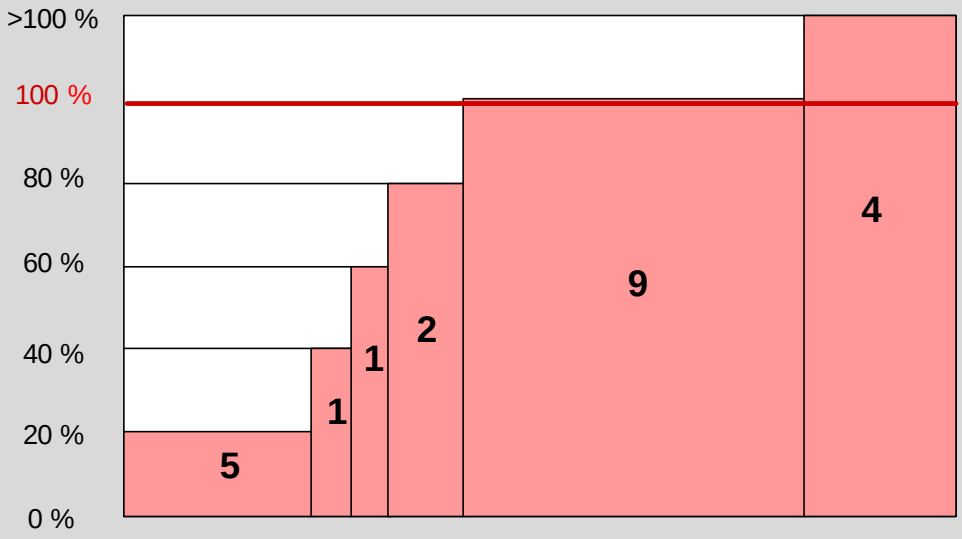


Table 2.5

The discussion of this result at the 1996 annual meeting of FIG in Budapest made clear that individual entities had very different understandings of the term ‘cost recovery’ and that the

indications cannot really be compared. It was suggested that the topic be investigated in further detail and a second questionnaire was formulated.

This second questionnaire elicited a very good response from over 50 countries or states around the world. The results were discussed in detail at the 1997 annual meeting of FIG in Penang, and a significant paper was produced with the material of the responses [Steudler et al., 1997]. Although there were many doubts, it became obvious that the indication of a clear degree of cost recovery of a specific cadastral system is very difficult. System specific details are involved as well as many social and ethical realities both of which can influence the cadastral system. The topic is also politically very delicate and unless enough case is taken, indications can lead to wrong conclusions.

The general trend, however, became very clear. The cost recovery aspect is a very important criterion in the era of New Public Management and will increasingly influence strategic decision-making in the cadastral field.

2.4 Common Aspects of Reform Projects and Summary of Trends

All countries or states, with the exception of two, have a cadastral reform planned, in progress, or accomplished. Although the purposes of the reforms differ from country to country, there are common aspects. The reform projects want to:

- improve customer services with increased efficiency and an improved cost/benefit ratio;
- involve more of the private sector;
- provide more data in better quality;
- provide data that are sufficiently accurate;
- have data available at the right time.

The development trends of the cadastral systems are the:

- introduction of digital cadastral maps based on national reference systems;
- transformation of land registry information into digital form;
- introduction of title registration systems instead of deed registration systems;
- embedding of the cadastre into land information systems by linking different data bases;
- unification of real property and land property registration systems;
- reduction of staff in the cadastral organizations and land management;
- regionalization of and increased involvement by the private sector;
- introduction of cost recovery mechanisms to at least cover the processing costs or to recoup the investment costs.

3. THE VISION FOR A FUTURE CADASTRE SYSTEM (CADASTRE 2014)

3.1 Traditional Definitions in the Domain of Cadastral Systems

The definitions of land, cadastre, land registration, and land recording, as given by Professor Jo Henssen [1995, p.5] at the Delft seminar, were the basis for the work on Cadastre 2014. These definitions are appropriate for the existing situation. For future cadastral systems, however, Henssen's definitions must be enlarged to some extent. This will be done in Section 3.2.

Henssen's definitions are:

> ***LAND***
>
> *Land is defined as an area of the surface of the earth together with the water, soil, rocks, minerals and hydrocarbons beneath or upon it and the air above it. It embraces all things which are related to a fixed area or point of the surface of the earth, including the areas covered by water, including the sea.*
>
> ***CADASTRE***
>
> *Cadastre is a methodically arranged public inventory of data concerning properties within a certain country or district, based on a survey of their boundaries. Such properties are systematically identified by means of some separate designation. The outlines of the property and the parcel identifier normally are shown on large-scale maps which, together with registers, may show for each separate property the nature, size, value and legal rights associated with the parcel. It gives an answer to the question where and how much.*
>
> ***LAND REGISTRATION***
>
> *Land registration is a process of official recording of rights in land through deeds or as title on properties. It means that there is an official record (land register) of rights on land or of deeds concerning changes in the legal situation of defined units of land. It gives an answer to the questions who and how.*
>
> ***LAND RECORDING***
>
> *Land registration and cadastre usually complement each other, they operate as interactive systems. Land registration puts in principle the accent on the relation subject-right, whereas cadastre puts the accent on the relation right-object. In other words: the land registration answers the questions as to who and how, the cadastre answers the questions as to where how much.*

Because land registration and cadastre complement each other, the terms ‘land recording’ or ‘land records’ are usually used to indicate that these two components belong together as a whole.

3.2 Definitions for Cadastre 2014

The working group suggests that the following definitions of land object and Cadastre 2014 be included.

LAND OBJECT

A land object is a piece of land in which homogeneous conditions exist within its outlines.

These conditions are normally defined by law. Every society creates the rules for the co-existence of its members. These rules, normally in the form of laws, define how a society will understand the phenomena within the area in which it lives. In the same manner the rights and the duties of the members of a society are defined. These duties are, in most cases, defined by restrictions of the freedom of individuals.

Even natural objects, like rivers, lakes, forests, and mountains are defined in some way by a law.

If a law defines phenomena, rights, or restrictions which are related to a fixed area or point of the surface of the earth, it defines a land object.

A piece of land, where either a private or a public law imposes identical juridical parameters could be called a legal land object. The laws define the outlines of a right or a restriction. The legal land objects normally are described by boundaries which demarcate where a right or a restriction ends and where the next begins and the contents of that right.

Examples of legal land objects are:

- private property parcels;
- areas where traditional rights exist;
- administrative units such as countries, states, districts, and municipalities;
- zones for the protection of water, nature, noise, pollution;
- land use zones;
- areas where the exploitation of natural resources is allowed.

When a piece of land is under unique natural or artificial conditions and there is no definition in the legal framework, it can be called a physical land object. A physical land object may be a piece of land covered by rock, water, timber, a house, a street, or any other non-legal characteristic.

The coming into being of a land object can be defined as in Figure 3.1.

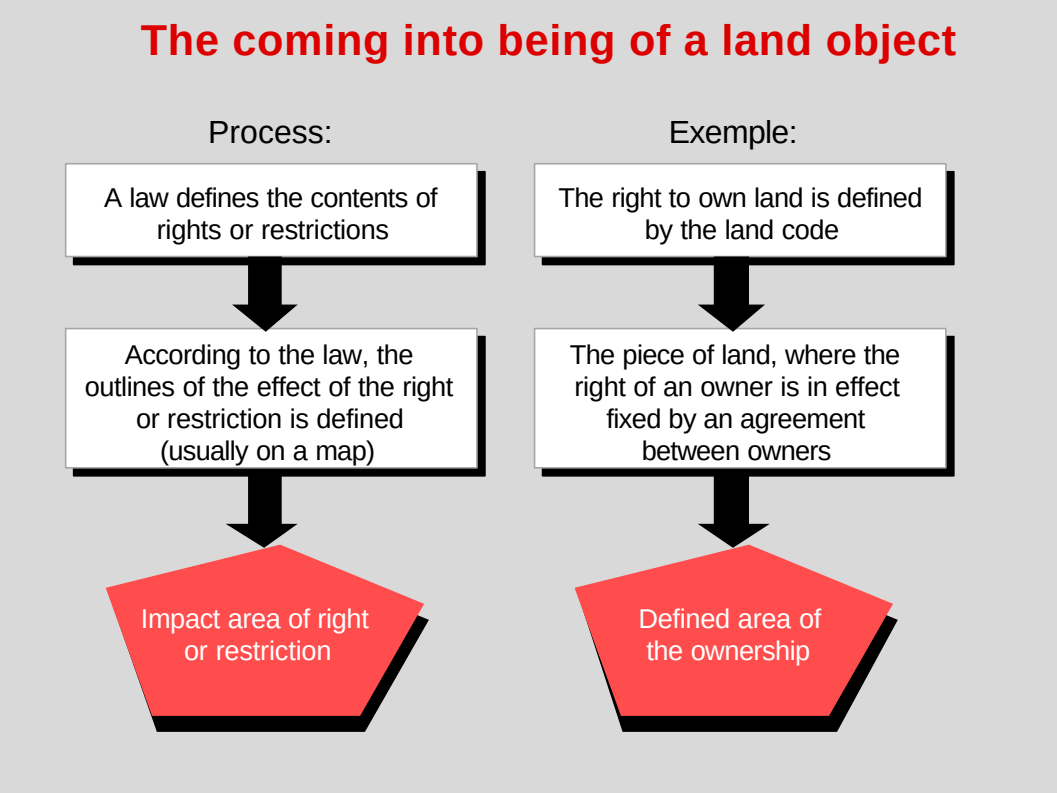


Figure 3.1

CADASTRE 2014

The following definition is based on that of Henssen [1995], which only refers to the private property law aspect. It has been adapted to take into account public and traditional law aspects as well:

Cadastre 2014 is a methodically arranged public inventory of data concerning all legal land objects in a certain country or district, based on a survey of their boundaries. Such legal land objects are systematically identified by means of some separate designation. They are defined either by private or by public law. The outlines of the property, the identifier together with descriptive data, may show for each separate land object the nature, size, value and legal rights or restrictions associated with the land object.

