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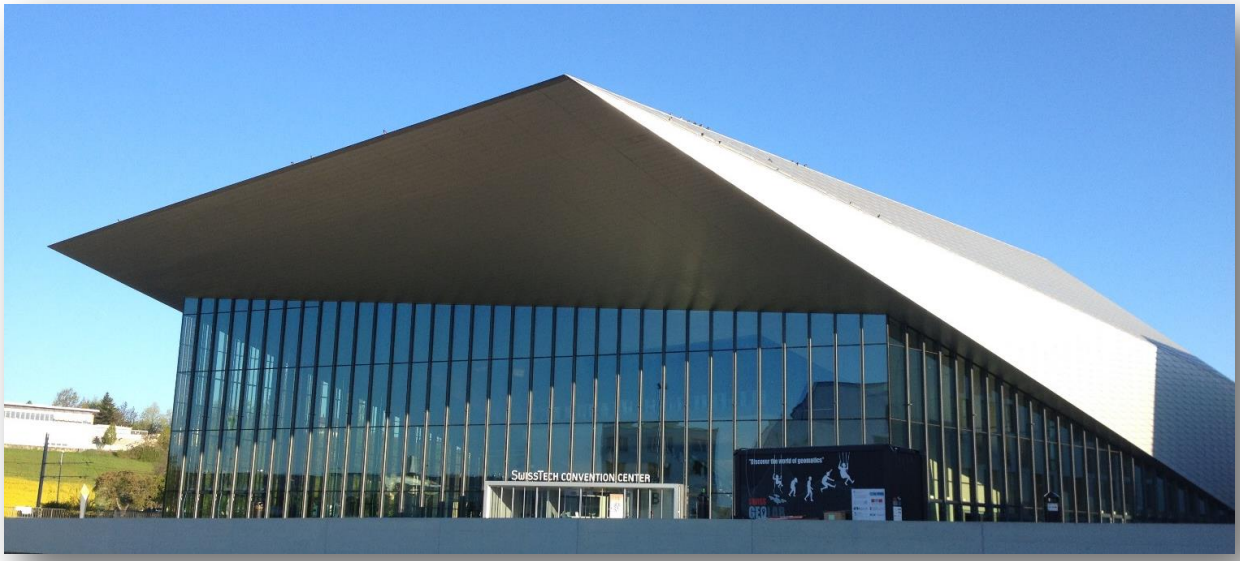

Report of WPLA/CLRKEN Joint Workshop

LAND ADMINISTRATION AND LAND MANAGEMENT IN THE INFORMATION AGE

Lausanne, 21 April 2017

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Edited by

Carmen Vega Orozco and Daniel Steudler,
Member of CLRKEN Core Team

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Introduction

The UNECE Working Party on Land Administration (WPLA) and the EuroGeographics-Cadastre and Land Registry Knowledge Exchange Network (CLRKEN) organized a joint workshop in Lausanne, Switzerland on 21 April 2017. The workshop addressed different aspects of how enhanced land administration functions contribute to efficient land management, essentially through capitalizing on the disruptive technological advancements and digital opportunities. The Swiss approach and several examples of international best practices and ongoing R&D were also presented. The workshop discussed the relevant future initiatives and development work to strengthening these aspects.

The workshop was structured in four sessions. The first two sessions focused on enhanced land administration systems while the last two sessions treated the opportunities and challenges of the technological advancements in the digital age:

Session 1 – Land Administration "Made in Switzerland": this session aimed at introducing the land administration system of the host country (Switzerland), and its current developments.

Session 2 – Efficient Land Management through Enhanced Land Administration Functions: this session aimed at presenting different land management aspects relying strongly on the stable and sound land administration system.

Session 3 – Digital challenges and Opportunities: this session aimed at looking at the challenges and the opportunities that the digital age is posing to land administration and land management.

Session 4 – The Need for 3D: this session aimed at looking and exploring the needs, the developments and the opportunities related to the 3rd dimension.

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Session 1 – Land Administration "Made in Switzerland"

Land Administration in Switzerland

Daniel Steudler (Federal Office of Topography swisstopo, Switzerland)

Basic Facts

Switzerland is situated in the center of Western Europe, bordering with Germany, Austria, Liechtenstein, Italy and France. Its territory covers an area of 41,290 sq. km and is dominated by mountain ranges (Alps in the South, Jura in the Northwest) with a central plateau of plains, rolling hills and large lakes. The highest point is Dufourspitze with 4,634m, while the lowest point is Lago Maggiore at 193m above sea level.

The total population is 8,418,000 (end of 2016). The largest urban areas are Zurich (950,000), Geneva (460,000), Basle (410,000), Berne (320,000), and Lausanne (290,000). Switzerland is relatively densely populated, with most of the population concentrated in the central plateau between Jura and Alps. There are four languages in Switzerland that are used and recognized as official administrative languages. About 65% of the population speak German, 19% French, 8% Italian, and 1% Romansch; a remaining 7% speak other languages.

Switzerland is a federalist state, meaning that state powers are divided between the federal, cantonal, and municipal levels. Cantons and municipalities have extensive powers and their own sources of income. Federalism makes it possible to enjoy diversity within one single entity. For Switzerland with its linguistic and landscape diversity, federalism makes an important contribution to social cohesion.

The principle of subsidiarity is being applied, meaning that nothing that can be done at a lower political level should be done at a higher level. Land registration and cadastral surveying therefore are in the responsibility of and are carried out by the cantons. The majority of the cantons are applying a public-private partnership for the operation of the cadastres.

Other land administration segments such as land taxation, land evaluation, land-use planning, agriculture, forestry, or environment are taken care of by several other offices, which – depending on their duties – are placed on different administrative levels.

Legal Basis

The Civil Code from 1912 is the basis for the enactment of a uniform and consistent land registration system, based on comprehensive cadastral surveying providing the spatial description. The aim of the legislators was that landownership is to be documented in a comprehensive way over the whole territory for the sake of a secure land market. The articles of the Civil Code defining the land registration and cadastral system follow three principles:

- no ownership without registration (art. 656)
- no registration without surveying (art. 950)
- no surveying without boundary definition (art. 669)

The cadastral system thus was conceived as a title registration system, where the state provides the legal guarantee. Bona fide landowners are to be compensated by the state in case of mistakes or damages caused by the cadastral system.

With the introduction of the digital format in 1993, cadastral surveying took a major leap forward. Its purpose was extended from purely serving land registry to also be the basis for other land information systems.

Technical Elements

In the 1980's the need for reform of cadastral surveying became obvious. The reasons were mainly:

- the increasing demand for digital data had the consequence that architects and other engineering fields started to digitize cadastral maps on their own, resulting in the duplication of work;
- inhomogeneity of cadastral data across municipalities and cantons;
- new technologies, such as optical and electronic distance measurements, air-borne methods, or satellite technology had not been adopted mainly due to outdated regulations and tariff systems.

The reform project resulted in two new ordinances (VAV and TVAV), which were enacted in 1993. These two ordinances have defined the digital format and the basic elements of cadastral surveying since then. Mainly because of the introduction of tendering in cadastral surveying at that time, the ordinances define the final product instead of the method as it was the case the previous 80-90 years. The introduction of tendering entails that data acquisition methods and GIS software systems are free to be chosen; it is up to the private sector to find the best solution or method to acquire the data and the best system to transfer and exchange the data. In order to achieve that, the definition of the system was done with a data model based on the system independent data description language INTERLIS.

The traditional cadastral map, originally on paper and serving as a data storage and communication tool, was from then on in principle a side product from the digital cadastral database. Initially the cadastral data model consisted of eight information layers; they were extended to eleven layers in 2004.

Developments and Future Role of the Cadastre

The role of a cadastral system is relevant in terms of economic and social contributions to society and government. This is no different in Switzerland, where the concept for the cadastral system has been established in 1912, as described above. The main objective for the land registration and cadastral system is to document landownership and thus enable an efficient, transparent, and secure market for land transactions. Considering the estimated total value of real estate in Switzerland of approx.

EUR 2'200 billion and the total of mortgages of approx. EUR 850 billion in 2015, this objective has clearly been achieved. Switzerland has and benefits from a well-established and efficient cadastral system documenting and ensuring landownership rights. It is a trustworthy system providing peace of mind to landowners and it is well accepted within society.

As the system has been established a century ago and as it is running smoothly in the background, the initial reasons and arguments are often forgotten. This becomes an issue when decision-makers are questioning the system and its costs, not taking the huge economic benefit into account that the system provides.

The above described traditional purpose of a cadastral system, i.e. documenting and securing land-ownership rights, is not going to disappear anytime soon. Such social and economic processes are and will remain crucial for the economic well-being of a nation.

However, with the advent of the digital age, data are now predominantly managed and handled in digital format. This facilitates the use of the cadastral data for any other purposes, something which was much more difficult and cumbersome in earlier times when maps and plans were paper-based. Digital data and information – when managed in an intelligent way – can be shared and integrated with partner systems, resulting in better and more efficient services to governments and citizens. As Figure 1 illustrates, the number of purposes that cadastral data can support in the future is increas-ing.

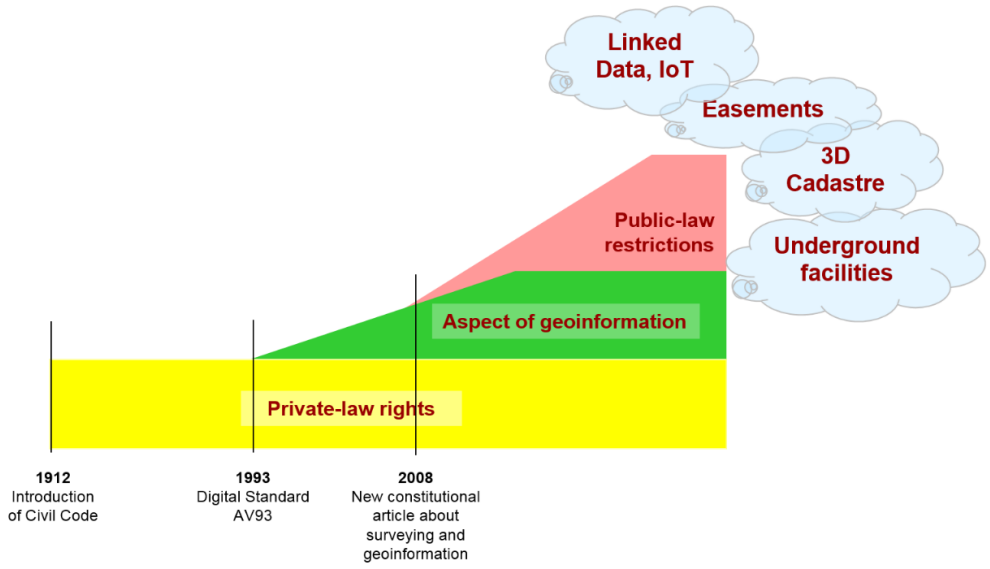

Figure 1. Increasing number of cadastral purposes

In Switzerland, there are developments, which will further increase the number of purposes that the cadastral system is providing for: public-law restrictions, easements, 3D issues, underground facili-ties. They are either being established at the moment or might be established in the future with the aim to document legal facts with a geospatial extend in order to provide a more complete picture of the legal situation of the land.

