Dimension Cadastre – Stepping Beyond Limits

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SUMMARY

New information and communication technologies, along with economic, financial and political globalisation, the increasing movement of persons and cultural and social change, all have an impact on the way how geographic information systems, including cadastres, are perceived.

In Switzerland, the digital age for cadastral surveying started more than 20 years ago. The dynamic context mainly in the fields of geoinformation and spatial data infrastructures, however has implications, which need to be reflected on. A Think Tank was established in 2012 with the aim to identify the current trends and to develop a strategy for the cadastre to adjust to those trends.

A first result was a discussion paper published in May 2014, where several trends were being acknowledged. These touch on issues such as technology push vs. citizen pull, crowd-sourcing, open data, big data-data mining, legitimacy often prevailing legality, Internet of things, linked data, social media, social change, etc.

This article presents the identified trends.

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1. Changing World

Examining the evolution of the cadastre, of surveying and its various aspects means above all tracing the development of methods and technologies from drawing board and pencil to computer, from 2D to 3D, from terrestrial measurement to global navigation satellite system, from terrestrial surveying to photogrammetry, from databases to knowledge bases, and from analogue to digital technology. Boundaries between the private and the public sphere are disappearing.

>*Technology*: Today's devices no longer are passive terminals linked to central systems. They are computers in their own right, equipped with diverse sensors and countless apps; they even can show us the way around due to the built-in global navigation satellite systems. This allows for a contextual presence, in situ. These devices also can take photos and create video footage instantly – a far cry from Polaroid technology – since digital images can be modified, transmitted and stored "on the spot". This is a key factor for the coming decade. Our societies are moving away from the written word towards imagery, forming new semantics, new languages and a new framework of understanding.

>*Data*: Massive data collections are being generated also with help of those devices. The use of data mining, an approach to analyze and search such large databases can make use – or misuse – of those data collections. This development also caused considerable anger and concern throughout the world following the revelations by Edward Snowden. In that same context, the issue of open data is gaining ground, especially within public administrations, based on the concept of the openness of the Internet and open source software.

>*Social networks*: The rapid rise of social networks brings about the biggest change in social behaviour in decades. People are enabled to "socialise" freely with others at low cost, with varying degrees of commitment and for an indefinite duration in a new kind of "common interest club". This represents a complete restructuring of social relationships. It is not driven by religious movements or cliques, and even less by political circles or unions. Decisions are taken by each individual citizen. This empowerment is the very essence of the ongoing social revolution.

2. Positioning

We are witnessing the end of surveying in the conventional sense, mainly because positioning might soon be just as accurate and more or less obtainable in real time by the above mentioned devices. The contributions from – traditional – surveyors will decrease, which also can mean the end of the surveying profession as we knew it up to now. But what does that

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mean for the future of the surveying profession? There are indications that surveyors in the future will have a role to play in the transition process, i.e. as professionals in charge of changing and adapting representations of properties, and the management of land and augmented reality.

One thing that seems certain is that official cadastral surveying provides authentic and certified data that are essential for a country's economic development through guarantee of the required geometrical and attributive accuracy. And this official guarantee needs to be retained, as numerous political and social decisions depend directly on official cadastral data.

What may change, however, is the method of data collection. Global navigation satellite systems in combination with smart devices may provide data, collected by citizens, through visual recognition. It is by pointing the smart device at a building, a land parcel, or even a landscape that recognition in its entirety will work. The territory will signal our position to us with absolute accuracy. In a manner of speaking, the land will become the map encompassing all maps.

The theoretical and practical consequences will certainly concern the legal recognition of such methods, or more precisely of the algorithms behind. Up to now we set out to define databases of objects, cadastral layers, etc. But in the future, in addition to all the existing or new databases, we will also be storing and archiving algorithms. These will require official certification because they will form the basis of the reconstitution of datasets and data.

3. The Objects of the Cadastres

The legal mandate has been an essential factor for the traditional cadastres, based on surveying and land registration. But increasingly, and in the wake of digital technology and the political call for professional land management, new categories of legal land objects are evolving and thus give rise to new levels of representation.

While technological and political pressures led to the rapid development of the cadastre over the last two decades, particularly following the advent of the Internet some 20 years ago, we have to anticipate that social changes – increased involvement of the public (access to open data, apps and open source software) and social networks (e.g. participation in activities such as Wikipedia, eBirds, Youtube) – will give rise to radical new approaches, namely a society driven more by a legitimate than a legal impetus.