In addition to this descriptive information defining the land objects, Cadastre 2014 contains the official records of rights on the legal land objects.

Cadastre 2014 can give the answers to the questions of where and how much and who and how.

Cadastre 2014 can replace the traditional institutions of 'Cadastre' and 'Land Registration'. It represents a comprehensive land recording system.

3.3 Characteristics of Cadastre 2014

3.3.1 The Six Statements on Cadastre 2014

Based on studies of existing cadastral systems and on the answers to the questionnaire, the working group agreed to six statements on the development of cadastre in the next twenty years. These six statements dealt with the mission and content, the organization, the technical development, the privatization, and the cost recovery of cadastral systems. These statements have been the guidelines for the definition of Cadastre 2014.

3.3.2 Mission and Content of Cadastre 2014

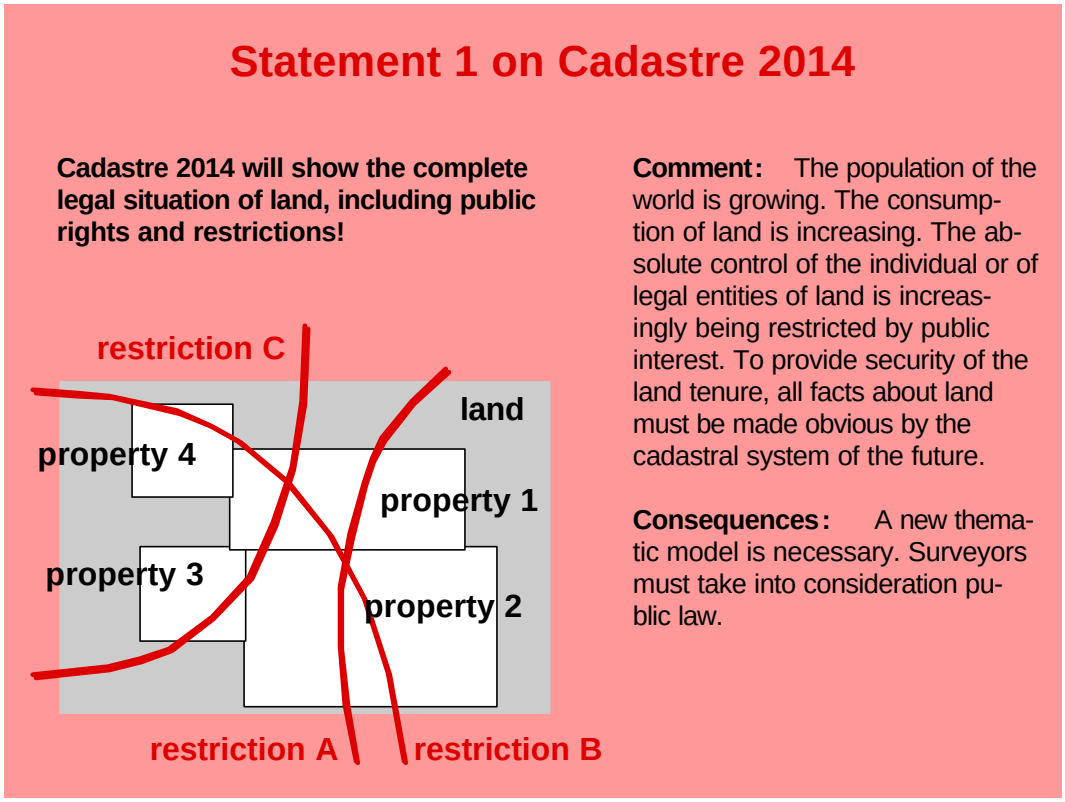


Figure 3.2

Cadastre 2014 must cover a wider field than the traditional cadastre has since its introduction. The circumstances of the resource land have changed significantly since its inception.

Traditional and customary rules referring to land and land use rights and restrictions existed before the development of formal legal systems.

During the development of the legal systems the private laws were dominant. The constitutions of most countries defined the rights of the citizens, one of which is the guarantee to own property. Civil codes have reinforced this guarantee and defined clear procedures and institutions to protect the rights of citizens against alienation.

One of these procedures was the registration of land rights and its institution is the land register. For land registration, four principles — the booking principle, the consent principle, the principle of publicity, and the principle of specialty — were more or less generally applied [Henssen, 1995].

One can note that these procedures and institutions have worked successfully for more than a century, and they still do.

The situation referring to the private law aspect is characterized in Figure 3.3.

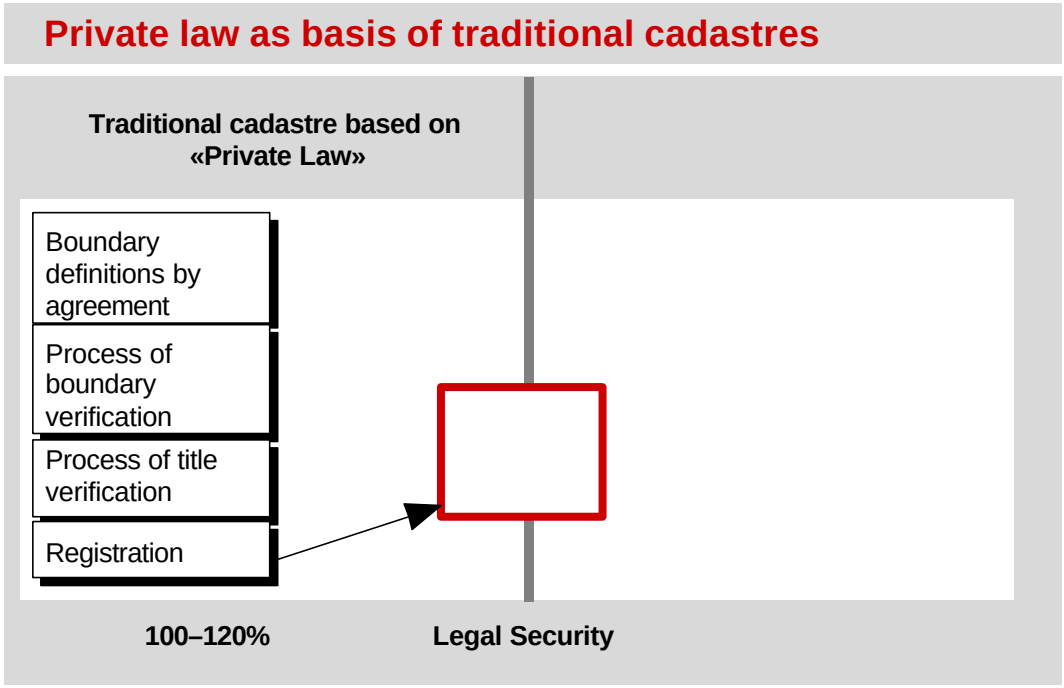


Figure 3.3

The existing systems have sometimes been so perfected that their legal security level seems to be above 100%.

The growing world population and the development of new technologies lead to an intensified use of natural resources including land. To protect the natural resources from being totally consumed, damaged, or destroyed, restrictions of the absolute right to use the natural resources were defined in the name of the social necessity.

The private laws already previewed the possibility to expropriate land in cases in which the public interest was considered to be more important than the individual interest. But expropriation was a hard measure in which to incorporate restrictions, and it proved to be a difficult task because states had to deal with every individual land owner. So states began to designate zones where restrictions were in effect. In Cadastre 2014 these zones are called legal land objects.

Especially after World War II a growing number of new public laws were created. Land use planning, environment protection, noise protection, construction laws, protection against danger caused by natural phenomena, and so on, were regulated by public laws.

All of these new laws were also based on national constitutions. They define areas where certain things are permitted or forbidden. The boundaries of these areas are in principle independent of the private property boundaries, but they have an impact on the possible use of the land.

These definitions under public law can have an impact on the property right of the owner, but because they are not part of the official register, they are not subject of the principle of publicity. Although there is in most cases a well defined procedure for the definition of the respective boundaries of the rights and restrictions, the results are not publicly known. The respective maps are presented, though, during the consultation process of a law-setting before it is put to the vote. Afterwards this documentation is kept with the responsible governmental unit. Interested citizens and organizations can find property information about a piece of land in the land registry. But they must make further efforts to get information about other rights and restrictions that have an effect on the legal situation by making a survey at different governmental organizations. If citizens fail to find out all aspects of the legal situation of a piece of land, they risk the loss of money and time spent for inadequate land use or land use planning. The situation is shown in Figure 3.4.