In Switzerland, the "common data integration concept" (Steudler, 2012) is at the core of how the cantonal and national geodata infrastructures are being set-up. This concept respects four simple principles to ensure a clear, simple, flexible, and modular structure for the geodata infrastructure (compare Figure 2):

- respect the institutional and legal independence of different institutions;
- use of topical information layers, allowing a clear definition of stakeholders, responsibilities, and data flow;
- use of a common geodetic reference framework;
- no logic relations between objects of different information layers; the only relation between objects is the geographic location.

The management of geodata infrastructures in Switzerland follow those four principles, and are therefore very modular and flexible for any adaptations.

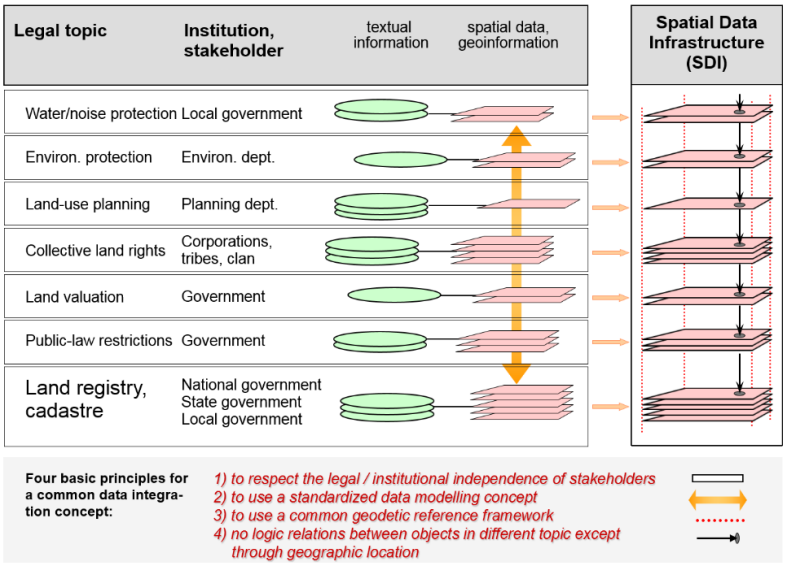

Figure 2. The "common data integration concept" with the four basic principles

Conclusion

The Swiss way of thinking can be summed up as following:

- data and information need to be shared among partners (horizontal, vertical, across sectors), therefore data exchange is essential;
- clearly defined data models are crucial and basic; we do not talk of maps and plans, we are talking and thinking in data sets;
- data models need to be under the control of the public sector (not software companies or private sector organizations);

- the four principles of the "Common Data Integration Concept" need to be followed and respected by all partners; only then a modular and flexible SDI can be established and operated.

Steudler, D. (2012). Common data integration concept. In: Rajabifard and Steudler: Spatially Enabled Society, FIG publication No.58, Joint publication FIG/GSDI, 72p.

Organizational and Technical Implementation of Cadastral System

Christian Kaul, Department of Geoinformation, Canton of Zurich, Switzerland

Technical progress has to support the political and organizational realities, not the other way around. Though, we have to face certain realities since we live in a specific political system with its typical organizational structures. The technical possibilities have to serve all actors to establish sustainable solutions.

We often spend a lot of energy complaining about the basic conditions instead of investing in creative ideas. Nevertheless, in the long term perspective internet of things, digitalization, smart cities and so on, will have an impact on the political system.

Federal structures require a technical implementation based on decentralized databases. To ensure secure and efficient data transfer and exchange between users and the different administrative levels, data validation has to be assured. This is a daily routine since the beginning of the digital format in cadastral surveying. Data modelling is the core precondition for a standardized data exchange and an effective data check service. Based on more than 20 years of experience, Switzerland now is redefining its cadastral data model, being called "DM-flex".

In Switzerland we have to take into consideration the interest of federal organization, shared responsibilities, decentralized datasets as well as freedom of methods and systems. How do we act in Switzerland under these conditions? With creativity – which is a key skill for the future.

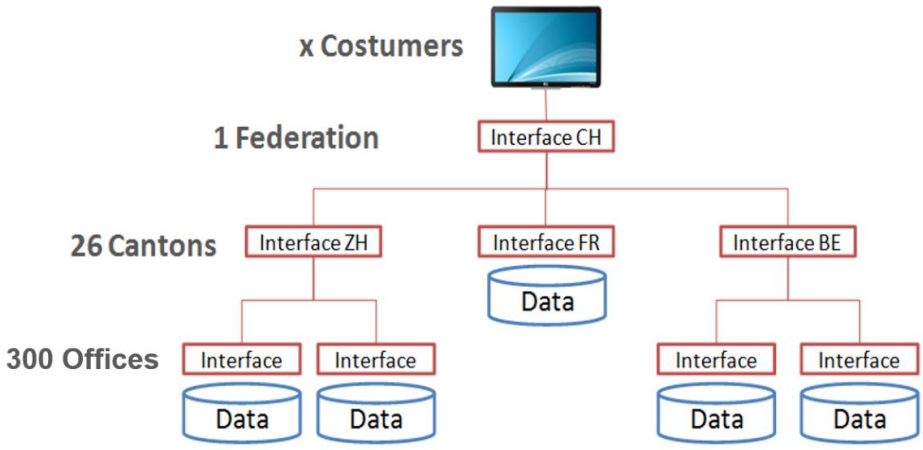

Figure 3. Example 1 - central user portal for official cadastral surveying data

Figure 3 illustrates an example of a solution for the cadastral official data with a central user portal. How do we meet the customer's need when facing our decentralized datasets? The answer is that we do not copy physical data; instead, we create interfaces to connect the three levels in an intelligent way.

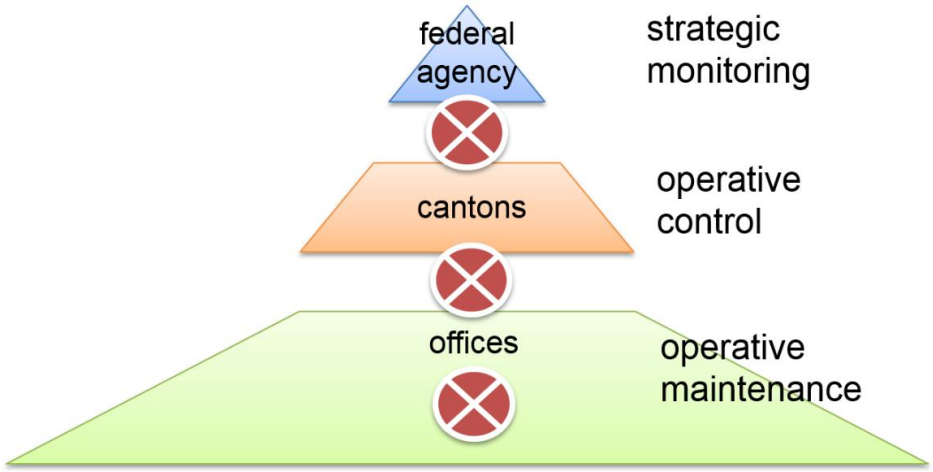

Figure 4. Example 2 – centralized check service

Figure 4 presents other example with a centralized check service. Offices have to constantly check data during their daily work. The cantons have to control data in line with their job of validation. Additionally, the Federal Agency operates supervision checks of data. In order to execute the entire controls in an efficient way, we established a central service for all check levels.

All these solutions need data exchange. Therefore, a reliable data-exchange was a forceful precondition for the digitalization of cadastral in Switzerland, with "reliable" also meaning:

- to be independent of different systems.
- to include the whole spatial content in a highly structured way.

However, the main challenge was the time of availability. In the early nineties there was no tool or language available. In a creative way, Switzerland built a new "Swiss knife" called INTERLIS – The Geolanguage.

A common data modelling concept is one of the key elements for a spatially enabled society. But why is the data model the core of a successful spatial information infrastructure? Data models are the basic framework to establish automatic check services. With INTERLIS-Models you can automatically create a transfer structure for data exchange – just with one click!

Last but not least, the standardized description of data is a helpful input for the implementation and configuration of tools.

After over 20 years of successful experience, Switzerland is now on its way to create a new data model for cadastral surveying data. How do we tackle this challenge? We built a joint study group to reflect upon visions and strategies for this new model.

Members of the Federal Agency, the cantons as well as the private offices drafted a vision for the new model which should be flexible, stable, developable and also able to meet the expectations regarding the digital needs of the society.

One may say this is impossible. We may say it is a vision. Two ideas show the first steps into the direction of this vision:

- Today, we have one very large model with different topics. It is nearly impossible to change small things in this model. Consequently, there is neither continuous improvement nor responding to actual needs. Hence, we would like to get agility by splitting the old heavy model in different small and more flexible models.
- We plan to establish a permanent change board for the new data model in order to constantly follow the technical progress and to respond faster to different needs. Consequently, it will be possible to keep most of the model stable and to change important issues at once in a precise manner.

These are only two of a wide range of aspects that will be discussed. The next steps with regards to this project are:

- Informing the different professional committees;
- A wide consultation of ideas;
- A concretion will lead to the necessary standardization of legal, technical, organizational and financial standardizations;
- And finally, a step by step implementation.

Today, we assume that the first steps of implementation will take place in 2019.

Enhancements of the Cadastral System in Switzerland: “Cadastre of Public-law Restrictions on Landownership” and “National Utility Cadastre”

Christoph Käser (Swiss Federal Office of Topography swisstopo, Switzerland)

1. The Swiss Cadastre of Public Law Restrictions on Landownership (PLR cadastre)

The Cadastre of Public-law Restrictions on landownership (PLR-cadastre) is a reliable, official system providing information about the most important public law restrictions on landownership. Public-law restrictions come into existence through a decision by the legislator or the public administration. They are publicly accessible in certain regions of Switzerland and a central information website is available for consultation. 17 themes are integrated: spatial planning, motorways, railways, airports, contaminated sites, groundwater protection, noise, forests.

Owners of land in Switzerland cannot simply use it in any way they wish. Certain conditions have to be complied with that have come into being as the result of legislation or decisions by the authorities. Public-law restrictions on landownership are legally binding for landowners. For those who need to obtain a range of information about a particular property from more than one authority, for example in order to find out which land-use restrictions may apply to it, the PLR-cadastre is an instrument that greatly simplifies the search process. It contains a broad variety of complete, reliable and comprehensible data from a variety of sources.

The most important PLR

In Switzerland there are more than 150 different public law restrictions on landownership. In the development stage up to 2019, the 17 most important restrictions at the federal level from eight sectors (named above) are to be entered.

Components of PLR

A public law restriction on landownership generally comprises a map and the applicable legal provisions. It also contains information about the legal bases, together with additional information and explanations.

Access to data

Existing data are available in digital or analogue form, depending on their origin, and thanks to cantonal PLR geo-portals they can be called up via the Internet. Here a distinction is made between a dynamic online request via a PLR geo-portal – i.e. a dynamic cadastre extract – and a static PLR-cadastre extract – issued on paper or as a PDF.

