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Cadastre 2.0

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International FIG Symposium & Commission 7 Annual Meeting

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September 2011

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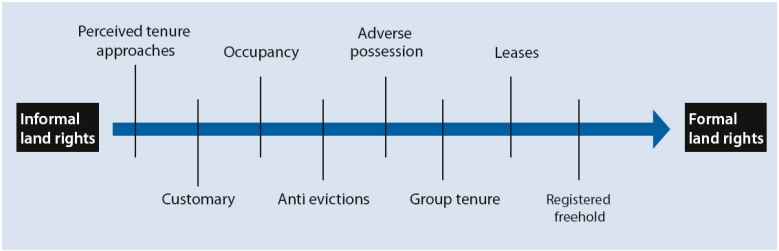
Gerda Schennach (Editor)

Congratulations to FIG Commission 7 and Österreichische Gesellschaft für Vermessung und Geoinformation (Austrian Society for Surveying and Geoinformation) on the publication of the proceedings for this One-day International Symposium on “Cadastre 2.0” as well as that of the 2011 FIG Commission 7 Annual Meeting held in Innsbruck, Austria.

“Cadastre 2.0” is meant to be forward looking, taking into consideration past experiences and present development, to develop a vision of the cadastre for the approaching times. The current and approaching periods do see Humanity facing a series of challenges ranging from adequate food and shelter; environmental degradation, natural disasters and climate change; economic crisis, growing income chasm as well as providing sufficient opportunity and human dignity. The profession too, cannot just measure but also need to manage, to mitigate, to meaningfully deploy its sciences and technologies, its knowledge and practices for the betterment of humanity so that the profession remains relevant.

FIG had its visionary “Cadastre 2014”, as envisaged back in 1998, will be a complete documentation of public and private rights and restrictions for land owners and land users. It will be embedded in a broader land information system, fully coordinated and automated, without separation of land registration and cadastral mapping. It will remain a public task, although operational work will be done by private organizations, and it will have a 100% cost recovery. It can provide optimal services to the different societies at a lower cost than today’s systems. It will not only concentrate on private rights, but increasingly on public rights and restrictions as well (*FIG Publication: 1998*).



The Global Land Tool Network facilitated by UN-HABITAT, an international coalition of Partners including FIG said “The continuum of tenure types is a range of possible forms of tenure which can be considered as a continuum. Each continuum provides different sets of rights and degrees of security and responsibility. Each enables different degrees of enforcement. Across a continuum, different tenure systems may operate, and plots or dwellings within a settlement may change in status, for instance if informal settlers are

granted titles or leases. Informal and customary tenure systems may retain a sense of legitimacy after being replaced officially by statutory systems, particularly where new systems and laws prove slow to respond to increased or changing needs. Under these circumstances, and where official mechanisms deny the poor legal access to land, people tend to opt for informal and/or customary arrangements to access land in areas that would otherwise be unaffordable or not available" (*UN-HABITAT:2008*).

At this juncture, it may pay for us to take some cue from Web 2.0, a term associated with Tim O'Reilly (*O'Reilly Media Web 2.0 Conference, 2004*) who suggested that it is about, amongst others, participatory information sharing, interoperability and collaboration.

Against this backdrop and in the quest to survey the landscape ahead and scope the next generation of the cadastre, it is important that we also ask that fundamental question. Who is "Cadastre 2.0" for; for whom will "Cadastre 2.0" serve?

I congratulate all the presenters at this One-day International Symposium and all participants. I trust collectively you will have a clear understanding of the very purpose for "Cadastre 2.0". This is crucial since "Cadastre 2.0" is meant to be forward looking. I hope this publication on the proceedings of this One-day International Symposium as well as that of the 2011 FIG Commission 7 Annual Meeting will unlock that which is necessary to accomplish that which is desired.

CheeHai TEO
President
5th September 2011

In 1998, under the leadership of our colleagues Jürg Kaufmann and Daniel Steudler, Commission 7 of the International Federation of Surveyors (FIG) launched the successful publication Cadastre 2014 in which it was proposed a vision of future cadastre. After many years, there is a need to once again look forward, wondering what would be the future of the cadastre in our societies. This is the mandate that Mrs Gerda Schennach has accepted to undertake as Chair of the FIG Commission 7 Working Group 7.3 Cadastral perspectives.

The symposium Cadastre 2.0 is, as proposed by the Austrian Society for Surveying and Geoinformation, a manner in which to continue the discussion about future cadastre from a citizen's perspective.

When we talk about a Web 2.0 site, it is associated with web applications that facilitate participatory information sharing, interoperability and collaboration in a social media dialogue within a virtual community. Can this model be applied, at least partly, to the management of the cadastre without threatening the integrity of land rights or cadastral data? And what about crowd sourcing? Can this approach be used in land administration? How can we integrate citizens and stakeholders into cadastre processes? This is what the international experts coming from various horizons have presented and discussed with the participants during this successful event.

This international symposium would not have been possible without the commitment of the Austrian Society for Surveying and Geoinformation and the support of our sponsors: BEV, Trimble and ESRI. Thank you for the tremendous support.

Thanks to the Commission 7 delegates and collaborators, specifically the speakers, who contributed to the calibre and quality of this symposium.

In closing, I would like to give my sincere thanks to Gerda Schennach for this wonderful initiative, and her commitment that ensured the success of this important event in the Commission 7 agenda.

Daniel Roberge, Chair

FIG Commission 7

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AUSTRIA

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11th Austrian Geodetic Congress

May 8th to 10th, 2012
Velden / Wörthersee

The Austrian Geodetic Congress is a conference and trade fair for geodesy and geoinformation. It is held every three years, at changing event locations in Austria. The congress covers all topics related to geodesy and geoinformation, such as the latest developments in land surveying, geoinformation and geoinformation systems, remote sensing, and navigation. Besides the scientific congress various events and excursions are organized. The congress is the highlight of the community in Austria, attracting more and more participants from neighbouring countries.
Come and join our conference - we are looking forward meeting you in Velden / Wörthersee, Austria.

For further information please check our website.
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Crowdsourcing Support of Land Administration
A Partnership Approach

Robin MCLAREN

ABSTRACT

Only 1.5 billion of the estimated 6 billion land parcels world-wide have land rights formally registered in land administration systems. Many of the 1.1 billion slum dwellers and further billions living under social tenure systems wake up every morning to the threat of eviction. These people are the poor and most vulnerable and have reduced forms of security of tenure; they are trapped in poverty. Increasing global population and the rush to urbanisation is only going to turn this gap into a chasm.

This paper explores one potential solution to the security of tenure gap through establishing a partnership between land professionals and citizens that would encourage and support citizens to directly capture and maintain information about their land rights. The paper presents a vision of how this might be implemented and investigates how the risks associated with this collaborative approach could be managed.

1. INTRODUCTION

Land Administration Systems (LAS) provide the formal governance structures within a nation that define and protect rights in land, including non-formal or customary institutions. Their benefits range from guarantee of ownership and security of tenure through support for environmental monitoring to improved urban planning, infrastructure development and property tax collection. Successful land markets depend on them.

Despite this pivotal support of economic development, effective and comprehensive LAS exist in only 50 mostly western countries and only 25 percent of the world's estimated 6 billion land parcels are formally registered in LAS. This leaves a large section of the world's population with reduced levels of security of tenure, trapping many in poverty. Missing and dysfunctional LAS can precipitate problems such as conflicts over ownership, land grabs, environmental degradation, reduced food security and social unrest. Rapid global urbanisation is exacerbating these discrepancies.

This security of tenure gap cannot be quickly filled using the current model for registering properties that is dominated by land professionals. There are simply not enough land professionals world-wide, even with access to new technologies. To quickly reduce this inequality we need new, innovative and scalable approaches to solve this fundamental problem. This is one of our fundamental global challenges.

[1] This is an extract from a joint RICS and Know Edge Ltd paper to be published by RICS at the end of 2011

This paper explores one potential solution to the security of tenure gap: 'crowdsourcing'. Crowdsourcing uses the Internet and on-line tools to get work done by obtaining input and stimulating action from citizen volunteers2. It is currently used to support scientific evidence gathering and record events in disaster management, as witnessed in the recent Haiti and Libya crises, for example. These applications are emerging because society is increasingly spatially enabled. Establishing such a partnership between land professionals and citizens would encourage and support citizens to involve themselves in directly capturing and maintaining information about their land rights.

Although citizens could use many devices to capture their land rights information, this paper advocates the use of mobile phone technology. Due to high ownership levels (5 billion licenses world-wide) and widespread geographic coverage (90 percent of the world's population can obtain a signal), especially in developing countries, mobile phones are an excellent channel for obtaining crowdsourced land administration information. Frugal innovation is making them affordable for all, especially in developing countries where a new generation of information services in health and agriculture, for example, is turning the mobile phone into a global development tool.

Mobile phones are progressively integrating satellite positioning, digital cameras and video capabilities. They provide citizens with the opportunity to directly participate in the full range of land administration processes from videoing property boundaries to secure payment of land administration fees using 'mobile' banking. But even today's simpler phones offer opportunities to participate in crowdsourcing.

A key challenge in this innovative approach is how to ensure authenticity of the crowdsourced land rights information. The paper explores applicability of the approaches adopted by wikis3, e-commerce and other mobile information services and recommends the initial use of trusted intermediaries within communities, who have been trained and have worked with local land professionals. This approach has the potential to provide a good level of authenticity and trust in the crowdsourced information and would allow a significant network of 'experts' to be built across communities. To optimise the scarce resources, these intermediaries could be involved in a range of other information services, such as health, water management and agriculture.

2. ARE CURRENT LAND ADMINISTRATION SYSTEMS DELIVERING THE EXPECTED BENEFITS?

Despite the clear link between effective LAS and efficient land markets (Al- Omari, 2011), sustainable development and the other benefits, their current adoption and effective implementation are limited to about 50 and found mainly in western countries and in countries in transition in central Asia (Enemark et al, 2010). A number of factors limit their scope of implementation:

[2] www.crowdsourcing.org
[3] Wiki is a piece of server software that allows users to freely create and edit Web page content using any Web browser.

- Costs are significant and national solutions can take from five to over 20 years to implement
- Overly complex procedures lead to high service delivery costs and end user charges, excluding the poor and the vulnerable
- Lack of a supporting land policy framework ensures that the LAS do not deliver against the main drivers of land tenure, land markets and socially desirable land use
- Insufficient support for social and customary tenure systems excludes large proportions of the population
- Lack of transparency encourages corruption in the land sector, lowering participation through lack of trust
- Communication channels to customers are either office or Internet based and lead to geographic discrimination or exclusion through the 'digital divide'
- A mortgage requires a bank account and credit rating, which is difficult for the poor and those remote from financial services to obtain
- Cadastral surveys using professional surveyors are normally mandatory and generate higher fee rates, e.g. in the USA a typical residential land parcel costs $300 -$1,000[4] to survey depending on local rates and the size and type of parcel.

It is estimated that there are around 6 billion land parcels or ownership units world-wide. 4.5 billion parcels are not formally registered and of these 1.1 billion people live in the squalor of slums. With urbanisation predicted to increase from the current 50% to 60% in 2030 and a further 1 billion being added to the world's population in this timeframe, the security of tenure gap will become a chasm. This will be impossible to fill in the foreseeable future using the currently available land administration capacity. The International Federation of Surveyors (FIG) currently represents 350,000 land professionals world-wide. The current LAS paradigm cannot be scaled up quickly enough to meet the demand.

The lack of effective, affordable and scalable LAS solutions conspires to limit access to land administration services by large sections of society, especially the most vulnerable, leaving them trapped in poverty. There is a pressing need to radically rethink LAS: simplify procedures, reduce the cost of transactions, and open new channels for participation. Crowdsourcing through ubiquitous mobile phones, for example, offers the opportunity for land professionals to form a partnership with citizens to create a far-reaching new collaborative model and generate a set of LAS services that will reach the world's poor. The rest of this paper explores how citizens can be empowered to support the delivery of LAS services through crowdsourcing.

3. A NEW CITIZEN COLLABORATION MODEL FOR LAND ADMINISTRATION

This section provided a vision of how citizens armed with mobile phones, with the help of land professionals, could effectively capture and manage their land rights.

3.1 The Increasingly Pervasive Mobile Phone

[4] http://www.costhelper.com/cost/home-garden/land-surveyor.html

Although citizens can provide their crowdsourced data through a number of traditional channels, including paper, mobile phones are progressively proving to be the device of choice. Mobile phones have made a bigger difference to the lives of more people, more quickly, than any previous communications technology. They have spread the fastest and proved the easiest and cheapest to adopt. In the 10 years before 2009, mobile phone penetration rose from 12 percent of the global population to nearly 76 percent. It is estimated that around 5 billion people currently have mobile phones and 6 billion will have them in 20135.

Recently the fastest growth has been in developing countries, which had 73 percent of the world's mobile phones in 2010, according to estimates from the International Telecommunications Union.6. In 1998, there were fewer than four million mobiles on the African continent. Today, there are more than 500 million. In Uganda alone, 10 million people, or about 30 percent of the population, own a mobile phone, and that number is growing rapidly every year. For Ugandans, these ubiquitous devices are more than just a handy way of communicating: they are a way of life (Fox, 2011). Not all phones in the developing world are in individual use, but are actually used as a communal asset of the household or village.

Due to their high ownership levels and widespread geographic coverage, especially in developing countries, mobile phones are therefore an excellent channel for obtaining crowdsourced land administration information. But are they affordable and do they have the necessary functionality?

3.2 The rise of smart phones and tablets

Telecommunications has developed exponentially. Phones have changed: there is a big shift from holding a phone to your ear to holding it in your hand. Smart phones have emerged that are able to browse the web, send and receive email, and run applications - as well as storing contacts and calendars, sending text messages and (occasionally) making phone calls. See figure 1 for the range of Cyborg (an organism that has enhanced capabilities due to technology) functionality provided by smart phones. Smart phones represented 24 percent of all mobiles sold worldwide in the first quarter 2011 – up from 15 percent a year before. The tipping point when they make up 50% may only be a year or so away. Although smart phones may cost around US$600 today, volume of sales and frugal innovation will drive the cost down to an estimated US$75 in 2015. A US$100 smartphone has already arrived on the streets of Nairobi. Before the end of the decade, every phone sold will be what we'd now call a smartphone and cost US$25 (Arthur, 2011).

Although smart phones have combined an array of technologies onto the mobile phone platform to significantly increase its functionality and its applicability in a wide range of new applications, regular mobile phones can still be used to support information services and gather crowdsourced information, through text messaging services (SMS) for example.

[5] http://www.itu.int/ITU-D/ict/statistics/.
[6] http://www.itu.int/ITU-D/ict/statistics/.

The emergence of tablets is also providing an opportunity for effectively supporting crowdsourced information, especially graphical information. This technology will play a significant role in the future of crowdsourcing.

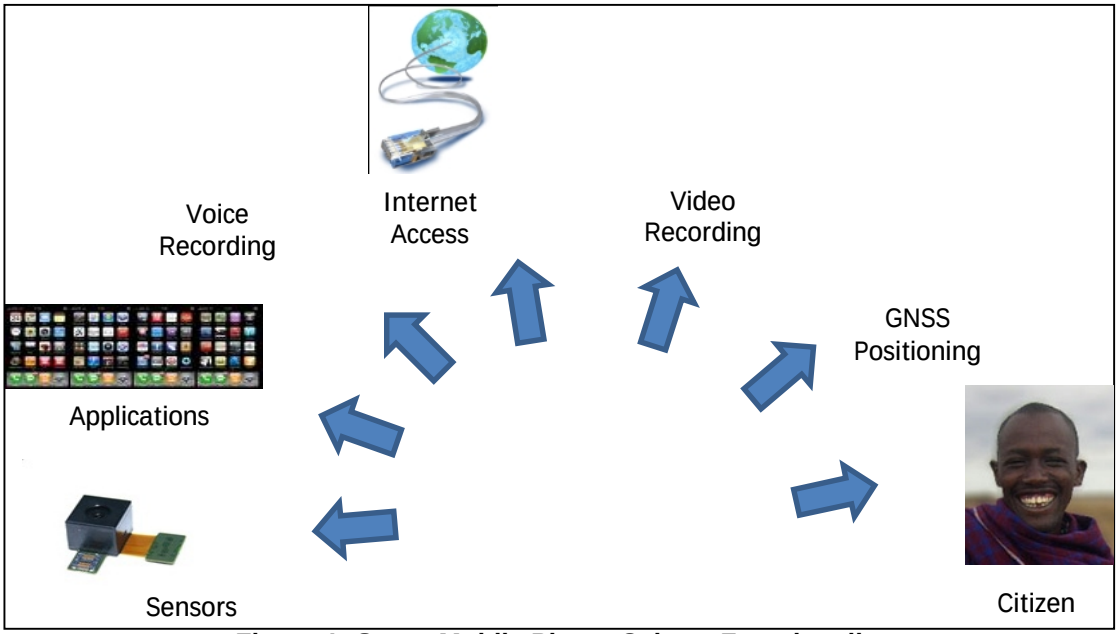

Figure 1: Smart Mobile Phone Cyborg Functionality

3.3 Vision of an effective crowdsourced Land Administration solution

This increase in functionality of the mobile phone, its migration to lower cost devices through frugal innovation, its increasing pervasiveness across developing countries and its connection to Internet and information services is opening up significant opportunities for its use in delivering more effective and accessible land administration services. The possibilities are explored below:

Accessing Customer Information Services **-** A whole new generation of innovative information services, such as agricultural and health, are being provided to users of mobile phones in developing countries. A good example is the use of mobile phones to record and transfer water quality or water source inspection data from the field to a central database where water sector professionals can then view the data collected and identify hazardous water sources[7]. A similar set of land administration services for users could provide explanations of procedures, electronic forms for completion, standard applications and best practice for land registration and cadastre, for example. This remote guidance and support will be essential when there is more significant citizen participation in land administration services and could be provided by tiers of citizen intermediaries with guidance by Land Professionals.

Recording Land Rights **-** The mobile phone will allow citizens to directly record the boundaries

[7] www.bristol.ac.uk/aquatest/about-project/workplan/ma6/

of their land rights. This can be achieved in several ways:

- marked up paper maps digitally photographed with the phone
- a textual description of the boundaries recorded on the phone
- a verbal description recorded on the phone
- geotagged digital photographs of the land parcel recorded on the phone
- a video and commentary recorded on the phone – this could include contributions from neighbours as a form of verification (mobile phone numbers of neighbours could be provided)
- the positions of the boundary points identified and recorded on imagery using products such as Google Maps and Bing, for example
- the co-ordinates of the boundary points recorded directly using the GNSS capability of the phone.

In all cases the authenticity of the captured information would be enhance by passively recording the network timestamp at time of capture. This information is not something that most (99.999%) of users can tamper with.

The results of this crowdsourced or self-service information could then be submitted electronically to either the land registration and cadastral authority or open data initiative for registration. Although there are limitations in the quality and authenticity of the ownership rights information provided, it could form the starting point in the continuum of rights (UN-HABITAT, 2008) being proposed by UN-HABITAT. This recognises that rights to land and resources can have many different forms and levels.

To increase the authenticity and quality of the registration application, the concept of the 'Community Knowledge Worker' created by the Grameen Foundation (Donovan, 2011) could be adopted. The 'Community Knowledge Workers' are trained members of communities supporting agricultural and health information services who act as trusted information intermediaries to those who have limited skills and access to information. A similar model could be used for crowdsourced land administration services to record or check ownership rights prior to their submission. In fact, the 'Community Knowledge Workers' model could be extended to also support land administration information services. This model is similar to the administrative roles of the *Patwari* in India and the *Lurah* in Indonesia.

This engagement of local communities is also being highlighted as a key success factor by crisis mapping projects. They realise that without community buy-in, the valuable crisis mapping tools will not be used. Communities must be engaged at all stages of the project and technical design to ensure that crisis mapping efforts are in line with local incentives and capacities. For example, this community led approach brought fourteen organisations into a network in Liberia contributing data to a multi-layered map that served as a central nervous system for early warning signs of conflict in the run up to the national elections in 2011 (Heinzelman et al, 2010).

When the captured land rights are submitted to the property register (see section 4 for a discussion on an alternative shadow property register based on an open data initiative) a variety of quality checks could be applied to the submitted information, including: random checks in the field; comparisons with other applications submitted in the same proximity;

checks on ownership of the mobile phone; review evidence for the location of its owner through the log showing that the phone is frequently used within a location; network time stamping of captured information; and contact the client and their neighbours on their mobile phones to ask for clarification. Further details of approaches to managing the authenticity risk are contained in section 5 'Managing the Risks'.

Obtaining Title **-** The submission of an application for registration usually involves the payment of a fee. This is normally paid as cash over the counter or a financial transaction through a bank or post office. However, in the context of mobile phones, the payment could be made by the client through 'mobile banking' on the mobile phone.

Mobile phones are currently being used to manage identification information. In Finland chip ID cards for government employees are being adopted throughout Finnish central government. It is therefore feasible that encrypted forms of land title could be incorporated into clients' mobile phones and used as proof of ownership.

Accessing Land Information **-** Effective LAS are supported by Land Information Systems. These are initially developed to support the internal operations of the land registration and cadastral authority. However, the next development stage is to make them outward facing and accessible by customers either by Extranet or Internet. However, with mobile phones directly supporting Internet access, these information services can now be accessed by mobile phones. This new channel, which will be the only access to the Internet for many countries, creates much more accessibility for the citizen, bringing land administration services to a wider range of society, many of whom are currently excluded.

Paying Mortgage Instalments **-** Securing a mortgage normally requires the property owner to have a bank account to support the mortgage payments transactions. However, the mobile phone offers opportunities to provide secure payment of land administration fees with the increasing use of 'Mobile Banking,' simplifying the procedures and again potentially opening up the means of wider property ownership.

4. IMPACT OF NEW CITIZEN COLLABORATION MODEL ON THE EXISTING LAND ADMINISTRATION SECTOR

The introduction of this new LAS model will likely be perceived by most land professionals working in the land administration sector as radical and by some as a serious threat. However, the current generation of mobile phones and other devices are increasing the potential range of participants in land administration. We are seeing the rise of the 'proamateur', somewhere between the professional and the amateur, caused by this easy to use and accessible technology. Disruptive technology has caused professional realignments in the past: total stations allowed surveying technicians to perform more tasks, more accurately than before. Crowdsourcing by 'proamateurs' is not a risk to land professionals, but allows a wider range of participants to be involved in land administration and more quickly address and solve our global challenges.

Land professionals' attitudes towards this new model will determine how land administration is shaped in the future. Here are two scenarios of the potential impact of the new model on the land administration sector.

Rejection by Land Professionals: Shadow Property Register - In countries where there is little citizen trust in poorly performing or corrupt land administration services provided by the government, an alternative property register may be created through crowdsourcing. This 'shadow' property register would be similar to the OpenStreetMap crowdsourced model that has successfully provided an alternative source of mapping for many countries. An 'OpenCadastralMap' (Laarakkar and de Vries, 2010) or 'OpenLandOwnership' open data initiative would emerge. Despite not having the usual endorsement and guarantee from government, its legitimacy may progress over time as quality and trust evolve. It may even be embraced by the informal market as a trusted repository to support transactions more affordably and effectively than the formal property register. The real test will be if financial services use it to judge risk in the mortgage market. Ultimately, it may either replace the government land administration service, reinforcing the informal land market, or be adopted by government once it has reached a critical mass and quality.

Acceptance by Land Professionals: Supplement to the Formal Property Register - Other countries may embrace this new model as an opportunity to accelerate the number of properties being registered across the country and support a much more inclusive solution to land administration. If land professionals work in partnership with citizens and communities and grow a network of trusted citizens to record and register land rights then this source of land information could be managed directly by the formal property registers. Initially these crowdsourced records could have a provisional status that would be formalised following checks on authenticity. This could be performed directly by land administration staff or accepted directly from trusted community experts or quality checks achieved through crowdsourcing. The approach to and judgement of authenticity would evolve and improve over time, just as has happened with the maintenance of all wikis. This would involve a changing role for land professionals, working with citizens rather than for citizens.

In emerging nations where there are insufficient land surveyors or land surveyors do not wish to embrace a crowdsourced approach, the lawyers, assessors or even bankers may eventually try to remove or at least reduce the need for land surveyors in the property transaction by either resorting to direct crowdsourcing or identifying another type of intermediary to facilitate crowdsourcing in different communities in exchange for some cash or in-kind consideration.

5. MANAGING THE RISKS

As with all radical changes to long standing approaches, vested interests will be jeopardised and entrenched opposition will inevitably be encountered. Here are some of the risks that will most likely be raised to attempt to keep the status quo.

5.1 Can crowdsourced land rights information be sufficiently authenticated?

One of the most contentious issues surrounding crowdsourced information is the authenticity or validity of the information provided. Without the rigors and safeguards associated with formal professional and legal based processes, crowdsourced information is of variable quality and open to potential abuse. Crowdsourced information has provided input to wikis, feedback of quality of services and counting birds, for example, but is not normally used to

capture information as critical and legally binding as property rights in an authoritative register. So what techniques could be used to quality assure the authenticity of the information to a level that would be acceptable for inclusion in a property register? Some alternatives, including lessons learned from leading wikis and e-commerce, are discussed below. However, the most appropriate crowdsourcing approaches to authenticity assessment will only be identified through testing in the field.

Grameen Community Knowledge Workers as Intermediaries

This approach would avoid open, direct crowdsourcing at the outset and only allow information to be provided by trusted intermediaries within communities who have been trained and have worked with local land professionals. Initially, there would be comprehensive quality assurance of the crowdsourced information, but over time as trust is established with the intermediaries the level of quality assurance sampling could significantly decrease. These initial intermediaries could then train further experts to build a significant network of 'experts' across communities. Each expert would be continually checked and appraised to determine the level of expertise and trust in the associated crowdsourced information. To optimise the scarce resources, the intermediaries could be shared with a range of information services, such as health and agriculture.

Community based Quality Assurance

Quality assurance could be directly provided by members of the local communities who take direct responsibility for authenticity. The crowdsourced land right claims could be posted for communities to review and comment on. Some form of local or regional land tribunal could be established to arbitrate on conflicting claims. Once a critical mass of land rights information is obtained it is then easier to identify anomalies and conflicting claims. Levels of trust and accuracy of the land rights would be upgraded over time as more evidence and cross checking validates the claims.

Wiki and e-Commerce Solutions

Beyond local involvement in quality assurance, a centralised user reputation system based on feedback from crowdsourced registrations, similar to the buyers' ratings of the sellers used in eBay, could be used to assess the credibility of contributors and the reliability of their contributions (Coleman, 2010). Leading wikis, such as Wikipedia.org, originally relied solely upon the "wisdom of the crowds" to evaluate, assess and, if necessary, improve upon entries from individual contributors, usually with great success. However, recent contributions of deliberate misinformation to specific entries have caused Wikipedia to re-assess its approach. Beginning in December 2009, it has relied on teams of editors to adjudicate certain "flagged entries" before deciding whether or not to incorporate a volunteered revision (Beaumont, 2009).

Although the data that are contributed to VGI projects do not comply with standard spatial data quality assurance procedures and the contributors operate without central co-ordination and strict data collection frameworks, research of VGI is starting to provide methods and techniques to validate quality and also the needed evidence to show that this data can be of high quality. Recent research (Haklay et al, 2010) supports the assumption that as the number of contributors increases so does the quality; this is known as 'Linus' Law' within the Open Source community. Studies were carried out using the

OpenStreetMap dataset showing that this rule indeed applies in the case of positional accuracy.

Crowdsourcing Quality Assurance
Some elements of the quality assurance process do not require local knowledge of the land rights claim and could be crowdsourced to a network of informed consumers and world-wide professionals or could even be automated.

Passive Crowdsourcing Quality Assurance
Mobile phones can also be used passively to collect evidence that supports validation of user entered information. For example, the use of a mobile phone is continually logged and this log can be analysed to show where the phone is frequently used, inferring the location of the owner. The network timestamp is another robust piece of evidence that could be associated with collected land rights data, such as images or videos. This is not something that most (99.999%) of users can tamper with.

The extent to which control is held by the contributor, by the institution, or by "the crowd" of contributors assessing each other's contributions may be different across different implementations of crowdsourcing.

5.2 Will openness lead to more corruption in the land sector?

Land administration is often perceived as one of the most corrupt sectors in government. Although individual amounts may be small, petty corruption on a wide scale can add up to large sums. In India the total amount of bribes paid annually by users of land administration services is estimated at US$ 700 million (Transparency International India, 2005), equivalent to three-quarters of India's total public spending on science, technology, and the environment. However, one of the best means of reducing corruption within a good governance framework is through transparency of information and the ability to have two-way interaction with clients.

Data collected by the public must be validated in some way, otherwise the crowdsourced information is open to abuse, and in the case of land rights, corruption through false claims. However, transparency, which is at the heart of the crowdsourced philosophy and the increasing use of the mobile phone to check authentication, should support a fight against corruption.

5.3 Will Land Professionals form a new partnership with citizens?

This new partnership model implies that Land Professionals will have a different relationship with citizens or 'proamateurs'. The increased collaboration with citizens opens up the opportunity for new services to train citizens and community intermediaries and to quality assure their crowdsourced information. It should therefore not be perceived as a threat to their livelihoods and profession. But will Land Professionals accept this new role and will sufficient citizen entrepreneurs provide land rights capture services and become trusted intermediaries? Disruptive technologies have and will continue to challenge the relationship between 'proamateurs' and land professionals, but these drivers of change also present significant opportunities for all stakeholders.

5.4 Will crowdsourcing just reinforce the informal land market?

There is a danger that the emergence and acceptance of crowdsourced land rights information by citizens will just reinforce the informal land markets in countries where there is ineffective land governance, poorly performing land administration systems and weak formal land markets. Lack of trust in the formal land administration system will persuade citizens to try crowdsourcing alternatives that are attractive due to their transparency and citizen involvement. The final outcome of the informal or formal market will depend on the Land Administration agencies' reaction to crowdsourcing and whether they reject or embrace it.

5.5 Who will provide the ICT infrastructure to support this initiative?

The implementation of crowdsourcing in land administration requires technical infrastructure to support the uploading, management and maintenance of the land rights information. The implementation could mirror the voluntary support model of OpenStreetMap. OpenStreetMap's hosting, for example, is supported by University College London's VR Centre for the Built Environment, Imperial College London and Bytemark Hosting, and a wide range of supporters[8] provide finance, open source tools or time to support the initiative.