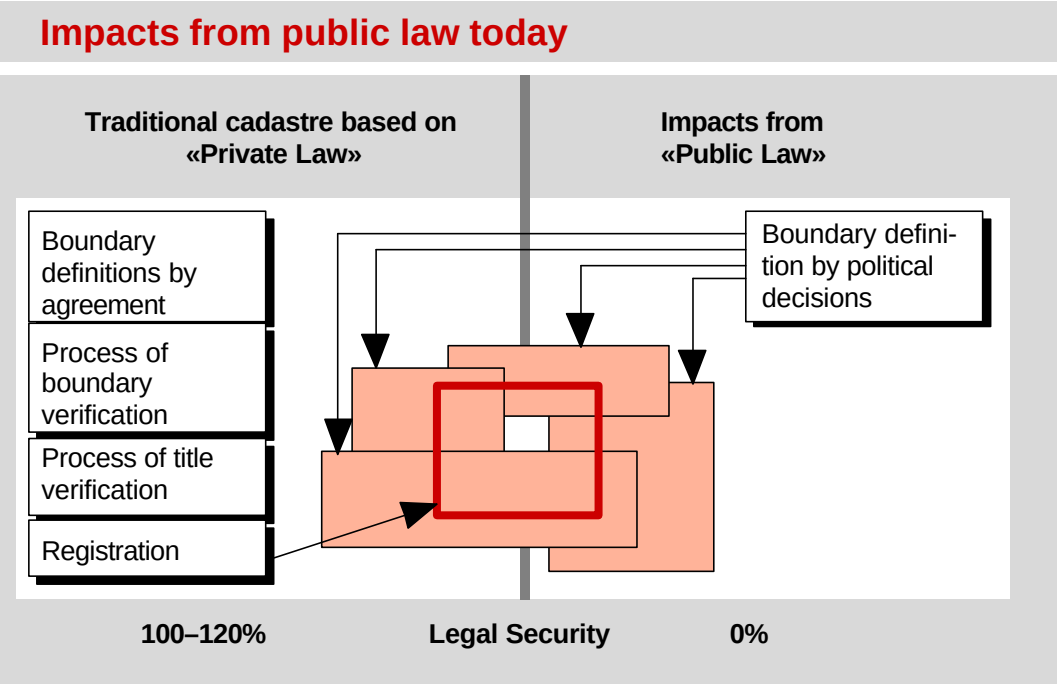


Figure 3.4

The boundary definition process of the rights and restrictions defined under public law corresponds to the consent principle because it follows democratic legal rules. But there is no boundary verification, no title verification, and no registration in an official legal register. The principles of booking, of specialty, and of publicity are therefore violated.

While legal security in a cadastre-based land registration system is close to or even more than 100% for private law rights, it is near 0% for public law restrictions.

Aside from land objects from private and public law, a third category of legal land objects occurs in several countries where traditional rights exist. In these cases, areas are defined where tribal land use rights exist. They can overlap other legal land objects, such as private property rights and public rights and restrictions, and concessions for the exploitation of natural resources. These traditional, customary rights are often not documented in a manner that creates the necessary legal security.

Cadastre 2014 must correct this situation, which is becoming more and more precarious. It must document, in a safe manner, all legal aspects of land. Cadastre 2014 shall lead to the situation portrayed in Figure 3.5.

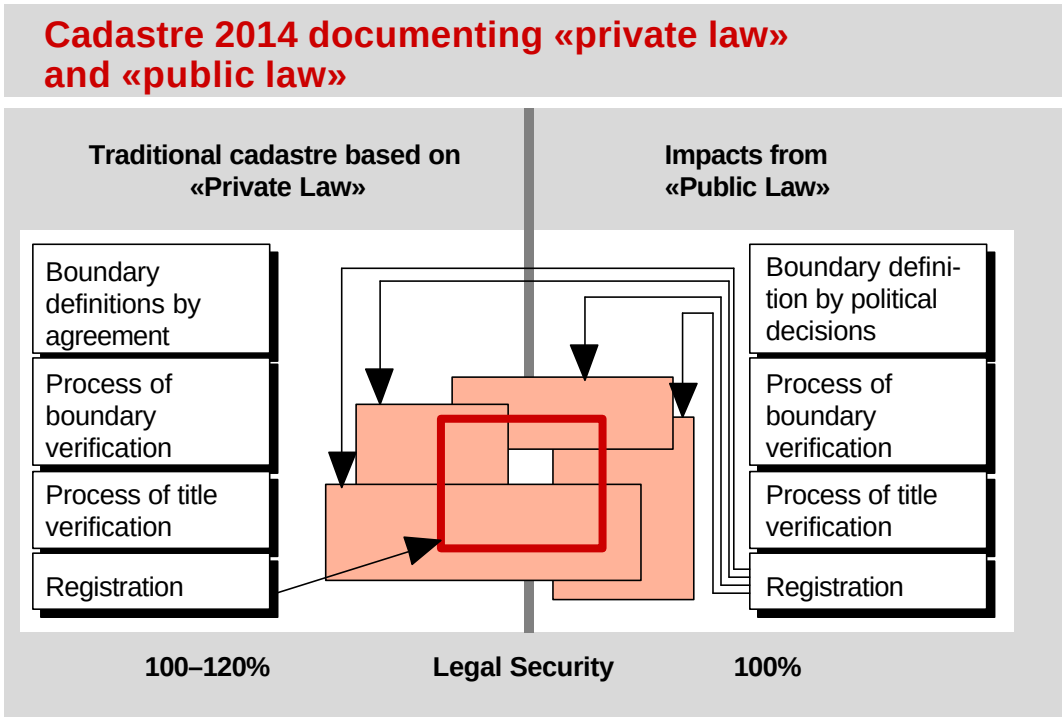


Figure 3.5

It will be necessary in future for existing and new legal land objects introduced by traditional, private and public law, that the boundary definition and the correctness of this definition are verified carefully, and that the results of the definitions are published in an official public register. In this way the security of land tenure, land use, and resource management will be maintained in view of the land owners and of the societies as a whole.

3.3.3 Organization of Cadastre 2014

The cadastral systems will have to have a lean organizational structure to match the future requirements of the individuals and the societies.

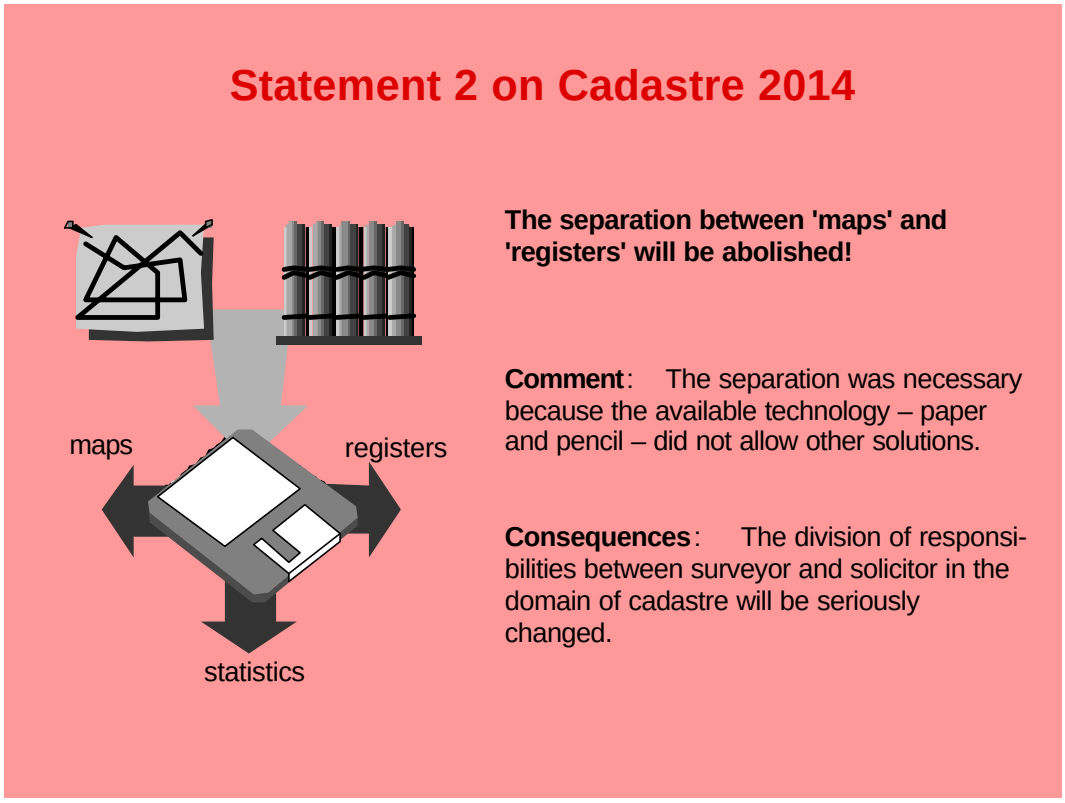


Figure 3.6

Most countries have a land recording system consisting of cadastre and land registration components. The cadastral part is normally handled by surveyors, while notaries and lawyers take care of the land registration part. This subdivision has often resulted in two different organizational units dealing with the same matter.

Because of the traditionally available technological possibilities, the working procedures of land survey and land registration have been quite different. Cadastre surveying and mapping require special skills to obtain a sufficient result, whereas the and land registration process was very close to bookkeeping. So the work was subdivided in the past according to the required skills. The correct treatment of the legal aspects of land property transfer matters was ensured by the requirement of a license for land surveyors and by the special education of notaries and lawyers.

