

INTERNATIONAL EXPERTS SPEAK OUT

Towards Cadastre 2034: Part II

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 future vision. We received no fewer than ten replies, half of which were printed in the September issue. Here are the remaining five.

Cadastre 2014 is an influential publication produced by a FIG Commission 7 working group between 1994 and 1998. Approaching 2014 it becomes relevant to ask to what degree the objectives of Cadastre 2014 have been accomplished and what are the 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 initiative of isolating six design elements for future cadastres (see side bar). In Part I of the Invited Reply on Beyond Cadastre 2014 the following international experts voiced 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. One of the five respondents in Part II, Daniel Steudler himself co-authored Cadastre 2014. We start with his reply. In Part I, four of the six statements of Cadastre 2014 were presented together with the illustrations from the original publication. For the sake of completeness, we present the remaining two statements in this Part II.

- Move from approximate boundary representation towards survey-accurate boundary representation
- Shift focus 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 level
- 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.

Strategic Significance

Daniel Steudler has worked for the Swiss Federal Directorate for Cadastral Surveying since 1991. He has conducted extensive research in the field of cadastral systems and co-authored Cadastre 2014. Since 2003 he has been the Swiss delegate to FIG Commission 7 and is currently its vice-chair.

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Congratulations and thanks the University of Melbourne team for reviving the dialogue on cadastral science and developments! Some issues raised, such as survey accuracy, object-orientation or information layering, were already dealt with in principle in the original Cadastre 2014 publication, but experience has shown that they need more and continued emphasis and discussion. Often mistaken for purely technical issues, they are of great strategic significance, with serious implications for the conceptual design of a cadastre. The benefits, however, are substantial, as the article by Bennett and co-authors clearly illustrates. Other issues, such as '3D and 4D', 'real-time processing', 'regional and global scales', and 'fuzzy and organic', are contemporary topics and certainly need to be discussed.

Data Modelling and RRR

Two issues from the original Cadastre 2014 need to be emphasised: data modelling, and extension of cadastres with RRR (rights-responsibilities). Cadastral systems are documentation systems: data collections of authentic official data stored in digital databases. A clear definition of the final product is needed, to be made using data modelling techniques, if possible in a system-independent way in order to guarantee broad data interoperability. The documentation of RRR and their integration into the cadastre has

already begun in some, mainly developed, countries to better manage scarce-resource land and make the land market more transparent. Examples that would have to be considered in future discussions include water rights or carbon credits, ever higher on government agendas. Global warming is increasingly facing societies with natural disasters. This situation requires enhanced preparedness through better disaster management; that is, better prior data. Data about protection and hazard zones, as well as landownership information, play an important role.

Change in Paradigm

It is crucial for the profession to understand that cadastral systems, like topographic mapping, are in the midst of a change in paradigm. The digital revolution requires ubiquitous access to data and information in digital form. Drawing maps is not the first priority, but provision of information to be stored in readily accessible databases. The issues around cadastral systems are more complex than they seem, but it is a motivating challenge to explain their potential to society and decision-makers. Let's continue the dialogue; FIG Commission 7 over its coming four-year term 2011-14 will certainly continue its commitment to collaborative research in this field.

Accuracy No Solution

Dr. Clarissa Augustinus, chief of the Land, Tenure and Property Administration Section, Shelter Branch, Global Division, UN-HABITAT, received a PhD in Social Anthropology based on her research into customary and informal land tenure in an informal settlement in Africa. Prior to joining UN-HABITAT she was senior lecturer at the School of Civil Engineering, Surveying and Construction, University of KwaZulu-Natal, South Africa, focusing on land management. She has also acted as an international consultant on land management and administration from an institutional perspective.

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There exists enormous global challenges for which the land industry needs to produce solutions. The current accurate parcel-based Beyond Cadastre 2014 approach proposed by Bennett et al. is not the solution. The land industry needs rather to be developing appropriate tools for users across the spectrum, including the poor, women and men, and in different regions of the world, not just for the developed world, as outlined in their article.