6. CONCLUSIONS

Crowdsourcing within the emerging spatially enabled society is opening up opportunities to fundamentally rethink how professionals and citizens collaborate to solve today's global challenges. This paper has identified land administration as an area where this crowdsourced supported partnership could make a significant difference to levels of security of tenure around the world. Mobile phone and personal positioning technologies, satellite imagery, the open data movement, web mapping and wikis are all converging to provide the 'perfect storm' of change for land professionals. The challenge for land professionals is not just to replicate elements of their current services using crowdsourcing, but to radically rethink how land administration services are managed and delivered in partnership with citizens. Land administration by the people can become a distinctly 21st century phenomenon.

REFERENCES

Al- Omari, M. 2011. "Land Administration Systems and Land Market Efficiency"
FIG May 2011, Morocco FIG Working Week.

Arthur, C. 2011. "How the smartphone is killing the PC." Guardian Newspaper, 5th June 2011.
Retrieved from http://www.guardian.co.uk/technology/2011/jun/05/smartphones-killing-pc.
(Last accessed 10 August 2011.)

Beaumont, C. 2009. "Wikipedia ends unrestricted editing of articles". The Telegraph. 26th August 2009.
Retrieved from http://www.telegraph.co.uk/technology/wikipedia/6088833/Wikipedia-endsunrestricted-editing-of-articles.html. (Last accessed 11 August 2011.)

Donovan, K. 2011. "Module 6: Anytime, Anywhere: Mobile Devices and Services and Their Impact on Agriculture and Rural Development", "ICT in Agriculture" e-sourcebook. World Bank. To be published September 2011.

[8] http://wiki.openstreetmap.org/wiki/Partners

Enemark, S., van der Molen, P. and McLaren, R. 2010. “Land Governance in Support of the Millennium Development Goals: Responding to New Challenges”
Report on FIG / World Bank Conference Washington DC, USA 9-10 March 2009, FIG Publication.

Fox, K. 2011. “Africa's mobile economic revolution”, The Observer Newspaper, 24 July 2011.
Retrieved from http://www.guardian.co.uk/technology/2011/jul/24/mobile-phones-africa-microfinance-farming.
(Last accessed 12 August 2011.)

Haklay, M., Basiouka, S., Antoniou, V. and Ather, A., 2010. “How Many Volunteers Does It Take To Map An Area Well? The Cartographic Journal, 47 (4), pp 315 – 322.

Heinzelman, J., Sewell, D.R., Ziemke, J. and Meier, P. 2010. “Lessons from Haiti and Beyond:
Report from the 2010 International Conference on Crisis Mapping”.
Retrieved from http://www.usip.org/files/resources/PB83.pdf. (Last accessed 17 August 2011.)

Laarakkar, P. and de Vries, W.T., 2010. “www.Opencadastre.org - Exploring Potential Avenues and Concerns”.
FIG May 2011, Morocco FIG Working Week.

UN-HABITAT. 2008. “Secure Rights for All,” United Nations Settlement Programme (UN-HABITAT), 2008
ISBN: 978-92-1-131961-3.

Zimmerman, W. 2011. Private correspondence.

BIOGRAPHICAL NOTES

Robin McLaren is director of Know Edge Ltd a UK based, independent management consulting company formed in 1986. The company supports organisations to innovate and generate business benefits from their geospatial information. Robin has supported national governments in formulating National Spatial Data Infrastructure (NSDI) strategies. He led the formulation of the UK Location Strategy and has supported similar initiatives in Kenya, Hungary, Iraq and Western Australia. He has also supported the implementation of the EU INSPIRE Directive in the UK and was recently a member of the UK Location Council. Robin is also recognised as a world expert in Land Information Management and has worked extensively with the United Nations, EU and World Bank on land policy / land reform programmes to strengthen security of tenure and support economic reforms in Eastern and Central Europe, Africa, Middle-East and the Far-East.

CONTACTS

Robin McLaren
Director
Know Edge Ltd
33 Lockharton Ave
Edinburgh EH12 1AY
Scotland, UK
Tel: +44 (0) 131 443 1872
E-mail: robin.mclaren@KnowEdge.com
Web: www.KnowEdge.com

New Media for Cadastre

Matthew DELANO, LS

Abstract

This paper explores the new media in the context of Web 2.0 and looks at potential applications in context of Cadastres and the Cadastral community.
New media concepts enable the collection of vast amounts of data for common benefit. The costs related to both data collection and retrieval are comparatively low relative to more traditional organized processes. Interactive new media also tends to take on a life of its own. The collective input and evolution driven by the participants in new media tends to drive innovation. The result is often in unforeseen benefits. It is becoming clear that we may benefit tomorrow from our data in ways that we have not yet even thought about today. These are the types of benefits that are driven by the new kind of community that web 2.0 makes possible, a community that in its very nature, breeds collaboration across space and time and at a scale never before possible.
This paper considers some ideas about how the benefits of this new media can be applied in the Cadastral realm. Can web 2.0 and crowd sourcing concepts be applied to the collection and dissemination of geospatial and Cadastral data? What are the benefits and risks associated with sourcing this information from the public web? Is there relevance in the developing world? This paper proposes that these concepts can be effectively in both developed and developing Cadastre context. Three specific concepts are presented for consideration:

- Professional Social Networking and the Professional Survey Cloud
- Crowd sourcing for coverage in developing cadastres
- Decentralized open data for maximum leverage and unforeseen benefits.

New Media

Media in our context is defined as a medium for communication. In simplistic terms, the concept of Web 2.0 is effectively the use of web sites as a communication medium. This is the “new media” to which this paper refers. This is not the same as the internet being a medium for communication. The internet is perhaps the most powerful manmade medium of communication ever invented, but we are not talking about the internet per se; we are talking about bi-directional communication on websites, or sometimes called “the participatory web.” The differentiating factor is that site visitors may contribute to the content vs. simply viewing it.
To begin with, this paper will discuss some new media concepts in an effort to “put us all on the same page”, to create a foundation of concepts for the reader to consider in the context of Cadastral and Land Administration systems. The most common new media examples are wikis, mashups, social media, blogs. An interesting observation to make about all of these phenomena is that they have effectively evolved by themselves from the basic idea of the participatory web into commonly known and defined concepts. Even the words themselves

(wiki, blog, etc.) were coined on the participatory web. Today Wikipedia, YouTube, Facebook, Twitter and LinkedIn have become internationally recognized, virtually standard vocabulary. The point is that once created, media concepts like these tend to take on a life of their own. Relatively simple concepts have evolved to create value in ways that were never considered by their original creators. For example, those who may have seen the movie Social Network may remember that creator of Facebook started by accessing data from dormitory pages with basic student information and photos. I doubt that the person who developed first dormitory student site ever considered the possibilities of what Facebook has become.

Crowd Sourcing

Closely related to these common forms of new media is the concept of crowd sourcing. The idea is to harness the power of the participatory web as a vast source of data for a particular purpose. Wikipedia is a good example of how the collective information of the crowd has been harnessed to provide vast amounts of information for the crowd, but OpenStreetMap is perhaps the most dramatic example for those of us in the geospatial community. In XX days after the devastating earthquake in Haiti, detailed maps of Port au Prince were produced by the OpenSteetMap community that simply didn't exist before. The results were incredible and unprecedented. These maps became invaluable in rescue and relief efforts, and are still being used every day.

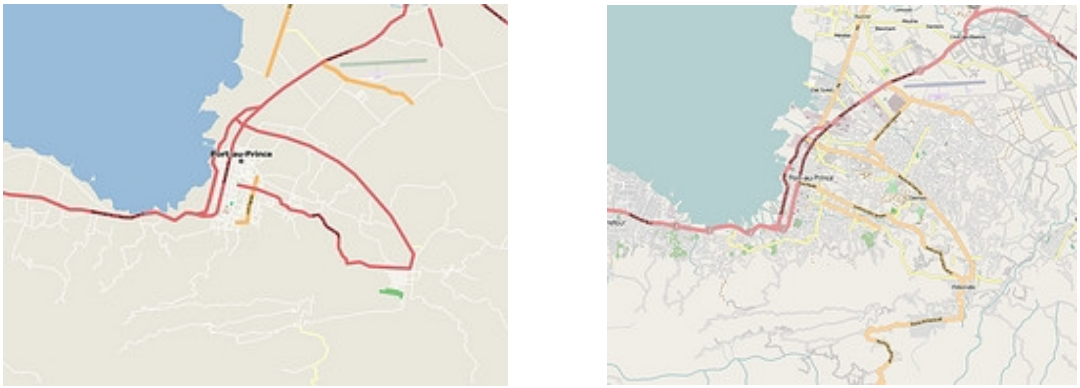

Figure 2 Port au Prince OpenStreetMap before and after maps.

The Haiti case is an example of active crowd sourcing. The concept of passive crowd sourcing collects typically non-personal information from routine public web activity and compiles it in such a way to provide value. For example, shopping websites monitor habits of their shoppers when they show "people who looked at this product also looked at…" Search engines also passively crowd source from user input on web searches For example, search indexes for subjects are collected and analyzed to determine which sites were visited most often for given search criteria. When a first word is typed in, crowd sourced information is utilized to predict and suggest what the full search criteria might be. A correct prediction means a rapid search result. Geographic referenced have also been used. Search engines can map the locations where people are searching for specific key words. For example, Google monitors flu trends geographically based on this approach and posts the results on an

interactive site www.google.org/flutrends . This is modern day variant on the use of geospatial data in the 1854 London Cholera epidemic.

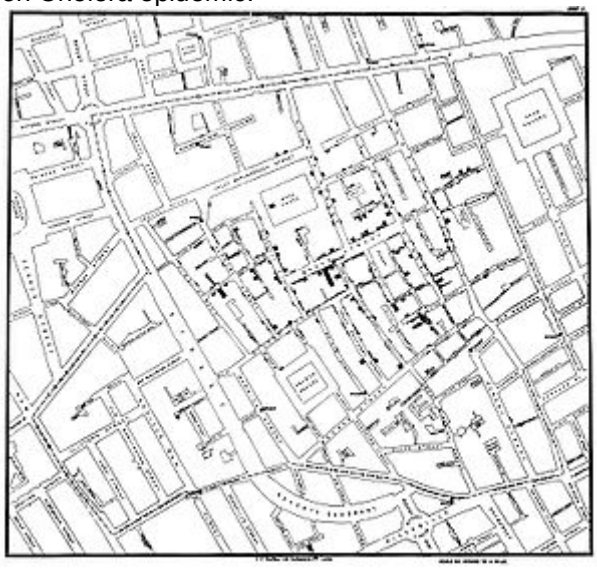

Figure 3 Original John Snow map showing clusters of Cholera cases in 1854 London helped to isolate the problem to a specific public water source.

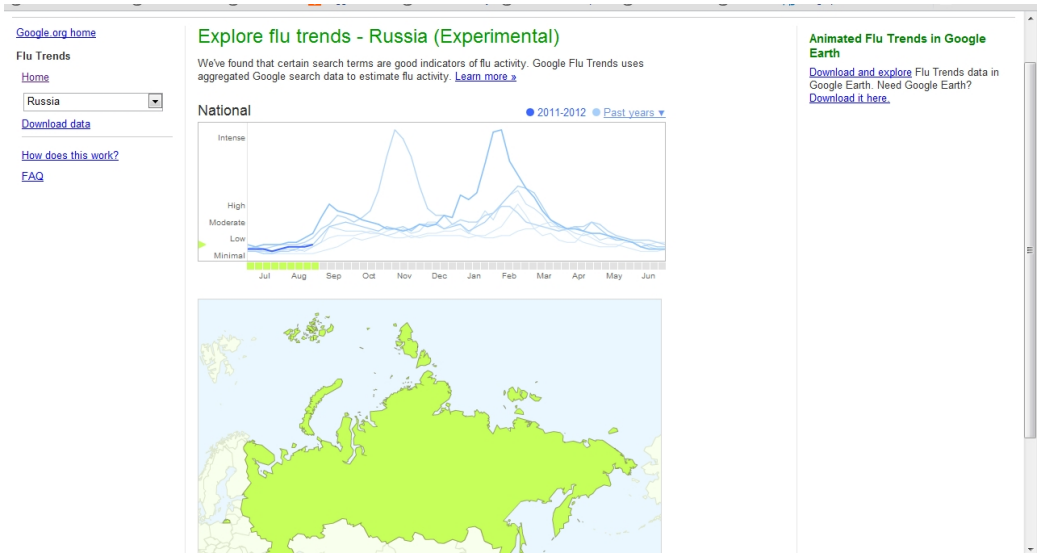

Figure 4 Google Flu trends (www.google.org/flutrends)

A key point related to passive crowd sourcing is to understand that the benefits that may be derived from data acquired during interactive web transactions may not be understood or foreseen at the time the data is being entered, or even be related to the transaction process itself.

This paper has not attempted to fully explore web 2.0 and the related new media. The intention here is to lay a foundation of common understanding so that we may investigate the potential benefits in Cadastral applications.

Benefits of the new media

As a community focused on the Cadastral industry, we consider the needs of the stakeholders in Cadastres and land administration systems. The stakeholders are governmental Cadastre organizations and/or national mapping organizations, the public that they serve, and the professionals that participate in the processes related to the Cadastre. How can we help these stakeholders to achieve their objectives and solve their problems, and/or exceed expected results.

While some would argue an exhaustive list of potential benefits, this paper takes the approach to identify three key broad benefits in the hope that focus can achieve progress.

First is the vast potential for collection and dissemination of data. The internet never sleeps. The interactive web and crowd sourcing provide a facility to collect data 27/7, and from anyone who is willing and able to contribute. This enables collection capabilities never before possible. The result is more information, lower collection costs, and lower dissemination costs. Since Cadastres are all about collection and dissemination of data, there must be way to leverage these benefits for the Cadastre.

Second is the virtual community. The internet facilitates the interaction across time and space. Collaboration between Cadastral pier organizations and professionals allows them to help each other solve problems and share best practices. While language divides are still prevalent, the medium already bridged government jurisdictions and local Cadastral system boundaries.

Third is the creation of unforeseen benefits. As mentioned above, the new media evolve and take on a life of their own. As a custodian of land information that is critical to the public, Cadastral organizations must embrace the unforeseen value that may be derived.

For example in 2009, Tom Taylor took publicly available information about cycling accidents that were reported to the police in London. By mapping these incidents, a list of “hot spots” were discovered. This information could then be used to modify cycling routes and potentially safe cyclist lives.

Figure 5 Cyclist hot spots in London (London Evening Standard 18-March-2009)

Another example of unforeseen benefit is www.zillow.com. Zillow is a US based company that runs a website focused on the real estate market. Zillow combines publicly available Cadastral information (property and improvement attributes, sales data, tax information, etc.) with other information sources like imagery, mapping, mortgage information, commercial real estate, public services, etc. and combines this information in a way that adds increased value for users of Zillow.com. The beauty of this approach is that it spans all of the Cadastral data sources and jurisdictions making it easier for users to get the information they want from a single source, and in a consistent interface.
Zillow also crowd sources input directly from users of the site. For example, their "make me move" feature allows a property owner to pre-market their property for potential sale.

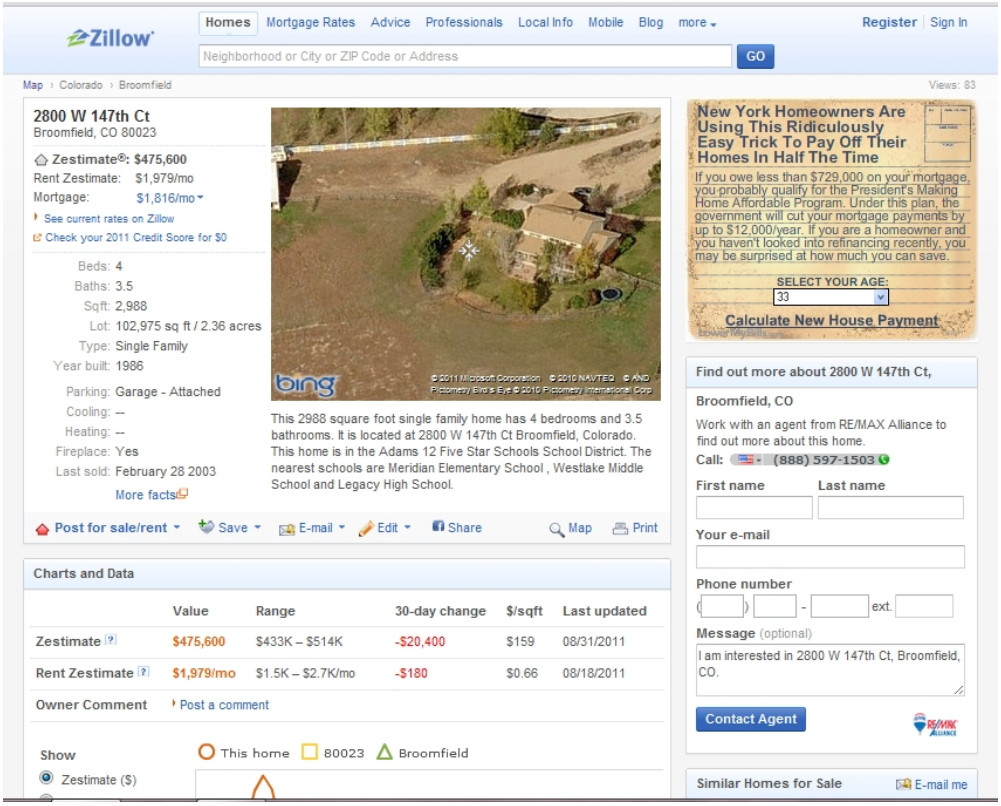

Figure 6 www.zillow.com

This paper proposes that the benefits described above may be realized in the Cadastral context, both in developed and developing applications. Three specific concepts are presented for consideration:

- Professional Social Networking and the Professional Survey Cloud
- Crowd sourcing for coverage in developing cadastres
- Decentralized open data for maximum leverage and unforeseen benefits

Professional Social Networking and the Professional Survey Cloud

Social networking has become a powerful tool in professional applications, and surveying is no exception. There are surveying related groups on LinkedIn, and several online land surveying forums where surveyors can share ideas, solve problems, and propagate best practices. While a virtual community benefit is exhibited here, it falls short in terms of its potential.

In many countries, private surveyors are responsible for field surveying execution, and production of parcel surveys. Where deed systems are in place, there may not be a requirement for the surveyor to file the survey (title insurance underwriters review the survey). In some locations, the surveyors practice area may span multiple Cadastral jurisdictions. In any case, there is always more information in the surveyor's file than is ever submitted to the relevant authorities. A wealth of survey control and measurement data ends up in decentralized and inaccessible locations such as private survey company records, title company records, building department records, planning commission offices, bank files, etc. Since this information is not available, and not shared with other surveyors, the result is inefficient and potentially inaccurate surveying.

A professional surveying cloud would permit surveyors to share this valuable information from a spatially enabled collaborative forum. Imagine a community with geospatially referenced, detailed survey data that bridges Cadastral jurisdictions, and provides other social networking and professional benefits. Taking a page from Zillow's model, the data could be referenced from public Cadastral sources, but be visible in the Professional Survey Forum. Other benefits to the surveying community can be provided on the forum, user upload field notes and survey file data, technology information, equipment and supply sales, best practices, title insurance links, legal services, professional liability insurance, etc. In fact, businesses that target the surveyor community can serve as sponsors to help fund the community.

Such a concept would result in decreased cost for the surveyors, increased accuracy in the surveys they produce, lower costs for the public, and a potentially stronger business for the surveyor. This case provides all three of the benefits described above; low cost crowd sourced collected field survey data, a virtual community (for both data and networking purposes), and surely unforeseen benefits will arise as the community evolves to provides more and more.

Crowd sourcing for coverage in developing cadastres

The mandate in developing Cadastres is coverage. The more properties that can be brought into the formal land system, the greater the benefit from a social and economic development perspective.

The concept of crowd sourcing has the potential to generate large volumes of data. Can this be applied effectively to developing Cadastres?

To achieve this, there are some conditions that must be met:

- Access to technology to provide the data

- Incentive for people to participate
- Quality control process to safeguard the public interests

In poorer countries, typically only 10% of the population has access to the internet. Access to the technology becomes a significant burden. Some ideas:

- Use a process of identifying parcel lines on aerial or orthometric imagery (low accuracy is better than no accuracy, as long as the dereferencing is managed correctly.)
- Provide community internet access points for Land Registration applications. While this requires funding, it is much cheaper than hiring survey crews.
- Appeal to the volunteer community; the OpenStreetMap data in the post earthquake phenomenon in Haiti did not come from the Haitians on the street. It came from volunteers working with available imagery.
- Engage in the participatory approach. Participatory Enumeration process was developed by the UN and Global Land Tools Network. Participatory mapping is being executed in Rwanda. This shows that it is possible to get the community to engage when they understand the benefits.

Incentive is key to drive participation. Public relations and participatory practices may be enough to drive participation, but maybe more incentive is needed.

Consider a commercial entity that may benefit from the process; perhaps the banks who might put mortgages on the properties post registration. Ask the bank to sponsor the web input locations, or provide free internet access at public internet cafés in return for advertising their services on the registration website, or provide a discounted rate or subsidized fees for those who provide qualified input data.

The remaining issue is quality control. This is where the evolving role of the Surveyor comes into play, and another opportunity to drive increased public participation.

Every parcel submitted must have the adjacent parcels submitted, and the bounds undisputed as a prerequisite for acceptance. This means that for every person who desires to submit, that person must enlist the abutting owners to do the same. The adjacent owners are witnesses to each other, and the process becomes self-sustaining as they will have to keep enlisting neighbors.

The evolving role of the surveyor

As data collection technologies become more and more powerful, and the raw collection becomes cheaper, the skill sets required to collect effective solutions will also diminish. The value that a qualified Surveyor brings is his/her understanding of the data collection technology, its accuracies, and its limitations. The role of the surveyor will evolve from a

collection role, to a role of data interpretation and evaluation. There is an opportunity to leverage the surveyor for quality control, and harness the power of the crowd for raw data collection.

Decentralized open data for maximum leverage and unforeseen benefits

The last concept for consideration is driven by the new media capacity to deliver unforeseen benefits. To enable this process, Cadastral organizations must engineer open access, and APIs into their data infrastructure. While applications and user interface designs will be required to serve the primary stakeholders in the system, the open API characteristic of the data will enable third parties to use and combine our data in new and creative ways that we have not yet considered This is what makes applications like Zillow, and the Professional Survey Cloud possible. This concept allows Cadastral organizations to maximize the public return on the Cadastral data investment by leveraging the data to the maximum extent possible. The Cadastral organizations operational model will need to shift to that of an organization that provides data integration tools and services,

Conclusion

The concept of Cadastre 2.0 is to challenge a traditional and conservative Cadastral community to think on the terms of the progressive Web 2.0 world. While the concepts discussed and proposed are a long way from being executable plans, they are intended to present possibilities for consideration. Whether the specific proposals are ever implemented or not is not important; what is important is to leverage the new media to drive its benefits into the Cadastral community, and ultimately to the benefit of the public at large.

Contact

Matthew Delano, LS
Business Area Director, Trimble Cadastral Solutions
Trimble Navigation Limited
10355 Westmoor Drive
Westminster, CO 80021
USA
Phone: +1 (720) 587-4543
matt_delano@trimble.com
www.trimble.com

The Rise or Fall of the Cadastre Empire[9]

Gavin Adlington
Lead Land Administration Specialist, The World Bank[10]

Background

In the ECA (Europe and Central Asia) region there has been a major reform in the Land Administration and Management (LAM) sector because of the political changes that occurred following the collapse of socialism in the late 1980s to early 1990s. The World Bank has been in the forefront of assisting countries with their land reform throughout the region over the past 20 years. Many countries have made remarkable progress and some have gained EU membership status. In ECA, Land Administration and Management (LAM) has been included within 39 projects, 21 of which were 'stand alone' LAM Projects. Over US$1.1 billion in loan or credit funds from the Bank has augmented government programs and assistance from bilateral donors in a region that has seen a greater level of land and property redistribution than has been experienced anywhere else in history. The injection of funds through making property assets more liquid and the establishment of effective and efficient property registration systems that have allowed or promoted the introduction of these assets into the economy have been a major factor in the positive economic trends that have been seen in the region.

The overriding and predominate policy behind the projects and the reforms was to rebuild the systems of secure real estate tenure by developing, within a framework of laws, good systems of real estate registration and cadastre. The Bank has recognized that 'no country can sustain stability within its boundaries, or economic development within the wider world, unless it has a real estate rights policy that promotes internal confidence between its people, its commercial enterprises and its government'.[11] Establishing trusted and efficient systems would make possible the re-establishment of private land rights for citizens and businesses. Such systems are in turn making possible the development of a property and mortgage market, and can increase levels of transparency and accessibility of property information. This is the essential foundation for a functioning market economy where: the property assets of all players are secure; social safeguards are respected; and land and natural resources are sustainably governed.

The program of LAM projects originated in the early 1990s following a series of studies that led to a strategy of involvement in the LAM sector at that time. The full program of LAM activities experienced in the region occurred in three stages: (1) Assignment of property rights to individuals and companies following the collapse of the socialist systems in the region; (2) Protection of property rights and encouragement of the real estate market; and (3) Improving the efficiency of the management and administration of land and property. Stages (1) and (2) are largely completed for most of the countries, who are now working on Stage (3).

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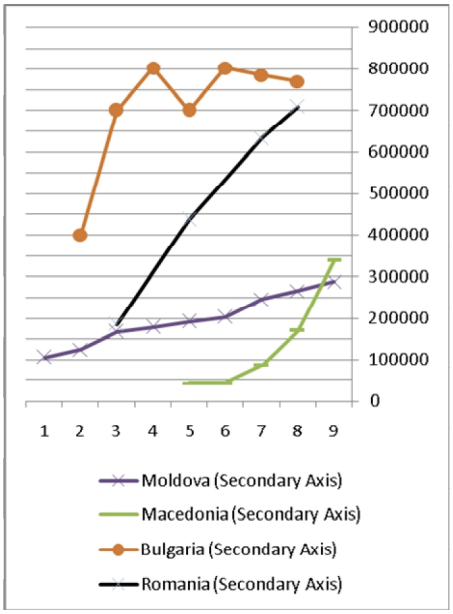
[9] Title taken from the classic text *The Rise and Fall of the Roman Empire (or more accurately 'The History of the Decline and Fall of the Roman Empire)*, 1776-1789 by Edward Gibbon.

[10] The views in this paper are those of the author and not necessarily the policy of the World Bank.

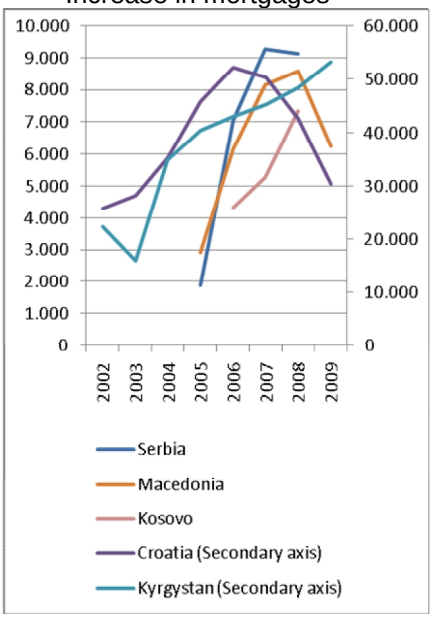
[11] UNECE Statement on Social and Economic Benefits of Good Land Administration 2005

The scope of work completed and the results are very impressive. An area of 27.4 million sq km and a population of almost 900 million have received a huge number of property assets. Exact figures are not known, but an estimate would be that 300 million properties have had documentation checked or new documents produced; properties surveyed; and ownership registered – mostly in automated registration and cadastre systems. Much of this property was given 'free of charge', which in itself was a massive stimulus package that helped transform the region economically. Samples of the increases in mortgages and transactions experienced in the region demonstrate the impact that the program has had:

Increase in Transactions



Increase in mortgages



The World Bank Publication *Doing Business 2011* shows countries from the ECA region as well represented in the top twenty for the category *Registering Property Rights*

1. Saudi Arabia	*11. Iceland*
2. Georgia	*12. United States*
3. New Zealand	*13. Estonia*
4. United Arab Emirates	*14. Switzerland*
5. Armenia	*15. Singapore*
6. Belarus	*16. Sweden*
7. Lithuania	*17. Kyrgyz Republic*
8. Norway	*18. Moldova*
9. Slovak Republic	*19. Thailand*
10. Azerbaijan	*20. Palau*

This is a remarkable achievement when it is considered that many of the ECA countries had to develop and pass laws, train personnel, establish offices from scratch, develop methodologies and procedures, load their databases with reliable information and establish support activities in the private sector (including mortgage, real estate agency, valuation, conveyancing and cadastral surveying). Overarching was the need to inform the public and educate them on what it means to be an owner, how they can utilize their assets and educate them on the organizations that will assist them and protect their rights.

The Fall of the Cadastre Empire

In the ECA region, especially in the former Soviet Union countries, the term 'cadastre' and 'cadastral survey' was associated more with surveys for soil quality and agricultural productivity in the early 1990's. The cadastral survey profession as known in many countries with a tradition of private land ownership and licensed cadastral surveyors did not really exist. *It is highly questionable whether the achievements in the region could have been achieved had such a profession existed at that time.*

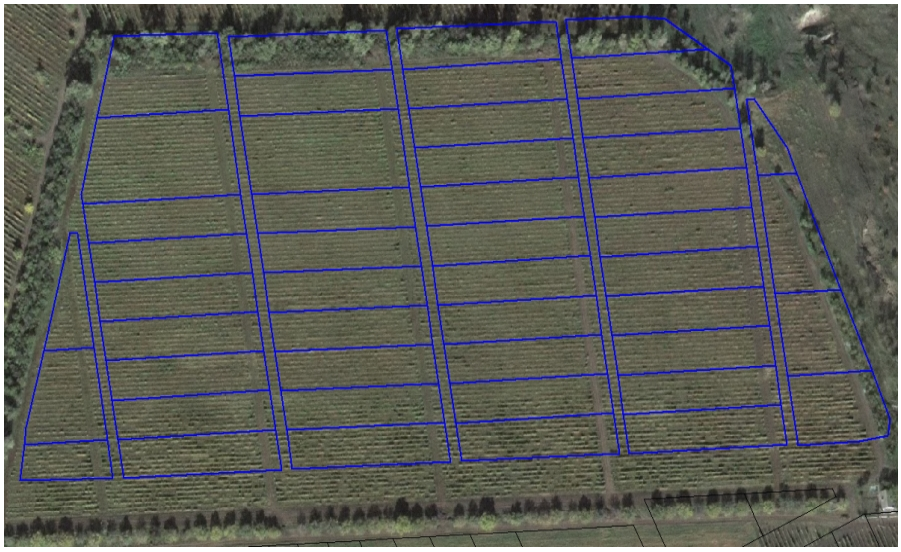
In many developing countries around the world there have been attempts to undertake systematic registration of property rights because existing systems were dysfunctional. There have been some successes but many failures. The normal procedure is for the government to go to the professions (legal and cadastral survey) and ask: 'what needs to be done?'; 'how much it will cost?'; 'how long will it take?'; and 'how can this work be completed?'. Then to attempt to do the work using the methodology proposed. The contention of this paper is that this is the wrong approach and a better approach has been demonstrated by the governments of the ECA region. The very strong governments historically associated with the ECA region went to the professions and staff of the government agencies and told them what needs to be done, how much money was available and how long it would take. Then required the agencies to do the work in the time and cost budgets available. The option of failure was not something that would be tolerated. Thus, in 1997 when President Akiev of Kyrgyzstan told the land committee to complete the break up of the State and Collective farms and issue individual titles to 600,000 individuals by the end of 1999, without additional budget, they just had to get on and do it. Similarly, when President Putin required the Federal Land Cadastre Service to register all land plots held by 43 million owners and impose a more equitable land tax, for the whole of Russia, within a five year program (2000 to 2005) the Cadastre Service did just that[12].