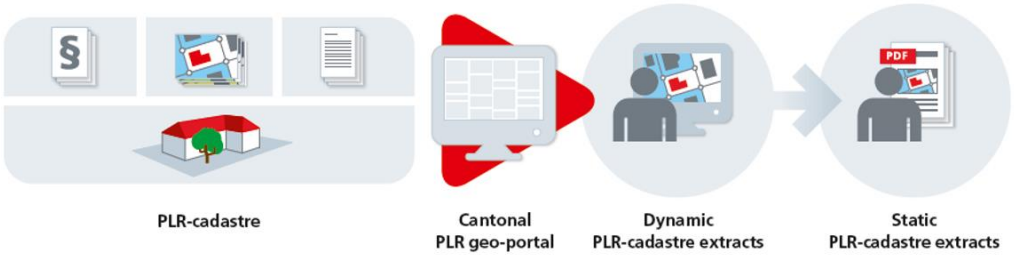

Figure 5. PLR-cadastre data

Planning & step-by-step Introduction

At the national level, the PLR-cadastre will be introduced on a step-by-step basis. It will be available throughout Switzerland by the end of 2019.

In an initial phase up to 2015 eight cantons introduced the PLR-cadastre in their sovereign territory or in parts thereof. At the same time, various issues were clarified and certain background conditions were defined. This first phase was concluded successfully.

The remaining 18 cantons will base their efforts on the activities and experiences of the pilot cantons and introduce the PLR-cadastre in their sovereign territory in the period from 2016 to 2019. During this period, the pilot cantons will complete their data collection process throughout their entire territory. (See www.cadastre.ch →PLR-cadastre → Initial developments).

Organization and Financing of the PLR-cadastre

The PLR-cadastre is jointly managed and financed by the federal government and the cantons. The division of tasks and finances is as follows:

- The federal government defines the strategic orientation of the PLR-cadastre. It contributes towards the operating costs.
- The cantons are responsible for organizing the management of the PLR-cadastre and for appointing the relevant administrative bodies. They bear the costs of updating the PLR-cadastre.

Further information can be found on www.cadastre.ch → PLR-cadastre

2. National Utility Cadastre

In 2016 a broad survey was made over Switzerland about the need of a national utility cadastre. Infrastructure companies, public data integrators and users participated largely. Most of them would appreciate a national utility cadaster and they see a good benefit in it.

The legal basis for a utility cadastre exists in only 14 of 26 cantons. So there is still enough open space for a national legislation. The basic question of the survey is: If – and if yes, how – a utility cadastre has to be established on a national level, and for what purposes should it be built?

The national utility standard for Switzerland is defined in SIA405 (Swiss Engineers and Architects). It consists of two different levels: the utility network for the utility owner and the utility cadastre for a regional and national coordination level. The definitions are the following:

Information about the Utility Network (UN)

- It represents all data of one specific media within the perimeter of an infrastructure company (utility owner) for operating and maintaining its network.
- It includes position data and a multitude of thematic data.
- It serves the infrastructure company for the planning of its infrastructure (new construction, replacement, upgrading, and maintenance), network simulations, or financial calculations.

Utility Cadastre (UC)

- It is the sum over all media of a certain amount of utility network data. This data allows to describe the space, which is occupied by conducts of different media. It mainly consists of the planimetric network, the visible objects and few thematic data.
- It is an important coordination instrument for information and planning tasks in the public space.

Survey

The survey was an online questionnaire, which took place in summer 2016 and had 354 participants, enclosing 22 associations. 141 (40%) participants were owners of a utility network, 142 (40%) were data integrators responsible for utility cadastre and 62 (17%) were pure users of utility cadastre data (today or in future). 10 participants answered, that they were not affected by the topic resp. not interested in the survey. So there remained 344 «true» participants.

3. Conclusions

A national utility cadastre is not only considered doable, but there is a clearly expressed need for it. This is even articulated by cantons, which do not have regulations about a utility cadastre up to now.

The role of the confederation should be the coordination; the operational responsibility should be with the cantons. No new utility cadastre should be created, but rules for gathering a homogeneous nationwide utility cadastre should be established.

Points to be clarified are:

- what aim and purpose should a homogeneous utility cadastre serve?
- what quality standards are required?

Only after these points have been clarified, a serious calculation, a costs/benefits analysis, and decisions for further steps are possible.

Session 2 – Efficient Land Management through Enhanced Land Administration Functions

Land Consolidation in a Modern Setting in the Netherlands

Marije Louwsma (Senior projetleader, Kadaster, Ruimte en Advies, Netherlands)

The Ambiguity of a Modern Setting

Land consolidation practice in the Netherlands has been shaped over time since 1916, when in Ameland the first project was executed on a voluntary basis. At that time a very modern technique to improve land-bound circumstances for agriculture. In conjunction with new technological developments and changing socio-economic demands, land consolidation practice kept pace with modern settings. With today's knowledge, we may regard land consolidation practice in former times as simple or outdated, but in that period they were modern as well.

In this presentation we look back to understand contemporary practice of land consolidation in the Netherlands and look forward to trends and developments that influence land management, in particular land consolidation. We distinguish six time intervals: (1) the start-up phase of land consolidation practice, (2) the initial projects, (3) a period of reconstruction, (4) a period with a comprehensive approach, (5) the contemporary modern setting and (6) trends and developments.

The Start-up and Initial Projects

Already in 1862 the idea for land consolidation arose to counteract land fragmentation (Staring, 1862). However, the first known attempts date back around 1900 and in 1916 the first land consolidation deed for the Ballumer Mieden was registered (Berg, S. van den, 2004). These first projects could draw on previous surveying experiences in the division of communal land rights into individual land rights to transform extensively used heathland into arable land (see Demoed, 1987). The division of land was based on how individuals actually used the communal land or held use rights that were drawn on oral agreements or 'informal rules'. The allocation of land rights is also part of land consolidation and therefore such experiences were valuable.

Due to absent legislation land consolidation projects were employed on a voluntary basis, meaning that all participants had to agree with the new allocation. The number of projects started was low, because it was difficult to convince farmers to join a project. Therefore, the government enacted the land consolidation Act in 1924 whereby land consolidation included all land owners in the area to improve agriculture. Over time legislation was changed, but the main principle of reallocation remained. Between 1924 and 1945 several land consolidation projects were executed, yet the largest number of projects still had to come.

Reconstruction after WWII

After World War II, awareness rose for a stable food production to feed the people. Destroyed farms and infrastructure had to be repaired and mechanization in agriculture was put forward to increase food production. Mechanization required the parcellation to be improved. According to Mansholt, Minister of Agriculture at that time, land consolidation was indispensable to improve the parcellation and infrastructure to introduce mechanization in agriculture (Andela, 2000). As a consequence, the government funded land consolidation substantially and launched a long-term program to consolidate the land area by area. Although agriculture was still the main aim of land consolidation, it was also applied to improve life in rural areas by building new, modern farms according to standardized designs, and to use the rural areas for recreation.

A Comprehensive Approach

Last decades a comprehensive approach dominates practice, pursuing multiple aims in land consolidation projects such as climate change mitigation and adaptation measures (mostly related to water management), improve agriculture, landscape and nature conservation. This development can be interpreted as reaction to the previous period. In the 80's and 90's it became apparent that land consolidation led to uniform, rational landscapes which are good for agriculture, but affected nature and heritage landscape patterns negatively (Andela, 2000). In this period also awareness arose for environmental issues, e.g. pollution and pesticides, and the need for a sustainable development. These two developments reinforced the development of a comprehensive approach in land consolidation.

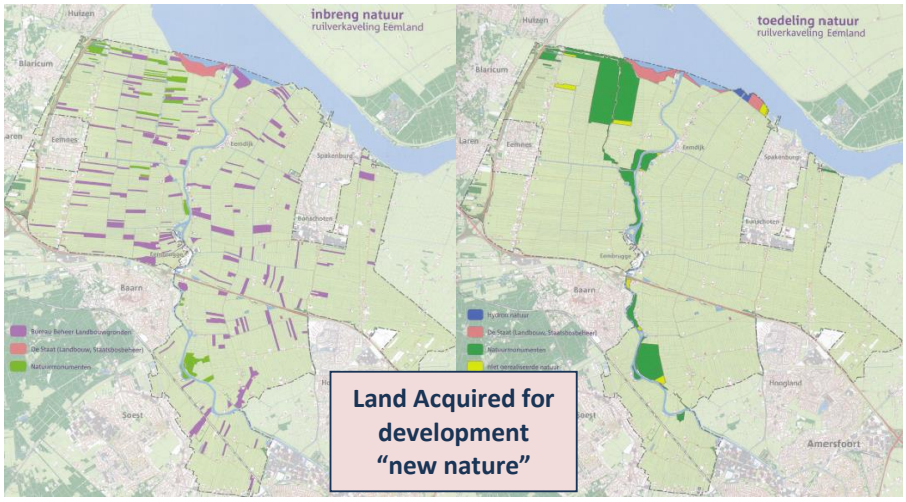

Figure 6. Comprehensive and sustainable development

Contemporary Modern Settings

Nowadays, government and stakeholders demand a more flexible and faster approach in land consolidation and land readjustment to respond to contemporary socio-economic developments. It was no exception that a land consolidation project in the '50's or '60's in the previous century lasted 15 to 20

years. The new allocation was more to the benefit of the farmer's successor than to the farmer himself. With the help of technological developments, fine-tuning of the processes and higher levels of participation, the duration of land consolidation projects and voluntary reallotment has decreased to respectively 4 to 5 years and a year.

New forms of participation, particularly in voluntary reallotment, emerged whereby the level of participation shifted from information and consultation towards co-creation (Louwsma et al, 2014). Land owners sit together in groups to discuss their wishes and possibilities for land exchange and ultimately design the reallocation plan with the help of the surveyor. This process is supported by a GIS system that captures participants' wishes and suggestions for land exchange on the fly and provides checks and balances during the development of the reallocation plan, including financial and administrative consequences for involved participants. The readily available information helps negotiations among participants about land exchange.

E-government is another technological development that currently supports land consolidation and voluntary reallotment. It enables stakeholders (land owners and land users) to exchange geo-information and administrative data digitally with the government or the surveyor. Also, it allows stakeholders to follow the progress of the project and look back into older information.

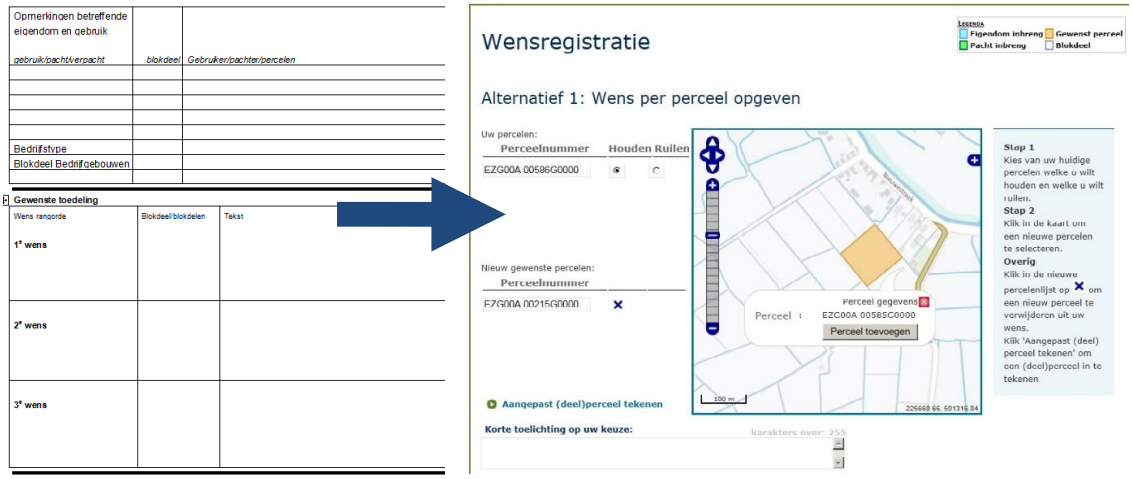

Figure 7. E-government portal for land consolidation

Trends and Developments

Climate change has a huge expected impact on all aspects of society and environment, and thus on our economy as well. Global warming, sea level rise, and more extreme rainfall patterns resulting in drought or floods, are just a few effects that affect land management. In the Netherlands, measures are taken to mitigate the negative effects of climate change. In the area of Veessen-Wapenveld a bypass along the river Rhine was created to temporarily store water in times of high water levels and high discharge. Voluntary reallotment helped the affected land owners, mainly farmers.