A advantage to this type of organization is a certain cross-control that can help to eliminate errors.

The disadvantages of such solutions are obvious:

- The system is tiresome. The participants in the land market have to address two different authorities for land transactions.
- The information is partly redundant which creates the risk of inconsistencies.
- Every organizational unit has its own fees to at least partly recover the cost of maintenance of the system.

3.3.4 The Changing Role of Maps in Cadastre 2014

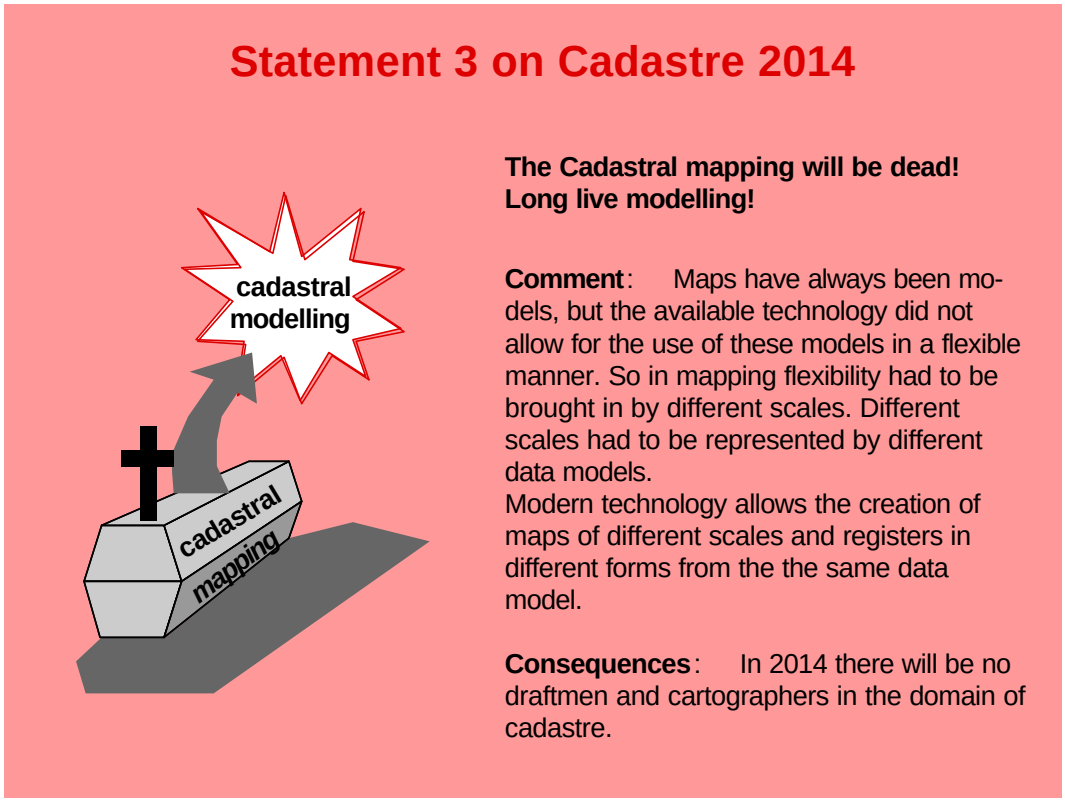


Figure 3.7

If future cadastral systems are to meet the requirements, the function of maps must be re-defined. Maps will lose the function of information storage. They will serve in future simply to represent information derived from data stored in data bases.

The new possibilities of information technology will change the work of surveyors significantly. In the past, the ability to survey objects and to represent them in a reference system needed very special skills. One of the most important things was the craft to represent measured objects in a comprehensible map. The surveying and mapping process was characterized as in Figure 3.8.

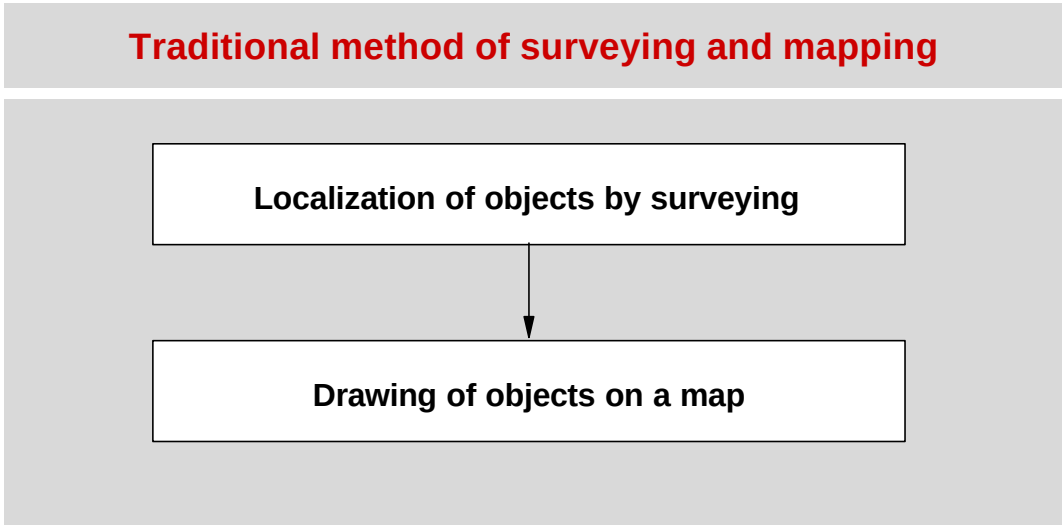


Figure 3.8

With the utilization of information technologies, the process substantially changes . The determination of object co-ordinates becomes easier with GPS and remote sensing methods, and the direct drafting of objects on a map is superseded by the creation of objects in an information system. The result of this process is a data model of the real world (Figure 3.9).

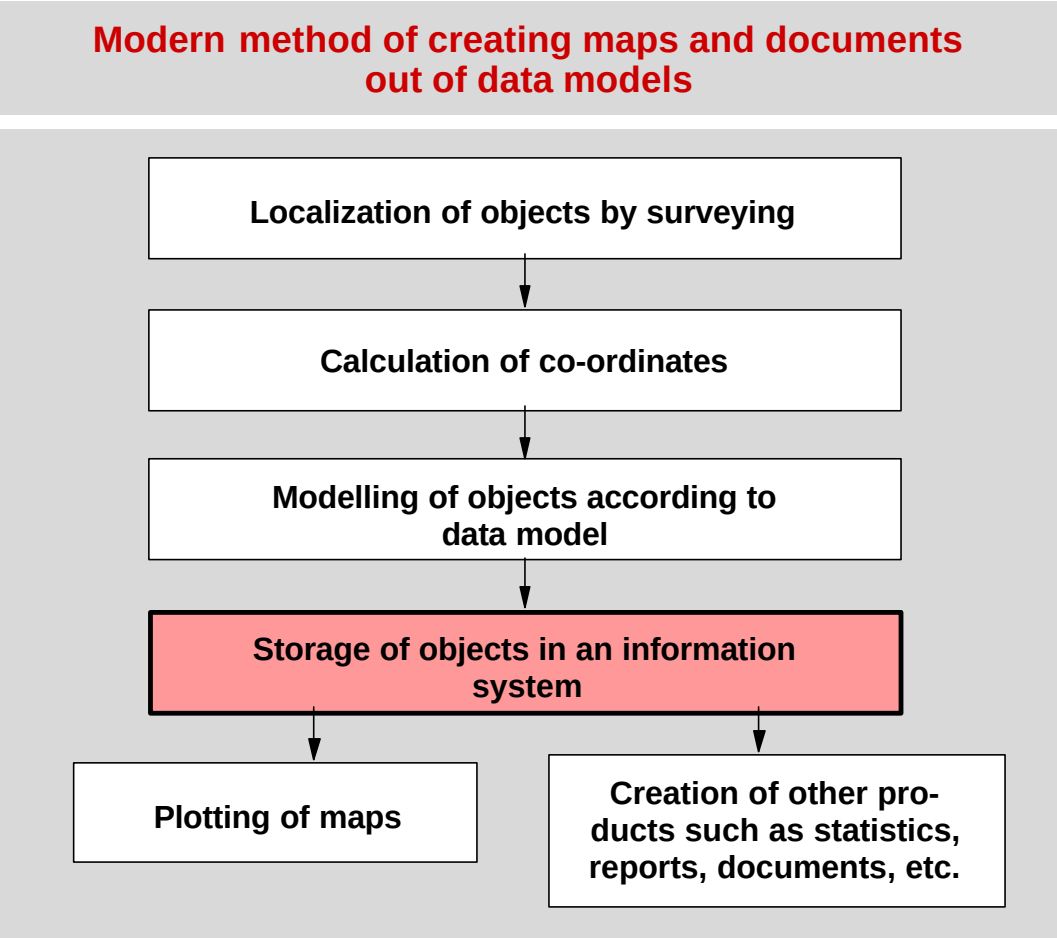


Figure 3.9

Maps are created out of this model by using representation functions operating plotters and drafting machines.