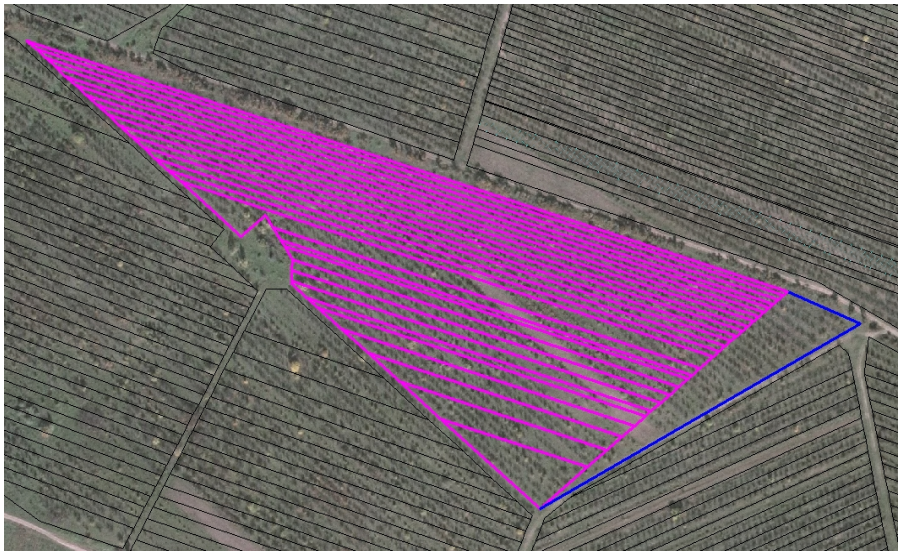
Apart from strong government, the success of the program for LAM in ECA is a result of the focus on the client and the needs of the client. Most often the people just needed to know where their property was on the ground and feel trust that the new systems protected them and their assets. Secondary focuses in projects on training, IT system development, private sector development, transparency and the operations of land administration services were also key to success.

[12] Overchuk, A. Cadastral Valuation of Land in Russia and Introduction of the New Land Tax. IAAO 71st Annual Conference, Anchorage, September 21, 2005.

The accuracy of surveying work was varied to say the least. In *Kyrgyzstan* hundreds of individuals were hired, trained in systematic registration procedures and sent out with tape measures and whatever maps happened to already exist to conduct systematic registration for the entire country. Two and a half million properties were registered (including 661,000 that had to be 'legalized') during a period of about 7 years. In *Georgia* a similar approach was used under a German funded project, but the 400 trainees were supplied with pen computers, digital orthophotomaps and GPS equipment that automatically recorded boundary points on the pen computer. Approximately 40 new companies were established. Together with other donor support and the government's own resources the entire country was surveyed and title registered. In *Moldova* the private sector was established and then used for the survey work. 150 companies now exist. Between 1999 and 2007 four million properties were systematically surveyed, documentation checked and registered.

Similar work was conducted in other countries of the region, but a common theme was speed and low cost, with it being typical to complete the survey and registration of a property for less than $10 a property. Of course, monuments were generally not placed, rigorous checking was not conducted and errors in the position of boundaries are common. For example, the following slides from Moldova show some of the issues that are now being addressed:





Although these errors in position may need to be solved at some stage, they have virtually no impact on the functioning of the property market, which flourishes despite these drawbacks. Indeed, it is clear that very few people, apart from surveyors, are concerned about the accuracy of showing property boundaries on maps.

The methodologies used in the ECA region were developed to meet the needs of society. It is already being said that *google earth* and similar technologies provide free location information about properties and their boundaries, so why would it be necessary for surveyors to go to the field or measure at all. The current generation understand how to read aerial imagery and use GPS, so any person can locate a boundary on a mass produced map found on the internet. A geo-referenced image of any boundary or building can be recorded by any member of the

public using their mobile phone. This is sufficient for the public and professional users – including banks, lawyers and estate agents. Accurate ortho-rectified imagery of properties for specified years is becoming available on the internet and this will also show the position of a boundary as seen from the air for the specific year that is requested. Thus, even historic boundary information is now becoming available freely. These methodologies will meet the requirements of the public and other professional users for land market purposes perfectly well.

In many ways, we have come round a full circle. In earlier centuries, when people did not move from their villages it was sufficient that everyone in the community, or at least the leaders of the community, knew the locations of boundaries, the owners and the history of the ownership. The three dimensional image of the boundary was held 'in the head of the local elder'. In case of dispute, the elder would solve the problems. As people became more mobile and new territories were conquered in other parts of the world it was necessary to mark boundaries and record them, with increasing levels of sophistication over the years, but again, primarily so that a boundary can be protected or relocated in time of dispute. The profession of the licensed cadastral surveyor has been necessary to prepare the records and then interpret them when needed. Modern technology has brought the issue full circle because it is now possible to have that 'knowledge of the elders' recorded in picture format and understandable to any person. Thus, the usefulness and role of the cadastral surveyor appears to be declining and their days may be numbered.

The Rise of the Cadastre Empire

The last paragraph of the last section is a bit of an exaggeration. There will be a need for many years to come for a professional person to be able to understand and follow documents and cadastral records that were produced to describe property locations over the past couple of hundred years. When disputes occur or new owners want assurances, experts with this knowledge will be needed. The past cadastral records are just one piece of evidence that is taken into account - together with the testimony of the parties and the 'pictures' from past aerial photography or other photographs. But they are still part of the evidence. However, the standard cadastral surveyor that surveys boundaries and measures frontages primarily because the survey regulations tell him that he must do so, is unlikely to have a justifiable role much longer. The cadastral survey expert of the future must be much more scientific and skilled in understanding historic and current technology and methods, but will be needed only in exceptional cases.

The mobile telecommunications market is getting ever larger. It is estimated that 50% of the 950 million population of Africa will have the use of a cell phone by the end of this year. 70% of these will be in rural areas. Other professions are already making use of this phenomena. In many parts of Africa systems have been put in place so that cell phones can be used to access information about farm operations, product prices and supplies, the weather and the whole supply chain. Many uneducated farmers are using these resources to improve profit margins. The cadastre profession needs to embrace the new technology too. For example, African villagers could easily walk around their own boundaries, record their own boundaries and housing using mobile devices, then send these geo-referenced images to a cadastral office over the internet. Their property rights could be registered and protected or transactions recorded quickly and cheaply. This might be a solution for example in South Africa, where, 20

years after independence, the government is still trying to work out how to include 90% of the population in the formal land administration systems. New ways of doing this are resisted by most of the legal and cadastral survey profession in South Africa.

The future for the cadastral surveyor lies on two new areas with enormous potential.

1. Within the realm of creating and maintaining the national spatial data infrastructure;

2. Utilizing new technology to provide cadastre services to locations that previously could not be included in LAM because of time and cost constraints.

This paper was not designed to address the emerging needs for spatial data infrastructure, but it is a huge growth area as governments realize the benefits of providing spatial information in standard format to both the government and private sector. The importance of creating spatial data only once for multiple users and the add-on benefits to the economy that the private sector provides once the data is available are reported elsewhere. The basic understanding of cadastre professionals of the use and limitations of various maps and map sources is key, and the profession should be focusing on this area and leading the way forward. There is probably no profession more skilled at understanding the importance of meta data and dealing with errors that are inherent when spatial data is gathered from multiple or unusual sources. The cadastral surveyor should be widening his/her horizons. Spatial data is becoming much more widely available and is being used to improve governance and is becoming a key management tool for local government. Twitter, facebook and any other social media method is an ideal way for the public to raise concerns, provide input and generally keep their local authorities aware of their needs. This will affect almost every avenue of life (e.g. bus routes, instances of crime, crumbling buildings, etc, etc.). This then needs to be reflected in the spatial information systems as quickly as possible. The opportunities for the cadastre survey profession are huge – if it branches out from a narrow focus of property boundaries.

The more traditional role of the cadastral surveyor in recording boundaries is changing, and it is necessary to embrace the new technology to meet the needs of society. Developed economies with existing accurate records can gradually embrace new technology as they have always done in the past. The World Bank tends to deal with countries that still need to formalize records and provide good, corruption free, services to the public. The opportunities for using lidar mounted on vehicles, cheap and quick aerial photography, existing imagery available on the internet, hand held GNSS systems, digital photography and even cell phones that can record and geo-reference properties can all be used to conduct mass survey by non-specialists. The public awareness, public support and public viewing needed in mass registration programs, which is still required in much of the world, can utilize social media. Facebook and twitter will be able to get the message across quickly and effectively and can be used for recording complaints or objections. The author does not know of cases where this has been used yet, but there is little doubt that it will. The internet is a marvelous tool for ‘public viewing’ and improving transparency of dealing in land. This type of facility has already been used in Croatia and Montenegro, where the cadastre agency put all their records on the internet and invited the public to check the records and inform them if there were errors or changes needed. The cadastre in Croatia has had over 41 million searches on their database

since 2005 and the Croatian land registry has had over 121 million. In Serbia SMS is routinely used for the cadastre office to advise customers that their records are ready for collection. This new service has already been used over 19,000 times.

Conclusion

In the ECA region a very successful land reform and land registration program has been largely completed by people without formal training in cadastral survey. It was often guided by surveyors with a cadastre background who were willing to be pragmatic rather than stick strictly to historic methods and high levels of accuracy. The driving force was the need of their clients – either the public or the government program. The achievements in the region would probably not have been possible if the cadastral survey profession had existed and insisted on the standard methods and accuracies required in other regions. Much of the developing world can learn from the experiences and approach in ECA, but it is also a warning to the profession that it must meet the needs of society or be bypassed. With the advent of social media, crowd sourced technology and imagery available on the internet there is a wonderful opportunity for establishing land administration capacity in places that previously could not afford such systems, and to provide transparent land administration services in places where corruption and inefficiency is endemic. Historically the cadastre profession has been one of the hindrances that prevent new systems being put in place, but there are now many other professions, especially GIS professionals, that will do this work if the cadastre specialist does not. The public is getting more demanding and more technology savvy, and the cadastral surveyor will need to adapt and embrace new technology and social media, or the fall of the cadastre empire is imminent.

The cadastre empire has the opportunity to lead the way in the utilization of social media and to integrate all forms of spatial information of whatever standard, source or accuracy, into the on-line spatial information revolution that is happening. It will occur either with or without the cadastre specialists, but no other profession can compare with the cadastre specialist in the understanding of errors, accuracies and the usefulness of different forms of spatial information. The cadastre profession needs to lead the way. The rise of the cadastre empire is a distinct possibility.

The King is dead. Long live the King.

FAO Land Tenure Role in Disaster Risk Management

Paul Munro-Faure and Adriana Herrera Garibay[13]

Introduction

Natural disasters frequency and severity has been increasing steadily in the past decades. Just between 2010 and 2011 a devastating earthquake hit Haiti in January 2010 (7m Richter Scale - RS) killing 230,000 people and leaving 3 million affected. One month later Chile experienced an (6.9m RS) earthquake with an estimated US$15-30 billion[14] losses to the Chilean economy. Resulting from heavy monsoon rains, Pakistan severe floods in mid-2010 affected some 18 million people and left approximately one-fifth of Pakistan's total land area underwater[15], with desolating effects for the agricultural sector, fundamental for the Pakistani rural economy. In mid-2011, 12 million peoples' livelihoods in the Horn of Africa are being threatened with famine as a result of the worst drought that has affected the entire eastern Africa in the past 60 years.

In the period between 2000 and 2007, 98 percent of the 230 million of people affected annually by disasters, were due to climate related hazards, mainly floods, windstorms and droughts. This trend is not likely to change. The Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC 2007) has confirmed that frequency and intensity of extreme weather events such as heat waves, tropical cyclones, floods and droughts are likely to increase with climate change.

Although the trend of natural disasters is increasing, the severity of the impacts in the single individuals or the society, is closely linked to the relation between their vulnerability[16] and resilience[17]. Numerous case studies demonstrate that vulnerability to natural disasters is greatly increased by pre-existing country and local area social, environmental and economic conditions. Widespread poverty, bad nutrition, poor access and tenure insecurity of land and natural resources, weak governance; all contribute substantially to peoples' vulnerability to the effects of natural disasters.

According to FAO's 2010 estimates, there are more than 925 million of undernourished people in the world. 98 percent are in developing countries.[18] They are experiencing poverty, and many depend on agriculture or agriculture related activities for their livelihoods. It is this 98 percent of people that are the most vulnerable population to the effects of natural disasters. The role of FAO is to support affected member countries in their efforts to deal with

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[13] Paul Munro-Faure is the Chief of the Land Tenure Group in FAO. Adriana Herrera Garibay is the Land Tenure Group Officer in charge of the Natural Disasters programme in the Group.

[14] UNEP Year Book2011, An Overview of Our Changing Environment, United Nations Environment Programme 2011 page 2.

[15] around 796,095 square kilometers (307,374 sq mi)

[16] *Vulnerability*: the conditions determined by physical, social, economic and environmental factors or processes, which increase the susceptibility of a community to the impact of hazards. (www.unisdr.org/terminology)

[17] *Resilience:* the capacity of a system, community or society potentially exposed to hazards to adapt, by resisting or changing in order to reach and maintain an acceptable level of functioning and structure. This is determined by the degree to which the social system is capable of organizing itself to increase its capacity for learning from the past disasters for better future protection and to improve risk reduction measures. (www.unisdr.org/terminology)

[18] http://www.fao.org/hunger/en/

vulnerability in the event of crisis and natural disasters, increasing their resilience to face them.

The Role of FAO in Disaster Risk Reduction

The Food and Agriculture Organization of the United Nations (FAO) was founded in 1945 with a mandate to raise levels of nutrition and standards of living, to improve agricultural productivity, and to better the condition of rural populations. Today, FAO is one of the largest specialized agencies in the United Nations system and the lead agency for agriculture, forestry, fisheries and rural development. Being an intergovernmental organization, FAO has 191 member nations, two associate members, plus one member organization, the European Union. Since its inception, FAO has worked to alleviate poverty and hunger by promoting agricultural development, improved nutrition and the pursuit of food security - defined as the access of all people at all times to the food they need for an active and healthy life.

Within this framework, "Disaster Risk Reduction (DRR) in FAO seeks to protect livelihoods from shocks, to make food production systems more resilient, more capable of absorbing the impact, of performing well and recovering from disruptive events. Disaster risk reduction safeguards development investments in the agricultural, livestock, fisheries/aquaculture, forestry and natural resources sectors, helping the world's most vulnerable people to become food-secure."[19]

DRR is one of the three organizational results of the overall Disaster Risk Management (DRM) in FAO. DRM has been included as a corporate priority in the FAO's Strategic Framework 2010-19, aiming at reducing countries vulnerability to crisis, threats and emergencies *through better preparedness, response, transition to development and integration of risk prevention and mitigation into policies, programmes and interventions*[20]. In order to support and give strategic direction to the implementation of such FAO's corporate priority in its member countries work, FAO has elaborated a Framework Programme on Disaster Risk Reduction including four integrated thematic pillars:

PILLAR 1: *Enable the Environment*. Institutional strengthening & good governance for DRR in agricultural sectors.

PILLAR 2: *Watch to Safeguard*. Information and early warning systems on food & nutrition security and trans-boundary threats.

PILLAR 3: *Prepare to Respond*. Preparedness for effective response & recovery in agriculture, livestock, fisheries & forestry.

PILLAR 4: *Build Resilience*. Mitigation, prevention and building resilience with technologies, approaches & practices across all agricultural sectors.[21]

The FAO emergency and development work on land tenure feed into the FAO DRR Framework Programme and in direct support of its broader risk management approach.

[19] Resilient Livelihoods. An FAO Framework Programme on Disaster Risk Reduction for Food & Nutrition Security. p. 3. Draft, 11 August, 2011.
[20] Idem p.3
[21] Idem pp. 4 and 5.

Disaster Risk Reduction and the Hyogo Framework for Action 2005-2015

In January 2005 the United Nations International Strategy for Disaster Reduction (UNISDR) organized a World Conference on Disaster Reduction, in Kobe, Hyogo, Japan. The Conference represented an important change in the disasters response emergency relief approach used since the Yokohama Conference of 1994. It emphasized the need for a more integrated response including disaster risk reduction in the pre-disaster phases by strengthening prevention, mitigation and preparedness. With this approach the Conference agreed on a Hyogo Framework for Action 2005-2015 (HFA) to integrate DRR strategies into development planning, to reduce substantially loss of life, and economic, social and environmental losses in communities and countries.

Concurring with this objective, the HFA strategic goals aim at the integration of disaster risk and prevention considerations into sustainable development policies, planning and programming at all levels, strengthening institutions, and incorporating risk reduction into emergency preparedness, response and recovery programmes. They aim at the development and strengthening of institutions, mechanisms and capacities at all levels to contribute systematically in building up resilience to natural hazards. For the achievement of the strategic goals, Disaster Risk Management[22] (DRM) emerged as an approach combining pre-disaster work of DRR with emergency response from a management perspective.

The HFA identifies five priorities for action:

1. Ensure that disaster risk reduction is a national and a local priority with a strong institutional basis for implementation
2. Identify, assess and monitor disaster risks and enhance early warning
3. Use knowledge, innovation and education to build a culture of safety and resilience at all levels
4. Reduce the underlying risk factors
5. Strengthen disaster preparedness for effective response at all levels

The HFA general considerations for addressing the priorities call for the use of a multisectoral approach; and encourage regional and international organizations (such as the United Nations and international financial institutions) to enhance cooperation and assistance integrating DRR into their policy, planning and programming. Similarly they underline the importance of international organizations in supporting state agencies to develop the "knowledge, capacities and motivation needed to build disaster resilient nations and communities"[23].

The FAO Framework Programme on Disaster Risk Management was elaborated following the objectives and priorities of the HFA.

Land Tenure in Disaster Risk Management in FAO

Why is land tenure important in FAO's work on DRR?. In addition to loss of life and the severe impacts on national economies, some of the most drastic effects of natural disasters on peoples' livelihoods relate to the disruption of land tenure systems and property loss. Access to land and security of tenure are very often damaged as a result of natural disasters,

[22] Disaster Risk Management includes but goes beyond DRR by adding a management perspective that combines prevention, mitigation and preparedness with response. *FAO, Disaster Risk Management Systems Analysis, A Guide Book, Rome, 2008. pp.6*

[23] UNISDR. Hyogo Framework for Action 2005-2015: Building the Resilience of Nations and Communities to Disasters. Extract from the final report of the World Conference on Disaster Reduction. (A/CONF.206/6)

leaving people unable to access their land either for production or for housing purposes. The effects can result from destruction of land tenure records like land titles, cadastre maps, land registry records, identity cards, and insurance claims. They can involve the total or partial destruction of physical evidence of property boundaries; the disappearance or death of people who have the memory of property boundaries; the emergence or intensification of conflicts over land tenure that were already present but exacerbated as a result of the disaster, such as conflicts over inheritance of land rights. In case of the need for resettlement, there can be difficulties involved in addressing land rights in resettlement areas, especially if there is lack of proper legislation to facilitate access to land to those who have lost it. Where property rights are unclear and people have left their land as a result of a natural disaster, land grabbing and abusive building practices can happen where there are not suitable norms to avoid it. All these effects can severely impact peoples' livelihoods and increase the vulnerability of the people if the security of the use and property of the land is affected.

International and development agencies working with disaster management and mitigation have confirmed the importance of land tenure security and access for the long-term reconstruction of communities' livelihoods. They consider that building up communities' resilience involves recovering and protecting property rights to land, which in turn will lay down a solid basis for reconstruction, physical planning, compensation and economic growth.

Despite growing awareness of the importance of land tenure related issues to disaster risk reduction, the international humanitarian community not related directly with tenure issues, possesses limited understanding of the precise nature of the linkages between tenure and DRR on the one hand, and their implications for relief, early recovery and rehabilitation programmes on the other. Additionally, there is limited awareness of the tools and approaches that could be used to incorporate land tenure issues into programmes to enhance mitigation, preparedness, and favour good disaster response operations. This has been in part, the result of a lack of a clear understanding of the importance of land tenure issues in the disaster context. There has been also a commonly-held perception that land issues were either too "complex" or too politically sensitive to merit consideration in emergency settings.

In 2007, in the context of the HFA principles applied to land tenure, the Inter-Agency Standing Committee (IASC), the main mechanism for inter-agency coordination for humanitarian assistance[24], agreed on the need to coordinate efforts on land tenure issues addressed after natural disasters. Accordingly FAO, UN-HABITAT and the IASC Early Recovery Cluster decided to produce material jointly to:

- analyse the linkages between vulnerability on land tenure and DRM;
- promote awareness on the importance of land tenure for both the national and international community working on DRM, and;
- elaborate training tools to support the work of frontline, decision making people who have to deal with land tenure matters in all phases of DRM in natural disaster affected countries.

The work carried out through FAO partnership with UN-HABITAT and IASC has been very fruitful. We have addressed all the proposed topics in the publications we have produced. We have analysed the linkages of land tenure issues and DRM looking at the lessons learned in countries prone to natural disasters; in the Philippines, Indonesia, Honduras, Madagascar,

[24] The IASC is formed by 9 UN Agencies which are full members of IASC and 9 international agencies working on emergency operations
and human rights, which are standing invitees. See: http://www.humanitarianinfo.org/iasc/

Bangladesh and Ecuador[25]. To raise awareness we have published country briefs analysing the importance of dealing with land tenure rights and property issues for disaster risk management in the particular context of the concerned countries.[26] Finally we have elaborated guidelines and a training manual to address the main land tenure and natural disasters issues that people working at national level on both land tenure and on natural disasters need to have in mind when formulating programmes and policies under the HFA objectives and priorities for DRR.[27]

These outputs have not yet completed the work of the UN community on land tenure in this context, nor have they exhausted the challenges for the support of member countries in their efforts to achieve the HFA 2005- 2015 goals. There is a need to undertake wider initiatives both to create awareness, especially at national decision-making level, and to train nationals and internationals working in the forefront of land tenure and natural disaster management programmes, legal frameworks and institutions. We need to encourage the exchange of experiences between countries presently addressing land tenure and natural disaster management. We need to develop tools and approaches to incorporate land tenure issues in DRM programmes within existing national programmes and specificities. We need to support innovative initiatives to improve mechanisms to create better access and security on land and other natural resources rights. We need ultimately to address the governance of tenure to allow tenure to be addressed responsibly and without corruption in natural disaster management.

FAO, in collaboration with other stakeholders from UN, International Agencies, civil society, private sector and academics, has been working in the formulation of the Voluntary Guidelines on the Responsible Governance of Tenure of Land, Fisheries and Forests in the Context of National Food Security (VGs). In the present draft, these guidelines address the main issues that responsible governance on tenure needs to address in NDM. The Voluntary Guidelines are presently under negotiation in a process led by the UN Committee on World Food Security (CFS), housed in FAO, with a view to their finalization and endorsement during the 37th Session of CFS in October 17-21 2011.

FAO's land tenure work on disaster risk management will continue to address these challenges along with UN, national and international partners working for the reduction of vulnerability to and risks of natural disasters.

United Nations Food and Agriculture Organization
Land Tenure Group
Rome, Italy. August, 2011

[25] FAO, UN-HABITAT, Land Tool Network, IASC Early Recovery Cluster. *Land Tenure and Natural Disasters. Addressing Land Tenure in Countries Prone to natural Disasters.* FAO, Rome, 2010.

[26] FAO, UN-HABITAT, Land Tool Network, IASC Early Recovery Cluster. *On Solid Ground. Addressing land tenure issues following natural disasters*. *Country Briefs*. FAO, Rome, 2010.

[27] UN-HABITAT, FAO, IASC Early Recovery Cluster, Global Land Tool Network. *Land and Natural Disasters. Guidance for Practitioners*.
UN-HABITAT, Geneva, June 2010.
FAO, UN-HABITAT, Land Tool Network, IASC Early Recovery Cluster. *Assessing and Responding to Land Tenure Issues in Disaster Risk Management. FAO Land Tenure Manuals 3.* FAO, Rome, 2011.

What about an OpenCadastreMap?

Paper presented at FIG Commission 7 International Symposium “Cadastre 2.0”
Peter LAARAKKER, Walter T. DE VRIES

ABSTRACT

In search of alternative cadastral information systems for local communities, the openstreetmap.org provided an appealing avenue. This article explores if the analogy of opencadastre.org could be a realistic and feasible endavour. Studies on volunteered geographic information (VGI) and open systems have generated potential avenues of applications and a list of critical concerns. Our study hypothesized that in the cadastral domain many of such potential avenues and concerns were also valid when starting up an opencadastre application. We conducted an extensive inventory of professional opinions on the potential of an opencadastre application through various discussion boards on Linkedin. After 4 months, we were summarized and categorized the discussions, and compared the results to the list of potential avenues and concerns from the VGI and open systems community. The results show that the regulatory nature of the cadastral domain complicates open access and participation of a potential opencadastre. The opencadastre concerns coincide with many of the technical concerns of the VGI and open systems. On the socio-organizational and legal side there are fundmenatal differences. The most valuable potential application of an opencadastre relates to the exploratory phases of setting up of land registrations. The visualization aspect and the potential of participation could increase the legitimacy of land adjudication and delimitation of boundaries. Opencadastre could be complementary for land administraiton practices when no formal cadastral systems are present. However, security and protection of data remains a potential problematic area. Further research should therefore focus on piloting an opencadastre application in a real-life setting.

INTRODUCTION

The key question of this exploratory paper is whether voluntary contributions of citizens in an ICT environment which is open to all citizens can offer additional and/or complementary opportunities to develop and maintain cadastral or land information systems. This question is opportune and timely, because in many other application domains similar developments are currently occurring. Openstreetmap.org is one among many examples which has empowered citizens to contribute with their own insights and in maps, and attributes of map objects. Openstreetmap has developed into a global patchwork of street maps. Most users do not only consider the quality reliable, but also the result is frequently the only map available. The street maps of Port-au-Prince created after the earthquake disaster in Haiti[28] are a prominent example of relevance of voluntary mapping contributions through the openstreetmap facility. Other examples on a wider scale include wikipedia[29] and wikimapia[30]. All these examples provide any users the opportunity to share their own information and to correct each other’s information. Both occur in a internet-based environment which is open to all internet-users,

[28] http://haiti.openstreetmap.nl
[29] http://www.wikipedia.org
[30] http://www.wikimapia.org

hence to all citizens. What a similar endeavour would entail for the cadastral and land information domain? For this domain the information collection, provision and sharing is usually heavily regulated, and the technology is usually far from 'open' to all citizens. This paper will therefore explore the implications of an 'opencadastre'.

The paper consists of the following sections: first we provide a summary of the research on 'open' and 'voluntary'. Clarifying and founding these terms in current scientific views is important to understand the character of the technological opportunities as well as the changing nature of government-citizen interaction. Next, we provide the methodology to collect and share opinions on the issue of opencadastre, followed by a section summarizing and synthesizing the results of this. We discuss the results in the light of our earlier explanation on 'open' and 'voluntary', aiming to derive critical bottlenecks and challenging opportunities in the context of the cadastral domain. Based on these findings we conclude with a list of recommendations for further research in the field of cadastral and land information sciences and a proposal for action-based pilot projects to test opencadastres.

THEORETICAL CONTEXT OF 'OPEN' AND 'VOLUNTARY' INFORMATION

As mentioned above, the system of an 'open' cadastre could rely on the experiences and guidelines of similar other systems. For this paper we summarize the pros and cons based on two particular fields: 'open systems' and 'voluntary geographic information'. While many of the publications on either VGI or open systems seem to overlap to a certain extent, in particularly when discussing the examples of 'openstreetmap', we still discuss these separately, because VGI often originates from the geographic scientific domain, whereas research on open systems originates from the research on internet and new media. Each type of research reasons from its own perspective, even though the conclusions and implications for opencadastre may be similar.

Research on 'open' systems originates from earlier publications on organizations. From an organizational science perspective the difference between organization in a closed or open system is that the former only considers influence and control from internal actors and factors, while the latter also assumes environmental influences, i.e. agency from other actors and factors outside the single organization (Scott, 2001). In information infrastructure research this basic concept of 'open systems' has increasingly gained attention. A crucial aspect of 'openness' is the issue of scalability. Craglia et al. (2008) refer to the specifications of the open geospatial consortium (OGC) as a way to increase the number of users and applications. Interoperability of 'open' spatial data infrastructures would improve through open standards and as a result inter-organizational collaboration and data exchange should become more effective. Yet, with additional actors contributing to the development of system also the complexity in managing and controlling the system contributions. Braa et al. (2007) find, for the case of open health information systems, that as a result of increasing scale standards of contributions and information exchange tend to become increasingly flexible. With an increase of 'openness' the agency of external actors and factors in how the system is operating becomes increasingly persuasive. This was further investigated by Niederer and van Dijck (2010) in their research on Wikipedia as open infrastructures. They regarded wikipedia as an open system of collaborative knowledge, which has pros and cons. They highlight the fact that in open infrastructures anonymous amateurs can produce quality information, yet there is a contest to Wikipedia's claim to accuracy and neutrality.

Research on 'voluntary geographic information' (VGI) has emerged rapidly in the past 5 years. Goodchild explored the phenomenon of the voluntary build-up of geographic information through the web. In his 2007 articles on citizens as sensors (Goodchild, 2007a; Goodchild, 2007b) he explores sites such as wikimapia and openstreetmap, and questions what drives people to voluntarily contribute to such sites, how accurate the results are, and how they augment more conventional geo-information sources. In subsequent publications (Goodchild, 2008; Goodchild, 2009a; Goodchild, 2009b; Goodchild and Glennon, 2010) he differentiates areas where VGI has a crucial role and where it has virtually no role. The former concerns disaster and environmental management in particular. The latter specifically include areas which are highly dominated by legal rules. As cadastral mapping has historically been rooted in rules and regulation, this would explain why VGI in the cadastral mapping world has not yet taken off.