Another example is the technological progress in agriculture that leads to changing demands with respect to land as a resource. Developments like cultured meat (meat produced in laboratories), fully

climate and light controlled spaces (vertical agriculture), or the idea of a circular economy introduce another way of thinking in food production and in the use of land as a resource.

Mentioned trends, together with a growing population and land market dynamics, require us to re-think the role of land administration in society. With the application of land consolidation in the Netherlands, we see that land administration moves beyond the 'registration mode'. Apart from its traditional role to register land rights, it provides a solid information basis for spatial planning and other processes too.

Rail Baltic as Land Consolidation Project

Tambet Tiits (Estonian Land Board, Estonia)

The Estonian Land Board faces many new challenges in the light of the Rail Baltic Project. One of the main ones being land consolidation. Land acquisition has been straightforward, negotiations for compulsory acquisition or expropriation. Land consolidation as a process was underestimated. Now the magnitude of the RB project will change the opinion.

On average, the state carries out around 260 land acquisition transactions every year. Around 94% of these cases relate to infrastructure developments, but also for defense and security purposes. Most cases proceeded through Compulsory acquisition process (negotiations, 90% or more). Expropriation process has been in use only in some more complicated cases. Land consolidation has not been in use for solving the issues. The regulation as well the practice for land consolidation has been underestimated. There is extensive nature conservation program in Estonia. Almost 18.5 % of the land has conservation program. Quite many of these are so restrictive conservation programs that the acquisition of land becomes relevant. National Land Board (NLB) so far has been responsible for the acquisition of land for conservation only.

One of the main challenges NLB is facing in the upcoming years will be acquiring land for the construction of the Rail Baltic (RB) railway. RB is an international railway connection between Tallinn and Central Europe. Railway development is going to be in collaboration with Latvia and Lithuania. It will include substantial EU funding and will be the first major cross-Baltic cooperation project. The project is currently in the planning stage, however the designing stage has also commenced. The construction should be finished by 2026. National Land Board has expertise in surveying, mapping, land cadastre, valuation of land and forest, expropriation and land related legislation so it has the relevant competencies for significantly contribute to the project. In order to implement the project, the state has to deal with approximately 1000 parcels, including 650 private properties. RB has high importance and political support but also faces debate as it is common for the democracies.

In addition to other land acquisition alternatives, we must use land consolidation options in order to avoid expropriations. There is extensive law amendment prepared for the successful process. Acquisition of land is going to have three different processes:

1. Land consolidation process

2. Compulsory acquisition process
3. Expropriation process

Compulsory acquisition and expropriation have been in use in Estonia. The consolidation is now going as additional process. The basic idea was rather new for the politicians. Consolidation would help to have sustainable farms, businesses and properties. It will keep the acquisition costs down. It has a positive public impact so far. NLB is hoping that positive experiences will support the use consolidation for the other projects and purposes as well. NLB when analyzing the acquisition case will first look into the consolidation options. Consolidation includes private properties and lands in public ownership. That provides the option to minimize the harm of land acquisition.

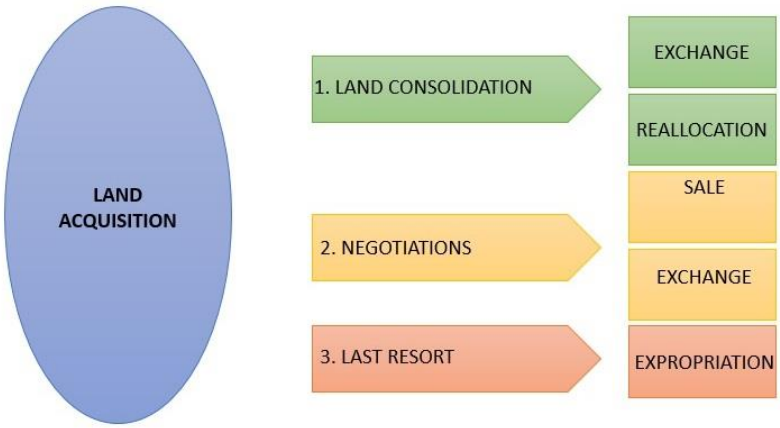

Figure 8. Acquisition alternatives and compensation

More than ever, land consolidation is now necessary.

Collaborative Approaches for Bringing Together Land Development and Land Administration

Lilian Zihlmann (Sofies-Emac, Switzerland)

The Need for Collaborative Approaches

A collaborative approach is needed when e.g. the integration of large scale infrastructure projects create spatial conflicts in terms of complex interactions of multiple land use demands.

The following case from the Swiss Plateau (Mittelland) includes a spatial coincidence of highway extension from 4 to 6 lanes including the realization of two wildlife corridors across, flood control and river restoration measures including retention basins and a ground water protection project in the context of high intensive vegetable production. These large-scale infrastructure projects are spatially concentrated in a region where intensively used industrial zones contain important logistic centers. The highway extension was also initiated due to the fact, that this section is part of an important

European transit route. This combination of large-scale infrastructure projects and multiple land-use demands causes high land-use pressure especially on the surrounding highly valuable agricultural production areas, despite the fact, that industrial zones and settlement areas are extended in a more restricted way due to the new and stricter law on spatial planning.

Collaborative Approaches in Land Development

Two combined approaches are presently applied to coordinate the multitude of projects, tasks, demands and conflicts. One approach is the Integrated Participatory Land Management (IPLM), which includes a strong participation of the concerned actors and stakeholders, mainly farmers and their associations. The other approach contains two workflows: The definition of compensation processes (including a pilot project) and the positioning and design of wildlife corridors. For those two work streams the collaborative approach focuses on the integration of the responsible cantonal offices for agriculture, spatial planning, environment and nature protection (wildlife).

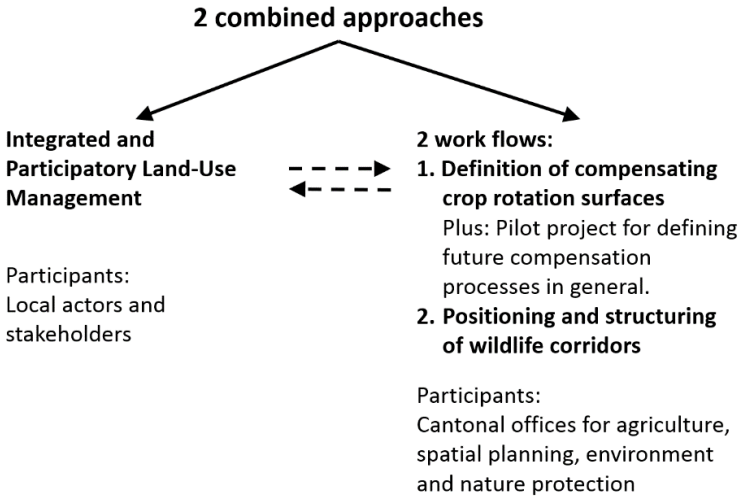

Figure 9. Two collaborative approaches applied in Land development

Both approaches include also a significant information exchange between stakeholders and cantonal services as well as knowhow transfer in particular regarding the structuring and execution of complex planning and decision-making processes. The two interconnected approaches have similarities in the process itself but address and involve as mentioned different actors.

The presentation of the case is focusing on the Integrated Participatory Land Management (IPLM), a guideline for participatory planning, decision-making and the conflict resolution process. From 1st January 2018 onwards it will become part of the Swiss Federal Legislation for Agriculture and thus can be initiated and financed within the common and existing mechanisms of the Federal Office of Agriculture.

The core element of IPLM is a continuous participatory process including the above-mentioned actors, stakeholders and authorities. Therefore, the main result of an IPLM is the process itself, allowing setting in place a continuous interaction between context, working content and the participants.

The objective is to make sure that the project team understands the demands, interests and needs of the involved parties, because their views and contributions are the basis for finding solutions.

The IPLM is structured into 5 modules, each including several workshops. The first module aims to create a common understanding and awareness and a so-called reference status. The second module contains an overall development strategy as well as specific strategies for the following five thematic fields: Agricultural production, shared (ecological) services, technical and human resources, nature and landscape protection, spatial planning and land administration. Subsequently, these 5 strategies get translated in Module 3 into a structured, symmetric and hierarchical target system, which will be weighted by the actors and stakeholders. Module 4 defines concrete measures as well as the identification of specific and suitable implementation instruments such as e.g. Integrated Land Consolidation. The last module 5 takes place only in case of subsequent implementing projects.

In the presented case even two IPLM processes were initiated. One for the core project, which is the highway extension and the wildlife corridors. One with a focus on river restoration, ground water and flood protection. An advisory and monitoring group composed of mainly cantonal authority representatives is responsible for the coordination between the two IPLMs.

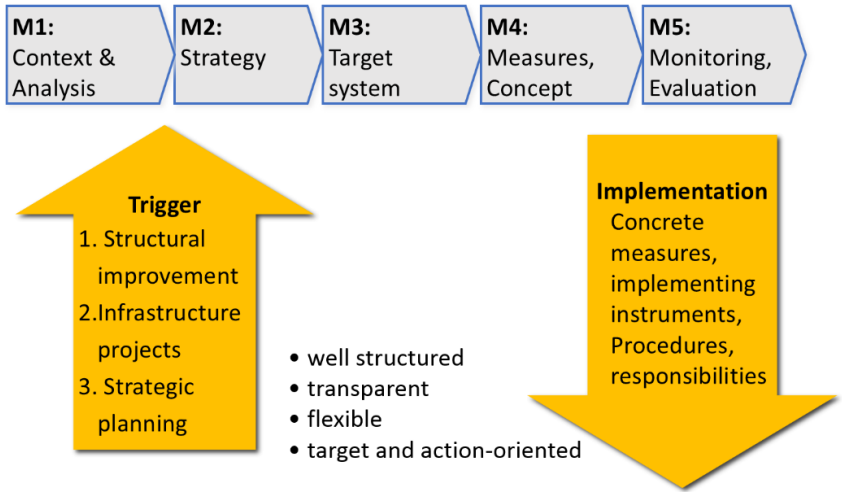

Figure 10. Integrated and participatory land-use management (IPLM)

From Land Development to Land Administration

The results of such a collaborative process are the indispensable basis for identifying suitable land administration tools as a second step. Integrated Land Consolidations (ILC) turn out to be still one of the most efficient and comprehensive procedure to adapt land use structures on property level in a sustainable and conflict resolving way. ILCs can further be combined with Regional Development Projects or Agricultural Adjustment Programs to initiate additional a complementary economic and infrastructure development. However complex land administration adjustments can only become possible once decisions have been prepared in a preceding collaborative approach, bringing together Land Development and Land Administration.

