

INTERNATIONAL EXPERTS SPEAK OUT

Towards Cadastre 2034

To what degree have the objectives of Cadastre 2014 been accomplished? What are the societal and technological dynamics that may affect the international practice of land administration over the coming twenty years? Bennett and co-authors from the University of Melbourne, Australia, have described six design elements relating to the role and nature of future cadastres, presented at the FIG 2010 congress in Sydney and published in GIM International (July 2010); an inspiring starting point for further dialogue. To encourage discussion we invited leading experts and practitioners to send us their own views and vision. We received no fewer than ten replies; five are printed here, five will be published as Part II in the October issue of GIM International.

Cadastre 2014 is an influential publication produced by a FIG Commission 7 working group between 1994 and 1998. The task was to develop a vision for the modern cadastre of twenty years hence. Authored by working-group chairperson Jürg Kaufmann and secretary, Daniel Steudler, both also contributing to this Invited Reply, this excellent review of the strengths and weaknesses of cadastral systems of twenty years ago and vision for the future, were presented at the FIG Congress in Brighton in July 1998. As Prof. Ian Williamson, then chair of FIG Comm. 7, noted in his foreword, the vision recognised many ongoing changes, including the role of government and surveyors in society, relationship of humankind to land, the growing role of the private sector in cadastre operation, and dramatic influence of technology on cadastral reform.

Magic Number

As we rapidly approach the year 2014 it becomes relevant to ask to what degree the objectives of Cadastre 2014 have been accomplished. Those involved in land administration also need to signal societal and technological dynamics that may affect the practice of land administration worldwide over the coming twenty years. Rohan Bennett, Mohsen Kalantari and Abbas Rajabifard, all scientists at the University of Melbourne, Australia, took the laudable initiative of isolating six design elements:

- move from approximate boundary representation towards survey-accurate boundary representation
- focus shift from purely parcel-based systems towards systems of layered property objects
- expansion from 2D approaches to include the third (height) and fourth (time) dimensions
- updating and accessing of cadastral information in real time
- making national and state-based cadastres interoperable at regional and global levels
- inclusion in property interests, now designed around strict bearings and distances or Cartesian coordinates, of modelled organic natural environment by enabling fuzzy and dynamic boundary definitions.

Six seems to be the magic number when it comes to developing a vision on the future of cadastres. The authors of Cadastre 2014 too presented six topics, calling them not 'design elements' but 'statements'. For the sake of completeness we present these, distributed throughout this article and accompanied by illustrations from the original publications.

Technology: Enabler not Driver

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Delighted to be invited, although responding presents me with quite a dilemma! It is highly commendable to 'let the dialogue begin', but Dr. Bennett et al. have adopted a supply-driven, techno-centric approach: spatial accuracy, new geospatial technologies, and so forth. Their emphasis is on the spatial component rather than on broader and more important social, legal, fiscal, economic and environmental issues. For sure, a robust and healthy debate will ensue!

Cadastre 2014

No other document on cadastral reform has been so widely accessed, quoted and misquoted, dissected and repackaged, as well as applauded criticised, utilised and plagiarised as the seminal Cadastre 2014. Its strength has been its success in raising awareness and encouraging debate. It has fostered broader multidisciplinary and cross-sectional dialogue. It was published before De Soto's *The Mystery of Capital* and the accompanying plethora of accolades and rebuttals, and before the Millennium Development Goals (MDG) were in place. Climate change and food security were not yet on the global radar screen. It was clearly influenced by John McLaughlin's multi-purpose cadastre, around since 1975. Cadastre 2014 does not explicitly refer to land governance as an issue, but raises throughout many

governance themes; it is therefore particularly significant that FIG, the World Bank and United Nations institutions are now placing such strong emphasis on land governance, especially in the light of a global land-grab rush.

Demand-Driven Focus

It is time for the demand-side view, prioritising important social, legal and environmental agendas: securing basic rights; providing for equity, fairness, transparency, accountability and the rule of law (Figure 1); government decentralisation; and responsible triple bottom-line sustainable development. The cadastre is fundamental to responsible, sustainable development of land, the most fundamental natural resource. Hence the importance of registering all land parcels, both state and private, with an appropriate level of spatial accuracy. However, not every right and interest in land requires registration. This is especially true for countries where people live in extreme poverty, defined as existing on less than USD1.25 per day, and governments and donors need to make hard strategic choices in allocating limited funds.