Elwood (2008a) argues that the research field on VGI is still new, given the variety of terms that are available to refer to similar issues and phenomena: *Research on these new geospatial technologies and forms of data is still nascent enough that a central line of discussion remains how to name these phenomena and the activities they enable.* However, there is a difference between the terms which emphasize the new technologies of cartographic representation (such as 'neogeography', 'web mapping') and terms which emphasize the data themselves and the processes through which they are created and used ('collaborative' or 'participatory' information, 'user-generated' content, 'voluntary' information). In addition, Elwood (2008b) argues that for the latter category *problems of data access, quality and content are rooted in grassroots groups' resource constraints, diverse knowledge systems, and socio-political position as less powerful actors in local government and unrecognized stakeholders in local spatial data development. The efforts of these groups to obtain and adapt local government data for their own use, as well as their propositions for bringing their own deep local knowledge into public data resources, can serve as starting points toward imagining solutions to grassroots data challenges.* Elwood (2009) questions furthermore to whose advantage and to whose disadvantage the 'geoweb' is developing. She argues that it is still unknown yet crucial how '*different constituencies, variously more and less powerful, will take up the technology and what they will create with it'*.

Geomatica dedicated two special issues to VGI (volume 64, no. 1 and no. 4). Feick and Roche (2010) provide an overview of the current practices and research efforts in VGI. Amongst others, Budhathoki et al. (2010) address the issue of motivation of volunteers through posing why individuals give their time and expertise to develop VGI. Coleman et al. (2010) also reasons from the motivation dilemma when comparing citizen-sourced geographic data to mapping agencies data. Feick and Depardy (2010) evaluate selected visualisation methods used in VGI. Genovese and Roche (2010) provide a SWOT analysis of VGI for developed and developing countries. Grira et al. (2010) discuss the quality issue when relying on VGI.

Haklay (2010) and Ather (2009) found that the quality of openstreetmap (OSM) as compared to maps of the Ordnance Survey (OS) of the UK is fairly good. The positional accuracy of *OSM information is on average within about 6 m of the position recorded by the OS, and with approximately 80% overlap of motorway objects between the two datasets* in comparison to OS MasterMap*. In the space of four years, OSM has captured about 29% of the area of England, of which approximately 24% are digitised lines without a complete set of attributes*.'

Finally, de Leeuw et al. (2011) found that local knowledge through participatory mapping is likely to improve the classification accuracy of many other attributes featured in topographic maps. As a result, VGI provides a reason to consider engaging local expertise in the production and updating of topographic maps, in case other means are not available.

Summarizing all these articles:
VGI research reflects in particular the issue of participation in the map production beyond government agencies only. In particular the role of citizens in information quality and information currency is crucial. VGI reasons from the volunteering actor perspective. Crucial is that not only formal agencies produce information, but also individual citizens produce information. VGI provides the complementary means to update local maps, hence has the potential to improve the quality and currency of existing maps. Also, all citizens can provide their own views on spatial entities and spatial phenomena. Concerns in relation to VGI are that VGI does not automatically imply unlimited participation. Resource constraints may limit the sustainance of contributions from communities and grassroots level groups. As a result, it is still unknown how those in power and those without power can benefit equally from the technological opportunities. Research on 'open systems' also deals with participation, however with a different focus. The research mainly reasons from the access perspective. Crucial is that the information systems grow through a collective of system contributors. The role of actors in information production and dissemination is related to issues such as information freedom and information system construction. Collective benefits arise from collective checks and balances. Concerns are that it remains unclear who or what controls the rules and who/what decides in the collective. Table 1 summarizes the main concerns raised in literature on VGI and open systems. These concerns are differentiated in concerns from a socio-organizational and a technical perspective.

Table 1. Concerns on VGI and open systems

	Main concerns from a socio-organizational perspective	**Main concerns from a technical perspective**
Voluntary information	• Participation versus exclusion • Power and (in)equality • Local versus central expertise • Autonomous / independent views vs accountable views	• Complementarity of datasets vs. redundancy • Ad hoc / occasional vs. systematic data collection
Open systems	• Scalability versus local use (socio-organizational) • Unlimited access vs. controlled access • Collective agency vs collective benefits • Rule making vs. rule enforcement	• Large vs small applications (geographic) • Data quality vs data completeness • Flexibility vs regulation in standards

METHOD TO EXPLORE THE POTENTIAL OF OPENCADASTRE

As we believed that the concerns derived by the Open systems and VGI discussions did not automatically or implicitly apply for the Opencadastre potential, we considered a further exploration of the issue with practitioners necessary. Given the exploratory nature of the research we started by compiling views from practitioners and professionals, and by assembling accounts of similar experiences and relevant documentations. We collected opinions of practitioners and professionals through online discussion groups in LinkedIn and

in Wikimapia.org, assuming we could tap from the collective knowledge of both scientists and practitioners. In all online discussions we raised the same main question:

> *Can social media have added value to the formal statutory cadastral systems that exist world wide?*

We posed this question in the following discussion groups:

Social media network	Discussion group	Number of members (on 5 April 2011)
LinkedIN	Land information systems (LinkedIn)	298
	Spatial data infrastructure and development (LinkedIn)	65
	NSDI group (LinkedIn)	842
	FIG (LinkedIn)	277
	Openstreetmap	1192
	Mortgage professionals	6235
	UNSDI	101
	Participatory Geographic Information Systems & Technologies	856
	ITC Alumni	896
Wikimapia	Wikimapia.org/forum	7500
Dggroups	Dggroups.org	Unknown

In addition to monitoring and moderating the discussion we set up a subdiscussion group opencadastre.org to exchange ideas and manage the process. We assumed that the high number of members would be an indicator for the total number of possible contributors. Furthermore, by posing the questions in more than one forum we aimed to receive a wide range of opinions, and to rely on different kinds of epistemic communities and networks. The original first post in just a few of the groups generated a number of new issues in the overall discussion, which we hadn't expected beforehand. Examples included the issue of community-based quality control and the question whether landclaims can influence mortgage rates. To accommodate for those issues as well, we decided to broader our initial focus, and pose the questions in other social media based groups as well. The majority of the discussions in the LinkedIn groups took place during November and December 2010, while for all other media there were more fragmented (in time and in content) contributions.

RESULTS

After December 2010 the total number of contributions amounted to approximately 100. Most contributed in one or more of the linkedin groups. Some also contacted one of the authors or moderators personally. It is difficult to count for the number of contributions exactly, because some comments appeared in more than one group simultaneously, as some (if not: most) of the social media are interconnected. In addition, the personal contacts through telephone email and personal communication also generated some overlap between the contributions. Overall, the contributions of the discussions can be grouped in two types of categories, socio-

organizational concerns and technical concerns, which can each be further subdivided in to special concerns:
Socio-organizational concerns:

- Necessity
- Legality / role of government
- Legitimacy control
- Economic effects

Technical concerns:

- Quality control in OpenMapping
- Quality control in OpenCadastreMap
- Technology to construct

In addition, a number of contributors provided comments at the meta-level of the discussion. These comments included concerns about:

- Redundancy due to overlapping discussions
- References and relevant documents

Some of the contributions within each of these categories are further elaborated hereunder.

Necessity
Several contributors reffered to a necessity to formulate a new citizen centric paradigm for land administration. This necessity drew upon several arguments, including:

- the need to find land administrative solutions for the 1.1 billion slum dwellers in the world,
- the problems of governments in many countries to solve the land registration issues in the classical way by executing big land registration projects.
- The current speed of land reform (being too slow).
- The need for simpler, more engaging and more inclusive approaches.
- The problems when government takes the lead in land registration (such as bureaucracy)
- The need of data after natural disasters and the need to build secured datasets in high risk zones. This includes community involvement and the use of community data, such as for the reconstruction of cadastral boundaries after a vulcano eruption in Indonesia.

Legality / role of government
A number of contributors posed that it should always be governments that have the lead in land registration processes since they act as a referee in land issues. A current fact is that governments are not taking the lead in OpenCadastreMap, or committing fast enough in the open systems endeavours. Coming from a country with a sound land registration system, it is hard to envisage the absence of such systems. Contributors concurred with the idea that a common concept of OpenCadastreMap could create important building blocks for a land registration system, but that without government support it will always remain a limited project.

Quality control in OpenMapping

OpenStreetMap and Wikimapia shared some experiences about quality control. The level of Quality control is closely related to the openness of the system. One contributor called it a sliding scale. Maximum openness is given by a totally open and free platform such as OpenStreetMap. In a totally open system everybody can do everything without being stopped. In principle it is possible to wipe out the whole map. In OpenStreetMap so called edit wars took place between people that disagreed on the spelling of geographical names. In less open systems contributors can only flag certain information as potentially out-of-date. The former USGS Map was an example of such a system. Also in Wikimapia the information that is uploaded is checked by a community of editors. There are some general norms but in practice editors tend to have their own norms.

An additional potential of Opencadastre was the possibility for a higher level of quality control. StackOverflow is a community where software developers share knowledge through an FAQ-type system and gain explicit recognition (trust!) by providing meaningful answers, insightful comments or just ask sensible questions. According to one contributor it could be possible to build such systems in OpenStreetMap by adding a 'social quality' to information: who has been involved in creating this particular unit of shared knowledge and what are their characteristics? Users with a lot of experience, whose contributions are less often superseded by newer versions, or in the case of a body of geographic information expose a lot of knowledge in the same geographical area, may be seen as more trustworthy for that particular (spatial) context. OpenStreetMap now does not have such a system for explicit user recognition.

The concept of openness can also be applied on formal organisations like mapping agencies and cadastres. The possibilities for individual users to update the information or to appeal against government decisions is defining the openness of the information system.

Quality control in OpenCadastreMap

The value of an OpenCadastreMap system could be highly improved if a process of quality management is in place. One remark referred the so called Trusted Broker in Ghana, which was established completely outside the government. The Trusted Broker is applying some best practices like rules that the occupied property is not in environmentally sensitive areas, under power lines, in flood areas, in cultural areas etc. etc.. These tools and processes could be put up to the web site for anyone wanting to become a trusted broker.

Another discussion dealt with the difference between Quality control and legitimacy management. The latter is supposed to imply the formal recognizance of claims. Quality is more associated to accuracy (of data) and efficiency (of processes). Legitimacy has to do with the legal acceptance in a particular social context. Legitimacy has more a political or institutional meaning.

In this distinction contributors argued that certain means of quality control would be acceptable. It means that the claims that are put forward to the government are according to certain quality standards. Certain contributors stressed the importance of the involvement of the surveying sector in this process, they have the knowledge to do it in a professional way. Furthermore, they pleaded for greater creativity to engage non tradition actors in delivering trusted services to the poor and collect enough information to allow the inclusion of those persons in a broader administration process. NGO's active in microfinance have broad knowledge of property issues as an example.

Several contributors referred to the availability of the Social Tenure Domain Model as a very important structure in which overlapping claims can be registered or claims that cannot be registered in a statutory system.

Legitimacy control
The question was further raised whether it is possible to set up a system of legitimacy control that is not run by the government. This brought up the aspect of trust in ownership matters: if everyone believes that someone is the owner of this parcel, that can be assumed to be a fact. This same principle applies to crowdsources like Wikipedia and OpenStreetMap: if everyone agrees to a certain description of reality, this is assumed to be reliable In less established environments these instruments could also be used to build up a registration. In all cases however he thinks it is necessary to have some independent authority that is responsible for:
- assuring that all parties with interests are involved in the process
- setting a kind of 'final status' that affirms that a representation on the map is the best representation of legal reality.
This final status will remain necessary to make those data reliable enough to base important decisions upon.
The edit disputes are interesting from a perspective that two or more potentially valid opinions collide with the concept of one definitive map or representation. While the cadastre is and should be a definitive statement of how a state acknowledges property ownership rights, there might be other views, legitimate or not, which might range from disputing individual properties to boundaries of entire administrative areas. If an OpenCadastreMap would be used to register those different opinions alongside each other, this could become a powerful policy instrument and collaboration tool. The process of revisiting and agreeing ownership rights can use this tool but needs to be a transparent and institutionalized process since it results in a legal outcome. The risk of an OpenCadastreMap could not undermine the authority of the definitive one, but would need to be managed carefully.

Economical effects
A serious concern was whether an OpenCadastreMap could be relevant in economical terms. It is clear that a mortgage can only be registered if there is an official registered title. On the other hand the interest on loans that banks ask is based on a risk assessment. And the strength of a claim on land could be relevant in such a process. This question was posted in the LinkedIn group for mortgage professionals (6000+ members) but no further reaction was triggered.

Technology
The discussion on technology was not so much on the availability of modern technology to be used in the OpenCadastreMap concept but more on which technology should be used in which social context. Contrasting views were given for the possibilities in Africa. Also a discussion was held whether the need for transparency can be created with technology in which pen and paper is still dominant. Rather than the technology focus - we need to focus on how we can engage non tradition actors in delivering trusted services to the poor and collect enough information to allow the inclusion of those persons in a broader administration process. Educating NGo's microfinance and others that already work with the poor and who collect much of the information needed to indicate rights to property.

Redundancy due to overlapping discussions
One contributor argued that many of the issues are not new, and warned that one should try to avoid to re-discuss what has been discussed already. The argument was that looking from an SDI perspective, the community would need to start from legal requirements and find solutions (authorised access, biometric approaches, layers with initial data and with

authorized data (that's the continuum of land rights from UN Habitat)). To restart a discussion about institutions etc and not about participatory approaches will not work, was the argument. There would be many example cases supporting this statement. Data collected in field can be projected to the community in the evening. There the discussions take place.

References and relevant documents
Specific papers which contributors brought up during the discussions included (Uitermark et al., 2010) and (McLaren, 2010). Specific websites referred to by contributors included:

Website
http://indigenousmapping.net/
http://indigenousmapping.net/imnconference/cfp.html
http://www.nativemaps.org/
http://siteresources.worldbank.org/INTARD/Resources/335807-1174581646324/InnovLandRightsRecog.pdf
http://www.fig.net/pub/figpub/pub52/figpub52.htm
http://en.landsystems.com/images/Presentations/esri_emea_ils_opentitle_presentation_25102010.pdf
http://sdh-sageo.teledetection.fr/index.php?option=com_docman&task=doc_download&gid=14&Itemid=35

Most of these website and documents refer to community mapping and alternative forms of setting up and maintaining cadastres.

DISCUSSION

Based on the results above, we can construct a comparative table, integrating the concerns from the vGI and open systems discussions with the opencadastres discussions. This results in Table 2.

Table 2. Relation between opencadastre discussion results with VGI and open systems concerns

Concerns		**Degree to which these are applicable for 'opencadastre'?**
Socio-organizational concerns	Participation versus exclusion	Since opencadastre can affect the land rights of people, participation is a crucial concern for openmapping. The discussion on necessity and the role of the government makes this clear.
	Power and (in)equality	Idem
	Local versus central expertise	The references to community mapping projects indicate that Opencadastre is most to originate from local expertise and benefit local communities. This is potentially risky, because relying on only few people.
	Autonomous / independent views vs accountable views	The issue of legitimacy and the role of the government is a central and crucial concern with regards to the quality control of opencadastre.
	Scalability versus local use (socio-organizational)	This concern will equally be applicable to opencadastre. Centralising and possible scaling up remains therefore a concern.
	Unlimited access vs. controlled access	Although contributors argue that the starting point of opencadastre is open access, they also urge for a government role.
	Collective agency vs collective benefits	The contributors did not emphasize collective agency. Apparently, this issue was much less

		prioritized than in comparable VGI and open systems discussions.
	Rule making vs. rule enforcement	Since opencadastre addresses legal claims on land this concern is of major importance
Technical concerns	Complementarity of datasets vs. redundancy	Opencadastre will most likely create differences with official records. The mechanisms to solve these differences are key to the success. The contributions on quality frequently mentioned this issue.
	Ad hoc / occasional vs. systematic data collection	Professionals envisage both approaches as practical and feasible options to construct any opencadastre platform or system.
	Large vs small applications (geographic)	Existing initiatives are at small scale. Scaling up to other levels is unlikely for the moment.
	Data quality vs data completeness	Quality is of main concern
	Flexibility vs regulation in standards	STDM is providing a standard that tries to solve this concern

Based on this comparison and integration we identify three lines of further discussion:

1) To which extent do the opencadastre discussion contributions converge with the open/VGI concerns? This leads to common paths and ideas.
2) To which extent do the opencadastre discussion contributions diverge from the open/VGI concerns. This derives a number of paradoxes and challenges.
3) To which extent is there a need for a common practice or theory? This leads to research challenges.

1) Convergence of opencadastre ideas with open/VGI concerns

Primarily the technical concerns coincide. For example the technical map quality concerns and the tools to create, maintain and/or restrict access to the data are similar. On the socio-organizational side the issue of having to rely on local expertise remains problematic. This also related to technical expertise. If such expertise is only available in a few fragmented locations, certain actors may benefit more from the technical opportunities than others. This concern has also been identified by earlier examples in open systems.

2) Divergence of opencadastre ideas from open/VGI concerns

The biggest difference between VGI and opencadastre concerns relates to the type of interests of the participants. The direct self interest of participants to opencadastre may be rather opportunistic rather then idealistic. That's why the contributors to the opencadastre discussions frequently urged for a role of the governments to regulate part of the contributions, part of the access and part of the quality. Whereas in openmapping much of the quality is self-sustained, in opencasdastre the mechanism of self-regulation is questioned. The stakes of associating contributions to sensitive issues such as land rights, are simply to high to leave it to anyone in the public. As a result, contributors stress the need for some sort of nt a better government intervention.

Another mjaor difference is the role of standards and standard exchange mechanisms. The cadastral professionals generally prefer the use of a standard model, such as the STDM. Flexible standards, sometimes promoted In the VGI and open systems discussions, are less preferred.

Finally, the rule making is of particular concern in the opencadastre discussion. Who sets and who maintains the rules to contributions and to the technical systems? There was no concrete answer to this question, but some of the contributors clearly pointed to this issue as one that needs to be resolved.

3) Towards a common practice or theory?

The initial reactions in the discussions ranged from “It is never possible” to “It is already happening”. The first reaction in general was based on the assumption that only governments can exercise the authority that is necessary to solve land issues between individuals. It is correct that authority is necessary but the question is whether that should always be national governments and what to do if national governments do not take that responsibility. The statement that “It is already happening” also needs further scrutinizing. How open are the existing initiatives? The extent to which current initiatives are open is unknown for two reasons:

- It remains unclear in the opencadastre what ‘open’ means. There is no clear reference framework.
- It remains unclear which initiatives have which impact. The social dynamics related to technical initiatives may be crucial, but are still largely undocumented.

Overall, the theory with respect to openmapping is very young and, as explained in the introductory section, there is no common terminology. A common terminology as a starting point for building a new theory can help in this respect. Much is still unknown about the technological feasibility and the potential socio-economic effects. A research framework to study both could help explore current initiatives.

CONCLUSIONS AND RECOMMENDATIONS

The concept of opencadastre is from a geographic information perspective an extension of the concept of VGI. There is not much difference between uploading the contours of a road or building and a cadastral boundary. From a social/economic point of view the potential participants to such a system are different because of the big differences in interest that lies at the basis of such participation.

From a technological point of view not much seems to be in the way of a opencadastre concept. One can question the functionality of existing technology but seen the rapid developments it is not difficult to envisage that these problems will be overcome.

Key issue in opencadastre seems to be the authoritativeness of the data. The land administration paradigm places the government in the centre of land registration processes. Individuals, social groups and companies have land rights, the government is the independent party that is setting the rules and solving the conflicts. The land administration paradigm does pay attention to a possible role of civil society in these processes. It needs a careful assessment of existing initiatives of more open cadastral approaches and the development of a common reference frame to be able to investigate the possibilities of such an approach.

We strongly depended on contributions in social media, such as LinkedIn. When we started we assumed that, given the large amount of members within the LinkedIn groups we could easily tap from the collective knowledge within the geoinformation/cadastre community and

produce a complete overview of issues relevant for the opencadastre concept. This happened to be too optimistic. The initial group of people that was involved in the discussion did produce a wide number of issues that are relevant but only a small number of people got involved later on. Especially the fact that from the LinkedIn group of mortgage professionals nobody reacted on the question about economic relevance, was striking. A better insight is needed in the circumstances under which such an approach can work. Literature on social presence of technology might be helpful to explore.

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CONTACTS

Peter Laarakker is advisor/researcher at the Cadastre, Land Registry and Mapping Agency, the Netherlands.
Email: peter.laarakker@kadaster.nl
Walter T de Vries is lecturer/researcher at ITC, Enschede, the Netherlands
Email: devries@itc.nl

REFERENCES

Ather A. (2009) A quality analysis of OpenStreetMap data.
Braa J., Hanseth O., Heywood A., Mohammed W., Shaw V. (2007) Developing health information systems in developing countries: The flexible standards strategy. MIS Quarterly 31:381-402.
Budhathoki N.R., Nedović-Budić Z., Bruce B. (2010) An Interdisciplinary Frame for Understanding Volunteered Geographic Information. Geomatica 64:11-26.
Coleman D.J., Sabone B., Nkhwanana N.J. (2010) Volunteering Geographic Information to Authoritative Databases: Linking Contributor Motivations to Program Characteristics. Geomatica 64:27-40.
Craglia M., Goodchild M.F., Annoni A., Camera G., Gould M., Kuhn W., Mark D., Masser I., Maguire D., Liang S., Parsons E. (2008) Next-Generation Digital Earth: A position paper from the Vespucci Initiative for the Advancement of Geographic Information Science. International Journal of Spatial Data Infrastructures Research (IJSDIR) 3:146-167.
de Leeuw J., Said M., Ortegah L., Nagda S., Georgiadou P.Y. (2011) Assessment of the accuracy of volunteered road map production in Western Kenya. Remote sensing : an international journal of the science and technology of remote sensing and the applications 3.
Elwood S. (2008a) Volunteered geographic information: key questions, concepts and methods to guide emerging research and practice. GeoJournal 72:133-135. DOI: 10.1007/s10708-008-9187-z.
Elwood S. (2008b) Grassroots groups as stakeholders in spatial data infrastructures: challenges and opportunities for local data development and sharing. International journal of geographic information science 22:71-90.
Elwood S. (2009) Geographic information science: emerging research on the societal implications of the geospatial web. Progress in Human Geography 2009:1-9.
Feick R., Depardy V. (2010) Evaluating se;lected visualisation methods for exploring VGI. Geomatica 64:427-438.
Feick R.D., Roche S. (2010) Introduction (special issue VGI). Geomatica 64:7-8.
Genovese E., Roche S. (2010) Potential of VGI as a resource for SDIs in the North/South context. Geomatica 64:439-450.
Goodchild M.F. (2007a) Citizens as voluntary sensors: spatial data infrastructure in the world of Web 2.0. International journal of spatial data infrastructures research 2:24-32.
Goodchild M.F. (2007b) Citizens as sensors: the world of volunteered geography. GeoJournal 69:211-221.
Goodchild M.F. (2008) Commentary: whither VGI? GeoJournal 72:239-244. DOI: 10.1007/s10708-008-9190-4.

Goodchild M.F. (2009a) Neogeography and the nature of geographic expertise. Journal of location based services 3:82-96.
Goodchild M.F. (2009b) Virtual geographic environments as collective constructions, in: H. LIN and M. BATTY (Eds.), Virtual Geographic Environments, Beijing. pp. 15-24.
Goodchild M.F., Glennon J.A. (2010) Crowdsourcing geographic information for disaster response: a research frontier. International Journal of Digital Earth:11.
Grira J., Bédard Y., Roche S. (2010) Spatial Data Uncertainty in the VGI World: Going from Consumer to Producer. Geomatica 64:61-72.
Haklay M. (2010) How good is volunteered geographical information? A comparative study of OpenStreetMap and Ordnance Survey datasets. Environment and planning B: Planning and design 37:682-703.
McLaren R. (2010) Can the Innovative Use of Mobile Phones Support More Effective Land Administration Services?, FIG Congress 2010. Facing the Challenges – Building the Capacity, Sydney, Australia, 11-16 April 2010.
Scott W.R. (2001) Institutions and organizations. 2nd - thoroughly revised and expanded - (original edition from 1995) ed. Thousend Oaks: Sage.
Uitermark H., Oosterom P.V., Zevenbergen J., Lemmen C. (2010) From LADM/STDM to a Spatially Enabled Society: a Vision for 2025, The World Bank Annual Bank Conference On Land Policy And Administration, Washington D.C., USA, 26-27 April 2010. pp. 13.

Vision for a Cadastre X.0: Adding 6 New Dimensions

Dr. Xavier COMTESSE
Dr. Giorgio PAULETTO

Abstract

The environment in which the professions of cadastre evolve has undergone profound changes. Technological innovation in the digital field has been considerable. Furthermore, social change has also been radically altered with, for instance, the emergence of social networks as a means of transforming our relations. Aside from the present crises, there have also been great changes in our economic evolution by the introduction of, on one hand, more flexibility and mobility and, on the other hand, the advent of globalization of production, work and consumption.

In addition to these exterior changes, internal changes have also taken place. These changes are specific to public administrations. Several trends can be mentioned: the evolution of the public discourse on transparency and accountability, the opening of public data, the emergence of the idea of a common good for our human societies. Other influences also have an impact, for instance, legislative change such as laws on administrative registers to foster interoperability or innovative professional software linked to the use of 3D.

These simultaneous changes apply considerable pressure on the profession. In this paper, we are going to identify the major trends that will most likely have an impact, apprehend the consequences expected and provide a structure for this development. We will try to give a general, coherent and prospective view of the evolution of cadastre.

Our paper will be divided into three sections:
1. Push and pull evolutions
2. Six strong foreseeable trends
3. Synthesis and conclusion

Section 1: Push & Pull

Push

With the advent of the World Wide Web, the cadastre has entered globally in the digital era. This can be seen not only by how we input data, we look up for it, we store and exchange it, but also by the web applications nowadays offered to the public and their evolution. The general public has seen striking examples with Google Maps, Google Earth, Bing Maps, Street View, Sketch Up, etc. These applications can no longer be ignored by the professionals because they offer a new way of reading the territory and they inevitably structure what the public understands and wants. Similarly, several innovations regarding the use of these technologies are fundamentally modifying the profession. For example, let's mention the "mash up" technique which allows (almost) anyone to use maps to create new applications,

the phenomenon of geolocalisation through smartphones, the flow of data generated by individuals, global services accessible through cloud computing offering platforms and applications or the huge potential offered by the billions and billions of new IP addresses accessible with the new Ipv6 protocol.

This technological evolution is the first wave we've identified under the « Push » section for upcoming change. A second one is linked to global economic change, it redefines the links between producer and consumer, which overlaps between what is called “hard” and “soft” laws and also we will see between private and public goods. As they evolve, these waves of change define new behaviors we will necessarily be confronted to : copyleft and creative commons which complement classic copyright laws, the common goods which present different attributes in the digital world than it does in the physical sense, so called “prosumers” who actively participate in the design of the product / service he or she will use, crowdsourcing which uses the ingenuity of the internet users to create what no other organization could come up with.

The economy is directly impacted by these profound changes. One only needs to observe sectors like the music industry, entertainment, the media, or telecom sector to see this. Doubtless, other economic sectors will also undergo such significant shifts.

These shifts require the rethinking not only of customer relationships, but also of the entire business model. It is of paramount importance to understand that, by entering in the value chain, the customer transforms all economic relations : we are no longer in a formal contractual relationship but in a participative transformational partnership.

The recent events of Fukushima and the Arab Spring clearly show that the conversations, the media coverage and the spreading of ideas are now global, almost instantaneous and socially unavoidable. A wind of change is blowing on the social organization of our society. Networks are proving to be the tools of this change.

By redefining a social layer based on volunteer work, the lack of binding constraints and the non-punishable, society is entering in the era of soft laws. It becomes legitimate, in a certain way, to act even though there might not be a legal framework to support the action. This fact will have significant consequences on our societies not only in public, social and political action but also in professional applications and services.

Legitimate action has found a legalizing base by bypassing classical processes. Fields where increased participation has created concrete examples are a perfect illustration of this change of paradigm: open source software, open data or linking internet users. Henceforth, acting with a willingly participating population will allow us to perform tasks which have so far been intractable for public or private organizations. We are living this in practical terms with Wikipedia, YouTube or e-bird, the content of which is created and shared by users.

Thus the participative empowerment fuelled by social networks redefines not only the social relation to public administration but also to ownership. Being able to add content to a parcel of official cadastre becomes a normal expectation for an increasing part of the general public. How should the owner position himself? And what about the cadastral systems, which must guarantee the information of real estate property?

These three « push » components, namely technology, economy and society, are the catalyzers of an explosion that will profoundly change the actual definition of cadastre.

Pull

For the last decade or two, information systems have become more open and have integrated an increasing participation from people. There are 5 main stages to this evolution:

1. informational (look up)
2. transactional
3. personalization
4. augmented participation
5. transformational

As mentioned previously, these stages correspond to external changes, linked to technology, economy and society, but there is more. They also show a political, legislative and administrative evolution. Indeed, we argue that both public and private institutions have also evolved from within, through an inside strength, a « pull », an attempt to adapt to the evolution of society in order to offer increasingly better services.

The following table illustrates this evolution :

Stages	**Societal policy**	**Laws and regulations**	**Administrative / Technical**
Informational (look up)	Social responsibility	ISO 14001 & 26000 Reporting regulations	Accountability (transparency & reporting)
Transactional	Productivity	Laws about standards of information exchange	Interoperability (e-Gov)
Personalization	Digital identity	Laws on personal data protection	“MyFiles” (e-Id cards, citizen data vaults)
Augmented participation	Social networks	Laws on social networks	Social platforms (e-initiatives, petitions, forums, voting)
Transformational	Common goods	Laws on transparency and freedom of information	Cloud government (Mash-ups, Open data, API services)

Three key “pull” stages determine the change and progress of the cadastre professions:

1. Social issues discussed at the political level,
2. Elaboration of laws and regulations to address the political objectives (International soft laws, European laws, National parliaments),
3. Regulations at a more local level that define the framework in which the public and private sector can act.

These three stages are interwoven in the political process and, together, form what we have called the pull process.