Definition of Territories' Boundaries as an Effective Tool for Land Management

Mikhail Bocharov (Deputy Director of the Real Estate Department of the Ministry of Economic Development of the Russian Federation, Russia)

A new law on registration of property came into force in Russia this year and it is worth focusing on the application of this law. The legislation on real property was significantly updated in Russia in 2015 – 2016 and it is confined not only to the law on registration of rights, but also affects other fields of law: zoning, development and renovation of territory, expropriation for state needs etc.

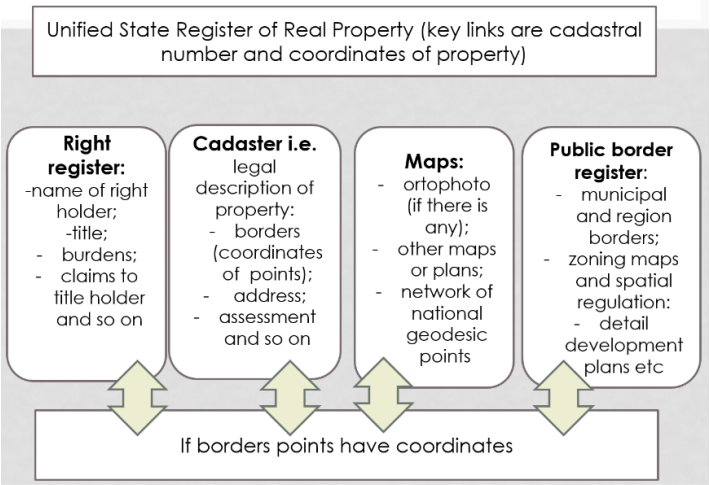

Figure 11. The 2017 Law on property registration

The most significant differences of the new law from the former law on registration of rights:

- Firstly, the new law allows us to concentrate in the Unified State Register of Real Property (abbreviated to EGRN) nearly all legal actions of state authorities that are georeferenced. In other words now EGRN gives us the opportunity to compare different zones and spatial regulations of rights with land plots borders. This is one of the achievements of the law, because it allows us to define exactly the legal regime of a land plot as a whole and in its separate part;
- Secondly, the law orders to check the compliance of the land plots borders with planning documentation that allows us to put into force the intention of the planner;
- Thirdly, more reliable transmission channels were created for both data in use for registration (for example, zoning map) and registration data used by other state authorities (for example, tax services or environmental services). Formats of transmitted data and procedure for their submission were harmonized.

Since the concept of the law comes from the cloud-based document storage (that is done for the first time in Russia in this scope), it means that any authorized person has the possibility of obtaining nec-

essary data at any time in the appropriate volume: request processed by staff personally should become a thing of the past. Probably the next step will be the full automation of requests and in course of time possibly automation of the registration actions.

However, one important fact prevents full use of all the advantages of the new law: almost half of the land plots in Russia do not have precise description of the borders. There are several reasons for so many inaccurate borders:

1. It is likely that concerned parties have clear vision of the borders of their land plots. If the land plot was established long ago, the law does not require the immediate elimination of uncertainty. Until there is no dispute about borders, the land plot can be in possession without setting borders. This rule was introduced in the early 2000s, primarily because at this time neither the state nor the population did not have sufficient funds to pay for the surveying of all land simultaneously (at that time – about 39 million land plots);
2. It may be that the land plots borders were established accurately, but in accordance with the old description, which up to 1997 was done quite arbitrarily, at the discretion of the surveyor. Most often this description does not match in terms of accuracy or coordinate system with the modern requirements. Accordingly, almost all data was transferred not fully. Most likely the description was limited to specifying addresses, numbers and landholders of the plots and to the indication that the land plot is in a certain municipality. Conscientious cadastral branches carried out the calculation of coordinates and transfer of the exact borders to the new cadastral system on their own initiative, but this was not done centralized across the country;
3. Finally, the land value may be so low that the surveying works are more expensive than possible violations of land rights. For comparison, 100 hectares of pastureland not in the coldest regions of Siberia could cost around 200 euros, and their survey will cost not less than 500 euros.

For obvious reasons, where the cost of land is high, the amount of land with inaccurate borders is much below average, and in abandoned areas much above average. However, it is clear that the uncertainty in the land plots borders must be eliminated. Without this it is impossible to allocate a land plot automatically to a certain zone, to establish territorial restrictions (for example, for the protection of nature or monuments), to calculate precisely the value of land for taxation. The hope is that someday landholders will want to set borders for themselves but that is a glimmer of hope. Over 20 years, when the single requirement for border description was set, there was a sharp splash in border description of expensive lands, which mostly already have precise borders. Cheap lands are slowly involved in turnover and their borders are described much less often.

To boost up the appearance of accurate borders in a natural way that means by the landholder request, the law prohibits deals with land plots until their borders are accurate established and described. Even these measures will lengthen the border delimitation for several decades.

Therefore, along with the new law on state registration of rights, a law authorizing establishment and delimitation of land plots borders owned by private persons at public expense was enacted. Also a

range of programs to establish the borders of certain public lands as forest areas, protected natural areas, and coastal lands was adopted.

The core of the above mentioned law is to ensure that the surveying works are carried out for a large number of lands, for example, city block and all plots located in it. This approach gives us at once several advantages.

Firstly, it is cheaper per single land plot. Secondly, the simultaneous border amendment of a large group of neighboring plots significantly reduces the risk of cadastral errors. Thirdly, it prevents land disputes. On the general map it is easier for people to see that it was an unbiased approach to them. If contrary to the entries in the documents about property rights everyone has not 0.2 hectares but in fact only 0.15 hectares, then the general map shows that this error was committed in relation to all land plots. Therefore, nobody can be the owner of 0.2 hectares, otherwise it means that someone from the landowners gets nothing.

In addition, in the course of comprehensive cadastral works plots for roads, driveways and other general use lands can be established.

As a result of comprehensive cadastral works the state and individuals will get a clear picture of the distribution of the cadastral unit territory on land plots.

Certainly, if the border of several plots is defined simultaneously then the special approval of borders is needed. Privately the approval of borders takes place in two ways: either by signing a respective act with a well-known owner of a neighboring land plot after border inspection, either by publication of notice to all prospective owners of neighboring plots calling them on the border inspection. However, in the case of definition of borders at public expense a different order is applied. The law provides for the establishment by the local authorities of the conciliation commission, which considers the territory map compiled by cadastral engineer and describing the borders of plots, location of buildings and structures. After reviewing this document landholders can submit their objections. The task of the conciliation commission is to help the landowners to remove the differences in the pre-trial order in part by revising the territory map. If this cannot be done, then cadastral engineer defines the border based on the requirements of the law and an unbiased approach to the concerned parties. For example, the law prohibits the land plots establishing in certain zones and municipalities, there are a number of other regulations.

All defined borders are transferred on the basis of prepared map to the cadastre. As for continuing disputes over borders, the border (or a part of it) proposed by cadastral engineer is entered into the cadastre with a note that in relation to the land plot the border is argued. However, it should be kept in mind that if there is no court judgement for 15 years, the border will actually cease to be argued, as each of the neighbors becomes the landowner within the new borders. The law preserves the right of the persons in dispute to go to court. However, such cases have not arisen yet.

In conclusion it should be noted that both laws were adopted approximately at the same time in order to mutually reinforce their application: the more accurate the borders of land plots will be set, the more reliable and better will be the registration database.

Session 3 – Digital Challenges and Opportunities

Smart Cities – Intelligent Buildings: a Tale of Two Scales

James Kavanagh and Tony Mulhall (RICS Land Group, UK)

Although it is difficult to imagine a city without buildings, when we talk about smart cities, unconsciously we may well be talking about the city as an abstract amalgam of all these disparate buildings without recognizing that the individual structures are originated as discrete projects in themselves.

At the urban scale we may be making plans for smart cities without being fully conscious that at the scale of the building there is a distinct difference between how the building is procured and for what purpose, and how the city is run and whom it serves. In commercial and governance terms the building and the city originate as completely different enterprises. The building originates mainly through a private procurement process with all of the characteristics of private sector motivation, proprietary commercial interests and the confidentiality requirements that surround such an enterprise. In contrast the city has emerged by way of agglomeration to serve the needs of the citizens, governed by concepts of communality, democracy and openness.

Unsurprisingly then the digital manifestations of the city and the building are being generated separately at these two different scales, with distinct objectives, wrapped in quite different concepts of good governance. The concern is that the city and the building may not be talking to each other at these different scales and from these different origins. As a result we may be missing out on a whole range of opportunities for the inter-operation of both. This article supports the argument for a new business model to integrate these two scales.

Different Kinds of "Smart"

Figures Figure 12 and Figure 13 provide typical representations of these two different scales. Figure 12 is a digital version of London, based on the space syntax method of analysis developed at UCL delivered on a 2D GIS platform. Figure 13 is a Building Information Model of an individual building developed on a 3D platform.

How these two systems interact has taken on a new urgency in the UK. By 2016 the UK Government has stipulated that all centrally procured projects should be planned to BIM Level 2 i.e. a managed 3D environment with data attached, but created in separate discipline based models that may include construction sequencing and cost information. Essentially a building design based platform geared to the requirements of building procurement.

By contrast in terms of city planning 2D GIS has been the typical platform on which municipalities build the digital city although increasingly this is now being realized as a 3D GIS model.

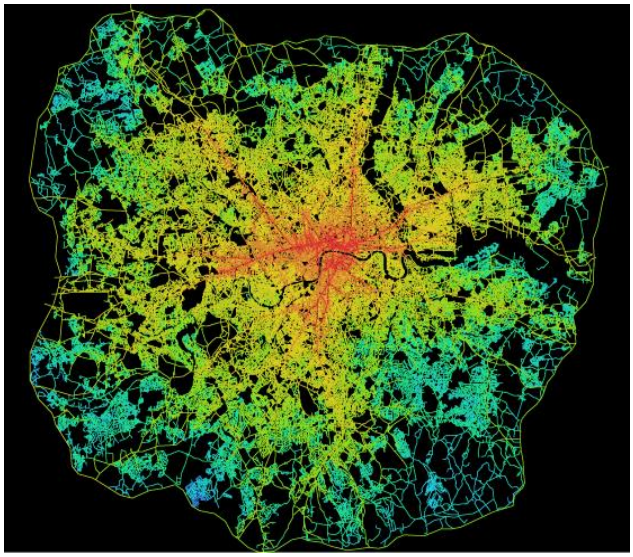

Figure 12. London, Space Syntax, UCL

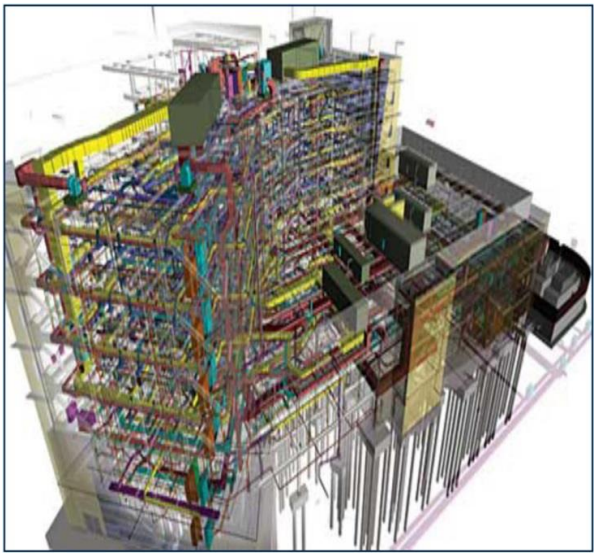

Figure 13. BIM Model

Cultural Difference

Despite the obvious interdependencies between buildings and cities the following clear cut distinctions emerge:

- City scale v Site scale
- City planning v Building design
- Public interest governance v Private interest governance
- Public sector objectives v Private sector objectives
- Public data v Private data

At the higher level the city tends to be urban policy driven for plan making, whereas the building is developer/investor led focusing on the creation of a secure property asset. Alignment of these interests will require the development of new business models combining the open sharing culture of city governance with the private proprietorial demands of commerce, with necessary safeguards for both.