Informal Settlements

What needs to be developed is a pro-poor land-administration system (LAS) of completely different design, interoperable with current cadastral systems. This technical gap needs to be filled for a range of purposes, including:

- forest management
- wetland management outside the register
- customary tenure with layers of group rights
- informal settlement inventory in preparation for upgrading
- large-scale identification of land rights and claims following natural disaster, including multiple households inhabiting same dwelling unit, as a pre-cadastral step
- development of claims database in post-conflict environments, including overlapping claims.

To take this further, Bennett and co-authors illustrate challenges to the cadastre in the developed world, which misses one of the greatest challenges to any country's cadastral system: informal settlements. By 2030 the urban population of all developing regions, including Asia and Africa, will far outweigh the rural. This massive shift towards urbanisation over the next twenty years will be characterised by informality, illegality and unplanned settlements. Urban growth will be associated with poverty and slum growth. Today about one third of urban residents in the developing world live in slums which either lie outside the cadastre or the occupation of which does not match it.

Pro-poor

Meeting this challenge requires collaborative research focused on the urban and rural poor, rather than just the developed world. FIG has seen this gap and been extensively engaged with UN-HABITAT, Delft University and ITC (Netherlands) in developing the Social Tenure Domain Model (STDm), a pro-poor land-information management system under evolution by the Global Land Tool Network partners. RICS, also part of this network, is working on how to value unregistered land, to help poverty-stricken widows. In most developing countries only about 30% of land is registered. The challenge facing the land industry is to design tools for the whole range of global society, not just the developed world. This is the only way towards stable, well managed cities and sustainable urban development. The current accurate parcel-based approach proposed by Bennett and co-authors provides only part of the solution. A linked pro-poor LAS, of completely different design, needs also to be put in place to ensure sustainable urban development.

Working Together

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It's a pleasure to reply to a positive and ambitious view on the future of cadastres. Our organisation, Kadaster (the Netherlands Cadastre) is in the process of updating its mid-term policy plan up to 2015; so already thinking beyond 2014! In common with our partner organisations within Europe, the Netherlands recognises many of the trends described by Bennett and co-authors, some of which have already been put into action.

Scarce Resources

Fundamental to changing the role of cadastre are limited resources. Scarcity of land and its natural resources, smaller budgets and tighter efficiency controls in relation to growing public and private interests lead to more complex social decisions. Opportunities are offered by the added value of (spatial) information and related technological developments which enable integrated decision making. Using as basis the existent scarce land resource, Kadaster has already developed into a mature and well maintained information system. In the future the 'traditional' cadastre will provide a strong foundation for integrating and linking spatial information. An example is the inclusion of the parcel as core spatial element in INSPIRE. We are experiencing increasing integration of our cadastral information with other spatial and non-spatial components (Figure 1), emphasising the importance of working together and maintaining strong relationships with existing stakeholders. We see this as the key to future success.

Interrelated Organisations

At the moment we frequently co-operate with new parties, helping improve our services. We also facilitate other users in both the public and private sector in serving their customers. So the cadastre of tomorrow is about creating a network or web of interrelated organisations and communities. Making processes interoperable forms the basis for successful e-government. In the Netherlands we have just embarked on a major public-sector programme for sharing and distributing spatial information. Many opportunities exist for cadastres in addition to those sketched in Beyond Cadastre 2014; however, implementation within our processes and institutional settings will pose many challenges. Kadaster looks forward to moving beyond 2014, and to sharing experiences and learning from counterparts. We want to stay involved and contribute to discussions on the cadastre of tomorrow.

Time Will Tell

Daniel Roberge, director of the Office of the Surveyor General of Québec, has been involved in the design, development and implementation of two national land reforms: that of the Quebec cadastre, which covers all privately owned land in Quebec, and modernising registration of rights on public land.

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I found the invitation to comment on Beyond Cadastre 2014 very opportune and timely because, as chair-elect of FIG Commission 7 (Cadastre and Land Management), I am currently elaborating a work plan for the coming four years, focusing on cadastral perspectives. Further, my organisation, Foncier Québec, will soon have to redesign its cadastral systems; we'll have to foresee a sustainable way of managing our land-rights infrastructure.