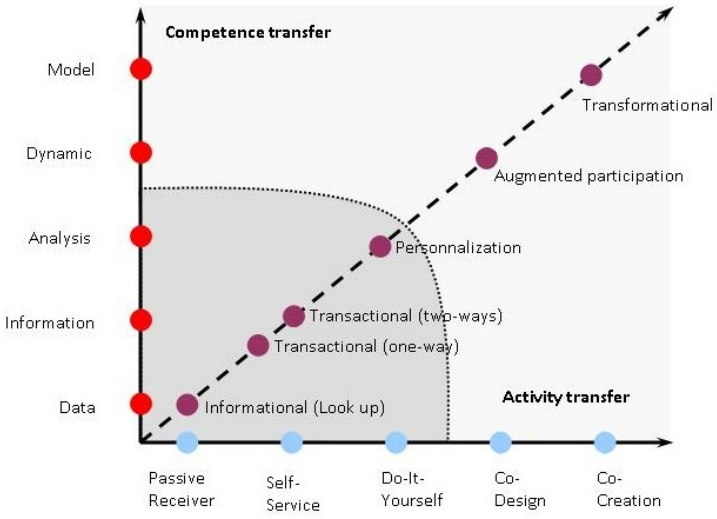
This pull process is, in a certain way, an institutional response to the push process and legalizes the existing (technological, cultural, economic and so on) behaviors created by society.

General model

Delivering online public services creates two essential transformations:

- An increasing transfer of the administrative *activity* to the final user.
- Simultaneously, a *competence* transfer to the final user.

The figure presented hereafter introduces a "transfer matrix", which not only allows the monitoring of the progress made in the availability of public services — and therefore benchmarking it — but also becomes a strategic management tool. By improving the understanding of the present and future role of users (citizens, businesses, others administrations, and civil society organizations, …) this transfer matrix illustrates the paradigm shift for the public services.
We are now dealing with a citizen empowerment process that has to be engaged beyond the simple translation of administrative services into their online counterpart.



The figure presented above radically transforms the classic approach by clearly defining the type of activities now transferred to the users and the competence transfer that accompanies it. Here, we introduce new sophistication levels: namely the "Augmented participation" and the "Transformation" levels.
Therefore, the horizontal axis now represents the activity transfer with the following levels:

1. Passive Receiver: The user only has access to structured information that he or she can discover through search engines or tree structures.

2. Self-Service (One-Way): The user can choose specific documents and download them.
3. Self-Service (Two-Way): He or she can exchange documents or emails with the administration.
4. Do-It-Yourself: The user can perform complete transactions, including payments.
5. Co-Design: Both the user and the administration can personalize services (e.g. tax forms, etc.)
6. Co-Creation: The user can participate in the political and democratic life of his/her region or country (e.g. the Swiss model initiative and referendum, forum, etc.)

The vertical axis represents the competence transferred to the user of the online service. The levels of sophistication vary from raw "data" to the "model" level, as follows:

1. Data: At this level, we deal with raw data or measurements, such as those produced by statistical services.
2. Information: A context is added to the data so that a meaning is created.
3. Analysis: We now can infer a theory from information. This allows analysis and better understanding of phenomena.
4. Dynamic: Time is introduced. The time series add a new dimension to the previous theory.
5. Model: Forecasts can be made from the dynamic theories inferred by using the information available. Scenarios can be tested and simulated to forecast the effects of changes and to discuss future changes.

The 5 levels used in this model are defined as follows:

Informational / Look up:

The user looks up information on the Internet. This phase is traditionally the first one to be implemented as an online service. This remains a strong demand from users. With the development of search engines, the way we look up information has drastically changed. The menu presentation is superseded by a fast access to information through these search engines, Google being the leading one.

Transactional One-Way:

The user can download documents. Even though this phase now seems very basic, it is still essential to the users who manage their documents electronically. A content and document management system is central to such activity.

Transactional Two-Ways:

The user can upload documents, send e-mails. It still is nowadays a major contribution but hasn't reached all levels of the administration, especially for non structured demands. The user can perform complete transactions, including payments. This stage is a milestone for productivity gains and profitability of eGovernment initiatives. It is underway in most administrations around the world. This stage will be crucial for a sustainable system since it saves time and money both for the users and the administration.

Personalization:

The user can use personalized information and transactions. The documents are pre-filled for his/her personal use. The transaction is completely secure and customized. This phase will use a key element that closely resembles a folder called "My Files". It will allow grouping all of the activities and administrative documents in a single virtual place that will be accessible at all times. The traceability of the transactions and activities will become essential to guarantee a sound accountability.

Augmented participation:
This level corresponds to what may be called a wiki-democracy where citizens and businesses can initiate change. This is exemplified by projects such as Open Government initiatives where users are asked to participate in the development of better administrative services. Another example is the Swiss initiative where citizens can propose new laws. In this context too, the U.S. primary campaign lead by Barack Obama is essentially based on participation. The field is of course very broad and much is left to explore in order to create new services in a connected world. Forums, blogs, social networks are only a few recent examples that have emerged, but most of the field still remains to be invented.
Transformational:
Co-creation is the key word here, leveraging mash-ups and crowdsourcing. This level profoundly modifies the concept of "common good" by redistributing the roles between the administration and the citizens. The latter are involved in the creation of a new digital administration. By opening up government data, citizens can transform the way the new public services are created and delivered. This transformation implies a redefinition of the "common good" and "public good".

The transformation matrix defined by the transformation along two axis gives a more complete approach to the evolution and strategy of eGovernment online services than the classical model. By going beyond a benchmarking goal, it helps to drive a strategy. The progress of services can still be analyzed, but the tool now also helps to better define priorities and explain the evolution of the services. The users become active stakeholders of the project and not merely final users. By being turned into a participative partner and not having to adapt to a forced evolution, the relationship between the administration and its users changes to better serve the citizen-actor, as well as the entrepreneur-actor or the consumer-actor.

Section 2 : Six theses

Trends

We have identified six major trends that will most likely have an influence on the vision of cadastre.
These trends are linked to technological, economic and social evolution, and come from the push process described above. They are also part of the emergent pull process that has begun to appear in several countries. The six theses presented hereafter influence the entire evolution of the field in which the cadastre operates. They tell us a story by adding dimensions not only in geometry but also in meaning.

Thesis 1: The cadastre will include the third dimension of the landscape and of the objects beyond the current legal framework.
Comment: The technology allows a thorough three dimensional vision of the land. This is now integrated in several products largely distributed by companies such Google and ESRI but also Nokia, Microsoft and several others. This paradigm change raises the issue of height, ownership and that of co-ownership (e.g. several owners of the different levels in buildings) and the rights attached to the third dimension such as for example the right to a view.
Consequence: A new 3D model of the land and of the buildings is necessary and land surveyors have to take 3D into account.

Thesis 2: The cadastre will blend the strategic map and the dynamic map of the land to show its historical evolution. Both views will evolve independently.
Comment: The push of technology makes it possible to store the information with different time stamps instead of erasing or superseding it. An animation of the evolution of an object or a region becomes possible by adding the dimension of time.
Consequence: The current separation between the static object and the dynamic object will be deeply transformed. A static object becomes a snapshot at a given moment of its dynamic version.

Thesis 3: The cadastre will be multifunctional and multijurisdictional.
Comment: The political as well as the technological influence foster the emergence of functions of a territory. Different regions can be viewed not only as jurisdictions, but also through the lens of different functions such as the environmental function, the transportation function, etc. It therefore will be possible to assess the impact of policies on different functions and to create many functional approaches to the territory. Moreover, the interoperability between various local cadastres will render a change of function possible upon request.
Consequence: The local cadastres will be blended into larger ones and include not only jurisdictional views but also functional views.

Thesis 4: Social networks will transform the cadastre.
Comment: The phenomenon of georeference by the public becomes a more and more normal and accepted tool to extend the cadastre. Almost all new moving devices include GPS chips (smartphones, cameras, cars, even cattle!) that can report flows of data. This allows to georeference the objects and their surroundings in a completely new way.
Consequence: The cadastre will deal more with flows of data and less with stocks of data.

Thesis 5: New commons will emerge as a referenced object of the cadastre.
Comment: Data will be more and more made available to the general public by the administration and, through mash-up techniques, will be transformed into a new virtual object the « Common Good ». This new object is a composition of several layers of data and services. It will create value and be used as a global public good.
Consequence: Both the private and the public sectors will gain added value by leveraging the these new commons. As it is mainly composed of information, the resource is essentially non-rivalrous (consumption by one person doesn't prevent simultaneous consumption by another) and non-excludable (it is difficult if not impossible to prevent someone to have access).

Thesis 6: The cadastre will become an essential element of knowledge society.
Comment: The cadastre follows the same path as society as it evolves from an information society to a knowledge society. This is seen through the addition of georeference to many human activities, the emergence of co-creation by entire crowds, and the body of knowledge that the cadastre carries enters more and more into models and decisions. The objects of the cadastre will be part of a feedback loop that makes its way into knowledge society.
Consequence: Land surveyors will be dealing more with soft fields of knowledge rather than hard science in the future.

Section 3 : Synthesis and conclusion

This document presents the different thesis that will most probably change the cadastre professions. We tried to describe how activities and competencies are shifting from the provider to the end user. Six main theses are then described by integrating the main trends that can be seen today as transformational for the cadastre. These trends come form a push from exogenous shifts (technological, economic, societal) or from pull shifts (as the public services adapt and operate change).

This is still a work in progress and should be seen above all as a tool for thought rather than a firm conclusion. It can be used, for instance, as the basis of a conversation process specifically for professional software applications. We can anticipate a (r)evolution towards new dimensions for the cadastre. While leaving behind the map (2 dimensions), the cadastre is going towards far unexplored dimensions. It is this evolution towards new dimensions that we should work on to design together with the stakeholders a future cadastre to better serve society.

Dr. Xavier COMTESSE
Director
Avenir Suisse
8, quai du Rhône
1205 Genève
xavier.comtesse@avenir-suisse.ch
+41 22 749-1100

Dr. Giorgio PAULETTO
Strategy and Technology Advisor,
Observatoire Technologique, State of Geneva
64-66 rue du Grand-Pré, CP 2285
giorgio.pauletto@etat.ge.ch
+41 22 388-1353

FIG Commission 7
Annual Meeting 2011

Towards Cadastre 2034

FIG should take the Lead

Jürg KAUFMANN, *KAUFMANN CONSULTING*, Switzerland

INTRODUCTION

During the XXIV. FIG Congress in Sydney 2010 a session was dedicated to the topic **'Developing Cadastre from Cadastre 2014'** with the contributions 'Cadastral Futures: Building a New Vision for the Nature and Role of Cadastres' from Rohan Bennett, Abbas Rajabifard, ohsen Kalantari, Jude Wallace and Ian Williamson from Melbourne University, 'Cadastre 2014: New Challenges and Direction' from Anna Krelle and Abbas Rajabifard, and 'Cadastre 2014 - Australia and New Zealand: Now and the Future' from Bill Hirst.
The first contribution activated GIM International to initiate a dialogue titled 'Beyond Cadastre 2014 – Let the dialogue begin'. After having published the paper in June 2010 GIM invited some authors to reply and published the respective comments named 'Towards Cadastre 2034 in 2 parts in September and October 2010.
GIM continued to deal with the topic in a special session during the FIG Working Week 2011 in Marrakech under the title **'Towards Cadastre 2034– A Panel Discussion with International Experts'** with the panellists: Danilo Antonio, UNHABITAT, , Stig Enemark, Denmark, Jurg Kaufmann, Switzerland, Martin Salzmann, Netherlands, Daniel Steudler, Switzerland, Jarmo Ratia, Finland, Ian Williamson, and Daniel Roberge, Canada. This event provoked me to reflect again about the problem of terms and definitions.

This paper assembles my contributions to the discussion in two parts, namely the reply in GIM of September 2010 and the thoughts on terms and definitions.

Part 1: FIG Should Take the Lead

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 centered 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 organize habitats within an increasingly complex and populated environment. The organization 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 localization 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.

Part 2: Beyond Cadastre 2014 – Towards Cadastre 2034, Continuation of the discussion – Thoughts on Terms and Definitions

I did very much appreciate the effort to continue the discussion on the future of cadastres and I thank GIM International very much for having initialized the Panel Discussion of international experts on this issue in Marrakech. GIM published a special FIG edition for this purpose, which I would like to thank for. Unfortunately the presentations of the different expert views took a bit too much time, which did not allow enough time for a proper panel discussion. Nevertheless some important aspects – in particular the request to better consolidate the terms and definitions raised by myself – were discussed in the plenum.
However, I feel that I need to better explain my motivation for these remarks. It is my impression that we do not have clear definitions in our thinking about cadastre and land administration.

Cadastre and Land Administration
In my presentation, which I attach to this mail, I addressed the problem of terms and definitions as illustrated in Figure 1.

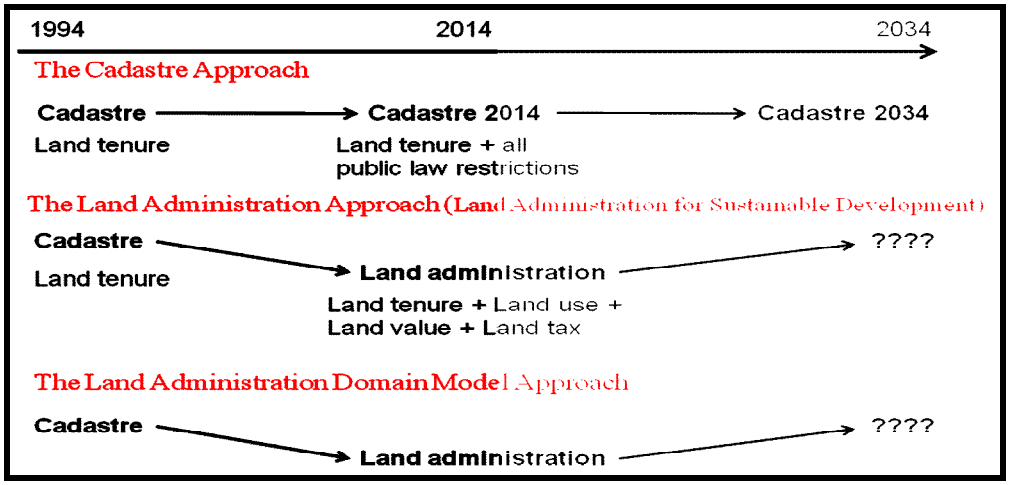


Figure 1: Land Administration and management paradigm.

The main problem is the use of the term 'land administration' and the idea that 'land administration' replaces the term 'cadastre'. This is fundamentally wrong. The publication 'Land Administration for Sustainable Development' by Williamson et al. [2010, p. 78] notes this change as a fact, without critical review: **'As a result MOLA replaced 'cadastre' by the term 'land administration' in its guidelines'.** These terms are not interchangeable because they define fundamentally different things.

Cadastre by definition given by Henssen [1995] in 'Basic Principles of the main Cadastral Systems of the World' is something static, namely:
'*Cadastre is a methodically arranged public inventory of data concerning properties within a certain country or district, based on a survey of their boundaries. Such properties are systematically identified by means of some separate designation. The outlines of the property and the parcel identifier normally are shown on large-scale maps, which, together with registers, may show for each separate property the nature, size, value and legal rights associated with the parcel. It gives an answer to the question where and how much.*

Activities in the context of an inventory mean to **document** a situation and to maintain this documentation according to clearly given rules. So the term 'land documentation' could replace 'cadastre' but not land administration, because land administration is a pure operation as comes out from the 2005 definition of UNECE in 'Land Administration in the UNECE Region [UNECE, 2005] *'The process of recording and disseminating information about ownership, value and use of land when implementing land management policies'*.

The administrative activities are to be adapted to the given situation and therefore not foreseeable.

Administrative activities are normally based on specific documentation systems. The business administration activities are based on the figures and names maintained in the bookkeeping system. Land administration activities are based on the figures and names provided by the cadastre. This interrelation was exemplified by Kaufmann [1999] as shown in Figure 2.

Level	General Business	Land Business
Strategy (goal setting)	**Policy**: Sound economic development	**Land Policy**: Land Market, Sustainable development
Management (measures to meet strategy)	**Company Management**	**Land Management** (ressource management)
Administration (business processes)	**Administrative unit**	**Land Administration**
Accounting (tools for documenting and monitoring)	**Accounting system** • accepted principles • reliable • complete • appropriate to needs • adapts to development	**Cadastre** • accepted principles • reliable • systematic • approriate to needs/laws • adaptable to development • public

Figure 2: Levels of general business in relation to land [Kaufmann, 1999].

This basic comparison did lead to a picture used by Steudler [2011] in the context of the studies about spatially enabled societies (see Figure 3).

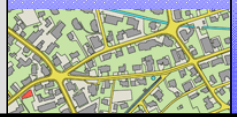
Tasks	Land related activities	Tools / Methods
Strategy • visions and objectives	**Land policy**	• political activities
Management • measures and projects for the implementation of the policy	**Land management** 	• land-use planning • land consolidation • land reallocation • melioration • landscape develop-ment • land recycling
Administration / Documentation • handling of spatial information, data analysis, data visualization • cadastral operations, data modelling, data acquisition, data maintenance, data distribution	**Land administration and cadastre** 	• monitoring • navigation • geoinformation • land registration • cartography • surveying • geodesy

Figure 3: Land Administration and management paradigm [Steudler, 2011].

The importance of reliable documentations

Documentation systems covering more information than just land tenure information are in urgent need. In every natural disaster, such as the 2004 tsunami as well as the earthquakes in Haiti, Christchurch and Japan, the assistance cannot be effective without information about the situation before and after the disaster. And without a reliable documentation system, effective land administration and land management are not possible. One gets the impression that in such cases we have too much administration by the assisting aid organizations, but we do not have sufficient documentation about the destruction on the ground itself.

The same urgency applies for illegal settlement situations, where reliable documentation about the land use by the people erecting buildings without having the necessary permissions or occupying land for shelter is needed. Only with a reliable picture of the really existing legal situation on the ground, the necessary measures to clean up the mess can be taken. To produce reliable information and documentations according to the ideas of Cadastre 2014 with contents exceeding the land tenure information should be a key competence of surveyors. To produce them in a short time by making use of modern tools such as satellite imagery, orthophotography, GNSS, and efficient field investigations, and to arrange them in a thematic and legally independent structure according to Cadastre 2014 would be a highly welcomed contribution of surveyors.

Models, administration processes and management approaches

The fact that the terms cadastre and land administration are describing non comparable things has the following consequences:

- **It is not reasonable to mix these two terms as is done in many publications;**
- **It is to be officially ascertained that the interchange of the terms cadastre and land administration is impermissible;**
- **FIG should help support to find a clear terminology and not accept publications and activities using inappropriate terminology;**
- It is very difficult to model the dynamic and not foreseeable processes of land administration. Also it is not possible to model land management processes;
- It is therefore not reasonable to speak of a Land Administration Domain Model, when modeling the content of an inventory as it is done by the FIG Task Force on Standardization. The very valuable work done by this Task Force is devaluated by the use of an inappropriate terminology;
- It is possible to speak of models describing the contents of the traditional cadastre which covers only the land tenure, of a cadastre covering tenure, land use, land value and land tax as it is used in many publications, of a Cadastre 2014 covering all rights, responsibilities and restrictions concerning land as proposed by Cadastre 2014. It is also not wrong to model a cadastre containing the social tenure information – which I would call Social Tenure Cadastre Model.

Comments concerning the special session in Marrakech

The presentations to the topics ‘Beyond Cadastre 2014 – towards Cadastre 2034’ in Marrakech showed a significant diversity of ideas and understandings and made clear that FIG is far from having a consolidated common view. This became already clear when GIM published the answers to the ideas concerning Cadastre 2034.

Accuracy vs. Reliability

I felt a bit uneasy about how the topic of ‘accuracy’ was dominating the discussion. Accuracy never was a topic in Cadastre 2014 – it was brought up by the Cadastre 2034 discussion. It must be clearly stated that accuracy is not to be defined by the surveyors nor the FIG. It is a

logic consequence of population density, scarceness of the resource land, and how societies deal with the resource land. In view of the rapidly growing world population, it is highly probable that in 2034 the need for accuracy is higher than today. Cadastre 2014 never stipulated a high accuracy. It rather focused on complete and reliable information on property rights, and responsibilities and restrictions connected with these rights.
The correct term in the context of cadastre would not be accuracy but **reliability**. A documentation with 'cadastral' quality provides reliable information to enable eligible land administration and land management. Reliable information is information in which the stakeholders can trust in. The crucial thing is that stakeholders do understand the meaning of those boundaries, they have to respect; be it property, use, protection, or other boundaries. All these boundaries are to be documented for land administration and land management purposes.

Cadastre in developed and developing countries

A statement from Cameroon was that Cadastre 2014 has been designed for developed countries only. This view is wrong, even though it was propagated by leading representatives of FIG since 1998.
What really happens is:

- Every country tries to build up a comprehensive property cadastre;
- Every country needs to have more information than only that on land tenure;
- Developing countries take the laws of the developed countries and begin to regulate land use, environment protection, cultural heritage protection, disaster prevention, etc. And finally they need to have – similar to the developed countries – an overview about what they have regulated. They need a complete documentation system on land rights, responsibilities and restrictions – they need a Cadastre 2014. They do not necessarily need high accuracy but rather completeness and reliability. It would be good, if FIG would support these people to understand their own problems instead of developing theories about accuracy and selling them land administration instead of cadastres. And it would be good to stress the fact, that with every new law, new boundaries are introduced, which are to be handled according to cadastral principles and rules.
- While developed countries had a time frame of 50 years to develop their legal framework developing countries have to do this in a much shorter time. This creates additional problems for them.

Therefore, I am convinced that developing countries need Cadastre 2014 more urgent than developed ones. They need it as a reliable and complete documentation system with an accuracy conform to their needs. We should stop to stress accuracy in high-level discussions like the one in Marrakech and rather focus on reliability.

The new role of maps

Still many FIG officials stick to the idea that a cadastre is a register **and** a set of maps. It is time to understand that modern cadastres only contain data on spatial and non-spatial objects as stated by Cadastre 2014. We are not to produce and maintained a set of maps in a defined scale. We are to produce and maintain information repositories in the scale 1:1. Extracts from

those repositories can take the form of maps in the scale best fitting the purpose and need. Applying such a different paradigm allows to design cadastral systems in less expensive ways. It is often the surveyors who cannot detach themselves from the idea of unnecessary high quality set of maps.

Recognize the efficiency of the Cadastre 2014 approach

Cadastre 2014 makes the complex topic of a complete documentation on rights, responsibilities and restrictions simple and lean by handling all possible land objects, which are localized in a common reference system by skilled surveyors, in the same manner. Once having understood this, Cadastre 2014 can easily be further developed in the sense of Cadastre 2034.

My input at a glance

1. Lets define the relevant terms under the auspices of FIG concerning:
    a. Land Policy
    b. (Sustainable) Land Management
    c. Land Administration
    d. Cadastre and Documentation
2. Standardized models can be defined for cadastral data structures – but not for unforeseeable processes. They are to be regularized by principles proposed in Cadastre 2014.
3. Land Administration and Cadastre focus on reliable data. A controlled data acquisition process can provide this. The accuracy problem will be automatically resolved by our modern instruments and systems.
4. A spatially enabled society whether in a developing or developed country will focus on a complete documentation system of rights, responsibilities and restrictions, which is simple and lean by handling all possible land objects in the same manner. Therefore, independently modeled data structures following the Cadastre 2014 principles have to be provided within an adequate legal framework.
5. Working with wrong terms and definitions does not contribute to FIG's officially published aims in FIG Profile on www.fig.net: *In general, FIG will strive to enhance the global standing of the surveying profession through both education and practice, increase political relations both at national and international level, help eradicating poverty, promote democratization, and facilitate economic, social and environmental sustainability.* Only when working with clear terms and definitions FIG will be able to achieve this.

I hope that I was able to express my concerns, to clarify my wish to consolidate the terminology in the field of cadastre and land administration, and thus to contribute to further fruitful discussions.

Reforms of a real estate cadastre in Poland at the local and global scales

Andrzej Hopfer, Stanisław Cegielski, Ludmiła Pietrzak

Abstract
On May 7, 2010 the act dated March 4,2010 on the spatial data infrastructure was proclaimed in the Official Journal of the Republic of Poland, No 76, item 489; that act transforms the European Parliament and the European Council Directive No. 2007/2/WE dated March 14, 2007, which established the spatial data infrastructure (INSPIRE) in the European Community.
This decree introduced basic changes to the obligatory Act, i.e. the Law of Geodesy and Cartography and, as the consequence, the demand to develop various administrative decrees occurred. At present, such decrees are being developed. Some of them will soon be published.
The authors of the paper present the analysis of the existing conditions of the cadastre, the task of governmental and public government administration, related to demands concerning the cadastral reforms, following the act on the spatial Data Infrastructure and they discuss possibilities to perform such reforms at the local and global scales.

1. Demands, goals and rules of reforms

On May 7, 2010 the act dated March 4,2010 on the spatial data infrastructure was proclaimed in the Official Journal of the Republic of Poland, No 76, item 489; that act transforms the European Parliament and the European Council Directive No. 2007/2/WE dated March 14, 2007, which established the spatial data infrastructure (INSPIRE) in the European Community.
This decree introduced basic changes to the obligatory Act, i.e. the Law of Geodesy and Cartography and, as the consequence, the demand to develop various administrative decrees occurred. At present, such decrees are being developed. Some of them will soon be published.
Many of them will start the revolution in the way of perception and understanding of the cadastre. For average surveyors in Poland, who is involved in activities of the governmental or local government administration, as well as in surveying works, the way of thinking and operating, resulting from the Act on spatial information infrastructure, creates many problems. The conceptually modern terms, which is included in the Act developed in accordance to the INSPIRE Directive, also create many problems.
What is the Spatial Data Infrastructure? Following the Act – it is understood as data sets, described by metadata, together with related services, technical means, processes and procedures, which are applied and distributed by leading bodies, other administrative bodies and third persons, who commonly create the spatial information infrastructure.

The next difficult and new term is the **interoperability of spatial data sets and services** – following the Act, it is understood as the possibility of combination of spatial data sets and co-operation of spatial data services, without repeated manual intervention, in such a way that results are coherent and the added value of data sets and services is increased.

As a result, one of the most important articles of the Spatial Data Infrastructure Act reads: Administration bodies, which maintain public registers, containing data sets related to spatial data themes, mentioned in annexes to the act, create and maintain – appropriately to their competencies and responsibility – a network of services concerning spatial data sets and services, including:

1. **discovery** services making it possible to search for spatial data sets and services on the basis of the content of the corresponding metadata and to display the content of the metadata;
2. **view** services making it possible, as a minimum, to display, navigate, zoom in/out, pan, or overlay viewable spatial data sets and to display legend information and any relevant content of metadata;
3. **download** services, enabling copies of spatial data sets, or parts of such sets, to be downloaded and, where practicable, accessed directly;
4. **transformation** services, enabling spatial data sets to be transformed with a view to achieving interoperability of spatial data sets and services;
5. **services allowing spatial data services to be invoked**.

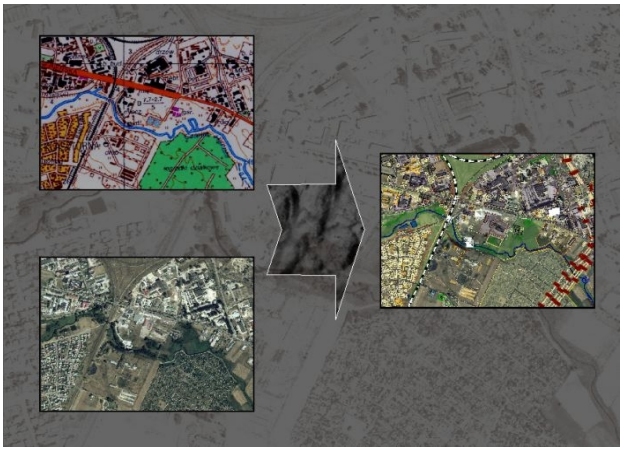
Those services are commonly accessible **by means of electronic media**.

Resuming, and presenting the above in the simpler way, the spatial data should be:

- inventoried,
- systematised,
- standardised,
- made accessible and exchanged, assuming the possibly minimum manual intervention in those operations.

We may state that we have several cadastral systems in Poland. As for now, we have the real estate cadastre, the forest cadastre, the water cadastre, the „cadastre of subsidies for farmers", the cadastre of roads, developed by the National Directorate of Domestic Roads and Express Ways. Every ministry or other institution, has created its own cadastre, sometimes using the reference data base of cadastral parcels, but – more often – they were created independently; as a result various reference data sets were obtained for the same cadastral objects. This results from various reference data or data sets, assumed for creation of those data bases, from various source data, methods of development etc.

Except of the real estate cadastre, own sources of data were used in each of the above cadastres and results of works are usually not transferred to the Geodetic and cartographic Documentation centres. Following the opinions of district surveyors, in cases when those documents are transferred to the centres, their usefulness for data resources is usually low, since they are not developed in accordance with requirements of the state resources. Correlations and legal basis concerning such types of works are missing in developed data bases. Probably, those problems will be solved by administrative regulations to the Act on the Spatial Data Infrastructure.



Therefore, every cadastre has become an independent cadastre, maintained by particular sectors. Those cadastral data are the legal and data base foundations for implementation of solutions, which are imposed by the INSPIRE Directive. We must implement regulations of the Act on the Spatial Data Infrastructure for those data; this will not be an easy task, since the same object, which occurs in many sectors, such as a road, will be geometrically described in various ways. Additionally, depending on the data base, will not only have different co-ordinates, but also various attributes, which will not allow for explicit determinations of its identity, and, therefore, implementation of procedures resulting from the Act will not be possible without utilisation of repeated manual interventions.

The same objects are described by various co-ordinates, depending on the cadastral system, together with assigning diversified attributes (V-MAP, TBD, Kataster, sectoral cadastres).
The Act on the Spatial Data Infrastructure introduced the regulation to the Law of Geodesy and cartography, which requires that – in the existing and obligatory legal regulations – the cadastral documentation consists of:

- a data base, maintained by means of a tele-information system, which ensures, in particular:

a) appropriately secured data storage and updating,

b) **data distribution and common utilisation, basing on rules specified in regulations concerning the spatial data infrastructure**,
c) data visualisation in the form of registers, records and lists and a cadastral map,
- a set of documents, which justify particular entries to the data base.

Information included in the cadastral documentation, among others, in the form of **computer files**, are formatted according to the obligatory standard of cadastral data exchange.