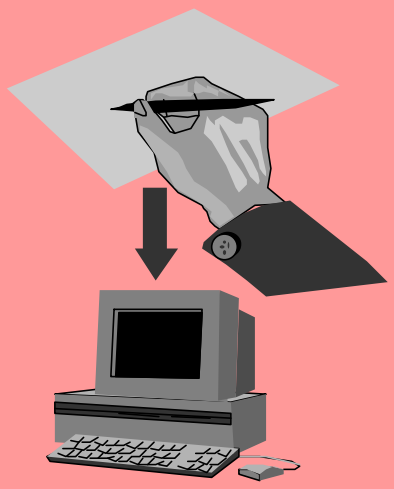
The distribution of information increasingly takes place with the help of data transfer possibilities. Geographic information is sent over the data highways. The Internet and its ability to facilitate worldwide data networks is playing an important role in the exchange of cadastral data. The exchange of data models will become common practice in the distribution of cadastral information.

This new procedure has several advantages:

- Flexibility in the representation of information of the data model. Type, scale, and content of a representation can be chosen according to the needs.
- The information is stored once and different products are derived from the same data.
- The digital model is easy to handle, and data representing the model cannot be destroyed physically as can traditional maps.
- Distribution and publication of cadastral information is easily possible with the help of the exchange of digital data models.

3.3.5 Information Technology in Cadastre 2014

Statement 4 on Cadastre 2014



'Paper and pencil - cadastre' will have gone!

Comment: Geomatics technology will be the normal tool for cadastral work. Real low-cost solutions are only possible when this technology is used in combination with lean administrative procedures.
Developed, developing, and transitional countries need models of the existing situation to resolve the problems of population, environment and reasonable land use.

Consequences: The modern cadastre has to provide the basic data model. Surveyors all over the world must be able to think in models and to apply modern technology to handle such models.

Figure 3.10

The traditional land recording procedures are increasingly computerized. Computer-assisted work has proven to be much more efficient. That is why bookkeeping all over the world is handled with help of computer programs. There is no reason why land recording should not make use of this technology.

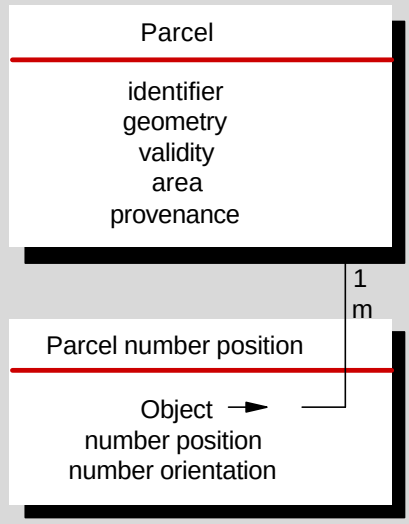
The handling of spatial objects requires more sophisticated software solutions than bookkeeping, but progress in this domain is accelerating. Spatial objects are nowadays not far from becoming normal objects of information processing. The spatial components of objects in object oriented models are nothing more than attributes defining the location and shape of the object.

An example of the definition of spatial objects and models is the Swiss data description language INTERLIS [Eidg. Vermessungsdirektion, 1997], which has been until now the only really operational tool to describe conceptual schemes. It uses the technique of data definition, compilation, and automatic format generation.

An example of a description of spatial objects is given in Figure 3.11.

Example of INTERLIS language

Entity-Relationship Diagram



INTERLIS-Description

```
TABLE parcel =
number:       TEXT*12;
geometry:     AREA WITH ARCS
validity:     [valid, project]
area:         [0…9999999];
provenance:   photogrammetry;
```

```
TABLE parcelnumpos =
object:  →    parcel;
numpos:       COORD2;
numori:       GRADS;
```

Figure 3.11

The geometry of an object is described simply as an attribute of the object. In the currently available information systems, this description must be translated into an internal data model, but it is expected that internal data models can be created automatically according to such a data description.

Aside from the bookkeeping information, the geographical information can also be processed easily, and computer-based technology will be the most efficient and cost-effective way to resolve the problem of land recording.

3.3.6 Privatization in Cadastre 2014

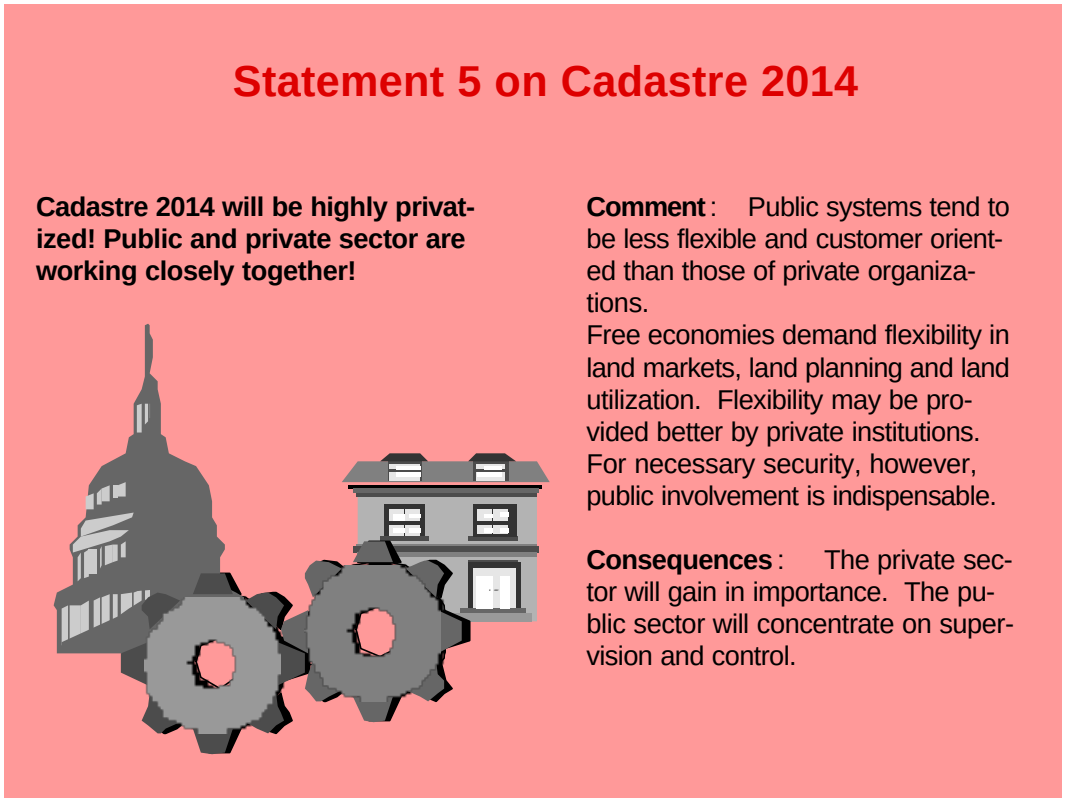


Figure 3.12

Within the worldwide trends of deregulation and privatization, tasks handled until now by the public sector are being transferred to the private sector. Within the framework of New Public Management [Schädler, 1995], public administration units are being converted to private or mixed organizations, doing the work in a flexible and consumer-oriented manner.

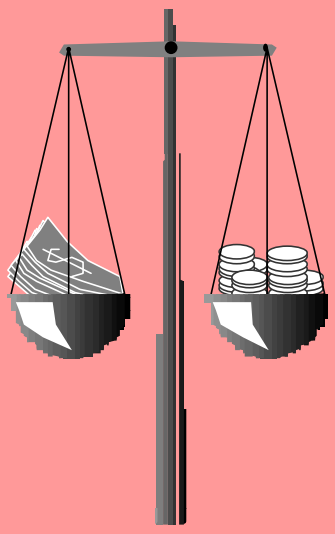
These trends will also involve the cadastral organizations. In this field we find a lot of operational work that can be done by the private sector as well as or even better than the public sector. The majority of tasks necessary to build up and to maintain a cadastral system can be handled by the private sector without endangering the security of the land recording. Also the preparation of titles and deeds and the registration of titles and deeds may be carried out by the private sector or by mixed-economy organizations. It is not necessary for the public sector to do all the work itself.

The public sector nevertheless, plays an important role, because it has to guarantee the legal security of the land recording system. It must be able to implement efficient and powerful procedures for supervision and control of the work. This can be achieved by strict and permanently applied computer-assisted control procedures; by the careful selection, education, and examination of staff; and by the financial involvement of the public sector in mixed-economy organizations.

3.3.7 Cost Recovery in Cadastre 2014

Statement 6 on Cadastre 2014

Cadastre 2014 will be cost recovering!



Comment: Cadastral systems need considerable investment. But the land documented and secured by the cadastre represents a multiple of the investment. The investment and operation costs have to be paid back at least partially by those who profit.

Consequences: Cost/benefit analysis will be a very important aspect of cadastre reform and implementation. Surveyors will have to deal more with economic questions in future.

Figure 3.13

Land is a natural resource having a considerable financial and ideal value. It can easily be understood, therefore, that financial resources are invested in land recording. In feudal times, land taxes had to be paid according to the production capacity of the land given to the farmers, then called serfs. Napoleon was interested in getting taxes out of land, and he introduced a land registration system in all of the countries he controlled. Later on, land recording became the basis for mortgaging and the economies could be provided with credits secured by land.

As governments themselves were often doing the cadastral and land registry work, they could cover the cost of building up and maintaining the systems through land taxes. In most cases, the land taxes were considerably higher than the expenses entailed in the land recording system.