If the legal basis was a constitutional element in democracies, especially in the West, the situation seems to become somewhat different today. In fact it now appears that an action deemed "legitimate" can prevail over a national legal system. An example can be seen in Switzerland in connection with the blacklist of countries regarded by the OECD as "tax havens". Although Switzerland's position was based on a sovereign and legal foundation, the "legitimate" pressure exerted by some of the major OECD member states sufficed to cause Switzerland to quickly bend one of its most essential principles, namely the rule of law.

The differentiation between a position based on a legal foundation and one based on "legitimate" actions is a constituting element of societies today, and especially of global governance. As more and more people become involved in social networks, they will continue

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to exert pressure in this sense, and if we consider the development of public opinion, transparency and "political correctness" in society in the course of the last few decades, there can no longer be much doubt about this process of societal change.

4. Cadastral Dimensions

When representation was planar, we were dealing with a world in which objects were described in two dimensions; maps and plans were sufficient. The representation of pipes and conduits beneath the ground, and of the height of buildings, slope of roofs, etc., led to the creation of what we now call 3D within geographic information systems.

But modifications, and above all their preservation together with their still legible notes on old plans and maps despite the fact that they had been partly erased, gave rise to the illusion of historical development. Today, with the aid of digital storage of data it is – and will remain – easier to obtain a history of modifications of the cadastral system and thus of the recorded objects. In areas such as tourism and land-use planning, as well as regional economic development, there are also calls for data to be attached or linked historically to buildings and land. Temporal (4D) data of this type are not currently regarded as an integral part of the cadastral system, but they should be incorporated in the future, also at the legislative level.

5. The Internet of Things

Smart devices act as intelligent systems equipped with functions for geo-localisation, visualisation, simulation and anticipation. They will act with algorithms and huge databases that are fed and accessed via cloud-services on the Internet, basically anytime anywhere.

What is lacking is an understanding of the implications for the cadastral system. Let us imagine how it may look like in twenty years time from now: we can assume that, in addition to surface, line and point objects, there will also be virtual and algorithmic objects. Together these will form the basis of a new cadastral system. Each of these objects will belong to a new nomenclature recordable in URI format so that it can be directly accessed via the Internet. This will resemble a huge virtual library in which each object will have an identifier just as each book has its own form of identification (ISBN). Initially, all cadastral objects will be provided with a uniform resource identifier (URI), in order to be addressed; later they will be given physical (IP) addresses to make it possible to connect smart systems associated with the objects.

As far as the objects forming the present-day cadastre are concerned, it can already be predicted that in the future they will mainly be linked with each other via the Internet platform. This is only possible when an infinite number of IP addresses is available, which will be very useful for urban development, construction of new roads, etc. It will be possible to provisionally deposit measurement instruments in order to simulate situations such as rainfall, landslides or exposure to sunlight.

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Surveyors in the future will ideally be the architects of this transformation and acting as brokers of the transition process. They will thus have to evolve towards a transformational profession.

6. Augmented Citizen

In the previous chapters concerning the major changes taking place today, we have noted that there has been an increase in the role played by citizens (grouped into social networks) in the value-added chain. Thanks primarily to the Internet and so-called smart systems and devices, people now find themselves in a situation in which they can directly intervene in information and production systems. Blogs, feedback, applications like Mash-up, etc., enable them to contribute to databases, including geographic information systems, to such an extent that these have come to rely heavily on their input. Consider, for example, feedback on restaurants, hotels, travel, visits to museums, etc., in the tourism sector, or reviews of music and books, or comments on numerous other products. Everything, or almost everything, can now be reviewed, commented on or ranked by anyone. The information about such items is significantly modified because it has acquired a subjective and more or less emotional dimension. This kind of contribution is unexpected for specialists working with "cold" objects like maps and cadastres! The way forward has been mapped out, and we are moving in the direction of integrated information systems: the objective and the subjective, the legal and legitimate, the real and the virtual. Through this integration we describe the core of our vision for which we have enhanced the dimensions, the objects and the involved players (or stakeholders).

One of the major challenges to be faced in the future concerns the integration of the public as stakeholders in the cadastral system. The solution will neither be obvious, nor easy. Initially the answer will be to prompt people to submit comments regarding, for example, footpaths by asking them to intervene prospectively to report identified dangers and problems and to give warnings so that their contribution can be clearly beneficial to others.

7. The new "Common Property" and Stakeholders

A new notion is emerging between private and public property, namely one that could be referred to as "common property" or "common asset", which to a certain extent takes the form of shared knowledge, or public and open know-how. To better illustrate, we may look at examples from various newspaper articles initiating a web-based platform for reporting of information that permits people to describe an aspect of specific locations in for example 100 characters.