The General Surveyor of Poland, together with district starosts, voivodes and marshalls of provinces and with the Minister of Justice, the minister appropriate for public administration issues, the minister appropriate for public finances, the ministry appropriate for environmental issues, the President of the Main Statistical Office and the President of the Agency for Restructuring and Modernisation of Agriculture, creates and maintains the integrated real estate information system, being the tele-information system, which, in particular, allows for **data exchange between the lands and buildings registration of lands and building (the real estate cadastre) and other public registers, in the form of electronic documents.**

The above bodies are to ensure, in co-operation with the General Surveyor of Poland, technical solutions allowing for access, **by means of the integrated real estate information system**, to data included in public registers, which are maintained by those bodies.

It is an important task, which imposes the obligation to co-operate, what will lead to uniform data bases, which may be inventoried, standardised and then made accessible and exchanged in obligatory formats.

Legal acts, technical instructions and exchange formats of descriptive and spatial data, do not follow the correlation between data bases, as well as the technological development which may be observed in the field of the real estate cadastre and in sectors, for which data from the real estate cadastre are the bases for further elaborations (such as Topographic Data Bases).

In general, integration of cadastral data with the basic map and topographic data bases is missing as far as common objects are concerned; however it should be added, that first initiatives aiming at such integration, have been already undertaken.

Additionally, explicit definitions (standardisation) are also missing; they should describe a given spatial object in an explicit way for all works, which originate from the real estate cadastre, by means of coding those objects in a way which would be explicitly recognised in other systems. Such administrative regulations to the Act on the Spatial Data Infrastructure are being developed (in many cases in the final phase of works).

Spatial data, included in the cadastral documentation, should meet the basic requirements, i.e. they should be:
a) easily accessible by possible users,
b) appropriate for particular demands, with respect to information content,
c) reliable,
d) sufficiently accurate, depending on applications,
e) updated,
f) complete with respect to the area and the content scope of a given system.

Cadastral data standardisation should result in their easy and fast data exchange, leading to:
- minimisation of data transfer costs,

- elimination of expensive, repeated acquisition or processing of such data, which have been already transferred to other systems and may be easily collected from those systems.

Implementation of such data standardisation for existing data will be extremely difficult, since:

- objects are not mutually integrated in particular data bases,
- object generalisation has been performed many times at the data base level; as a result geometric descriptions – and also attributes of objects have been modified (such as the size of built-up areas), what results in creation of an object, which is differently described in the space,
- every system has other codes of objects and libraries of codes are mutually incompatible,
- the same object does not have the same basic code on technical instructions, which might be developed according to the demands, with the same basic part of the code, left unchanged.

One of important issues concerns issuing of cadastral data for various purposes, without maintaining the most important attributes in the process of distribution of those data, being reference data sets for many systems.
The following information is lost in the process of data distribution:

- source of data (e.g. the basis of establishing the cadastre, whether cadastral data or modernisation of the cadastre were performed basing on the documentation, which is stored at the state resources of geodetic and cartographic data, whether data has been acquired by means of data vectorisation etc.);
- the accuracy of distributed data;
- date of creation, updating or modification of cadastral data, and, therefore, the data timeliness. Such data, for example issued by the system, in which lands and buildings registration is maintained, are received, for example, by the Topographic Data Base or the basic map system and almost all above information and attributes is missed; therefore, data of poor characteristics (sometimes all what is known about the data is that they exist) are transferred to another system. It is not possible to evaluate the data timeliness and reliability in such cases.
- Within the same system (e.g. lands and buildings registration) have attributes, defined in various ways (e.g. the object size), in the graphical and descriptive parts. Thus, one legally defined object is represented by two (or more) different objects (e.g. a building, a parcel, land use in its graphical and descriptive parts).
- In the case of the integrated cadastral system (integrated graphical and descriptive parts) the date of disclosure of the object in the cadastre and on the map is the same, but it rarely refers to the legal status of the cadastral object.

Therefore, the substantial and legal values of the obtained object are not known. We only know, that the lands registration is the source of knowledge about the object. But data included in the lands registration has various status, i.e. they may originate from modernisation or vectorisation, performed for various purposes, characterised by diversified technical and substantial values etc.

The Act on the Spatial Data Infrastructure, together with administrative regulations, will improve the above situation.

The real estate cadastre is the basic reference data set for many works, including, among others, works related to physical management and planning.

2. Required global reforms of the real estate cadastre

In order to perform those reforms, the following should be ensured:

- the uniformity of maintenance of the real estate cadastre at the level of the entire country, by creation of a uniform administration at the country, voivodship (province) and local levels;
- harmonisation of spatial data, including, first of all, cadastral data as the basic reference data sets, by achieving the appropriate legal status and appropriate dates of creation, or modification, providing that those data are not missed in other systems, by which those objects are commonly used and for which they are harmonised;
- standardisation of cadastral data, consideration of the legal status of objects in object attributes, i.e. the date when the object received the correct legal status, resulting from legal regulations (e.g. as a result of modernisation). For objects, which are the subjects of procedures resulting from the Act on the Spatial Data Infrastructure, including the necessity to standardise those objects, to harmonise and distribute them, such attributes should be introduced to administrative decrees to the Atc, which are being developed, as well as to the Law of Geodesy and cartography, or to the new Geodetic and cartographic Law;
- in data bases which are covered by the act on the spatial Data Infrastructure, the issue of legal status of objects, as well as the dates of object creation or modification should be solved; those attributes should be made unchangeable in the process of population of other systems;
- all works performed within the frames of various governmental programmes, which are stored at Geodetic and Cartographic Documentation Centres, should be included in the geodetic and cartographic data resources; they should be systematised, they should be assigned appropriate attributes (e.g. the method of acquisition, timeliness etc.) and then, they should be standardised and distributed to other sectors (e.g. for the needs of physical planning at the country level), in order to harmonise them and distribute for other purposes, related to development of the national economy;
- lands and buildings registration systems should be urgently integrated with land registers, since the same rights to real estates are recorded twice now – both, in land registers and in lands and buildings registration systems (real estate cadastres);
- Sets of documents existing in land registers should be computerised in land registers. At present, four basic sections of land registers were migrated, without computerisation of existing sets of documents, what makes utilisation of those data sets very difficult;
- Data existing on the real estate cadastre should be gradually amended with new objects, useful for other purposes of the national economy, including for appropriate administration of the real estate market;
- Responsibility for the data quality at particular levels of data creation or modification should be determined in legal regulations;

– Data with errors should be eliminated from the public register, such as the real estate cadastre; the quality of some data sets should be increased.

It is necessary to unify the rules of maintaining the cadastral data bases, using a tele-information system, which ensures:

– *Appropriately secured storage and updating of data;*
– *Distribution and common utilisation of data, following the rules, which are specified in regulations concerning the spatial data infrastructure;*
– *Visualisation of data in the form of registers, records and lists, as well as the cadastral map, as well as distribution of extracts from those registers, records and lists, and extracts from the cadastral map to all interested parties;*
– *Development and implementation of legal regulations, allowing for utilisation of the 3D cadastre, together with works aiming at the future preparation to utilise the 4D cadastre.*

Management of the 3D and 4d cadastres is possible assuming the developed technology – it is limited by the lack of sufficient financial means only.

3. Required local reforms in the real estate cadastre

The following works should be performed in order to introduce local reforms:

- To support the awareness of the system users, as well as operators, in the field of correct and legally approved maintenance and distribution of resources;
- To achieve the possibility to implement small local systems (such as district or municipal systems) in – for example – voivodship (province) systems,
- To aim at the unification of the system in order to settle the data and to assign the data status resulting from legal regulations, unchangeable in the process of data distribution, following the Act on the Spatial data Infrastructure,
- To remember about the systematic improvements of the cadastral data quality,
- To urgently transfer the lands and buildings registration into a reliable real estate cadastre, what is important for correct functioning of the state, for business activities performed by companies and for the secure real estate market.

The real estate cadastre (lands and buildings registration) is one of public registers, which create the state information infrastructure. For many works and elaborations, it has the primary and reference nature. Considerable parts of cadastral data, which, in particular, concerns cadastral parcels, outlines of land use categories and location of buildings, is of primary and reference value for other public registers. Considering this, as well as due to the requirements of the Act on the Spatial Data Infrastructure, it is necessary to accelerate works related to its modernisation and adaptation to the rules of interoperability, which have been introduced by that act.

The future cadastre should register, in the real time, all rights, limitations and obligations. This requires the involvement of many sectors and institutions - such obligation is imposed by the Act on the Spatial Data Infrastructure.

Following the authors' opinion, the current lands and buildings registration, after introduction

of small amendments, will become the complete real estate cadastre with information, which will often exceed the vision of the Cadastre 2014, developed by FIG. We think, that FIG should commence the development of the CADASTRE 2014 Plus, considering the technological development, development of cadastral systems and existing trends in legislation of particular countries.

In our country, we are aiming at unification of maintaining the real estate cadastre, although various data, resulting from the past annexations, utilised for development and modernisation of the cadastre, exist. Vector cadastral maps, developed for the needs of the Land Parcel Identification System (LPIS), in particular for arable lands, should be useful for faster unification of the cadastre. Utilisation of documents, which have been developed for the LPIS system differs in particular parts of the country, due to existing diversified input materials, which were used for creation of the vector map.
Finally, the cadastre should be developed and modernised basing on unified standards only (which were developed by the Head Office of Geodesy and Cartography and which are agreed by interested sectors and approved by professional organisations of surveyors), for the entire country; therefore a uniform organisation dealing with the cadastre in Poland, should exist. The past experiences point to the need of organising the cadastre at the state administration. Maintenance of the cadastre – being the state resource – by more than 400 local government units results in considerable difficulties in coordination of those tasks. As the authors, we suggest that this situation should be changed for the sake of the cadastre.
The resources should also receive various works, the wide information of which should be utilised by sectors and other users for, e.g. physical planning, crisis management etc., although such works themselves could not be the bases for introducing changes in the cadastre.
Following the Act on the Spatial Data Infrastructure, such data should be received by the state resources and inventoried; appropriate attributes should be assigned to such data, which will not be lost in processes of issuing and distribution of data. Then such data should be distributed for various purposes.
In order to achieve such data, the following components are required:
- time,
- funds,
- organisational opportunities.

As it may be noticed, it is difficult to separate global and local reforms, Reasonable and correctly implemented legal regulations will allow for implementation of appropriate global reforms, but mainly local operations will decide about their effectiveness.

1. *Andrzej Hopfer, Stanisław Cegielski - State-of-the-art and the prospects of polish cadastre as a system supporting citizens and state - 2nd CADASTRAL CONGRESS September 19–21, 2003, Kraków*
2. *Stanisław Cegielski, Ludmiła Pietrzak, Witold Radzio, Bogdan Grzechnik, Stanisław Zaremba , Alicja Kulka, Wojciech Matela- Prawne umocowanie konwersji danych geodezyjnych i problem odpowiedzialności związany z ich udostępnianiem – Przegląd Geodezyjny – 02/2011*
3. *Ustawa Prawo geodezyjne i kartograficzne z dnia 17 maja 1989 r. (Dz.U. Nr 30, poz. 163) tekst jednolity z dnia 24 października 2000 r. (Dz.U. Nr 100, poz. 1086) tekst jednolity z dnia 24 listopada 2005 r. (Dz.U. Nr 240, poz. 2027) tekst jednolity z dnia 8 października 2010 r. (Dz.U. Nr 193, poz. 1287)*
4. *Ustawa o infrastrukturze informacji przestrzennej z dnia 4 marca 2010 r. (Dz.U. Nr 76, poz. 489)*

Land Management Policy In Niger State, Nigeria: Progress and Challenges

Muhammad Bashar NUHU, PhD,ANIVS, RSV, MNIM, MNES,
Department of Estate Management,
Federal University of Technology- Minna
mbnuhu@futminna.edu.ng

1.0 INTRODUCTION

Land management in Nigeria has existed for a longtime now, for instant the traditional land tenure system, statutory land law (Southern and Northern protectorate) land and native rights proclamation 1910 were the backbone. However, because of their shortcomings and failure to meet up with the demand led the government to promulgate another land management policy on the 29th March, 1978 with regard to all land which to a great extent unifies the laws relating to land tenure in Nigeria. The Land Use Act has done away with the various state land laws governing land tenure system in the country.

The Land Use Decree now an Act (the principal Nigeria land management policy) was established to eradicate land speculation so as to protect the right of all Nigerians to land. It is in the public interest of all Nigerians to use and enjoy land in Nigeria and the natural fruits thereof insufficient quantity to enable them provide for the sustenance of themselves and their families. Despite all these objectives the principal land management policy still has some shortcomings, which shall be examined in this paper. The main aim is to assess and discuss the role of Land Management Policy in the Economic development of Nigeria. The objective is to examine its role in practical land accessibility for development in Minna urban area of Niger state.

2.0 BACKGROUND

To a farmer, land is a space upon the surface of the earth on which life exists, it is a factor of production; to a real estate agent, it is form of property, it is capital, and consumption goods; to most others it is as nature and a location parameter. The land tenure law of any country deals with who has the right to hold land. This, of course, includes the conditions and terms of such a holding. In the recent years, in Nigeria, the consequences of the population pressure, urbanization and socio-economic growth have social and economic problems connected with land uses. Due to urbanization, many people are moving from rural to urban areas where modern facilities are available population pressure in cities and town has made residential accommodation a peculiar problem. The congested urban places are in need of expansion but the lands were this expansion is to be made is scarce. Land has become of great marketable value and no longer the ordinary land known to Africa tradition as a gift of nature to mankind. The guarantee to a piece of land by the law to every member was neglected before the Land Use Act. The growth of the Nigerian economy due mainly to the discovery of oil has made large members of people rich enough due to build better houses and maintain large farms also heavy and large industries have been established and thus, bringing about more demand for land. The Federal Government at first created twelve states, nineteen states (19) and later thirty-six (36) plus Federal Capital Territory (FCT) and this added the pressure and therefore, more land for use in some places-particularly the new state capitals. Necessary

infrastructures like road, offices, airport, parks, and other institutions were established. Prior to Land Use Act, family, community or individual landowners occupied a special position in both social and economic circle. Bare land, which had no attended value whatsoever under the traditional system of land tenure has now attended a high market value, land became so expensive. For building a state secretariat on a piece of land 300 x 5000 yard the government paid compensation for occupier about the cost of the building. Acquiring land public by the government became very difficult and sometimes even impossible because of the cost of compensation. The Federal Government lamented the situation in the whole of Nigeria in the following terms recorded by (Yakubu, 1986)

"government requires land on an increasing scale for its development projects. This is also true of a private sector. Although legislation exist empowering the government to acquire land compulsorily for public purposes. It has become difficult to do so at reasonable cost in some of the Nigeria's urban centers. Several projects in the second development plan have failed to take off because of the difficulty in obtaining land in major urban centres. Many private projects must have also run into similar obstacles. Evan where land was readily available, the price is often prohibitive, and compensation claimed and paid by government have been generally much higher than the true opportunity cost of land. This situation has obviously been aggravated by the activities of land speculators which purchase land which they do not intent to develop, hold unto them development has substantially increased their market value and they sell at abnormal profits".

The paper intends to answers to the following research questions:

1. Do individuals have right of ownership to land in the state?
2. Is the state land being managed properly?
3. Are there shortcomings in the Niger state, Nigeria land management policy?

3.0 STUDY AREA AND METHODOLOGY

3.1 The study area

Minna is a Gwari town in the middle belt region of Nigeria, it lies at latitude 9^0 37 North of the equator and longitude 6^0 33 East of the Greenwich meridian. The town is the north-west direction of the Federal Capital Territory, Abuja. Over the years Minna became an administration centre of increasing importance, and its function as a rail way junction attracted more investment and people. February 1976, Minna became the state capital of Niger State. The present town is widely dispersed along the main spin from Chanchaga in the south to Bosso in the north where the Federal University of Technology-Minna Bosso campus is located. The total population of Minna in 2006 census was 201,429 with land area of 6,789 sq.km.

3.2 Research Methodology

The data for this study were collected from various sources of data include responses from officials of the Department of Lands, Survey and Town planning, Minna, private developers and individuals directly or indirectly involved in the use, management and development of land in Minna. The land officers and planning officers were interviewed on the planning regulations, land development, land management and management constraint in Minna town. The various neighbourhoods in Minna are fully observed to determine the extent of the impact of Land Use Act on lands distributed within the areas.

Also to assess the impact of land management in Minna, a field survey was carried out with structured questionnaires. The questionnaire for this research work is designed to cover socio-economic and physical features of the study area. It covers demographic distribution by wards, type of properties occupied, source of finance for property development, operation of land use Act of 1990 in the distribution of land in Minna. A pair of questionnaire were designed and administered to obtain the required data for analysis. Questionnaire was designed and administered to owner as well as tenant occupiers. Also another set of questionnaire were administered to properly developers operating in Minna. Stratified random sampling technique was adopted during questionnaire administration to the various wards in which the population of Minna is divided into an inhomogeneous units and each unit represents a percentage of the total population. Questionnaires were administered randomly in each of the wards using the population of each ward as a guide to ascertaining the number of questionnaire to be distributed. Table 1 show the number of respondents in the various wards.

Table 1 QUESTIONNAIRE ANALYSIS FOR EACH WARD

WARDS	PROJECTED POPULATION 2009	NO. OF QUESTIONNAIRE ADMINISTERED	NO. OF QUESTIONNAIRE RETURNED
NASSARAWA A	31507	15	13
NASSARAWA B	15379	7	7
NASSARAWA C	15051	7	7
SABON GARI	35049	16	16
TUDUN-WADA SOUTH	21958	10	10
TUDUN-WADA NORTH	24317	11	11
MINNA -CENTRAL	40596	19	15
MINNA -SOUTH	25611	12	12
LIMAWA A	28203	13	12
LIMAWA B	30707	14	14
MAKERA	27793	13	13
BOSSO	45376	21	19
MAIKUNKELE	7064	3	3
CHANCHAGA	24865	11	11
MAITUMBI	34000	16	13
TOTAL	407492	188	176

NOTE: Population growth is taken at 2.83%
Source: Field survey, (2010).

The total number of questionnaire administered to each ward was derived by dividing each ward population to total population multiplied by total number of questionnaire (188). The 2009 population is projected from 2006 population census. Out of the 188 questionnaire administered only 176 was returned. The percentage number of questionnaire returned is 94% which is a reasonable number capable of supporting logical inferences and conclusion. A total of 12 questionnaires were designed and administered to the property developers in

Minna in which only 9 was accounted for. Table 2 shows the names and addresses of the property developers with the total number of questionnaire administered.

Table 2 QUESTIONNAIRE ANALYSIS FOR PROPERTY DEVELOPERS IN MINNA.

S/No	NAME	ADDRESS	No of questionnaire Administered	No of questionnaire returned
1	Basmoh Enterpises Nig Ltd	Adamawa road, Dutsen Kura, Minna	1	-
2	Southgate Investment Ltd	Cosmic chambers, Bosso Road	1	1
3	Flamingo Ventures Ltd	Kuta road, Maitumbi	1	1
4	HomeFront Consultants Ltd	Opp ABSS Bosso road	1	1
5	Magaru Nig. Ltd	Muazu Moh'd Road	1	-
6	Urban shelter Ltd	Kure Modern Market, D/Kura	1	1
7	Shettima Ventures	Dutsen Kura off-bypass	1	-
8	Modern shelter Ltd	Off airport road, Airport Qtrs	1	1
9	Mass shelter Ltd	Paiko road, Tunga	1	1
10	Kuta Resources Partnership	Paiko road, Tunga	1	1
11	Alagbe & Partners	Muazu Mohd Road	1	1
12	M.B. Nuhu & Company	Bay Clinic road, Tunga	1	1
	TOTAL		12	9

Source: Field survey, 2009

Out of the 12 questionnaires administered (table 2 above) to the property developers only 3 were un-accounted for. The percentage of the number of questionnaire returned (9) is 75% which is a reasonable number capable of supporting logical conclusion. A total of 185 questionnaires were returned for analysis.

4.0 RESULTS AND DISCUSSION

The focus of this paper is to collect relevant information on the impact of land management policy on property values in Minna and to assess and discuss the role of Land Management Policy in the Economic development of Nigeria. The results obtained in examining land accessibility and management for development in Minna urban area of Niger state are presented as follows;

Table: 3 NUMBER OF APPLICATION FOR LAND ACQUISITION IN MINNA FROM 1999 to 2005

TYPE OF USE	YEAR							
	1999	2000	2001	2002	2003	2004	2005	TOTAL
Residential	1216	718	832	1021	776	703	639	5905
Commercial	120	101	125	102	52	37	43	580
Industrial	3	1	3	2	1	1	4	15
Agriculture	11	13	13	9	10	7	3	66
Religious	8	5	2	4	7	5	5	36
TOTAL	1358	838	975	1138	846	753	694	6602

Source: Department of Lands, Survey and Town Planning Minna, 2009.

Table 4: NUMBER OF APPROVED APPLICATIONS FOR LAND ACQUISITION FROM 1999 – 2005.

TYPE OF	YEAR

USE								
	1999	2000	2001	2002	2003	2004	2005	TOTAL
Residential	850	680	790	980	730	703	630	5363
Commercial	110	94	110	98	48	36	40	536
Industrial	3	1	2	1	1	1	3	12
Agriculture	10	12	11	7	8	6	2	56
Religious	8	4	2	3	6	5	5	33
TOTAL	981	791	915	1089	793	751	680	6000

Source: Department of Lands, Survey and Town Planning, Minna 2010

Table 3 and 4 above revealed that within a time frame of (1999 to 2005), out of a total of 5905 applications for land acquisition, 5363 were approved for residential land use, 536 was approved for commercial land use. Only 12 applications out of the 15 applicants were approved for industrial land use. Within 7 year period only 26 applications was granted for agricultural land use and finally, 33 application was granted to use land for religious purposes in Minna. Land granted come with land title which create or enhanced the Land value. Title and ownership of land secured. Land value is a function of land management. Therefore, the study established the property values in Minna as contained in Table 5 below.

Table 5: VALUES OF PROPERTY IN MINNA

Area/location	No. of persons Interviewed	High	Moderate	Low
Bosso	19	12	4	3
Tudun Wada North/South (Tunga)	21	18	2	1
Maitumbi	13	8	3	2
Sabon gari	16	11	4	1
Limawa A/B	26	17	5	4
Makera	13	9		4
Nassarawa(A,B, & C)	27	19	5	3
Chanchaga	11	7	2	2
Maikunkele	3	1		2
Minna Central/South	27	16	7	4
Property developers	9	7	2	
TOTAL	185	68%	18%	14%

Source: field survey, 2009.

Table 5 above analysis shows that the value of property is high in most neighbourhood of Minna.

5.0 SUMMARY OF FINDINGS

The study indicates that the Land Use Act of 1990 is the existing land policy in Minna and its environs. The department of Lands, Survey and Town planning is in charge of Land management and that the authority has granted a total of 5363 applications to various land uses within a time frame of 7 years (1999 – 2005).

The analysis revealed that residential land use is the dominant use of land in Minna and most of buildings are between 11 – 20years of age. The amount spent annually on property

development is ₦3, 000,000 or less. Annual cost on building maintenance is within the range of ₦100, 000 – ₦150, 000. Further analysis indicates that the state Government is vested with the control and management of lands in Minna and its environs. The majority of the inhabitant supports the existing reform policy on land due to its significant impact on land value.
Finally, the following factors accounts for the movement of people from one neighbourhood to another: the available facilities in a neighbourhood, the level of security, the distance of location to market and work place and lastly, change in the income of individual. Summary of identified problems during analysis includes: Poor land management, unregulated rent on property, private tenure on land, low access to land among others.

5.1 IMPLICATIONS OF THE FINDINGS

It is obvious that the land policy operating in Minna, that is, the land use Act of 1990 is intricately tied to urban planning and development. The land policy has a significant impact over the values of land and buildings. The ability of the neighbourhoods to develop into a standard and livable environment has been the major limitation which the organization responsible for the management of land in the state cannot guarantee. Hence, most of the neighbourhoods are rapidly developing into slums.
It is necessary for the government to re-examine its role in the control and management of land in Niger State. The members of the public should be enlightened on land affair in order to enable them understand the scope and limitations in the general use of land. The regulations of the Land Use Act should be properly implemented in Minna and its environs. The provisions of the Act should be strictly attended to in order to meet the criteria of efficiency, equality, compatibility and continuity. It should encourage efficiency and maximum utilization of land. The policy should provide access to land for economic and social uses. The policy should be compatible with other existing policy instrument and it should be able to integrate well and continue with the cultural and political system in the state and country as a whole.

6.0 RECOMMENDATION

Having identified some shortcomings in the existing land use policy in Nigeria, the following recommendations are put forward towards solving the identified land policy problems in other to achieve economic development.

6.1 REINFORCEMENT OF LAND USE ACT CAP 202, LFN OF 1990

The land use Act of 1990 sought in theory to break up large land holdings and hence facilitate the transfer of land for housing development and to encourage rehabilitation of older indigenous areas in prime commercial locations in city centres. In reality it has not accomplished these ends. The traditional authorities still exert influence over land and generally refuse to relinquish their control over land and the decree has not stopped land speculation and land hoarding. The states lack the will to implement the Act and generally, the principles have not been upheld.
It becomes necessary for the provisions of the Land Use Act to be reviewed and properly enforced in the state to facilitate alienation of land for development, reduce the restrictions of

traditional ownership which inhibits urban rehabilitation and peripheral urban development and to produce a more efficient land system.
In line with the above it is recommended that in order to ensure the effectiveness and achievement of the goals of the Land Use Act, the followings should be adhered to:

i. The Governor of each state must comply with the provision of Land Use Act of 1978 as the principal land policy of the country and be accountable to all stakeholders with sense of transparency.
ii. The Governor and the Local Government should be very careful on how they delegate powers i.e. they must not delegate powers to another person or authority without probity and honesty.
iii. The governor and Local Government should try to avoid in-ordinate delays in the processing of application of Certificate of Occupancy, approval of the application and finally allocation of land to people.
iv. Since the Land Use is to give access for the possession, use and occupancy of land, therefore, the charge or fees should be reduced to allow more investment and more land use in the nation. This will promote economic development.
v. The Governments should ensure justice in their dealing with the people particularly the people that they delegate power to. The people should not use the power being delegated to them contrary to the objective of the Land Use Act.
vi. Adequate compensation should be paid to landed properties or on unexhausted improvement on land to the people that their Rights of Occupancy are compulsory acquired.
vii. The Governor of each State and Local Government should be greatly accessible to by people and people should be greatly attended to.
viii. The basis of compensation should be based on open market value.
ix. The Land Use Allocation committee at the state level and the Land Use advisory committee at the Local Government level should be established/maintained and to include registered Estate Surveyors and Valuers.

Lastly, people generally should comply with the Land Use Act under the leadership or trustee of Governor or the appropriate Local Government i.e. customarily and statutorily.

6.2 FORMATION OF DEVELOPMENT LAYOUTS

Layout of plots should be designed and provided with serving public utilities in all the peripheral parts of Minna. This will go a long way in avoiding unplanned, unprotected land development. Opening up new areas will also decongest the already congested slum area. The layouts are recommended to cover low, medium and high densities. Special consideration should be given to the low income earners who suffer most from sub standard housing.

6.3 INFRASTRUCTURE

The provision of infrastructure in the decaying area of Minna will promote the quality of lives since it will lead to efficiency of service and create more jobs and enhance the attainment of MDG 11 goal and contribute to National Development. However, this requires that constant

maintenance of facilities is required to improve property values in the neighbourhoods. Also there is the need to re-examine the capacity of the state government to handle administration and political roles that will be required. The government should establish the capacity not only to make initial assessment on how services should be supplied but also to administer the role of the state once they have been established.

6.4. LOCAL GOVERNMENT HOUSING DEVELOPMENT

The first major step towards rent control might not be through rent legislation as this has proved to be ineffective in Minna. It is common knowledge that in the area of housing, the government always finds it difficult to control what is not her own. Therefore, there is the need for local government areas to provide housing at the peripherals areas of Minna on rental basis. The local government should build rental houses and then set pace for the rent. In others to increase the stock of such houses in the market, private housing developers and corporate bodies through the various labour unions should encourage formation of housing co-operative society.

6.5 LAND ACQUISITIONS AND SPECULATION

The present land acquisition and speculation tendencies of both individuals and government officials in Minna which have resulted into land banking of very large track of land from the locals and layouts of government. In which they neither develop the land nor do they release it into the market. There is a need for deliberate government policy to discourage such phenomena. There is the need for undeveloped land within built up neighbourhoods of Minna to be subjected to heavy land taxation. Also there is the need to legislate on maximum land ceiling areas that could be left undeveloped in built areas. This will discourage speculation and most of the lands are likely to be use for the purpose in which they will attract the best value.

6.6 PUBLIC PARTICIPATION

In the process of land management policy formulation, planning the place of public participation should be given a pride of place. This should involve the establishment of effective communication link with the public at initiation of any land use related policy or scheme. The objective of citizen participation should be tailored to inform and educate the public about the planning procedure in order to enable them understand the scope, limitations and to be able to select alternative useful policies that will be of general interest to the community

7.0 CONCLUSION

The research has revealed fundamental factors on existing land management policy in Minna. It identified the organization in charge of land management in Niger State. Problems associated to the land management policy in Minna are also identified, they include: traditional tenure on land, unregulated rent passing on properties, poor policy implementation, land acquisition and speculation problem, low accessibility to land, inadequate infrastructural facilities and social amenities among others. Certain measures such as rent and housing finance, land acquisition policy, public participation, technical infrastructure, formation of Government layouts, formulation of good urban policy on land and elimination of mixed uses

on land and building. These will go a long way in achieving functional, safety, security and comfort in the use of land for living, working, circulation and recreation in Minna.

REFERENCE

Land Use Act Cap 202, Laws of the Federation of Nigeria, 1990.
Minna Master Plan (1979 – 2000).
Law Lord (2000) Land Use Act 1978 Published by Law Lord Publisher Abuja.
Nigerian Urban and Regional Planning Decree No.88 of 1992. Federal Government press. Lagos.
Yakubu M.G (1986) Land Law in Nigeria Published by Macmillan limited London PP 193-214.
Agbola, T (1988), the role of Non – governmental organizations (NGOs) in housing provision in Nigeria. Ford foundation. Lagos.
Alabi J. K (1996) Land Law for Estate Management and Town Planning Students Vol. Published by Aregbesola Publisher Ilorin Kwara State

Barlowe, R (1978), Land resource economics. Second edition. Englewood clifts N.J Prentice hall
Ely; R.T (1914), Property and contract in their relation to the distribution of wealth. Book one. Mcmillan. New York.
Gobin, et al (2000), Logistic Modelling to derive Agricultural Land Use Determinants – South eastern Nigeria. Institute for Land and Water Management. Katholieke Universiteit. Belgium.
Goodall, B and Lean, W (1966), Aspects of Land Economics. Estate Gazettes Ltd.
Jinadu, A.M. (2004), Understanding the Basics of Housing. Jameson Publishers. Minna.
Ogedengbe, P.S. (2004), Formulating a Good Urban Land Policy for Nigeria. Department of Estate Management, Obafemi Awolowo, Ile – Ife. Nigeria.
Olayiwola, et al (2006), spatial variation in Residential Land value Determinants in Lagos, Nigeria. A paper presented at the fifth FIG. Regional Conference. Accra.
Payne, G (2000), Urban Land Tenure Policy Options: Titles or Rights. A paper presented at World Bank Urban forum. Virginia
Taylor, W.R. (2000), Urban Development Policies in Nigeria: Planning, Housing and Land Policy. Department of environmental, Urban and Geographic Studies. Montclair State University.
Sanusi, Y.A. (1997), the National Housing Policy of Nigeria: An Analysis. Solid printers (Nig.) co. Kaduna.
Suleiman, I.D. (2003), Development control under Rapid Urbanization: Evolving Modern Techniques for Controlling Development. A Course paper presented at Nigeria Institute of Town Planners 2003 Mandatory Professional Development Programme (MCPDC).