In systems in which the private sector is involved, the running costs are covered by fees, paid by the people involved in the land transactions.

Within this mixture of taxes and fees it is not easy to implement clean control with costs for expenditures and yields.

With the statement on cost recovery, we indicate that for the land recording systems there should be introduced a controlling mechanism that takes into consideration the real costs and benefits of the system, separates fees and taxes, and reflects on possibilities of how the cost of the system can be covered by adequate fees.

It seems to be realistic that land recording can be organized in such a manner as to achieve a return on investment.

3.4 Principles of Cadastre 2014

3.4.1 Identical Procedures for Private and Public Land Objects

The procedure of the definition is similar for land objects created under private and public law. The right of private property is defined by a contract, normally between two land owners. After the agreement between land owners about a transfer of rights, a deed or a title are created. The transaction of rights becomes legally effective by the registration of either deeds or titles in an official land register (Figure 3.14).

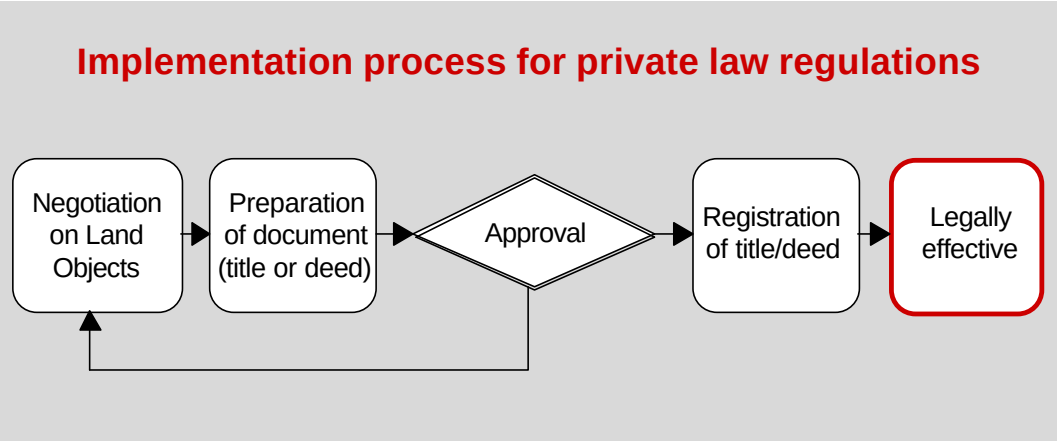


Figure 3.14

The determination of public rights and restrictions follow well-defined procedures prescribed by public law (Figure 3.15).

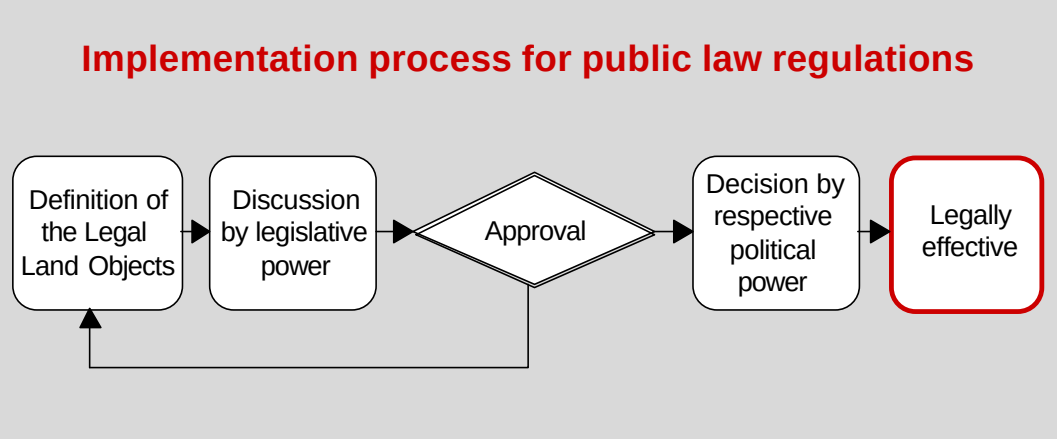


Figure 3.15

Once the adjudication process is completed, the right normally becomes valid. In contrast to land property rights, public law rights and restrictions in most jurisdictions need not be registered to become legally effective.

Cadastre 2014 expects that every right adjudicated to a legal land object will be registered officially.

3.4.2 No Change in Land Tenure

Land tenure is not changed by Cadastre 2014, but it is part of it. If a legal land object is the property of an individual or juridical person, it is a form of individual land tenure. If the property right

belongs to a traditional tribe or clan, it is a customary tenure; if it is given to a co-operative it may be called a co-operative tenure; and if the property right belongs to the state, we can call it a communist tenure.

3.4.3 Title Registration

Henssen [1995] uses the representation as in Figure 3.16 to describe the relation between the parcel and its owner.

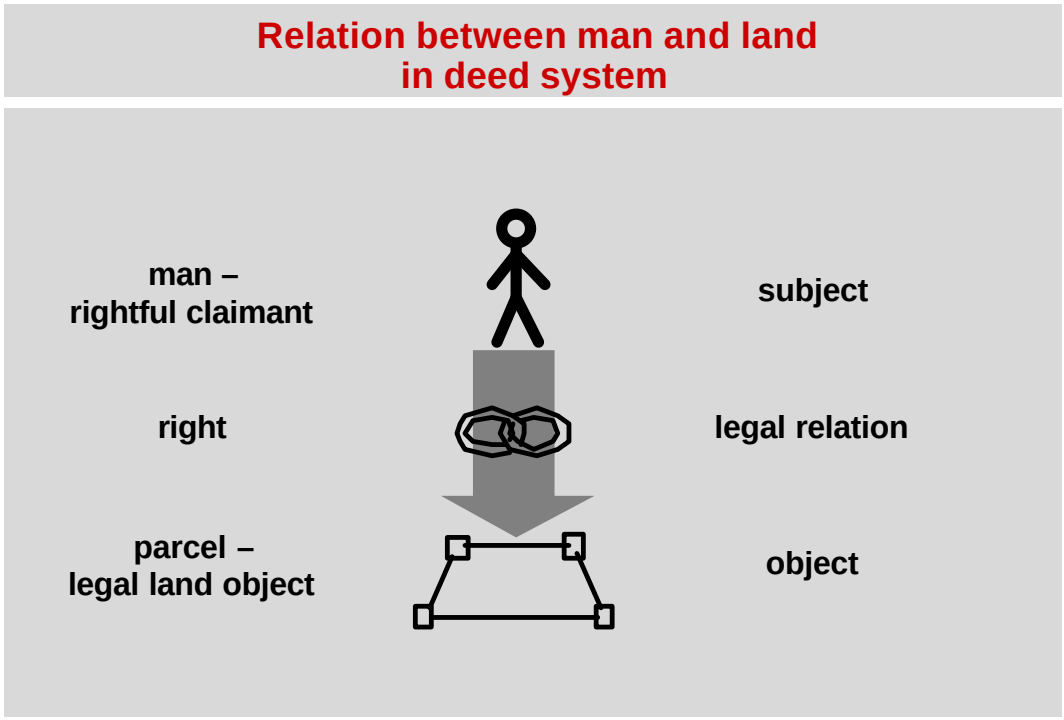


Figure 3.16

This definition may be called the deed approach. A rightful claimant has in hand a document proving his/her right as the owner of a piece of land by describing the transfer of the rights referring to him/her. This document, the deed, becomes legally effective, when it is booked or registered in the official land register in relation to the rightful claimant. The deed system is man-related.

Cadastre 2014 puts the legal land object into the center and adjudicates the right to the land object (Figure 3.17).

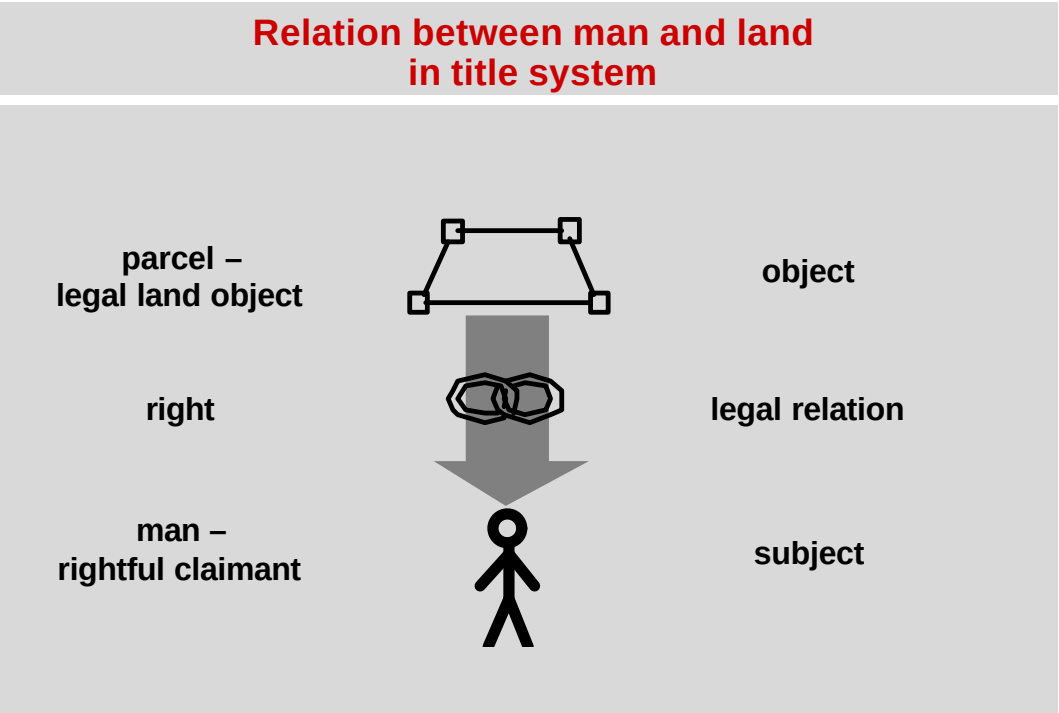


Figure 3.17

This definition corresponds to a title approach. In the title system, it is not the deed that is registered. The right referring to the parcel, the title, is registered together with the indications about the rightful claimant in relation to the land objects. The title system is land related.