The Business End of Smart

The UK Government regards the "smart" agenda as essential to delivering competitive advantage in the global economy. It sees the development of expertise in this area as highly transformative in terms of generating new services and new expertise for citizens as well as keeping the UK at the forefront of developments. (1) (2)

But it is not just about economic development. As well as creating a new economy the smart city agenda is about "effective integration of physical, digital and human systems in the built environment". (3)

Economic Drivers

At a basic level the economic drivers for smart cities are about managing all of those "dumb" 19th century networked infrastructure more efficiently through the application of sensors, actuators and a host of other digital aids to service maintenance and delivery. The benefits are reducing outages together with more efficient distribution.

In terms of smart buildings there are clear economic benefits to be achieved with savings on costs of up to 20% predicted through the application of Level 2 BIM (1). But there are challenges to effective exploitation of data:

- Additional costs - ensuring that data being collected for internal use by an agency is done in an open, standards based format making it widely available will have additional costs.
- Data security and privacy – maintaining data security and privacy in a way that will give confidence to those providing data and individuals to which data relates.
- Workable commercial arrangements – Income from data needs to be distributed fairly to a number of different agencies reflecting costs of making data available and value that data would have to others.
- Data Capture – Lack of a consistent approach to capturing data at every scale in a city specifically data modelling processes used by city planners and those used by architects.(2)

Professional challenges:

- Different professionals are using different data modelling systems.
- Scale gap between micro, building focused scale of architect and the macro city focused scale of planner.
- Meso scale (street) where important social and economic life takes place, falls through gap. It is also where most of the city's networked infrastructure is located.

- Identification of useful data – What data is most useful; how could it be most easily collected and made available and what exactly could it be used for?
- Lack of appreciation of potential of digital design: Architects and Planners use computers but simply to help do what they do already. The potential to design in a different way may be ignored. (2)

City Information Modelling

It is not difficult to see the connection between digital modelling at the building level and digital modelling at the city level. It has been observed that when BIM is more widely adopted the possibility of City Information Modelling (CIM) will emerge. (5)

The capacity to move beyond policy making and begin managing the resources of the city to achieve "more with less" is a goal worth pursuing through smart technologies – less waste in locations with abundance; better services for longer periods in places with extreme scarcity. So when we talk about the city and its infrastructure, clearly the need for interoperability at all scales becomes fundamental to effectively mediating between building and city.

CIM could address one of the key deficiencies in the construction and development process caused by the lack of precise, open-source data about the most basic daily challenges - the location of underground services for the purpose of connection or avoidance. Repeated failure to capture this information for shared use is one of the most contentious, disruptive and time consuming aspects of urban development.

Whoever might be the CIM custodian would need to promote the benefits of sharing information to developers and contractors and then ensure that the resulting CIM model is shared on a commercial basis informing and enhancing future projects.(4)

The long-term relationship between the building and the evolving city where BIM enabled buildings become long term multi-dimensional sensors in the city must be the goal. Clearly there will be a requirement for planners and architects to use a common approach to enable this to happen. But there are also cultural differences between those operating at the city level and those operating at the level of the building which will also need to be overcome.

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CALRIS – Co-development of Adaptable Land Register Information System Initiative

Ingmar Vali (Head of Court Registers Department, Centre of Registers and Administration Systems, Estonia)

A Short Overview of the CALRIS Project for Public Presentations

CALRIS stand for the Co-Development of Adaptable Land Register Information System. The CALRIS project proposal has been submitted to the Horizon 2020 program under the call CO-CREATION FOR GROWTH AND INCLUSION, topic CO-CREATION-04-2017: Applied co-creation to deliver public services.

The CALRIS project is contributing to the goals of the e-Government Action Plan 2016-2020 of preparing public authorities to be open, efficient and inclusive, providing borderless, user-friendly, end-to-end digital public services to all citizens and businesses in the European Union.

Figure 14. CALRIS goal

The CALRIS project is challenging the public institutions responsible for land and property registration to apply the principles of open and inclusive government to the design, development and delivery of land register information systems, which are fully digital, cost-efficient and based on open source software. At the same time providing the necessary system flexibility and configurability for adoption by multiple countries around the world.

The open development process will be carried out as publicly as possible, and the exploratory piloting of the co-development process will engage all interested parties such as citizens, academic circles and private sector representatives, from domestic as well as international communities, bringing together the field-specific best practices and technological knowledge from various countries and continents.

The deliverables of the project include the following:

1. Guidelines for conducting an inclusive, international and cross-sector co-development of a public land register e-solution.
2. A trans-nationally adaptable core land register information system.
3. A cloud-based land register demonstration environment, for testing the features of the solution.
4. A piloted country-specific adoption of the core land register software solution for Estonia.

The CALRIS Project is planned to be carried out during the period of September 2017 to May 2020, with a total budget of 7.1 Million Euros.

The CALRIS project partners' consortium includes 12 partners from 8 countries from different regions of the world. Namely, Estonia, Austria, Latvia, Scotland, Afghanistan, Nigeria, Ghana and the United Arab Emirates.

The Land Code – The Fourth Revolution in Geoinformation

Xavier Comtesse (Switzerland)

Introduction

Traditionally, the management of territory relied on a particular form of representation: the map. Accordingly, for centuries, the map has been a precious tool that represents land, property and certain objects and attributes of the territory on the same sheet of paper.

Each era, each region has built both a legal apparatus and regulatory institutions for the measurement, control and arbitration (private or public), as well as for the management of these territories. The "land code" has thus developed over the centuries. Here we can refer to the intervention of the "Napoleonic Code", enacted in March 1804, which consolidates the laws and the set of rules determining the status of persons (Book I), property (Book II) and relations between private persons (Books III and IV). This code organizes and structures the institutions in charge of implementation, including registration and warranty, control and arbitration. For the management of the territories, this was a remarkable change; land management hitherto focused on property taxation, and thus became a geo-political and economic issue. The static management shifts to a dynamic approach. Surveying and measuring the land become determining factors in the economic development of land.

Of course, with the arrival of computers and databases these representations continue to evolve by virtually adding new dimensions, such as 3D or time (4D) or even a fifth dimension, representing the prediction, anticipation, and acceleration of time. Computer technology has enabled us to establish a more sophisticated and detailed representation of the territory than the paper maps, notably by superimposing layers representing different themes and topics with land objects. With the digital revolution, the management of territories will once again change completely.

Theses

Today everything is still accelerating with the latest technologies of the digital revolution including “Big Data”, the Internet of Things (IoT), the “Blockchain”, predictive algorithms of “Deep Learning”, etc. These new techniques offer analytical tools for introducing the notions of anticipation and prediction into land management. This is a radical departure from previous statistical tools for modelling and simulation. We go from a serial data analysis of historical information to a form of “continuous presence” given by the ongoing streams of real-time data, providing a fundamentally new vision of the future!

The new technologies of the digital revolution bring even more options. They do not stop at the mere consideration of Big Data. Consider the following three examples:

- First, “Blockchains” will allow through their chain-based structuring of contracts to manage deeds and land records in a whole new way by bypassing the work currently done by notaries and municipal offices maintaining registers. Indeed, when the transactions of land deeds are inscribed into the code (computer code), they become accessible, transparent, traceable, encrypted and secure. The intermediaries are no longer needed. The system becomes open, decentralized and multiple. Even more, the law (the code) has become the code (computer).
- Secondly, the Internet of Things (IoT) enables objects to communicate with each other and to exchange data. Sensors and cameras installed/moving in the territories will produce astronomical amounts of data. IoT will provide a completely new picture of the territory, which suddenly has become a major producer of data. We still need to develop the tools to analyze this enormous and uninterrupted flow of data. And once again it is the "computer" code that will enable it, presaging a world where everything has become digital.
- And finally the algorithms, some of which could be of the “Deep Learning” type. As we already see now, geoinformation will be produced in such numbers that only virtual machines will be able to analyze and derive conclusions to humans. Land will thereby be managed by algorithms according to precise regulations, and the governance of the land will thus pass from humans to virtual machines for which it will be necessary that the different levels of government play key roles as arbitrators.

Development

When reviewing these transformations, it becomes clear that the representation, management and governance of territories will again change dramatically. The current transformation is characterized by the transition of governance into the digital code (software). Up to now, for each evolution a legal apparatus and institutions were established. However, this time everything will be in the “land code”. State or private institutions will have to adapt to or they may face the threat of becoming obsolete (i.e. notaries and land registers are likely to be affected by the appearance of Blockchains).

Therefore, we intend to propose a fundamentally new approach to master this new situation. First, we identify three key elements of this new digital representation:

1. Parcels

2. Objects and attributes of the territory, and the
3. Relationships between them

From this simple classification, one can imagine a new representation / codification of the territory that might be called: “The Land Code”. This term would refer to the fact that the proposed model would be both computational and legal since the “code” would serve as “law”. The example of “Blockchains” where computer code encrypts the management of territories (plots, properties, houses, or other land objects and thus affecting even cadastres and land registries) gives a clear indication of what the future may hold.

“The Land Code” would consist of three “Books”: the first book containing the algorithms of definition, measurement and arbitration for the land, parcels or other object of the cadastre; the second book containing the attributes and objects of geo-information; and in the third book, one would find all the evolutionary relations between the first two categories.

Conclusion

Inspired by the RFC (request for comments) of the Internet, one could thus imagine the creation of a “land code”, both at an international and at a national level. These “laws” would be derived from the codes (computational) and implemented in the new administrative services of the nations. The future role of governments would consequently be to provide such platforms that are open to and encourage the establishment of land codes. The different stakeholders and parties of territorial management could then "plug in” into the ecosystem (platform) set up by governments.

“The Land code” would be the “constitutional” support for the digital management of territories. This vision may appear revolutionary today but risks to be seen as a banality tomorrow.

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Why do we talk about Blockchain Technology?

Mats Snäll (Lantmäteriet, Sweden)

The talk about the Blockchain technology is spreading and that also counts for the Land Administration sector. The technology is not completely new but the use is still in an early phase. This session does not explain how the technology works and the reason is the same that goes for the reason why few cares about how the Internet works. Instead, I give some answers to why the technology is so interesting and in particular for the Land Administration in the use of real property registers and such.