Importance of Cadastre in Disaster Management

Gyula IVÁN – Bence TORONYI – Gábor MIKUS
Institute of Geodesy, Cartography and Remote Sensing (FÖMI), Hungary

1. INTRODUCTION

Institute of Geodesy, Cartography and Remote Sensing (FÖMI) as a part of the Hungarian Land Administration has a key role in Hungarian SDI. FÖMI's activities (e.g. GNSS services, Geodynamics research, Operation, Support and Development of Unified Land Registry IT systems, Remote Sensing activities, Data Services, Topographic mapping) cover an important, large part of national SDI.
On 4th October 2010. a red-mud accident happened at a sludge reservoir of alumina factory Ajka-Hungary. The watered red-mud flooded about 800 hectares plough-land and pasture and about 3,5 hectares built-up area (Devecser, Kolontár).
Because of the heavy losses in people's life, in the built and natural environment, the Government had to decide on many problems as soon as possible. Therefore FÖMI was put to serve and analyze data on the territory of the catastrophe.
Based on the wide-range of SDI data, managed at FÖMI, FÖMI satisfied the requirements, defined by the Government.

2. INTEGRATION OF SDI CADASTRE IN DISASTER MANAGEMENT, A REAL EXAMPLE

As it was mentioned in introduction on 4th October 2010. a red-mud accident happened at a sludge reservoir of alumina factory Ajka-Hungary. The red-mud broke through at the corner of the dum of a sludge reservoir at 12:10 o'clock. The watered red-mud flooded about 800 hectare plough-land and pasture and about 3,5 hectare built-up area (Devecser, Kolontár). 96-98 % of the red-mud settled remained in the sludge reservoir (first estimation). The watered red-mud is alkaline, therefore it is dangerious for the nature and it causes a corrodent injury on the skin surface. It is expected that the heavy metals had settled in the red-mud during the years therefore not too much run out from the sludge reservoir together with the watered red-mud. At the area of Alumina Factory Ajka there are ten sludge reservoir. About 50 million m^3 grey-mud and 30 million m^3 red-mud are storaged in that. There is no any information about similar accident in the history of the Hungarian alumina production. 9 people died and 123 injured by the alkaline watered red-mud (pH value was 13!) in the catastrophe.

2.1. Study area

The study area is a rectangular area flooded by red mud near Ajka
Soil environment of mud flooded area[31]:

[31] source: Research Institute for Soil Science and Agricultural Chemistry of the Hungarian Academy of Sciences (RISSAC HAS); webpage: http://www.mta-taki.hu/

The sludge flood disaster was in the valley of the Torna stream, having alluvial soils with silty sand loess, fluvial and runoff residual. The soils here have light mechanic composition: gravely coarse sand, loamy sand. Typical soil types of the mud flooded territory are: calcaric fluvisol - down in the valley, cambisols - on higher position.

Land use of the study area based CORINE Land Cover map (CLC100): forest (7.2%), arable land (44%), settlement (7.7%), orchard (0.1%), wine (0.5%), water body (0.5%), meadow (40/%).

Figure 1.: The damaged dam of the reservoir

In TAKARNET24 project the replication of District Land Offices' databases has already done, so we could use the capabilities of the Central Unified Land Registry Database.

This analysis showed that approximately 800 hectares of cultivated lands affected directly by the flood of red-mud. These are mainly arable lands, but meadows and pastures also influenced. All these areas the change of soil is required.

The next analysis pointed to the building categories, affected by the flood. The Central Unified Land Registry Database strongly helped this task, because the buildings and their categories are also included in it.

Devecser, a small town close to the factory, also received a part of the flood. This analysis showed that mainly homestead and residence buildings are damaged in the flood.

Of course, red-mud flood causes pollution on natural conservation areas too.
Based on the Central Unified Land Registry Database FÖMI also identified the owners, mortgages and/or users of land on the polluted areas for the distribution of aids, planning of reconstruction and for other goals.

2.2. Utilization of radar-interferometry in movement monitoring

The industrial disaster occurred is highlighting the use of the possibilities given by remote sensing on the field of prevention of spread and damage surveying as well. As monitoring continuously the spatial ground objects we can derive important information. With the use of radar interferometry a time-back monitoring of the movement of reservoir's broken damp, going back to many years could be accomplished, following the moving of the damp in mm precision. Such kind of survey and publication was done by the research team of the Satellite Geodesic Observatory of FÖMI (Grenerczy et. al. 2010).

The relief is rather diverse, the reservoir which had been hurt is on 200 m high, which has a gradual decrease to western direction. The red mud was flowed over the areas lower then the reservoir. The highest point of the territory is the Somló hill, which is an individual historical wine region as itself.

2.3. Study by Remote Sensing

The aim of our study was the monitoring of red sludge spill with remote sensing using WorldView-2 and Rapideye satellite images. The study was done in 3 steps, which are the followings:

1. Delineating the spill of red mud
2. Studying the stream waters of the contaminated area
3. Analysing the spectral features of the contaminated soils

The applied methods and results used in the above mentioned analyses are the following:

We analysed the following two satellite images out of the very high and high resolution images made after the catastrophe:

- RapidEye made on 7 October 2010.
- WorldView-2 – two days later: 9 October 2010

Beside these we had results of GPS measurements from the flooded area.

Methodology applied on processing of WorldView-2 satellite image

The classification was done based on segmentation, both on the WorldView-2 and RapidEye images, with the aim of the possible most precise delineation of the flooded area.

Spectral indexes:
Three indexes were used: NDVI, red - green and red edge – red indexes. These were chosen based on the main characteristics of spectral curves of target classes.

Segmentation:
By defining the segments the main intention was that the boundary of the segments must strictly follow the boundary of the land cover elements and the boundary of the flooded area.

Classification:
The classification was done with sampling using maximum likelihood (ML) method. There are 3 target classes:

1. open surface of red mud cover
2. soil spilled by the red mud

3. vegetation spilled by the red mud

Accuracy assessment:

We can state that both the accuracy of the segmentation and the classification is deteriorating as going further from the position of the dam was broken as the representatives of the surface has stronger effect to the swamp.

Comparison of red mud flood map derived from WorldView-2 and RapidEye satellite images

Differences in spatial resolution of WorldView-2 and RapidEye satellite images are apparent in the results. Classification by WorldView-2 follows the delimitation of the spill more accurately. While one pixel of the WorldView-2 image is 4 m^2, it is 25 m^2 in the RapidEye image, that is, spectral values of each pixels from the border of the spilled surface are from a much larger area. This is the main reason for the inaccuracies of the RapidEye classification. Differences in spectral richness are less obvious and their main consequence was the higher number of incorrect hits.

The aim of our study was to demonstrate how the spatial resolution of satellite images the WorldView-2 allows of the categorization of narrow watercourses with respect to the spill. First we digitalized watercourses accurately using the WorldView-2 satellite image and 1:10 000 topographic maps of the area. On the digitalized map of the watercourses, we created a 2-m-wide buffer zone in which we point-wise categorized the contamination. Flooded watercourse areas match the delimitation of other types of flooded areas (soil, vegetation).

6. CONCLUSIONS

In the last chapters we would like to introduce the Hungarian solution for the implementation of Land Administration and SDI. The structure of the Hungarian Land Administration Sector, and its activities provides a flexible, well-operating infrastructure to achieve a real SDI together with legal data included in Land Registry.

Red-mud catastrophe showed that integrating Land Administration and SDI results a good solution in the way for establishing a real e-Governance.

FÖMI's researches on movement monitoring by radar-interferometry in the case of red-mud disaster showed that we should continue broader implication of this technique. We are interested in tracking the long-term consequences of the disaster on the directly affected zone and in a larger buffer zone as well. We expect complete destruction of some trees and herbaceous plants on the main flood track and serious anomalies in vegetation development around it.

What happens to the cadastre when the earth moves?

Legislative and regulatory responses to the earthquakes in Canterbury, New Zealand

Don Grant, Mark Smith, and Mack Thompson
Office of the Surveyor General
Land Information New Zealand, PO Box 5501, Wellington 6145, New Zealand
dgrant@linz.govt.nz, msmith@linz.govt.nz, mthompson@linz.govt.nz

ABSTRACT

On 4 September 2010, a magnitude 7.1 earthquake in Canterbury New Zealand resulted in surface movements of up to 4 metres along a 30km fault line in a mostly rural area with cadastral boundaries being torn apart. Many residential properties in the nearby city of Christchurch were also affected by surface movements of several metres as the subsoil liquefied during the earthquake. On 22 February 2011, a smaller but more devastating shallow aftershock occurred right underneath the city and caused widespread destruction and many deaths. The impact of liquefaction was also more severe after this event. The efforts to rebuild the city over the next decade will depend on landowner and investor confidence in the security of property rights in the face of these significant land movements. Special legislation provides flexibility so that uncertainty over the location of land boundaries will not needlessly delay recovery efforts to rebuild the city. The impacts of the earthquakes on the cadastre, and the legislative powers developed in response, are described.

INTRODUCTION

At 4:35am on 4 September 2010 a magnitude 7.1 earthquake near the town of Darfield caused significant physical damage to rural land surrounding the greater Christchurch urban area, and to land in the urban area itself. Fortunately there were no deaths. Despite the known seismic activity in New Zealand there had been no major earthquakes affecting the cadastral boundaries of a large urban area since the Napier earthquake in 1931. Further significant land and property damage, and this time many deaths, resulted from a magnitude 6.3 aftershock on 22 February 2011. Another pair of aftershocks measuring 5.6 and 6.3 on 13 June 2011 caused further damage. The physical effects of the earthquakes on the certainty of cadastral boundaries were manifested in a number of ways:

- shearing of up to 4 metres in rural areas where a fault line passed through a parcel
- extension, compression and distortion close to a fault line
- block movements and rotations throughout the Canterbury area
- irregular deformation due to liquefaction of subsoils and surface flow of liquefied materials
- Landslips and rock falls in the hill suburbs.

Few applicable international examples of solutions for boundary re-establishment after such an event could be located.

PHYSICAL EFFECTS OF THE CANTERBURY EARTHQUAKES

A large number of buildings in the centre of the city were damaged by the shaking effect of the earthquake and many more sustained damage due to underlying soil disturbance. Vertical accelerations up to 2.2 times gravity in the 22 February aftershock resulted in some structures being effectively thrown up into the air. Demolition of damaged buildings is progressing and approximately 900 buildings in the Central Business District are expected to be demolished.

A large number of residential suburban homes were severely damaged by shaking, by rock falls and by localised areas of liquefaction and surface flow (lateral spreading) of liquefied material. To date, about 5000 homes have been identified as being on land which will not be rehabilitated and these properties will be purchased by the government. Another 10,000 homes are subject to further assessment to determine whether the land under them must also be abandoned.

The 4 September 2010 Darfield earthquake resulted in a fault shear visible on the land surface. Parcels of land astride the 30 kilometre long fault line were offset in places by up to 4 metres. Fences, water races and road formations clearly show the extent of the offset. The differential movement on either side of the fault is principally horizontal but with local areas of vertical movement.

Figure 1 illustrates the effect of the fault shear on a water race and a fence – both of which were previously straight.

Figure 1 – Effects of fault rupture on previously straight fence and water race. (Photo - Survus Consultants)

It is expected that parcel boundaries of land close to the fault will be shown to exhibit distortion reflecting the east-west direction of the fault.

There was also property damage, mostly in urban areas, caused by the liquefaction effects of the earthquakes. Surface supported structures and infrastructure tended to settle into the subsurface void created by the extrusion of the liquefied material. The liquefaction thus caused surface and structural damage in the vertical sense but also caused lateral spreading towards features of topographic weakness such as river bank or terraces. This surface

movement, of several metres in some cases, carried with it survey boundary monuments, fences and walls erected on boundaries and survey control monuments.

Measurements of survey control stations following the September 4 earthquake showed that the whole region had been subjected to a deep seated block shift in terms of previous positions. This deep seated movement is, in most cases, relatively uniform in relation to individual parcels of land.

THE EFFECT OF THE CANTERBURY EARTHQUAKES ON CADASTRAL BOUNDARIES

The New Zealand cadastral system supports a Torrens title system with a state guarantee of title. The survey system is supported by a strong network of survey control marks to which boundary points and monuments are connected. Most of the guiding principles for the re-establishment of boundaries come from common law which has established a hierarchy of evidence for the re-establishment of boundaries and boundary points. The two highest levels in this hierarchy are natural boundaries followed by the location of an existing boundary monument in the position in which it was originally placed. The earthquake introduces challenges to the definition of where the mark was originally placed

New Zealand had no prescriptive law or regulation for the re-establishment of boundaries following earthquakes or landslip. There is also a lack of common law to assist surveyors with precedents for re-establishing boundaries following an earthquake. Moreover, the movement experienced following the recent Canterbury earthquakes causes difficulty with the hierarchy of evidence when a boundary monument may appear undisturbed from its originally placed position but has, in fact, moved considerably.

The 1931 Hawke's Bay earthquake was the last significant earthquake in New Zealand which impacted upon major residential and commercial districts. A further result of that earthquake was the loss by fire of all official title and survey records for the district – thus much of the survey evidence of boundaries was lost. Better record management avoided that situation in the Canterbury earthquakes.

Other significant earthquakes in New Zealand, those at Inangahua in 1968 and Edgecumbe in 1987 have been in largely rural areas, and the 2009 Fiordland 2009 earthquake was in a wilderness area largely within a National Park. Where boundaries have been re-established following those earthquakes, decisions have been made by cadastral surveyors, in discussion with department staff, on a case-by-case basis. The number of boundaries affected by the Canterbury earthquakes precluded a similar approach being taken, although the principles used for the re-establishment of boundaries are generally consistent.

In 2004 the Surveyor General commissioned a study to synthesize international best practices in re-defining parcel boundaries following a deformation event (Ballantyne 2004). The study found there is a lack of rigorous principles to deal with such movement which could assist in preparing similar response for New Zealand. Two useful examples are the 1964 Anchorage, Alaska, earthquake and the 1971 San Fernando, California, earthquake. In those cases special legislation was used to deal with the effects of the earthquakes. Similar principles have been applied to the re-establishment of boundaries since the Canterbury events.

MANAGING THE SPATIAL CADASTRE

For 70% of land parcels, covering most urban and intensively-used rural areas, New Zealand has a survey-accurate spatial cadastre. For these parcels, boundary dimensions have been captured from vectors on historic survey plans, and subsequently new digital survey data, and adjusted in terms of the official geodetic datum to generate accurate coordinates. New Zealand has a monument and observation-based cadastre, so these coordinates do not legally define property boundaries. However the spatial cadastre that these coordinates represent, is used by Land Information New Zealand (LINZ) and surveyors to find marks and check the quality of new survey data. It is also used widely by the geospatial community. The movements caused by the Canterbury earthquakes are significant enough to require the updating of a large number of coordinates to realign the spatial cadastre.

Before the spatial cadastre can be realigned and new values for points produced, it is necessary to update the geodetic survey control system in the affected area. For full details on the re-establishment of the control system following the earthquake, refer to Donnelly et al (2011).

To update the spatial cadastre without resurveying every affected point, a model of the earthquake movements is used. This model is based on one developed by GNS Science, modified by LINZ so that it can be used to update cadastral data. A description of the general procedure used to update New Zealand's deformation model after an earthquake is given in Winefield et al (2010).

In areas of localised deformation (such as that resulting from liquefaction), the movements are generally so non-uniform that full least squares adjustment, rather than a model, will be required. Until updated cadastral data is collected, the accuracy may be comparatively low, but the results of the adjustment will be used to assign appropriate accuracy orders.

STATUTORY AND REGULATORY RESPONSE

Canterbury Earthquake Response and Recovery Act 2010

Following the 4 September 2010 earthquake, the Canterbury Earthquake Response and Recovery Act 2010 was passed by Parliament. The Act allowed for exemptions, modifications or extensions of certain Acts including the Cadastral Survey Act 2002.

Rules for Cadastral Survey (Canterbury Earthquake) 2010

The Surveyor-General used the powers provided by the Canterbury Earthquake Response and Recovery Act 2010, to prepare the Rules for Cadastral Survey (Canterbury Earthquake) 2010 (CEQ Rules). These Rules have the power of government survey regulations.

The CEQ Rules provide that where there has been deep-seated movement due to the earthquake, cadastral boundaries are deemed to have moved with the resulting land surface movement which can be displacement or deformation due to a fault rupture or relatively uniform block shift. This means that, in this case of deep-seated movement, landowners will generally retain ownership of the same assets on the surface of the land as they did before the earthquake.

The CEQ Rules state that re-established boundary points and related boundaries affected by deep seated movement must hold the same relationship to physical evidence, including survey marks and boundary occupation, as they did prior to the earthquake.

Where the deep-seated movement results in a relatively uniform block shift of an entire land parcel, then the relative positions of the parcel's boundaries to survey marks will remain the same as before the earthquake. In this case they may be unaware that their property and boundaries have moved relative to the geodetic network and more distant properties.

Where a parcel boundary has been displaced or distorted by deep-seated movement, such as a fault rupture, that exceeds the applicable accuracy tolerances, the re-established boundary must reflect that displacement or distortion. This may require the creation of new boundary angle points – for example across the surface rupture line.

Conversely, the case of shallow surface movement, due to liquefaction and surface flow, is considered analogous to land slip in which case survey and legal precedents indicate boundaries will normally be reinstated to their original positions as if the shallow movement had not occurred (after taking into account any deep-seated block movement that may have also occurred).

The CEQ Rules also provide for some relaxation of the normal requirements for orientation of surveys and for adoption of boundaries from existing cadastral records in certain circumstances.

No Rules were formulated for those boundaries affected by rock falls. Common law in this scenario supports the re-establishment of boundaries back in their original relative positions – although such properties may no longer be safe to occupy.

In a particular case where compliance with the rules is impractical or unreasonable the Surveyor-General can grant an exemption from the requirements, or specify alternative requirements. The provisions of the CEQ Rules have provided greater certainty for licensed cadastral surveyors to help them confidently certify their survey datasets as being compliant with the modified Rules.

The CEQ Rules and Guideline can be accessed from the Canterbury Earthquake page on the LINZ web site (LINZ 2010)

In general, boundaries will only need to be resurveyed for the purpose of subdivision, or reconstruction of buildings close to boundaries, therefore it may be decades before many of the boundaries affected by movement due to the earthquake are resurveyed.

The purchase, by the government, of all properties within the worst affected areas means that boundary determination in these areas will not be required. Where land damaged by liquefaction is being remediated, all structures will probably be removed first and the re-establishment of original boundaries will be the final stage of this work.

Canterbury Earthquake Recovery Act 2011

On 18 April 2011 the Canterbury Earthquake Recovery Act 2011 was passed into law, replacing the Canterbury Earthquake Response and Recovery Act 2010. This Act grants special powers to the Chief Executive of the Canterbury Earthquake Recovery Authority (CERA). Particular features of this Act affecting boundary definition include:

- Permiting the Chief Executive of CERA to require the Chief Executive of LINZ to approve a cadastral survey dataset even though it does not comply fully with the

Rules for Cadastral Survey 2010 or the modified CEQ Rules. Such direction can only be made after the Chief Executive of CERA has consulted with the Surveyor-General;

- Exempting the certifying surveyor from the liability for non-compliance with the Rules to the extent that the non-compliance was necessary for the purposes of the Act.
- Provision for the issue of a title limited-as-to-parcels resulting from a survey dataset which the Chief Executive of CERA directed to be approved and for which adjoining owners approvals have not been obtained.

These reserve powers are considered likely to only be used as a last resort. In such cases they will allow recovery efforts to proceed without being unduly delayed by doubts and conflicts over boundary location, while still protecting the enduring rights of adjoining property owners.

CONCLUSION

The CEQ Rules, developed as part of the post earthquake response, provide some certainty for surveyors when certifying datasets but are yet to be fully tested for reasonableness and for comprehensiveness to cover all the cadastral definition issues resulting from the earthquakes.

Landowners will often not seek a definition or re-definition of their property boundaries, unless they are developing their land or have a dispute with a neighbour. Therefore, the effect of the Canterbury earthquakes on some property boundaries may not be discovered for decades ahead.

REFERENCES

Ballantyne, B, 2004, *Managing the New Zealand cadastre after deformation events: Applying grit to a slippery slope*, LINZ research report.

Canterbury Earthquake Recovery Authority (CERA) cera.govt.nz/

Donnelly, N, Ritchie, J, and Amos, M, 2011, *Re-establishment of the New Zealand Survey Control System following the 2010 Darfield (Canterbury) Earthquake*, in Proceedings of FIG Working Week, May 18-22, Marrakech, Morocco.

GNS Science, 2011, *Canterbury earthquake - Most damaging quake since 1931,* media release web page, (www.gns.cri.nz)

LINZ 2010, *Canterbury Earthquake,* web page, (www.linz.govt.nz/survey-titles/cadastral-surveying/canterbury-earthquake/index.aspx)

LINZ 2010, *Rules for Cadastral Survey (Canterbury Earthquake) 2010 – LINZS65001*

LINZ 2010, *Guideline for Rules for Cadastral Survey (Canterbury Earthquake) 2010 – LINZG65702*

Quigley, M, 2010, *Science update on Darfield earthquake for press and public*, web page (drquigs.com/)

Tonkin & Taylor, 2010, *Darfield Earthquake 4 September 2010 Geotechnical Land Damage Assessment & Reinstatement Report – Stage 2*, Earthquake Commission Report (canterbury.eqc.govt.nz/publications/2010/11/stage2)

Winefield, R. Crook, C. and Beavan, J, 2010, *The Application of a Localised Deformation Model after an Earthquake*, in Proceedings of XXIV FIG Congress, April 11-16, Sydney, Australia. Available at: www.fig.net/srl/

3.11 East Japan Earthquake and Topics related to Land management

Masaru Kaidzu
Advanced Business Solutions Research Dept.,
Japan Construction Information Center (JACIC) Foundation
Akasaka Seventh Avenue Bldg., 7-10-20 Akasaka, Minato-ku, Tokyo 107-8416 Japan

Abstract

On March 11, 2011, East coast of Japan was hit by M9.0 earthquake. Strong shake and accompanied Tsunami damaged wide area along pacific coast. In the damaged area was the Fukushima Nuclear Power Plant site and this caused different kind damage.
This paper briefly explains what has happened physically and how land survey community or administrations responded.

1. 3.11 East Japan Earthquake

On March 11 2011, East Japan was hit by M9.0 large earthquake. Shake and Tsunami followed the earthquake caused heavy damage in quite large area. Parameters of the earthquake are as follows.

- Date-Time: March 11, 2011 14:46 JST (March 11, 2011 05:46 UTC)
- Hypocentral Location: 38.103°N, 142.860°E Depth: 24 km
  (JMA, as of 2011-03-13)
- Moment Magnitude: 9.0 (JMA, as of 2011-03-13)

Detail of fault model and crustal deformation associated with this earthquake are reported by some authors, for example, Ozawa, S. et al. (2011). According to Geospatial Information Authority, Japan (2011) and Japan Coast Guard (2011), Maximum dislocation reached more than 50m. Amplitude of the associated tsunami at coast exceeded 15m and caused unprecedented disaster.

Reported damage as of end of July is as follows.

-Human casualties:
  Found dead 15,726
  Missing 4,593
  Wounded 5,719
-Damaged Buildings:
  Totally damaged 114,464
  Half damaged 154,244
  Partially damaged 539,840
-Displaced persons
  Displaced persons 82,634

2. Crustal deformation and revision of coordinates

The earthquake caused wide spread crustal deformation both horizontally and vertically. Maximum horizontal displacement reached 5.3m and maximum vertical displacement reached 1.2m at the tip of Ojika Peninsula. Significant displacement is observed over roughly eastern half of Honshu, the largest of main four islands (Figure 1). After the main event, displacement continues. Geospatial Information Authority of Japan (GSI) has released new epoch coordinate and parameters for semi-dynamic correction for continuous GPS stations, GEONET on May 31. As there are more than 1,200 GEONET stations over Japan, we can find a station within 15km from any point on main and major islands. Thus a surveyor can carry out survey and coordinates can be reduced to those of epoch. For small scale survey like cadastral survey, we need denser control stations. For such purpose, GSI is now carrying out resurvey of geodetic control stations in northern Japan. New coordinates are supposed to be released at the end of October, 2011. Ministry of Justice (MOJ) that is responsible for immovable property registration issued an official notice on March 18 2011 that coordinates are to be temporally treated as local coordinates and at the same time, if surveyors can use control stations, note that so that later they can give official coordinates when GSI revised coordinates. MOJ also announced in its web site that people should be careful to date on map or certificate of map because those coordinates on such documents or maps will be corrected after GSI finishes their revision of coordinates of control stations.

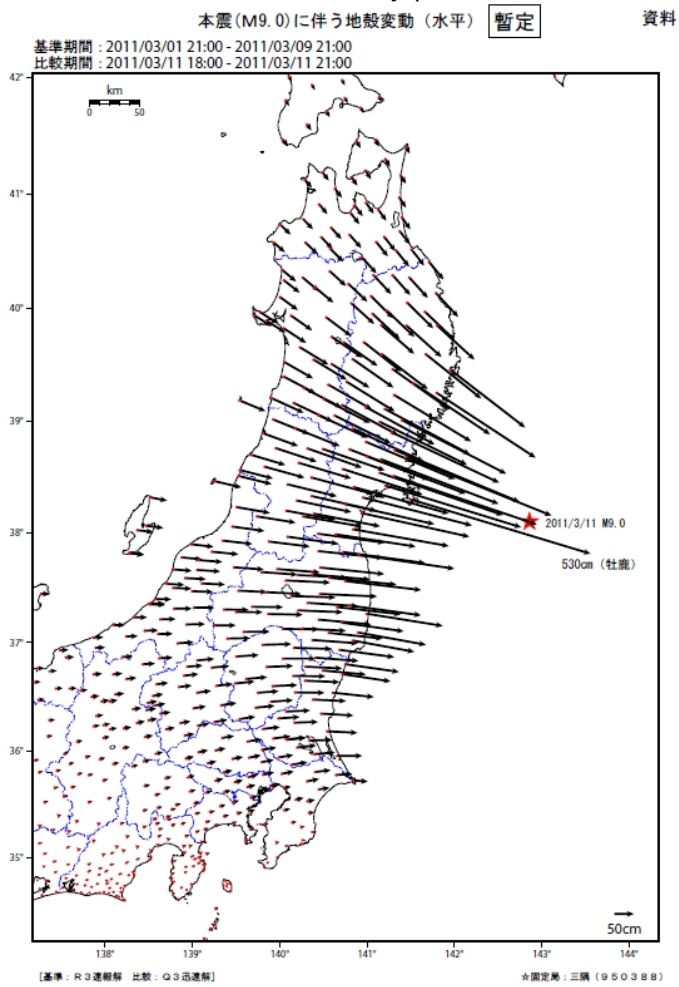


Figure 1. Co-seismic horizontal displacement after GSI (http://www.gsi.go.jp/chibankansi/chikakukansi40005.html)

3. Cadastre and registration

According to National Land Survey Law, when cadastral survey finished, a set of copy of cadastral books and cadastral maps are to be sent to registry office. The maps are replaced with old maps (Ko-zu) which are originally drawn in more than 100years ago. When

subdivision, merge or transfer occur, registry office inform of the fact and necessary data to municipalities concerned. In such way, cadastre and title are maintained. In the year 2008, MOJ finished digitizing document and maps of registration. Luckily therefore, even local registry offices are hit by tsunami and documents are lost or damaged, they are digitally backed up. As cadastral maps and books are updated regularly with transaction of title, practically cadastral documents also are backed up. MOJ also issued official notice and announcements. Examples available on internet are as follows.

On March 24: Preservation of boundary monument in restoration work

This official announcement request people working for restoration of infrastructure, houses, and so on not to destroy boundary monuments.

On March 29: When land certificate is lost by East Japan earthquake or tsunami

This official announcement assures even if the certificate is lost, land ownership is not lost.

On April 14: Treatment of request for preventing unjust registration of land, commercial registration and legal person registration.

This notification shows guideline to treat request of victims of earthquake or tsunami for registry office to prevent unjust registration.

For those working on ongoing cadastral survey, Ministry of Land, Infrastructure, Transportation and Tourism (MLIT) which is responsible for planning and implementing cadastral survey issued an administrative circular of assistant chief of division showing a guide line for immediate measure on March 24. It says that if a parcel is small and can be treated that the displacement is practically parallel shift and thus survey is carried on, it should be self checked locally and hold the result until GSI release new coordinates. The result of survey should be later evaluated using new coordinates. For this announcement, Questions and Answers followed so that people carrying out cadastral survey in municipalities can consult with.

4. Land price

On August 1, Press reported that MLIT will watch land price together with prefectural government. According to National Land Use Planning Act, government can set area under land price surveillance when unusual rise in land price is a concern. As people experienced large tsunami, there is a possibility that price of high land unusually rise, National government together with prefectural government set area for surveillance and if unusual rise of land price is observed, will take a necessary measure.

5. Land use and development plan

On June 24, Fundamental Act for Rehabilitation after East Japan Great Earthquake was proclaimed and enforced. According to this act, conference for planning rehabilitation after East Japan Great Earthquake was established. Based on its recommendation, head quarter for rehabilitation after East Japan Earthquake is carrying out following measures.

Creating special rehabilitation zone,
Delivery of flexibly usable grant,
Application of PPP, PFI and so on,
Secure about 13 trilion yen for above measure,
Action for rehabilitation such as
Create new regional society corresponding to change in population structure
General mobilization of hardware and software for reduction of damage
Mechanism for swiftly realize reorganization of land use (including monitoring
Land price and number of transactions)

Assistance in human resources

Rehabilitation will take 10 years and first 5 years are supposed to be period with intensified measure. Care for recovery from damage of Fukushima nuclear power plant is of course included.