The process of adjudication of rights to legal land objects in the case of public law corresponds to the creation of a title in the name of the society as claimant. It is much easier, therefore, to register the public law title than to create a deed. Deed registration must not be considered as a possible alternative.

For traditional land-rights, a title is normally created as a result of a political decision.

Cadastre 2014 dealing with legal land objects under traditional, private, and public law knows only the title registration approach to land rights. The legal land object, with the rightful claimant and the parameters of the right referring to it, is registered.

3.4.4 Respect for the Four Principles for Land Registration

The four principles for land registration mentioned by Henssen [1995], the booking principle, the consent principle, the principle of publicity, and the principle of specialty, are condition sine qua non for Cadastre 2014. In all democratic countries, the adjudication process for public law disposition follow these principles.

Cadastre 2014 as a public inventory of all legal land objects can help to support these important principles in the domains of private and public law.

3.4.5 Respect of the Principle of Legal Independence

The principle of legal independence is a key item in the realization of Cadastre 2014. The principle stipulates that:

- legal land objects, being subject to the same law and underlying a unique adjudication procedure, have to be arranged in one individual data layer; and
- for every adjudicative process defined by a certain law, a special data layer for the legal land objects underlying this process has to be created.

Cadastre 2014 is therefore based on a data model, organized according to the legislation for the different legal land objects in a particular country or district. The structure of an information system based on legal independence is as in Figure 3.18.

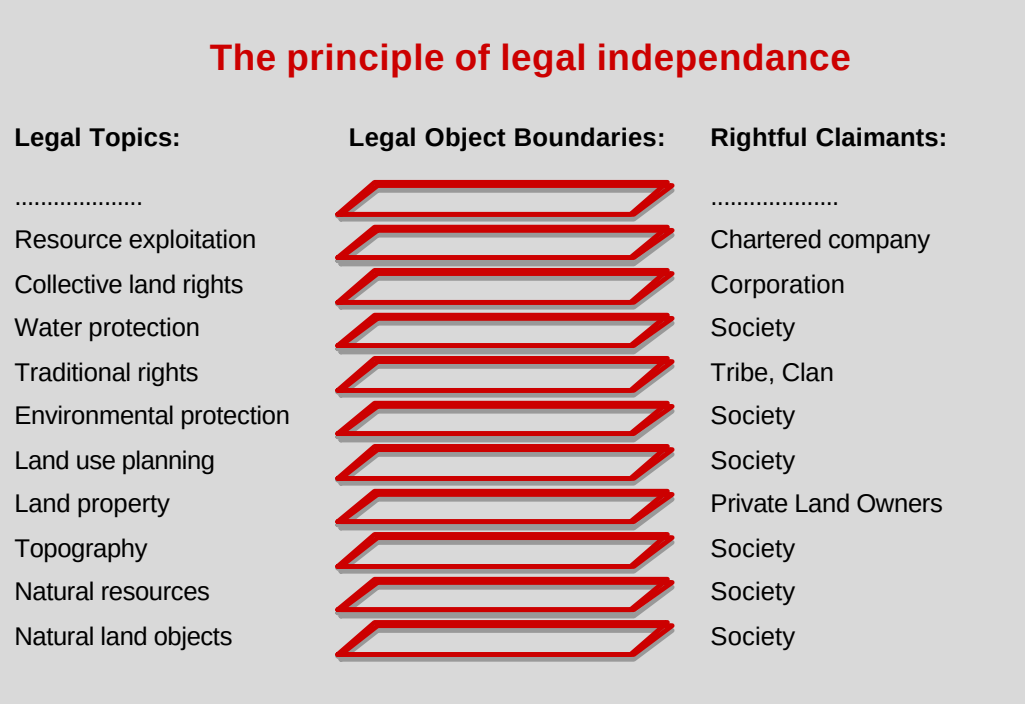


Figure 3.18

The Cadastre 2014 system is documenting all of these different categories of legal land objects, adjudicated to different rightful claimants, independently but in a common reference system.

3.4.6 Fixed Boundary System

Cadastre 2014 is based on the fixed boundary system. This means that boundaries are located by co-ordinates that are surveyed and not by a description of boundary features. Accuracy of the determination of the fixed boundaries is defined on the one hand by the needs of the users of the boundaries and on the other hand by the possible accuracy of the definition of an object boundary. Property boundaries must generally be determined to a higher accuracy standard than, e.g., valuation boundaries, because boundaries between different values cannot be determined exactly.

3.4.7 Location of Land Objects in a Common Reference System

To make sure that legally independent organized land objects can be combined, compared, and brought into relation to each other, Cadastre 2014 expects that they will be localized in a common reference system. The combination and comparison of the thus located land objects can be realized by the method of polygon overlaying. This method was published in Kaufmann and Bigler [1973] in the context of value calculation of properties using the principle of thematic independence.

4. JUSTIFICATION FOR CADASTRE 2014

4.1 Need for Support of Sustainable Development

Every organized form of a human society has to take care of land matters to ensure its sustainable development. The Statement on the Cadastre [FIG, 1995] identifies the important items in this domain.

The aspects to be dealt with are:

- Guarantee ownership and security of land tenure;
- Provide security for credits;
- Develop and monitor land matters;
- Support land and property taxation;
- Protect state lands;
- Reduce land disputes;
- Facilitate land reforms;
- Improve land use planning;
- Support environmental management;
- Produce statistical data.

A secure and complete documentation of legal and physical land objects supports the efforts to create sustainable development.

4.2 Creating Political Stability

Land rights have been and are again strong social and political arguments used by individuals and communities. They have a strong influence on the emotional feelings of individuals and communities about the role they play within a society. Even economic decisions are based on the manner in which societies are dealing with land property matters. This can be seen in those countries in transition, where foreign individuals and companies hesitate to invest in a country as long as the necessary land cannot be transferred to their own property, and which is secured by a safe institution for the registration of the rights. A strong legal and political basis is necessary to guarantee the required reliability.

In most countries, the traditional cadastral system is the instrument that reinforces the reliability of the land markets. In areas where no cadastral system exists, there is no functioning land market.

4.3 Omit Conflicts of Public and Private Interests

As land resources become rarer, societies are forced to regulate land use. Land use planning law defines what land use is desired and allowed or forbidden. Land use planning defines legal land objects which can have the effect of restricting land property.

With the growing danger of an environmental collapse caused by the over-utilization of natural resources and land resources in a non-sustainable manner, societies are creating laws for environmental protection. These regulations can also have the effect of placing restrictions on the freedom of land use given to the rightful claimants in principle by their property right.

An extreme form of restriction is created when a society has to protect its citizens from health dangers in a situation where environmental accidents have occurred. An example of this can be seen in the countries that were hit by the Chernobyl radioactive fallout.

In that instance, zones had to be defined where living is forbidden or where land use is restricted by law. Legal land objects have been created with a differentiated restriction of land use. If such land objects overlap land property rights, the effect can be that the land is devalued. In certain cases, the land value of a property can be nullified. That means that such a piece of land can no longer be an object in the land market. In several countries the same effect can be produced by the determination of zones that are suspected to be the sites of earlier environmental pollution.

Another aspect of restrictive land use is in the protection of risks from natural phenomena. Societies create laws to restrict land use where citizens are endangered by such acts of nature as floods, avalanches, falling rocks, etc.

In most countries these public laws have been developed in a defensive manner. The aim was to minimize problems in concurrent land use, waste of resources, and environmental damage.

Although the four principles of booking, consent, publicity, and specialty are respected during the adjudication process, they are not maintained afterwards. The adjudication decisions documented on maps are not made public within an official land administration system. These decisions are kept with the authorities who are in charge.

The lack of an arranged public inventory of all these aspects creates a lack of security for land owners and authorities. This results in:

- poor conditions for land credit (mortgaging);
- problems for a transparent land market;
- arbitrariness, corruption, and political disturbances.

Cadastre 2014 provides the necessary public documentation and contributes to political stability.

4.4 Support of Economy

Economies are in the process of internationalization. Frequently the production, marketing, service, research and development units of international companies are situated in different regions and countries around the world. The expenditures for acquisition and sale of land are growing. For international companies it is easier to deal with land matters when national cadastral systems differ little from each other.

A cadastral system publicizing the complete legal situation of land will diminish the risk of financial loss. With a single request interested people and institutions can get complete documentation about the situation of a certain piece of land.