Do you talk about the Blockchain or do you talk about Bitcoin? Do you talk about Trust the virtual and digital world?

We try to manage the future demands from society and citizens regarding user experience in the context of how a public agency may design and develop in order to give best possible delivery and even more, to engage citizens as part of the process.

The new generation may be recognized certainly as a new generation of citizens, customers, users and, in my field of interest, property owners. It is a generation of IT systems meant to be a part of our businesses and not just a support to them. It comes from the new generation of users and creators who were born in the world of social media, constant information flow and to the world of gaming and digital services. The generation to use government services, that has born into free and available information, Internet services, gaming and associating with people all around the world unregarded borders and politics and most likely to be totally free from older generations fear of pushing the ENTER-button and not having the possibility to regret or go back.

Tailoring digital government to improve citizen experience:

- What can agencies do to entice citizens to access available online government services?
- Are trust, satisfaction and loyalty the key elements to user experience?
- How can systems of engagement promote communication and attract citizens by providing better service access? What are the tools available in succeeding this?
- How can strategy, policy, and governance enable Digital Government?
- Creating trust in the virtual world, what are the ways for governments to achieve this?
- Are yesterday's as well as today's failures opening the doors to new solutions?

Sweden – a System of Trust

Some important aspects regarding trust in a system, like the Land Administration System:

- **A safe investment.** The Swedish economy is strong and the property market is driven by urgent need for dwellings. Certainly this business is based on trust in the system and we do have digital processes with automated decisions.
- **3.2 million owners.** Each ownership transaction is based on Trust. Trust for the system, Trust for the process, and Trust of the information.
- **Big values.** The Swedish real estate properties worth three times as much as the national GDP. Real estate is normally of great value in a working national economy. The importance of Trust for the system is obvious.
- **Earned trust.** In Sweden the Trust is earned over a long time without wars and development; driven to efficiency and quality based processes in order to serve citizens an experience of trust. But still the system is built on the idea of having paper as bearer of information put there with a pen or a printer.

Keep Trust in the Virtual World

We are in the time of digitization where we see lots of new things coming up as alternatives to the world we, the elder ones, are used to. So when we come to the time of digitization we are in it is something of a new situation where we need to create Trust for the virtual and digital system. Now this may seem like a modest thing because we all seem to Trust anything in our smartphones…

But, what about to buy a house in the digital world? It is now very close to handle the complete transaction of selling and buying a real property in a digital process. So the issue of Trust will certainly be important. One of the most physical objects to handle in a transaction is real estate transactions. In spite of this very hands on transaction we have no problem to handle virtual worlds and digital societies as "real" worlds. We buy things over internet and buy "properties" created in digital worlds with little regard to security. We trust the system.

I think we now can see the first really good alternative to give us a "Trust machine" to support any kind of transaction, even the land and real property conveyance. Now we suddenly have a situation with a technology that offers all the things that we need to have secure digital transactions. If someone have a machine for Trust it is hard to say you dont want it.

Conclusions

The Blockchain technology offers: digital originals for real, true open diary, a log for transactions and a log for processes, and really smart contracts. It may not be of great importance for Sweden right now to improve the systems because we have so much Trust in it. But for countries in transition blockchain technology may be the difference from making the transition from a developing country to a developed one.

By 2022, a Blockchain-Based business will be worth $10 Billion. It is predicted that the blockchain technology will make a huge impact on our systems of Trust.That's why we talk about the Blockchain. In Sweden, it is a system of Trust that guarantee information on land and property in the past, now and in the future. We take the responsability to seed to our next generations best interest.

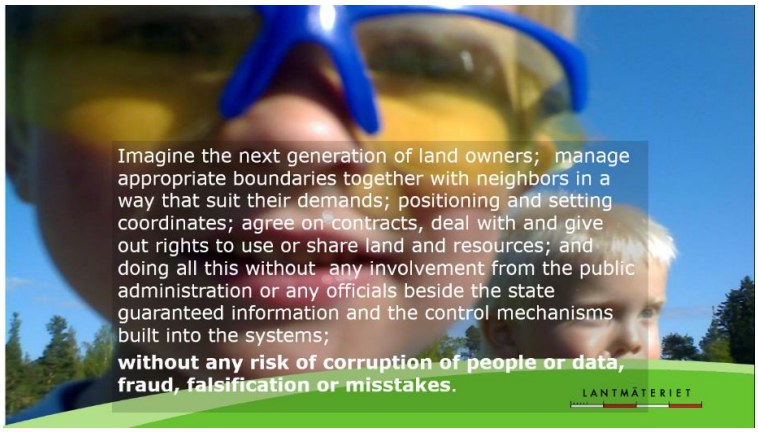


Figure 15. So take a moment to imagine…

Session 4 – The Need for 3D

Next Generation Land and Urban Systems are 3D

Mika-Petteri Törhönen (Lead Land Administration Specialist, Global Land and Geospatial Unit, The World Bank, USA)

The World Bank has financed land tenure and land administration interventions for over 50 years including some 65 standalone land administration projects and over 100 agriculture related land reform and administration projects. Today, the World Bank remains as the largest global financier of land administration investments with a portfolio of about $1.2 billion committed to land projects. As of now, the World Bank's technical land administration support often consists of investments to land and cadastral records, and in their most advanced scope focuses on automation and digital solutions; sharing and exchanging geospatial data; provision of electronic services; and integrating land and geospatial records to the eGovernment infrastructure of the State.

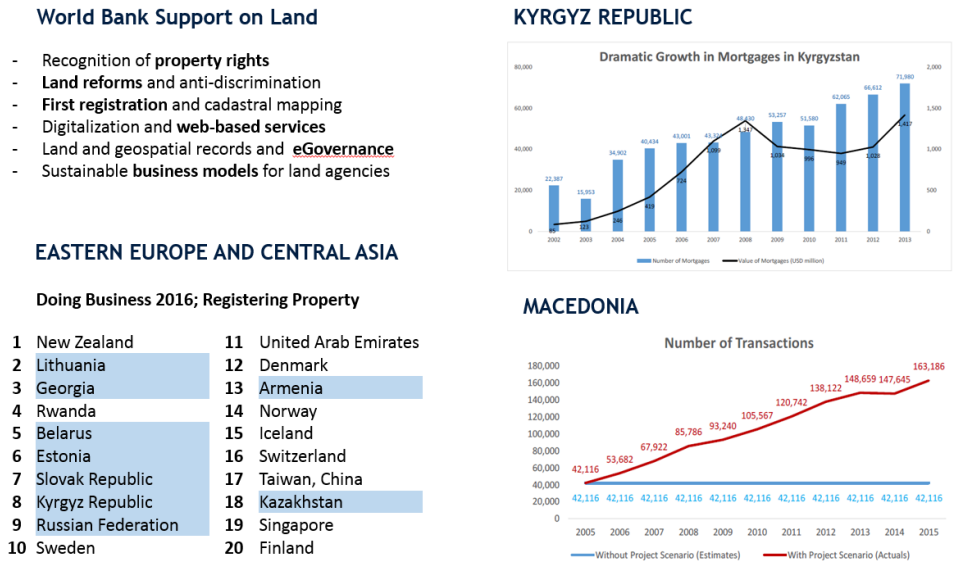


Figure 16. Land administration successes

Also more applied services (such as One Map, Mass Valuation Systems, and State Land Management) are being introduced, and in parallel endless number of private sector applications and Start Ups make use of the emerging Open Data policies. Having said that the publicly produced geospatial data is still far too often held back to the benefit inefficient monopolies, or to serve restrictions of defense or privacy origin, which have long been marginalized by the publicly accessible private sector or not-for-profit produced data and services such as the Google Map or the Open Street Map.

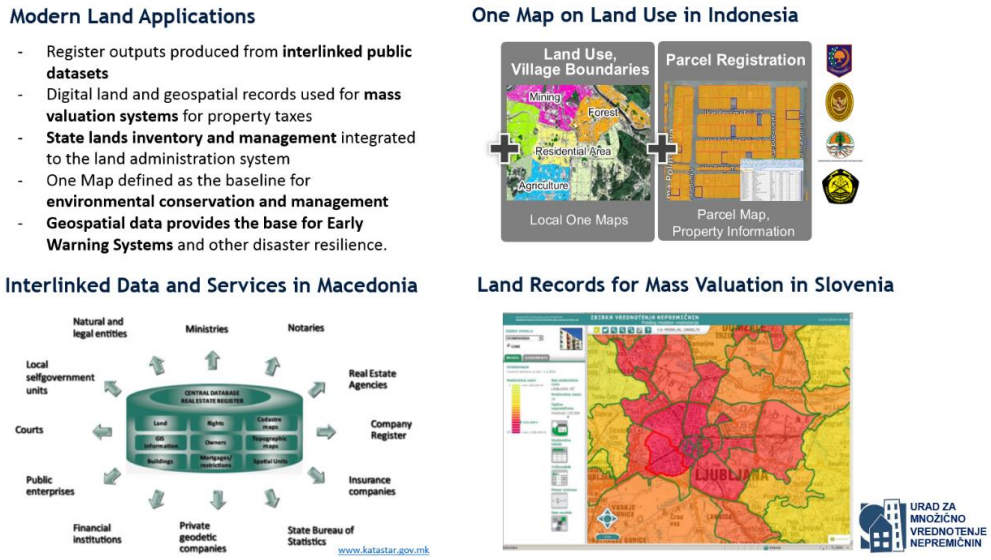
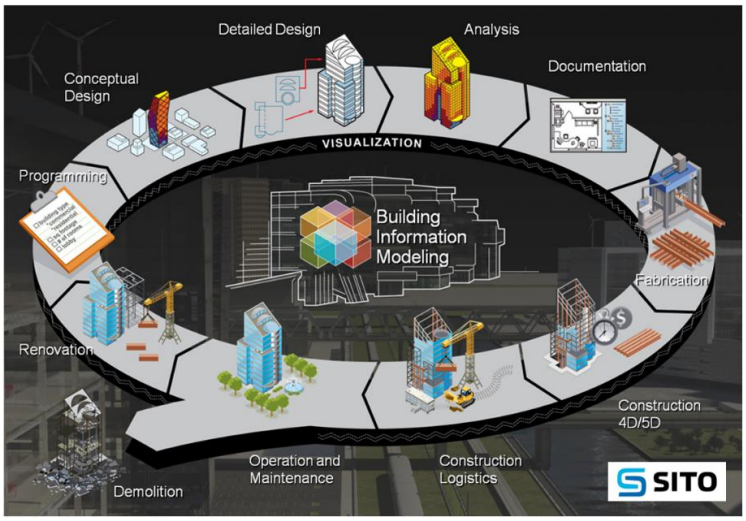


Figure 17. Applied land administration; trends.

Conceptually, the manual era and 2D logics still dominate, which scope this presentation suggested to be outdated. Finally, however, the change is near and happening.



Buildings & infrastructure are already planned in 3D

But regulatory processes and municipal SDI's are still 2D + paper

Figure 18. Solution: 3D SDI + BIM

The presentation envisioned that in 2027, land administration, geospatial and urban systems receive, produce and disseminate 3D information and services, and operate 3D processes build on the principles of BIM. The World Bank supported, and other, investments to land and urban systems, which are planned today and will serve the 2030'ies, will need to prepare and adopt 3D systems and processes as the aim nationwide in the middle-income and high-income countries, and perhaps more radically, also in cities in developing countries. Visioning anything else than 3D urban systems will prove historical much sooner than we dare to think today.