Land Governance

All too often, across all regions, the powerful elite grab land and enrich themselves by encouraging international and local investors in agribusiness, mining, forestry and infrastructure to the detriment of the poor and the environment. The high level of corruption prevalent in the land sector in many countries, especially under the 'Global Land Rush', is a major concern. The harmful effects are obstruction and manipulation of cadastral information, resulting in discrepancies between reality and registration that foster abuse on the part of the powerful. The bottom line is that information stored in cadastral registers should be trustworthy, but such good governance is obstructed by social power structures. Only recently have these topics become subjects of open discussion. Technology should be about improving transparency, good governance and peoples' access to services.

Priorities

What is important is completeness of the land inventory and good land governance. Are real-time, spatially accurate cadastres more important than water, sanitation and nutrition? Other than for national borders and maritime boundaries, I don't see arguments for investment in interoperability of systems across international borders, the exception being within the European Union. Australia's efforts to bring about e-conveyancing over its eastern states have been plagued with problems and controversy.

My work across three regions has shown me cadastres over-engineered, often by vested interests, in pursuit of high spatial accuracy, with little attention for the real need to build and maintain sustainable cadastral systems. Considerations concerning spatial accuracy should always be based on fitness for purpose! Improvements in spatial accuracy and records should be demand-driven and achieved incrementally over time. Technology should be enabler not driver. Investments must be sustainable and relevant to the needs of broader society, not about strengthening technocratic geospatial silos.

Continuum of Rights

Dr. Mohamed El-Sioufi, head of Shelter Branch, UN-HABITAT, has over 30 years international experience practicing, advising, training and teaching in the human settlements field.

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Bennett and co-authors project the future shape of cadastres. These systems will transform cadastres from two-dimensional parcels to property objects capturing their three dimensions and metamorphosis over time. These new levels of sophistication will add particular value to properties of historic, architectural or high value. Given the current time involved in developing cadastres, such enhancements will involve even more time and cost, even if technology gets cheaper. In the case of important properties this is certainly justified. We at UN-HABITAT look at the other end of the property spectrum. We are concerned with rights of access to land, particularly by the poor. In most developing countries only a very small proportion of properties are captured in cadastres; maybe as little as 15% in some countries. In African developing countries less than 30% of land is in cadastre systems, and only 2% of women own land; rights of access to the remainder are governed by various systems, including customary, tribal and others, mostly not officially recognised. That is, they are not documented.

STDm

To address these types of rights and bring them into the spectrum of documented property there is a need to acknowledge a continuum of rights that starts in the lower range, including perceived, customary, occupancy and group tenure, and extends to the more legally binding leases and registered freehold (Figure 2). To address this gap, partners in the Global Land Tool Network (GLTN) including the International Federation of Surveyors (FIG), the Faculty of Geo-information and Earth Observation (ITC) at the University of Twente, the World Bank and the United Nations Human Settlements Programme (UN-HABITAT) have jointly developed a new tool: the Social Tenure Domain Model (STDm). This was launched during the 24th (FIG) Congress held from 11th to 16th April 2010 in Sydney, Australia, and has the capacity to integrate informal, formal and customary land information, contributing to improved tenure security for the poor and vulnerable groups like women. The challenge now is to link these two land-information systems: the highly sophisticated multi-dimensional Beyond Cadastre 2014 and the rights-based STDm. The systems are complementary, addressing as they do the needs of diverse clients representing often differing but intertwined juridical and social realms. UN-HABITAT would like to see further discussion and research focused on linking the two systems to support the growth and development of cities without leaving behind the poor.

FIG Should Take the Lead

Jürg Kaufmann, graduate of the Federal Institute of Technology in Zürich, has since 1988 been an independent national and international consultant engineer based in Switzerland. With a background in surveying and business administration, he became a Swiss Federal Licensed Surveyor in 1981. He is co-author of the FIG Publication Cadastre 2014 and was awarded FIG honorary membership in 2006. From 2003 to 2010 he was president of the Swiss Association of Geomatics and Land Management, of which he is also an honorary member.