A standardized and complete cadastral system can help companies to more easily deal with matters relating to land and therefore money and time can be saved. The savings certainly will be passed on the customers, making products and services less expensive.

To provide these services, it is necessary to have on the one hand a single organization that can distribute the land information and, on the other hand, have efficient and effective procedures for data storage, retrieval, and maintenance.

If the principle of legal independence is respected, an information structure can be created that meets the requirements for being both efficient and effective.

4.5 Need for Flexibility and Effectivity

In order to cope with the great diversity of needs, the Bogor Declaration [United Nations, 1996] states that cadastral systems should:

- be simple and effective;

- be adaptable to rates and patterns of populations;
- provide access to land, security of tenure and trading of land rights;
- provide a vast array of options;
- include all state and private lands;
- be part of a national spatial data infrastructure.

Cadastre 2014 with its concept of complete area coverage, with its straightforward information structure, and following the principle of legal independence, can meet these requirements. As a basic part of a national spatial data infrastructure, it documents all legal aspects of land. It can follow the developments of the national jurisdiction, which is influenced by the development of many social aspects, in content and accuracy.

5. THE ROLE OF SURVEYORS IN CADASTRE 2014

Surveyors have a long tradition of dealing with property rights and restrictions. In most countries they can carry out the technical work without restriction. For the legal aspect of the traditional cadastre, however, they must hold a license. This license proves that the land surveyor is capable of fulfilling the task, as specified by society, with respect to technical and juridical directions.

The technical developments of the last few years has made it easier to survey the land objects. Thus, the license has been devalued in a technical sense. Discussions about the role of the licensed surveyor are taking place in every country where licensed surveyors exist.

The juridical side of the license has also lost its significance because lawyers and notaries have taken over this part of the division of labour. The development of property forms, settling boundary disputes, and drawing up contracts has been left to these professionals. Land surveyors have been reduced to concentrating on the location of parcels.

Within Cadastre 2014 the land surveyor will play the role of locating all legal land objects. Surveyors will not have to deal only with private property parcels.

Land surveyors must understand the processes involved in the determination and definition of legal land objects. They must know the adjudication processes and must understand the principles of land valuation. They must be able to manage the land administration system documenting land with all its physical and legal aspects and to provide land information for citizens, enterprises, authorities, and political decision-makers.

For this task within "Cadastre 2014" the skills demanded of a surveyor are much broader. The license must be re-defined. The role of the land surveyor within society becomes much more important.

6. RECOMMENDATIONS

6.1 What Must Surveyors Do, to Play an Important Role in Cadastre 2014?

The most important action surveyors can and must take is to understand that technology is changing the surveying profession. The two basic aspects of the profession — the ability to locate objects in the physical and legal worlds and the ability to represent these objects on a map — are influenced to a considerable extent by developments in the fields of electronics and information technology.

Measuring, which means determining the position of objects in a reference system, becomes a fully automated process with the use of GPS, photogrammetry, and remote sensing and robot theodolites. Surveyors can know less about the measuring process itself, but they must be knowledgeable enough to judge the plausibility of any results.

In the field of representation of the results, the production of maps is replaced by the ability to create graphs and diagrams out of digital data models. Creating graphs is quite different from drawing maps because in this process it is necessary to understand the data model and to be able to generalize the representation of the information in a manner that serves the interested user in the best way. The new requirements and the respective techniques have been published by Knöpfli [1993].

Mapping standards are no longer the only way to represent information. Producing individual maps with specialized content and representations or simply delivering spatial related data to interested people will be an important part of the surveyor's work.

After having understood these changes, the surveyor must take into consideration the phenomenon of the public-law land objects. Where once the surveyor had to have knowledge about all aspects of private property, today he/she must understand society's needs for all types of land objects, the legal basis and the legal procedures for the definition and alteration of land objects, the technical methods for the creation of land objects, and the economical and ecological consequences of the existence of land objects.

Surveyors must concentrate on these aspects, improve their skills in this domain through education and continuing professional development programs, and begin to play the role of specialists for all aspects of land matters. With that type of initiative, they will support the implementation of Cadastre 2014, and this will lead to the improvement of the often poor image of the profession.

6.2 How Can FIG Promote and Support Cadastre 2014?

FIG can play an important role by adopting the ideas for Cadastre 2014, to create a common view about the future role of surveyors in the domain of legal land matters – including public law aspects – by disseminating the information, and reviewing and collating all FIG initiatives going on under the umbrella of Cadastre 2014. It is therefore recommended that FIG should

- promote and sponsor a competence center for modern cadastral systems;
- develop a common view of and recommendations for future national licensing policies;
- further use its contacts with governments and non-governmental organizations to launch an initiative for new, reliable, cost-effective cadastral services, provided by competent professionals.

6.3 How Can National Organizations Contribute to Cadastre 2014?

National organizations can play a crucial role in the acquisition of information and the professional development of their members. They can create a common view and promote understanding of the

development of cadastral systems in the direction of an institution following the principles of Cadastre 2014.

Simultaneously with FIG's initiatives, national organizations can explain, to national politicians and their respective governments, the problems with traditional cadastre systems and emphasize the need to improve information about the legal situation of land for better land policies and greater legal security.

These organizations can support the initiatives to develop cadastral systems by providing skilled and officially acknowledged specialists as consultants to parliaments and governments.

7. CONCLUSION

The situation of land is changing steadily and at an accelerated rate, because of the rapidly growing world population and the internationalization of economies. Security of land property rights can no longer be guaranteed by the traditional cadastral systems. The performance of traditional cadastral systems is no longer adequate. They can provide neither sufficient and reliable information about the legal situation of a piece of land nor services that are efficient and cost effective.

A new approach to the reliable documentation of rights and restrictions on land has to be introduced. This approach has been discussed by the Working Group 7.1 of FIG's Commission 7, taking into consideration the worldwide social, legal, economic, and technical developments and the reform initiatives in the domain of the cadastre. The vision of this new approach has been named Cadastre 2014.

Based on the proven principles of traditional cadastral systems, Cadastre 2014 will obey the following rules:

1. Cadastre 2014 is an institution that inventories and registers all types of rights and restrictions that have an impact within a defined contour of the surface of the earth according to the four principles of traditional cadastral systems; namely, the booking principle, the consent principle, the principle of publicity, and the principle of specialty. The Cadastre 2014 institution makes sure that the limits of the impact of rights and restrictions to land are fixed and registered according to the public and private laws in effect in the respective countries, and that everyone can get reliable information about the legal situation of a piece of land.
2. Cadastre 2014 is making substantial use of the increase in information technology. Procedures are being adapted to the new possibilities to encourage maximum efficiency yet maintain maximum security. Benchmarking and selecting the best of the new practices will be a challenging task in the domain of modern cadastral systems.
3. The Cadastre 2014 institution shall be a co-operative between the public and the private sectors. The involvement of the public sector ensures that the system has the necessary continuity. The public sector shall concentrate on supervision. Efficiency and flexibility will be brought into the system by the private sector, which is responsible for carrying out the operational work. This division of work also guarantees that public and private interests in land are kept in balance.
4. The Cadastre 2014 institution shall have an economical structure that enables it to recover the investment and maintenance costs.

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APPENDIX

List of Participants in the Working Group

The following list of people participated in the different meetings and contributed to the results of the working group:

		Fredericton 1994	Delft 1995	Budapest 1996	Penang 1997
SWITZERLAND	Jürg Kaufmann (Chairman)	x	x	x	x
	Daniel Steudler (Secretary)	x	x	x	x
AUSTRALIA	Don M. Grant	x	x	x	x
	Ian Williamson	x	x	x	x
AUSTRIA	Gerda Schennach		x	x	x
	Ernst Höflinger			x	
	Fritz Hrbek			x	
BELARUS	Oleg Crupenin			x	
BOLIVIA	Edwin Mendoza Ocampo		x		
CANADA	Sue Nichols		x		
CZECH REPUBLIC	Ivan Pesl	x	x	x	
EGYPT	Shokry Rofail			x	x
	Shehata Ismail				x
	Christoph Steinacher				x
FIJI	Mele Rakai				x
FINLAND	Mikko Uimonen		x		x
GERMANY	Winfried Hawerk	x	x	x	x
GREECE	John Badekas	x	x		x
	Chryssy Potsiou		x		x
GUATEMALA	Roberto Gonzalez Diaz-Duran		x		
	Jorge Mario Solares		x		
HONGKONG	Conrad Tang			x	
KOREA	Kim, Jung Ho		x	x	x
JAPAN	Taichi Oshima				x
LATVIA	Mintauts Eglitis			x	
	Ginta Sluka			x	
MALAYSIA	Chia Wee Tong			x	
NEPAL	Kamal Prasad Shrestha			x	
NEW ZEALAND	W.A. (Bill) Robertson	x	x		
NORWAY	Hans Sevatdal			x	
	Einar Hegstad			x	
	Godfred Rygh				x
SLOVAKIA	Milan Dzur-Gejdos		x	x	
	Emil Rynik			x	
SLOVENIA	Jurij Rezek	x	x	x	
	Roman Rener			x	
TUNISIA	Ben Jedidia Moncef			x	
TURKEY	Nihat Sahin			x	
YUGOSLAVIA	Dusan Joksic		x		
	Marko Gostovic		x		