Combining data and knowledge, such initiatives can create a common asset. Other examples are knowledge about footpaths, Google Street View, City Wikis, as well as dedicated web sites such as Craiglist (San Francisco), eBird.org for birds, virtual visits to tourist destinations, but also knowledge of the past or present development of a particular city, district or street. At the same time, these private and open knowledge collections can be link or combined with

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public and authoritative data of different levels defined by geomatics, cadastre, geography, or geology.

For surveying, cadastre and land register professionals, the concept of "common property" as neither private nor public, but somewhere in between, certainly raises questions. It may mean that the professional communities may have to rethink their approach to these issues.

8. Conclusion and Discussion

In a kind of metaphorical reversal, it is the land that has taken today the upper hand and determines our activities; the land is becoming the map, so to speak. By looking at the landscape with the aid of mobile and intelligent devices such as smart phones, tablets, or drones, we are able to obtain images of augmented reality.

The virtual world has for many years been used mainly for special effects on big screens and will increasingly be used in the future, whether for activities via webcams or via applications for smart devices. There are three key elements that play a role in this: first, the Internet provides a common platform and simplifies the communication between systems that were previously incompatible; second, the introduction of geo-localisation via global navigation satellite systems means that any location can be viewed and accessed in real time and at any time; and third, visual recognition makes it possible to remotely identify, for example, the names of mountains, sites and monuments. The combination of these key elements makes it possible to bring more or less complex datasets and images onto the screen.

Future discussions will mainly revolve around issues relating to open data and open source software. Initially public administrations and politicians had good intentions by establishing and using large databases, mainly for providing security and public safety. However, the debate has taken a drastic new turn with the capacities of data mining and certain algorithms, and above all the use to which they have been put to, in particular in the USA by the National Security Agency to spy on people and organisations. Doubts regarding the non-private use of personal data will remain until a technical or legal solution is found to assure better privacy protection.

Another aspect of the ongoing discussion concerns the question of how to open up "big data" to the public, and not only to companies. The idea based on the model of Wikipedia is to offer virtual communities (social networks) the possibility of accessing these data without restriction and free of charge. The introduction of the Internet allowed for the concept of free of charge information access, which often led to radical modification of business models and activities.

So how can we incorporate the opening up process without harming the privacy at the same time (a question that is illustrated by the discussions around Facebook)? And how can we retain the concept of free of charge information access without harming the business sector? These are social issues that the current debate is only now beginning to address.

As far as the future of the cadastre is concerned, there are several key issues to be discussed:

First, the growing importance of "legitimate" versus "legal",which can be interpreted as a confrontation between a priori and a posteriori legislation. To a certain extent, there is a shift

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happening between the European continental (a priori) civil code and the Anglo-Saxon (a posteriori) common law jurisdiction systems that could be observed for the last two decades.

Second, there is the question of the relevance of introducing new objects into cadastral systems. Following the introduction of 3D, we are now witnessing the emergence of 4D with the history of modifications.

Third, there is the question of the public as stakeholder, as consumer, player, and co-creator of future information systems. Crowdsourcing appears to be invading the Internet and it is conceivable that it can affect matters, which were reserved for public administrations so far. It might therefore be essential to prepare for this development, even if the debate has barely commenced.

And finally, there is the central question of ownership, the private/public aspect and the new concept of the "common asset". This is still in its infancy to the extent to which, in our society, it initially concerns the issue of transparency. But if we can see the names of the owners of all plots of land throughout the country on our smart phone, it is difficult to imagine how the question of protection of the private sphere can be addressed. The question of transparency and privacy has not yet been resolved at the social and political levels.

In this discussion paper we have considered some of the issues which will be discussed in the future and will concern society as a whole. But we are well aware that, for the involved professionals, another matter appears to be just as urgent, namely the redistribution of tasks. In other words, who will be responsible for what in the future at the municipal, cantonal and federal levels, in the private and public sectors, and at the professional and private levels.

Our conclusion can perhaps be summed up by reversing Alfred Korzybski's aphorism "The map is not the territory", BUT **"The territory is the map"**.

This article is a shortened and summarized version of the report "Beyond Limits" by the Swiss "Dimension Cadastre" think tank (more information at www.cadastre.ch/vision). The intention of that report was not to predict the future, but to identify and discuss trends that are felt within society and within the professional community.

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BIOGRAPHICAL NOTES

Daniel Steudler holds a PhD degree from the University of Melbourne, Australia and is a scientific associate with the Swiss Federal Office of Topography swisstopo, working for the Federal Directorate for Cadastral Surveying. He is active in FIG-Commission 7 for many years and was chair of the FIG-Task Force on «Spatially Enabled Society». He published widely in the cadastral field and consulted internationally in land administration and cadastral issues. Since March 2015, he is chair of the EuroGeographics "Cadastre + Land Registry".Knowledge Exchange Network.

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