As an author of Cadastre 2014, I am pleased that the cadastral aspects are dealt with in a comprehensive manner. This was our aim when we recommended that FIG 'promote and sponsor a competence centre for modern cadastral systems'. The authors address a range of aspects to be taken into consideration when thinking about the future of cadastral systems, and they do this with an overall view which is highly appreciated.

Boundaries: the Real Challenge

For too long now, discussions have centred only on individual aspects addressed in an isolated and parcel-focused manner. Neglected has been the fact that the institution of 'Cadastre' has to adapt to new legal arrangements necessarily introduced to organise habitats within an increasingly complex and populated environment. The organisation of habitats requires determination and documentation of boundaries. This technique is applied by nature in many societies, and even by animals. All boundaries defined by modern legislation creating property or, in the sense of Cadastre 2014, legal land objects, are the real topic of and challenge to modern cadastral systems. So I would give first priority to statements about boundaries and overcoming restrictions on parcels. However, I agree in general with the remarks on survey accuracy. The need for accuracy is defined by scarce resources and dense population. In view of trends in cost and expertise, we may expect the accuracy issue to figure less large in the future. The moment we accept the dominant role played by legal objects in modern cadastre, the 3D and 4D problems will be solved. It is possible to use 3D coordinates to locate these objects. The fourth dimension is resolved as soon as legal procedures are integrated into the system. Real-time maintenance and access is mainly a matter of mental change. We dispose of the technical tools, but surveyors (and lawyers) hesitate to re-engineer the procedures. The term 'uncertainty averse' might be appropriate here.

Common Understanding

Regionally and globally linked cadastres will emerge with the application of ICT tools. The main factor in success will be common understanding of the contents of cadastral systems. The Cadastre 2014 definition with legally independent information layers and correct data models is vital to achieving mutual understanding. The statement on a fuzzy and organic approach brings us back to the key issue of cadastral systems: boundaries. Answers to the question of precise boundary localisation can be found only within the legal frameworks and respective case law. Society must define how to deal with this aspect; research is needed to determine how it reacts to fuzzy boundaries. It seems a breakthrough in this field would accelerate urgently needed mental change.

In my view Cadastre 2014 still provides a valuable framework. It is time for FIG, together with research institutes, to take the lead in developing comprehensive modern cadastral systems.

Finnish Perspective

Jarmo Ratia, since 1991 director general and CEO, National Land Survey of Finland, has held many administrative positions in national and international organisations including the 1996-1998 presidency of CERCO (Comité Européen des Responsables de la Cartographie Officielle). He was GSDI president from 2006-2008, and president of the Permanent Committee on the Cadastre in the European Union in 2006.

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Bennett, Kalantari and Rajabifard have made a very interesting contribution to discussions concerning the role of cadastre in modern society. Some of their main ideas are discussed below from a Finnish point of view. According to Finnish legislation and century-long practice, a boundary is defined first and foremost according to markers in the ground. Only in cities, for practical reasons, do coordinates play a decisive role. In large rural areas only some boundary beacons have accurately surveyed coordinates. For areas involved in development plans, more thorough coordinate information can be produced by improving the cadastral index map. Establishing survey coordinates for the whole country is, however, not considered economically sensible now or in the near future. Introduction of a coordinate-based cadastre in Finland would be a leap into the unknown. Striving for a survey-accurate cadastre is desirable as such, but its practical realisation requires the simultaneous development of legislation, IT systems and work processes. In any case, a long transition period would be needed. From the information service point of view, creating a metadata repository concerning the cadastre would in the first instance serve changing customer needs.

Crossing Borders

The new dimensions of the cadastre (time and height) are closely connected with a change in focus from parcels to property-object or

property-right approach. The need for 3D-properties is undisputed, especially in city centres. So in Finland preparatory work is underway towards enabling 3D-property formation. The need for registering the time aspect lies even farther in the future. The most obvious example of this type of phenomena is the 'time share', which is quite common in Finland, but for the time being there is no urgent need for cadastral registration of every such right.

It is, however, a logical future developmental step. Interoperability of national cadastral systems on the one hand, and the cadastres and other registers within them on the other, is an important goal. This has also been stated in the EuroGeographics vision on cadastre and land registration. There are several ongoing European and global projects the aim of which is either to lay foundations for or build systems that enable cross-border information flow. Among these are LADM, as well as EULIS, the INSPIRE directive, and national SDIs and eJustice. The National Land Survey of Finland is convinced that use of a cross-border cadastral information service will multiply over the coming decade or so. So that common efforts should be particularly directed towards building efficient information services.