Survey Accuracy

When we started the Cadastral Reform Program in Quebec in 1992, there were people who thought us crazy to undertake resurvey of all the four million private parcels while others were making the shift to a digital cadastre through digitising, compiling and rubber-sheeting their parcel plans at much lower cost (Figure 2). Today, with the development of eGovernment and the 'Spatially Enabled Society' intensively based on cadastral data, we are convinced our decision was the right one. For developed countries I do agree with the 'survey accuracy' design element. But developing countries, where the need for land-rights infrastructure is primary and resources are scarce, require light and low-cost solutions creating exact rather than accurate data.

Object-oriented and 3D/4D

Bennet et al. and the co-authors of Cadastre 2014 agree that future cadastres will integrate much more than cadastral data; they will manage not only land parcels but also all rights, restrictions and responsibilities (RRR) affecting the territory as independent objects. This laudable target will be hard to concretise, as it implies many jurisdictions. The constraint lies not at technical, but at administrative level. Existing technologies can manage the task, but how do we coerce public bodies such as municipalities and ministries into registering RRR

in one register? Legislation alone will not suffice without human and financial resources. Indeed, there are few national examples of comprehensive RRR registers. The one in Quebec covers only RRR relating to the public domain. Switzerland has recently adopted legislation to implement such a register at national level. Time will tell to what extent the vision for Cadastre 2014 is adopted by individual nations.

A proliferation of condominiums and superimposed rights and restrictions in large cities make obvious the need for 3D cadastres. Nevertheless, what are in use are mainly indirect solutions, thanks usually to technological constraints. Advances in technology management should soon make feasible the third and fourth dimensions, with all attendant RRR repercussions, but integrating this into legal and administrative processes will not be easy.

Real-Time and Global

Like many organisations in developed countries, we face a shortage of resources and will have to cope with this to achieve our future mission. The way we manage the national land-rights infrastructure has to be redesigned to simplify, streamline and accelerate registration. So the development of intensive automated and online processes, eliminating human intervention whenever possible, will continue.

The link with regional and global networks is desirable, but the challenge will be funding. Each jurisdiction is responsible for internally managing its local or national land-rights infrastructure, not linking it with that of neighbours. If networking is needed, federal or regional government will have to contribute funding to rally its partners around such project.

Propositions put forward by both Cadastre 2014 and now Beyond Cadastre 2014 represent very good targets. Will they be achievable? Time will tell. But FIG Commission 7 will continue to challenge and develop these proposals.

¹ - Foncier Québec is a sector of the Ministère des Ressources naturelles et de la Faune (Department of Natural Resources and Wildlife) responsible for the cadastre and land-rights registration covering both private territory and public land. Québec is the largest of the ten Canadian provinces, with an area of almost 1.7 million square kilometres. Most of the land (92%) is under public ownership.

Two Worries

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As the year 2014 comes ever closer we realise that Cadastre 2014 is about to have run its course. Who would have thought in 1994 that time would go that fast.....? Thanks to our Melbourne colleagues we can get going on a dialogue about what cadastres will look like when the magic year 2014 has flown. Knowing that a majority of countries are still struggling with the introduction and development of any form of land-information system ('cadastre'), one might ask what the big issues are 'beyond 2014', or better, 'now and beyond 2014'... I am worried about two major things, namely the lack of transparency in the land sector, and a lack of economic justification for investment in cadastres.

Corruption

The first worry is that the land sector appears to be corrupt through and through. Elites obstruct or manipulate the cadastre; cadastral data fail to reflect situations on the ground; cadastral data are misused and neglected by governments. Whatever cadastre we develop, it will become obsolete if not trusted by the people. Here we are touching on the power structures in society, land governance, state land management, personal ethics. Only over recent years have these things been so openly discussed. Continuing along this path will certainly open up new and socially beneficial opportunities for sound cadastral systems.

Lack of Investment

The second worry relates to the investment needed to develop '2014 and beyond' land-administration systems, and the prerequisite justification: that they can generate good returns. Some assessment studies cast doubt on whether there is indeed a return on investment in cadastre. Do people invest more in their land, and do new land owners have better access to credit? It cannot always be proven. Other reports, such as the 2009-WB report on Central Europe, sing a sweeter song. Qualitative reasons for the development of cadastres are plentiful; see, for example Benefits of Land Administration, WPLA, 2005. However, quantitative reasons are scarce. What is the effect of a good cadastre on land-market dynamics, and what is the contribution to GDP? How do peoples' feelings about security of land rights relate to economic growth? They are certainly good enough, all those ideas put forward by Rohan, Mohsen and Abbas: 'survey accuracy', 'property objects', 'height and time', 'real-time updating', 'regional and global', and 'fuzzy and organic' - but to give them a chance of becoming reality my worries first need to be laid to rest.