The transition to 3D is inevitable and has started, but the full change will happen gradually. The massive rate of urbanization means giant urban development projects all over the world, and they provide ideal platforms to test and deploy the next generation 3D processes.

Drivers for 3D Developments

Helena Åström (Federal Office of Topography, swisstopo, Switzerland)

Introduction

For the last years, 3D geodata is a hot topic amongst surveying and GIS-specialists. The technical development in these areas is immense. Still some people think 3D is only a technological hype, and they pose questions such as:

- Do we have to incorporate all technical advances in official surveying?
- Is there a real need for official 3D geodata?
- Who are the drivers for 3D developments?

People and Community

With the press release from 06.04.2017 the Swiss Federal Statistical Office, Neuchâtel communicated the provisional figures for 2016: "... Switzerland's population increased by 1.1% in 2016 to 8,417,700 inhabitants. All cantons recorded an increase in their population…"

We have to assess the population growth in combination with the demands of the population. Figure 19 presents the increased demand for living space per person, for area of housing and infrastructure per person and for mobility.

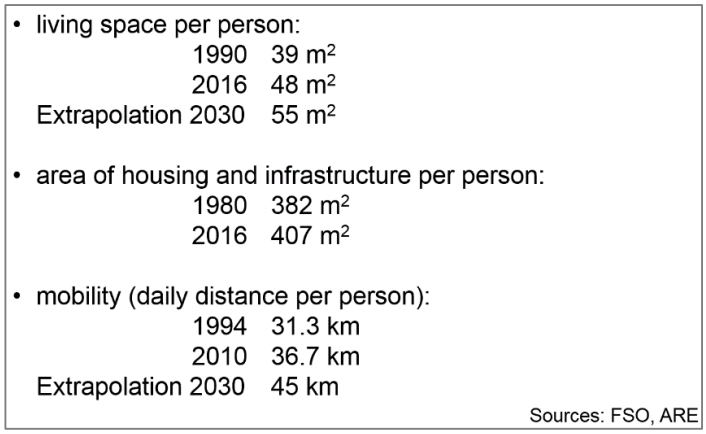


Figure 19. The increasing demand of Land space due to population growth

Switzerland's population is still growing. More and more people is living in a limited space. It has to be concluded that we need to optimize the use of our habitat.

But how can we intensify spatial use without loss of life quality? We could plan higher buildings and heighten existing buildings. But we have to take into account of light and shadow, and minimize noise and other pollution. With a bigger population and more mobility, we also have to improve traffic flow (public transport, pedestrians, cars).

With help of new technologies and official 3D geodata we fulfil this challenge!

Technology

In the last year's 3D data collection by lidar, georadar, drones etc. has become affordable and is now often used in the private sector.

The 3D data management in GIS is yet not common, even if professional design systems such as Archicad, Vektorworks and AutoCAD, are in use since many years. Simple design tools such as SketchUp and google maps are available to the public. BIM is about to be introduced in architecture and civil engineering.

3D visualization

Anyone can use 3D visualization. For example, 3D pdf is an easy to use file format. Gamers already know 3D virtual reality and appreciate the spatial impressions.

However, it's not only for fun. Mixed reality (the combination of real with virtual world) can also be used sensibly in the construction industry.

Politics

The underground is a recurrent topic in politics. Since 2009 there were about 50 parliamentary interventions pertaining to the use of the underground. Some Examples (original language and translation to English):

- 09.3806 Interpellation Riklin (23.09.2009): Regelung der nachhaltigen Nutzung des Untergrundes / Regulation of the sustainable use of the underground
- 09.4067 Motion Gutzwiller (03.12.2009): Im Untergrund herrscht Chaos. Ergänzung im Raumplanungsgesetz nötig / There is chaos in the underground. An amendment to the federal law on spatial planning is necessary
- 13.4158 Postulat Bourgois (11.12.2013): Potentiel du sous-sol. Règlement des conflits, gestion et organisation des tâches / Potential of the underground. Conflict regulation, management and organization of tasks
- 16.4108 Postulat Vogler (16.12.2016): Geologische Daten zum Untergrund / Geological data on the underground

These political interventions asked for:

- Regulations on the use of the underground
- Spatial planning
- Documentation of the use and potentials
- Documentation of the geology

Mostly they did not mention 3D geodata explicitly, but indirectly.

Legal Basis

Switzerland has since 2008 an advanced geoinformation legislation. It contains the general regulations according geographic information and geodata.

The details on the geodata sets are given in the technical legislation, e.g. federal law on spatial planning. If spatial planning in near future will take into account what is in the underground, then we need 3D geodata of the underground.

Hardly any law or regulation mentions whether a geodata set has to be in 2D or 3D. If a documentation has to be spatial, it can be assumed that the geodata set has to be in 3D.

A change from 2D to 3D has to be made only in the data model, which in most cases is a rather technical procedure, as the data models are described in technical regulations and not in the law itself. It does not demand a decision by the Parliament.

Conclusions

Therefore, my answer to the questions are:

- Do we have to incorporate all technical advances in official surveying?
  No, not all, but the essential needs of a majority of our customers, companies and public administration have to be fulfilled.
- Is there a real need for official 3D geodata?
  Yes, many tasks today can only be accomplished with 3D geodata. Existing official 3D geodata help companies and public administration manage their tasks efficiently and quickly.
- Who are the drivers for 3D developments?
  We, the ever-growing population who want to keep a high quality of life and needs more space and whose spatial development expands vertically.

Recent Developments in 3D with Special Reference to Cadastral Registration

Efi Dimopoulou (National Technical University of Athens, Greece)

Over the last years, scientific contributions and interaction between academia, industry and administration, showed remarkable progress in the fields of 3D Geospatial Models and Systems, which comprise Big Data, Data Management, City Modeling, Environmental and Infrastructure Management. These developments also reflect to the cadastral domain and improve land data management and modelling, as well as visualization of 3D parcels. Based on these technological advances and focused research, more operational 3D cadastral systems are establishing.

Since we live and act in a three dimensional world, 2D data is not sufficient to describe our world of growing large cities, with complex buildings and infrastructures. Our 3D reality needs 3D data and

this has been also realized by many mapping and cadastral organizations that move from traditional 2D based techniques to 3D data management and modelling. The same applies for stakeholders, decision makers and planners that demand for 3D information to efficiently support and promote their work. In recent years, 3D modelling techniques rapidly develop, providing new challenges and new roles in the Land Administration domain; these include 3D data acquisition and modelling, 3D representation, 3D data storage in spatial databases, 3D file formats for data exchange, as well as web-services.

Furthermore, “Smart Cities” is a fast growing “industry” that utilizes advanced technological tools for 3D mapping of buildings and facilities represented in several levels of details (LoDs). While the early digital representations of buildings was geometrical by the use of CAD software, nowadays with the development of Building Information Models, their 3D representation also contains topological and semantic information. These data can be potentially reused for land administration purposes, thus providing a challenging area for research.

In order to transform the huge amounts of data into useful information, 3D data needs to be structured into well-defined data models; the most important pure 3D physical models are CityGML, InfraGML, IndoordGML, BIM, and IFC, while among pure legal models are the LADM (ISO1915:2012) and ePlan (2010). Research initiatives towards integrating physical and legal reality include among others, LADM and CityGML through the development of CityGML ADEs (6), or LADM and IndoorGML (12) (see Figure 20 a & b).

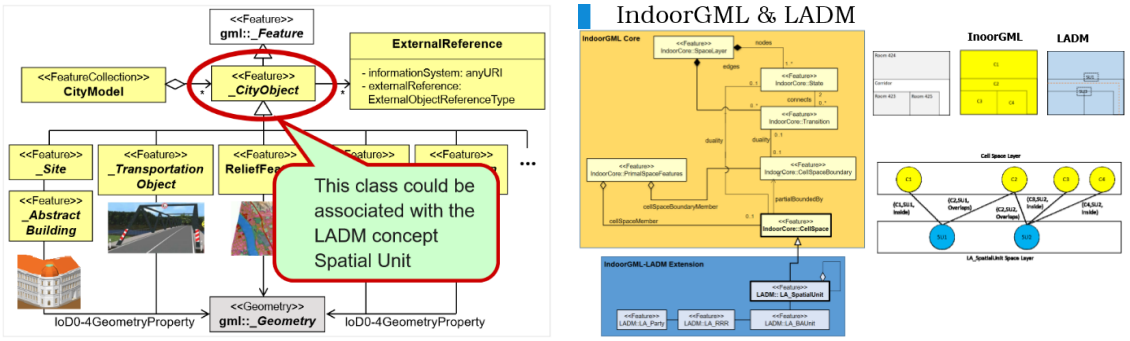


Figure 20. (a) “LADM as a CityGML ADE” (Kolbe, 2017) and (b) Synergy between IndoorGML and LADM (Zlatanova, et al. 2016).

Among other initiatives, the most important are listed as follows:

Çağdaş (1) developed a CityGML extension for the immovable property taxation system in Turkey; Góźdź et al. (2) also developed an ADE within the context of the Polish Cadastre; Soon et al. (10) proposed an extension of the LADM Web Ontology Language (OWL) to integrate CityGML with 3D LandXML, adopting ePlan as conceptual model; Rönsdorf et al. (8) demonstrated how the OGC CityGML standard can be used to provide an encoding for 3D land administration information; Dsilva (3) focused on the development of a CityGML Building Module ADE for cadastral purposes focusing on identification of the apartments and the ownership rights attached to them; Ying et al. (11) pro-

vided a framework and workflow of the conversion from CityGML data to 3D Cadastral unit; Roschlaub and Batscheider (9) used 3D City Database (3DCityDB2) to store 3D buildings in LoD2; and Li et al. (7) developed a LADM-based ADE for CityGML for 3D modeling of the ownership structure of condominium units in China by proposing a legal and physical hierarchy.

The above mentioned practical implementation of the CityGML-LADM ADE model display the benefits of providing relations between spatial objects from legal and physical world. The insight into the third dimension of physical objects helps to understand the location and extend of the legal spaces in the context of developing a multipurpose cadastral system (5). In all cases, Cadastre is at the core of Land Administration Systems, providing unique identification of every land parcel and associated rights, restrictions or responsibilities (RRRs). The development of three dimensional spaces in the different 3D modelling approaches, also requires developing a 3D cadastral management mode. A 3D building registration differs from a 3D Cadastre, since the Cadastre concerns legal spaces, that is, spaces described by geometry and topology where certain RRRs are attached to (4).

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The Added Value of 3D for Exploration and Design Activities in Geo-data Rich Environments

François Golay (Ecole polytechnique fédérale de Lausanne, Switzerland)

Over the last years, we experienced a tremendous growth in the offer of geodata on the market and on the Web. Satellites and drones are collecting huge amounts of images hardly manageable, planes and cars are collecting point clouds, archives are being digitized for any place and era in our world and history. Most of these data can be extended into 3D models that are made available for numerous exploration and design activities, going from the reconstitution of historical processes to the design of new urban developments. The presentation discusses promises and limits and the third dimension for such activities.

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