Natural Boundaries

A natural conservation area is an example of a restriction that does not follow parcel boundaries. In Finland prerequisites and process have been defined for forming a cadastral unit with fixed boundaries of, for example, such a conservation area. Natural phenomena such as post-glacial rebound or riverbank migration may again mean a cadastral boundary no longer runs along the original shoreline. These sorts of discrepancy can be dealt with in cadastral surveys and in the cadastre. Little or no importance has been paid to the idea of letting a boundary follow a moving geographical feature.

First Thoughts

Dimitris Rokos holds a degree in Rural and Surveying Engineering from the National Technical University of Athens, and received a PhD in Geography from the University of Iowa in 1995. Since 1996 he has been involved in the Greek Cadastre. He currently holds the position of deputy director of projects with Ktimatologio S.A., the state company responsible for developing Cadastre in Greece.

As 2014 fast approaches, the cadastral community needs to ponder to what extent the goals of Cadastre 2014 have been achieved and try to identify new trends and user needs beyond 2014. The discussion is now open, and what follows are some first thoughts on the six design elements presented. Real property objects emerge as a natural evolution of Cadastre 2014's third statement concerning cadastral modelling. Real property objects are, however, generally three-dimensional (especially in the context of urban environments) and may have fuzzy boundaries (indigenous rights, ecosystems, marine environments). To better integrate such real property objects in our cadastral systems, not only their visual representations but also their spatial and legal interactions must be effectively modelled. These complex interactions stop the issue of real property object representation being limited to just footprints and recording a height. New ways have to be adopted to allow 3D representations in the daily operation of cadastral systems. This will probably require the integration of digital representations of real property objects in titles and deeds which, to realise their full potential, must as future standard become digital documents (digitally signed).

Accuracy and Time

The issue of survey accuracy should be addressed with care, as this will considerably affect the cost of upgrading and maintenance. A cost-benefit analysis should precede such a decision, evaluating the benefits projected to arise from its extended usage. This, however, does not contradict a systematic effort to gradually upgrade the quality of the information contained in a cadastral database by incorporating newer and more accurate measurements conducted in the context of everyday operation (i.e. subdivisions, adjudication of cadastral boundaries). This can be achieved by documenting with appropriate metadata the level of quality/accuracy of each cadastral element, thus defining its possible future uses.

Time as a fourth dimension introduces the concept of recording history of real property objects and changes in rights, restrictions and uses on them. Tools for analysing and visualising change through time must be formalised, as the fourth dimension will allow better study of real property market trends and provide a very important tool for planning and development.

Property Markets

Globalised economy is now a fact, and such an environment confronts cadastre with new challenges. Although cadastres around the world carry different historical, political and cultural characteristics which make each system if not unique, at least different, there is now a stronger need to better realise the potential of global and regional real property markets. Projects like the European INSPIRE Directive, the Land Administration Domain Model and EULIS offer various approaches to the goal of interoperability. It remains to be seen whether the 'stricter' and more formal modelling of LADM or the 'looser' EULIS common portal will be the approach that eventually manages to achieve a 'usable' globalised cadastral picture.

Concluding remarks

In Part I of the Invited Reply on 'Beyond Cadastre 2014' the following international experts put forward their views and opinions: Keith

Clifford Bell, World Bank; Dr. Mohamed El-Sioufi, UN-HABITAT; Jürg Kaufmann, co-author of Cadastre 2014; Jarmo Ratia, National Land Survey of Finland; and Dimitris Rokos, Ktimatologio S.A., Greece. In Part II, to be published in GIM's October issue, another five international experts will speak out: Dr. Clarissa Augustinus, UN-HABITAT; Dorine Burmanje and Dr. Martin Salzmänn, Kadaster, Netherlands; Paul van der Molen, Twente University (ITC), Netherlands; Daniel Roberge, Quebec cadastre, Canada; and Daniel Steudler, co-author of Cadastre 2014. What conclusions can be made from the replies given by the experts to the six design elements proposed? This question will be answered in Part II. Many thanks to all the professionals mentioned above for their contribution to this discussion.

[Continued in Part 2](#)