Conclusion

What may be concluded from the expert replies to the six design elements proposed by scientists of the University of Melbourne? The initiative is highly appreciated, and FIG is encouraged to take the lead, together with research institutes, in developing how cadastres should operate in 2034 based on extrapolations of ongoing societal and technological developments. It seems the six chosen design elements emerged from considering highly urbanised areas in developed countries where societal needs can be summed up in three key words: accuracy, detail (3D, 4D, RRR) and real-time. Further, globalisation forces adjustment of cadastral content based on transnational interoperability criteria, while a shift is proposed in modelling boundaries of natural phenomena such as rivers, shores and forest, from crisp to fuzzy. However, completely different societal needs arise in developing countries, and design elements for these areas cannot be drawn up with anything like such steady hands.

How can cadastres contribute to eradicating poverty (a main Millennium Development Goal) and corruption? How can they enforce sustainable development of land? Underpinned by the seminal work of De Soto, received opinion now holds that poverty eradication in rural areas can be achieved by formal registration of land belonging to small farmers, enabling them to invest through a mortgage.

This assumption may, however, be challenged; small farmers have a low production capacity which will continue to fall as globalisation progresses. Within one or two generations adjacent farmlands now owned by hundreds of small farmers will probably be swept together into one big property parcel. Farmers' children will move to the cities and the small farmer become extinct. So there's not much sense in investing great effort in improving security of tenure in areas which will always remain rural. In stark contrast is the situation at urban fringes, where the city meets the countryside. Here farmers face the threat of ejection from their land with little or no compensation, and it is of the utmost importance that security of tenure is established here.

There is no such thing as 'one-size-fits-all'. There are urban areas and rural areas. There are developed and developing countries. In developed countries the needs of society seem clearer and finding solutions a matter of organising scarce resources, properly applying technology, and anticipating technology to come. Much more challenging tasks face the cadastre in developing countries, where there is an abundance of complicating issues. Here it is not just a matter of cadastre aiming to support a relatively frictionless society, but also enabling creation of a better one; eliminating malnutrition, gender inequality, illiteracy, corruption, and the immense gap between the haves and have-nots. So that's at least four sizes, each requiring specific approaches and solutions; summarised in Table 1.

Here in Part II, Clarissa Augustinus confirms the above, stating: 'The challenge facing the land industry is to design tools for the whole range of global society, not just the developed world'. From a global perspective, the six design elements are far from comprehensive. She thus seamlessly joins her argument to that of Keith Bell, who challenges Bennett and co-writers, asking (see [Part I](#)): 'Are real-time, spatially accurate cadastres more important than water, sanitation and nutrition?' Daniel Roberge too recognises that the 'survey accuracy' design element is more a thing for developed countries, as 'developing' countries, where the need for land-rights infrastructure is primary and resources are scarce, require light and low-cost solutions' creating exact rather than accurate data.

Paul van der Molen also has an eye for the gap between developed and developing countries, and again sharpens the focus: 'Do people invest more in their land, and do new landowners have better access to credit?' His point is that issues of corruption and lack of return on investment must be resolved before the six design elements have any chance of getting off the ground in developing countries.

Acknowledgements

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(Table 1. Urban and rural areas, developed and developing countries, each need vision, approach and solutions of their own.)

	Urban	Rural
Developed	Objects (3D, 4D)/Survey accuracy and RRR. Exploiting advanced technology.	parcels/Survey accuracy and RRR. Exploiting advanced technology.
Developing	Determination of role in society. Supporting good governance. Getting cadastres off the ground. Objects (3D)/survey accuracy. Society first, technology next	determination of role in society. Suporting good governance. Getting cadastres off the ground. Parcels/general boundaries. Society first, technology next.