Head quarter and other ministries and agencies prepared guidelines and laws to take care of salted farmland, to achieve quick and easy processing of administrative procedure for boosting recovery in private sector. The rehabilitation plan is prepared by prefectural governments and municipalities. Those plans take multi layered defense against natural disaster into account. That includes construction of embankment, preparation of efficient evacuation route, land use control and so on.

6. Concluding remarks

Rehabilitation after the 3.11 East Japan Earthquake and Tsunami is still in very early stage. As the crustal deformation caused by the earthquake is very wide spread and large in magnitude. The accompanied tsunami destroyed infrastructures and buildings. Liquefaction caused damage in many places including greater Tokyo area. Recovery of cadastre and title are quite important. That is because all the following works are somewhat related to land management. Fortunately, MOJ had already finished title documents and maps digitized at the time of the earthquake occurrence and database was not damaged. Although paper documents are damaged by tsunami in some registry offices, there occurred no serious problem so far.

Geodetic coordinates are to be revised by the end of October. GSI has experience in changing coordinates nationwide in year 2002 when Japan adopted geocentric coordinate system instead of so called Tokyo Datum (Geographical Survey Institute (2003)). The transfer to new coordinates will smoothly be done when re-survey finishes. We are sure that surveyors' effort on geodesy, cadastre, and engineering play an important role in rehabilitation from the disaster.

References

Ozawa S., T. Nishimura, H. Suito, T. Kobayashi, M. Tobita & T. Imakiire (2011):
Coseismic and postseismic slip of the 2011 magnitude-9 Tohoku-Oki earthquake, *Nature*, **475**, 373-376, doi:10.1038/nature10227

Geospacial Information Authority (2011): http://www.gsi.go.jp/cais/topic110520-index.html

Japan Coast Guard (2011): http://www1.kaiho.mlit.go.jp/GIJUTSUKOKUSAI/jishin/11tohoku/index.html

Geographical Survey Institute (2003): Overview of construction of Geodetic Datum 2000 (Sokuchi Seika 2000 Kouchiku Gaiyo: in Japanese)

Survey Accurate Multipurpose Cadastre in Malaysia

[1]Dr. Teng Chee Hua, [2]Dr. Abdullah Hisam Omar, and[3] Dr. Shahrum Ses
[1] Department of Survey and Mapping Malaysia, 50578 Kuala Lumpur, MALAYSIA.
[2&3] Faculty of Geoinformation and Real Estate, University of Technology Malaysia, 81310 Skudai, Johor, MALAYSIA.

Multi-Purpose Cadastre (MPC) has a potential to support spatially enable government, private sectors, and society in general, and to expand computer support in the process of visualization, organization and management of useful land information. The Geographic Information System (GIS) applications of MPC database can be divided into four main sectors namely economic, social, environment and infrastructure. Therefore, MPC will serve as the most important geospatial dataset required for economic, social and infrastructure development for the country and hence will be one of the catalyst for gearing the nation towards high income economy by year 2020. In the endeavour to develop MPC for Malaysia, Department of Survey and Mapping Malaysia (DSMM) has embarked on a Pilot Project for the Federal Territory of Putrajaya. The main reference base-map is the survey accurate National Digital Cadastral Database (NDCDB). NDCDB contains all information obtained from cadastral survey jobs related to boundaries of land parcels. The existing NDCDB, which covers the entire country, has been referenced to the new Geocentric Datum for Malaysia 2000 (GDM2000).It has been adjusted with respect to cadastral control infrastructure developed using Global Positioning System (GPS) MyRTKnetto provide a homogenous and seamless cadastral network for the entire Peninsular Malaysia and the Federal Territory of Labuan. The targeted spatial accuracy of NDCDB is better than 5 cm in the urban area and 10 cm in the rural area. On the other hand, the main source of large-scale geographical features for urban areas will be based on the Mobile Terrestrial Laser Scanning (MLTS) surveythat is also referenced to GDM2000 and Mean Sea Level (MSL) height datum.However for rural areas,existing database from State Geospatial Data Centre (SGDC) at the scale 1:10,000 to 1:25,000 will be used. The survey accurate MPC database will include the following fundamental layers: i) NDCDB; ii)two-dimensional large scale geographical features; iii) three-dimensional city model; iv) utility data; andv) street addresses. MPC for Putrajayawill be developed based on On-Line Web Access or OWA and will be accessible to the government, private and public users. The pilot project towards the development of Survey Accurate MPC for Putrajaya will provide informative insight on thefuture directionin implementingnationwide MPC and new cadastral management in Malaysia.

1.0 INTRODUCTION

Multi-Purpose Cadastre (MPC) has a potential to support spatially enable government, private sectors, and society in general, and to expand computer support in the process of visualization, organization and management of useful land information.The Geographic Information System (GIS) applications of MPC database can be divided into four main sectors namely economic, social, environment and infrastructure. Therefore, MPC will serve as the most important geospatial dataset required for economic, social and infrastructure development in this country and hence will be one of the catalyst for gearing the nation towards high income economy by year 2020.

The content of survey accurate MPC is principally survey-accurate National Digital Cadastral Database (NDCDB)that have been populated, adjusted and undergone quality checks at every level of its formation and large scale geospatial datasets that mostly will be acquired from measurement of mobile terrestrial laser scanner survey.Survey accurate MPC is a

spatially enabled system that integrate land information system which containing survey accurate cadastre, topography, man-made features and cultural (e.g., land use, demographics) information in a common and accurate reference framework. The reference frameworktypically is established with rigorous geodetic and survey control standard and coordinate system. The Cadastre is made up of multiple independent, interrelated layers commonly used to describe the graphic component of a GIS database. Each layer contains a set of homogeneous map features registered positionally to other database layers through a common coordinate system. MPC component as shown in Figure 1provides the means for enhancement of delivery system to the public as well as realization of connected government.

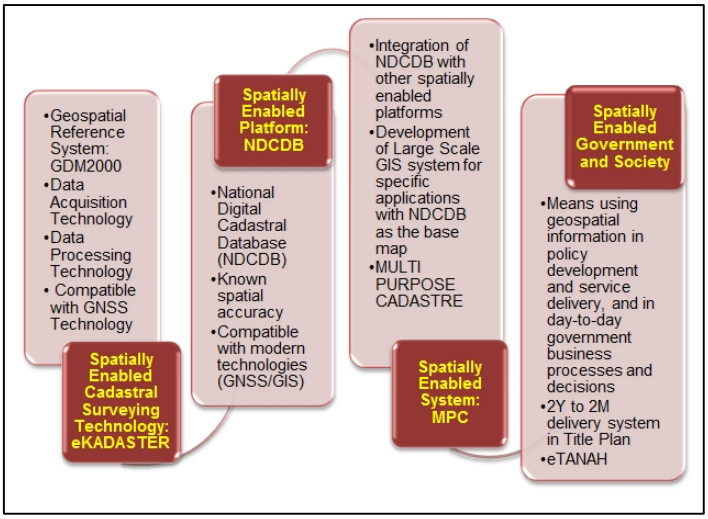


Figure 1: MPC as a Spatially Enabled System component

The conceptual model of MPC development consists of seven main phases is shown in Figure 2. The details functions of each section are listed in Table 1.

Table 1. MPC Development Phases

Phase	Details
1. NDCDB	Refinement and enhancement of existing NDCDB. NDCDB will provide a survey accurate fundamental layer in MPC.
2. Large Scale Geospatial Data Acquisition	MTLS will be used to capture large-scale spatial features such building, road, utility, vegetation and others features during the survey. MTLS is a main source of spatial data for MPC.
3. Large Scale GIS Base Map	Local Geospatial Data Centre dataset that consists of large scale topographic map and other GIS layer.
4. MPC Module	Application modules for integration of multiple data sources, validation of MPC database and updating new spatial features.
5. 3D-SDI	Applying data fusion method to generate 3D city model and 3D SDI using available large scale MPC database.
6. MPC Database	MPC database will consists of various geospatial datasets with the following compliance: i)MS 1759:2004 Geographic Information/Geomatics - Features and Attribute Codes; ii)MS 2256:2009 Geographic Information /Geomatics - Guideline for the Determination of Geographical Names;iii) MS ISO 19115:2003 Geographic Information Metadata Referencing by Coordinates Unique Parcel Identifier (UPI); iv)GDM2000 - Geocentric Datum for Malaysia, Colour Code and Symbol (JUPEM/MaCGDI).
7. Online Web Access	MPC OWA will provide a mechanism for access to spatial data as well as mapping and spatial analysis over the Internet.

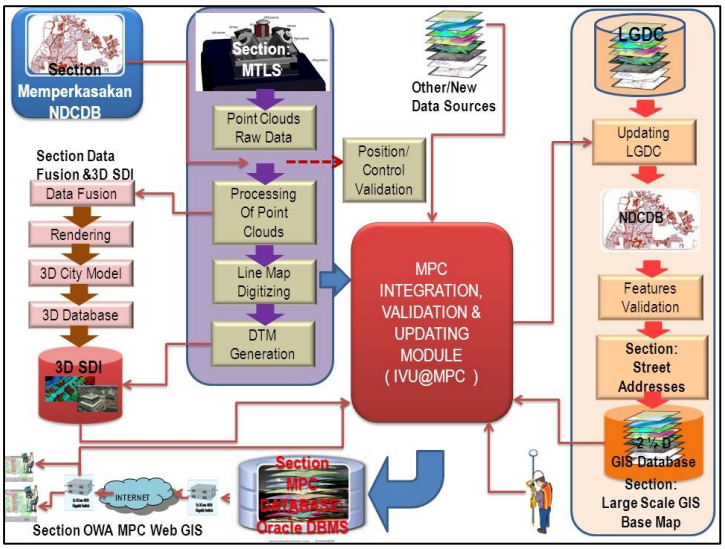


Figure 2:Conceptual design ofMPC as a Spatially Enabled System

2.0 MPC CORE DATA SOURCES

The fundamental data sources for development of MPC can be categorized as the following:

2.1 National Digital Cadastral Database (NDCDB)

The main objective of developing survey accurate NDCDB is to maintain a homogeneous spatial accuracy of cadastral boundary coordinates to better than 5 centimeter in urban area and better than 10 centimeter in semi-urban and rural areas from the present few meters accuracy level. This implies that the spatial accuracy of about 30-40 million cadastral boundary markers has to be within the 5 to 10 cm range. There are many factors that govern the outcome of the spatial accuracy of NDCDB namely: i) accuracy, density and distribution of control station coordinates; ii) accuracy of primary data input (cadastral fabrics); iii) accuracy of secondary data input (connection lines); and iv) network geometry.

Creation of survey accurate NDCDB not only crucial for many applications under the *e-Kadaster* environment but eventually will be the most important element in the development of large scale geospatial database in Malaysia. NDCDB will serve as the geo-referencing layer in the creation of most other geospatial data layers. Distribution of the cadastral markers in their block adjusted coordinate values in geocentric system that built up the NDCDB is shown in Figure 3.

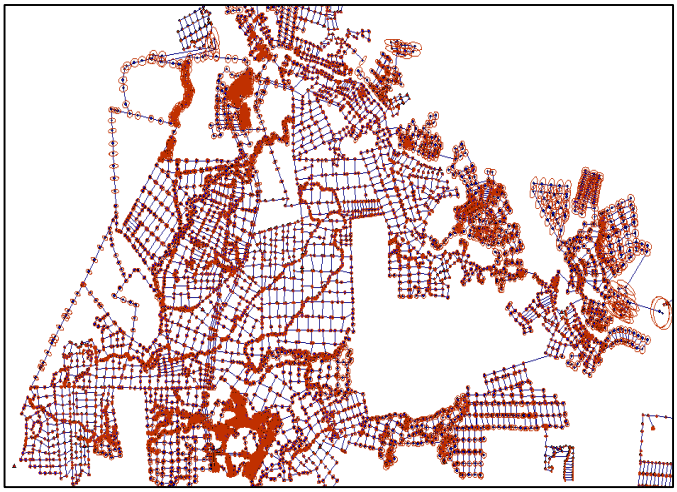


Figure 3: Distribution of the cadastral markers in
their block adjusted coordinate values in geocentric system that built up the NDCDB.

NDCDB creates opportunities in coping with and in accruing benefits from the present and future technology advancement. Since coordinates are the basic input/output componentof most modern data acquisition equipment such as Electronic Total Station (ETS) and GPS, introduction of a survey accurate NDCDB willoptimizethe utilization of such equipment and system.NDCDB will facilitate the integration of cadastral information with other large-scale map based information such as building footprints and utility plans.It will also permit the use of rapid data acquisition, storage, processing and management techniques necessary for the development of large scale Spatial Data Infrastructure (SDI) dataset.Undoubtedly, combined with other land information components,NDCDB has greater potential to support spatially enable government, private sectors, and society in general, and to expand computer support in the process of visualization, organization and management of useful land information.An example of thecontent of NDCDB block representing coordinate values for cadastral markers and their respective parcelsis shown in Figure 4.

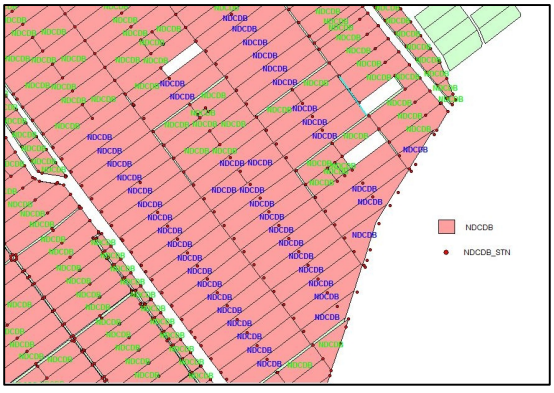


Figure 4:Content of NDCDB block representing coordinate values for cadastral markers and
their respective parcels as shown in Figure 4

2.2 Large Scale 2-D MTLS based Geographic Features Dataset

Mobile Terrestrial Laser Scanning (MTLS) is an emerging technology that combines the use of a laser scanner(s), the Global Navigation Satellite Systems (GNSS), and an Inertial Measurement Unit (IMU) on a mobile platform to produceaccurate and precise geospatial data. The data isinitially adjusted by post-processed kinematic GNSS procedures from separate GNSS baseby alocal transformation to well defined points throughout the project area to produce the final stations placed throughout the particular area (Figure 5).Point clouds can be georeferencedin GDM2000 coordinate system and Mean Sea Level (MSL). 3-D building extraction from point clouds requires the determination of building cues, ground elevation, building and rooftop heights. These systems provide dense 3-D point coverage at facades and the neighboring architecture (Figure 6).

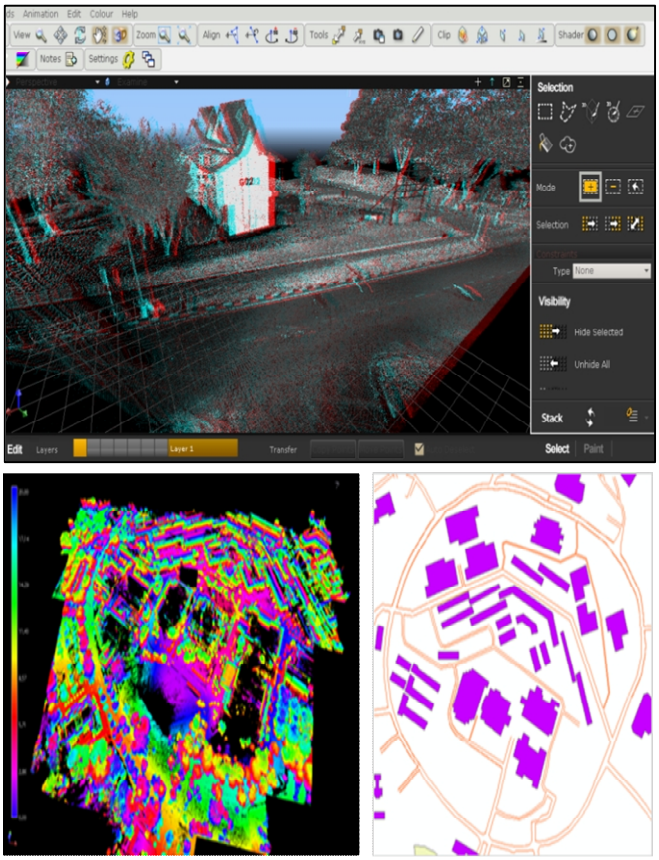


Figure 5: MTLS 3-D point clouds and line extraction of building footprint

2.3 3D City Model

3D city models are of growing interest in various application areas. 3-D city models are the basis for city planning, development and control. 3-D representations of buildings are becoming ubiquitous and the desired amount of detail is not limited to geometric aspects, but also includes semantic information about the facade. Frequently, terrestrial LiDAR pointclouds and images are used to extract high resolution building structures for the enrichment of planar facades. Such a purely data driven bottom-up modelling only leads to

large scale, robust and realistic facade models if the available observations are of high quality. To ensure the generation of realistic 3-D geometrieseven for inaccurate and incomplete measurements, reconstruction has to be supported by additional object information. Generating building models by integrating three-dimensional facade geometry with explicit semantic information, for example windows or doors. Building areas covered by dense and accurate measurements are used to extract 3-D facade geometries. In the context of a 3-D city model (see Figure 7), the main objects that can be modelled are the ground, buildings, transportation network, bodies of water, city furniture, electric power lines, and vegetation objects.

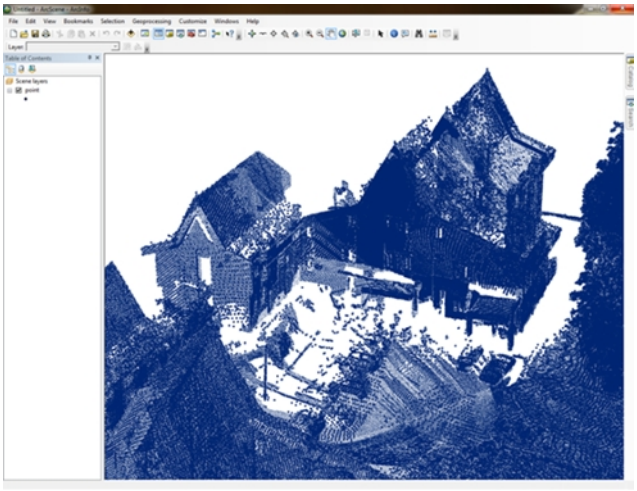


Figure 6: MTLS 3-D Point Clouds for 3D City Model

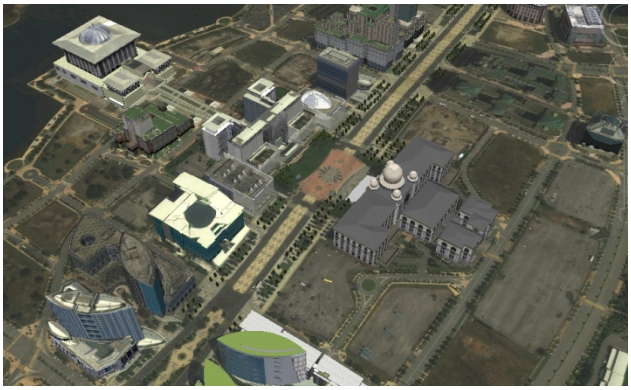


Figure 7: 3D City Model

2.4 Utility Dataset

Mapping of utility features is critical for authority in maintenance, controlling and preventive process of infrastructure development due to major investments neededfor utility supply lines such aswater mains, sewerage systems, telephone lines, power lines and gas mains. Often the geographic location of utility features is recorded on inferior quality maps and in some cases it is not documented at all.

Certainty of supply, environmental protection and efficiency of operations, however, require good basic database. Excavation damage can be largely avoided when reliable

information regarding location and description of underground utility lines are available. Repair and replacement of utility lines can be carriedout in the optimal manner with efficient GIS/utility mapping system.

Figure 8: Large Scale Utility Dataset

Figure 8 and Figure 9 show the large scale utility dataset and a sample of utility map, respectively.With regards to the government direction on the utility mapping, DSMM has embarked utility survey and mapping for FT Putrajaya since 2008. The objective of the project is to provide a comprehensive utility GIS dataset. GIS/Utility mapping systemscontribute to benefits of MPC in term of the following criteria:

- Locations and characteristics of features are stored systematically.
- Easy access to the information - also for users without any specialist expertise.
- Simple comparison of data about different types of utility lines and base maps.
- Flexible extraction and analysis options.
- Efficient updating.
- Links to register data and consumer information.
- Staking automation.
- Easy map distribution via digital or hard copy.

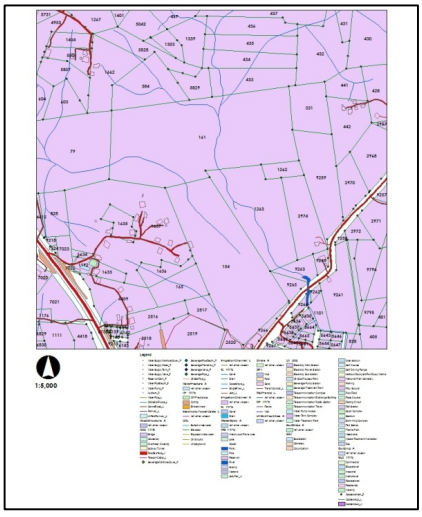


Figure 9: Utility Map

2.5 Street Address

Address is animportant information required to support realization of ubiquitous MPC. Street address compile all information, presented in a mostly fixed format, used to describe the location of a building, apartment, or other structure or a plot of land.Generally they use administrative boundaries and street names as references, along with other identifiers such as house or apartment numbers. Some addresses also contain special codes to aid routing of mail and packages, such as a ZIP code or post code. Geocoding of Street Address database will be based on the enhanced NDCDB and building feature acquire during data acqusition process. Enhanced NDCDB consists of cadastral lot information, UPI and newly created Object Identification (OID). OID also will be created for building features.

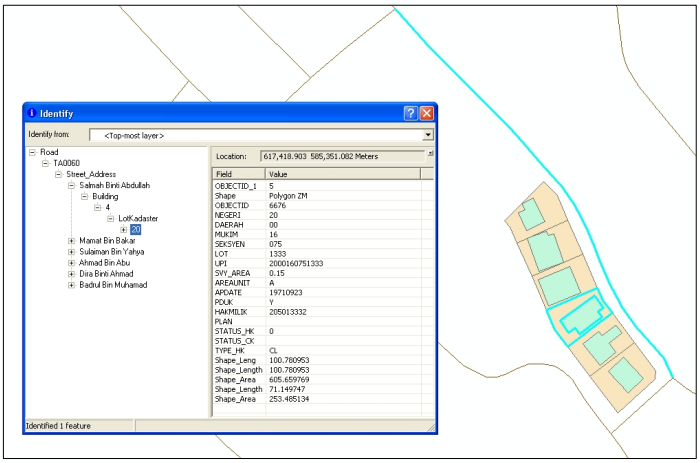


Figure 10: Relationship between Road, Street Address and Cadastral Lot Using UPI and OID

FID	Shape	OBJECTID	LOT	PARCELKEY	ADD_	NAM_RD	NAM	POSKOD	NAME_OWN	BAS
0	Polygon ZM	4531	1310	2000160751310	No.46	Jalan Kerupang 2	Taman Desa Rahmat	21200	Ahmad Bin Abu	W.P. Labuan
1	Polygon ZM	6666	1308	2000160751308	No.47	Jalan Kerupang 2	Taman Desa Rahmat	21200	Dira Binti Ahmad	W.P. Labuan
2	Polygon ZM	6667	1309	2000160751309	No.48	Jalan Kerupang 2	Taman Desa Rahmat	21200	Mamat Bin Bakar	W.P. Labuan
3	Polygon ZM	6675	1331	2000160751331	No.49	Jalan Kerupang 2	Taman Desa Rahmat	21200	Sulaiman Bin Yahya	W.P. Labuan
4	Polygon ZM	6676	1333	2000160751333	No.50	Jalan Kerupang 2	Taman Desa Rahmat	21200	Salmah Binti Abdullah	W.P. Labuan
5	Polygon ZM	6677	1334	2000160751334	No.48	Jalan Kerupang 2	Taman Desa Rahmat	21200	Badrul Bin Muhamad	W.P. Labuan

Figure 11: Information related to Road, Street Address and Cadastral Lot

Based on the street address database, geocoding process can be conducted systematically using cadastral lot number, UPI and OID as shown in Figure 10 and Figure 11. These

information can be linked to zip, postal or situs method to generate street addreses based integrated MPC GIS base map.

2.6 State Geospatial Data Centre (SGDC)

MPC for rural area could be developed usingSGDC dataset as a core geospatial data input. This is due to the creation of SGDC datasetat macro level oflarger map scales at 1:10,000 and 1:25,000 forplanning and control of any development instate region.The running of SGDC requires cooperation from state agencies and local municipalities. The fundamental geospatial dataset consists of twelve (12)main categories that comply to the Malaysian Standards as follows: i) MS 1759:2004 Geographic Information / Geomatics - Features and Attribute Codes; ii) MS 2256:2009 Geographic Information / Geomatics - Guideline for the Determination of Geographical Names; iii) MS ISO 19115:2003 Geographic Information- Metadata Referencing by Coordinates, Unique Parcel Identifier (UPI); and iv) GDM2000 - Geocentric Datum for Malaysia. Figure 12 shows available themes in SGDC datasets.

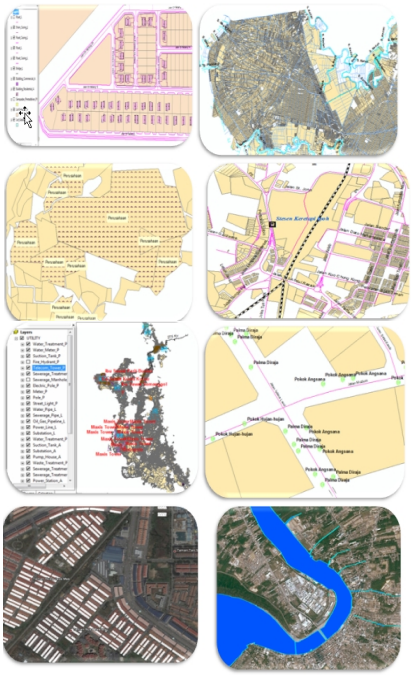


Figure 12: SGDC themes

2.0 3-D MPC DATABASE AND ONLINE WEB ACCESS

FT Putrajaya MPC Databasedevelopment will apply and comply to aMalaysian Standard for Geoinformatics/Geomatic as mentioned in previous section. Existing MPC Database category is shown in Figure 13. The development of MPC databaseincludes five (5) functional processes as follows:i) data format translation; ii) data structure migration; iii) data editing; and iv) data checking validation.

Figure 13: MPC Database Categories
(MaCGDI, 2010)

i. Data Format Translation

Conversion of multiple data source to required format ofGeodatabase and MapInfo table. Translation of data structure to comply with MS1759.

ii. Data Structure

Data structure to comply with MS1759 and Open Architecture Methodology.

iii.Data Editing

Feature Class Overlay Methodology and Topology Rules will be applied in Data Editing.

iv. Data Checking Validation

Validation Methodology for MTLS and MPC database will be applied in Data Checking.

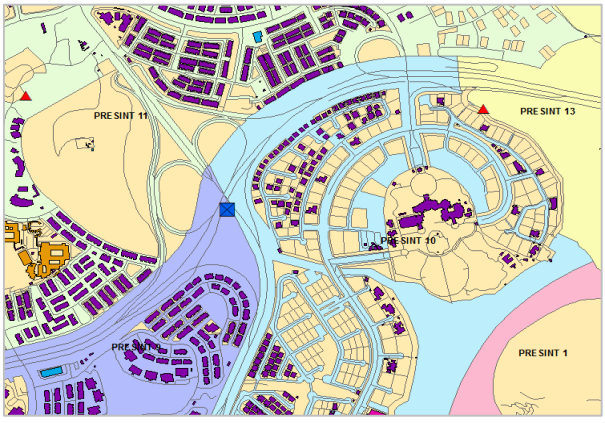


Figure 14: FT Putrajaya Database

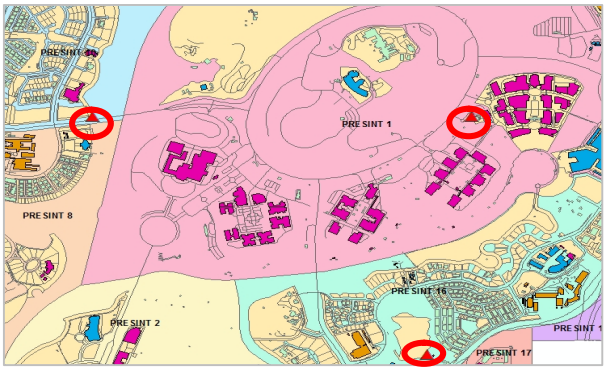


Figure 15: Overlay analysis of FT Putrajaya Database

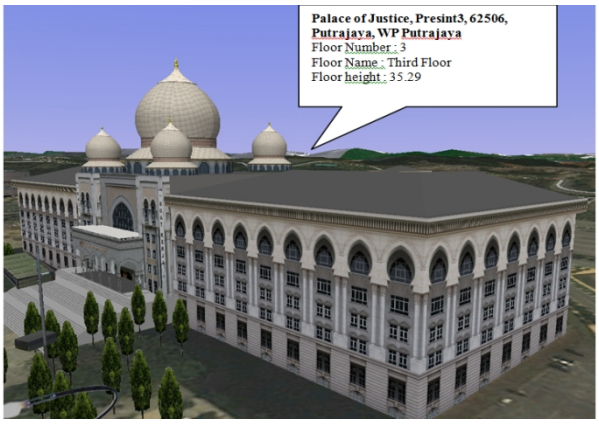


Figure 16: 3-D City Model of MPC FT Putrajaya

Online Web Access (OWA) or Web GIS is emphasis on visualization, analysis, processing of project specific geodata and exploratory aspects. MPC OWA is needed due to the demands of geospatial omnipresent dataset such as cadastre parcel, building, road and thematic map (from data fusion method). The MPC OWA will consists of the following:

i. Features Location
ii. Spatial Reference (example road map)
iii. Context information -what data are
iv. currently relevant for specific circumstances
v. Ability to analyze context
vi. GIS standard
vii. Ability to access context information continuously.

The component of MPC OWA includes web GIS Administrator for managing server, user, security and configuration and web application for MPC database visualization, layer management and service oriented architecture linkage to existing system. Figure 14 to Figure 17 show functional processes in proposed development of 3-D MPC Database.

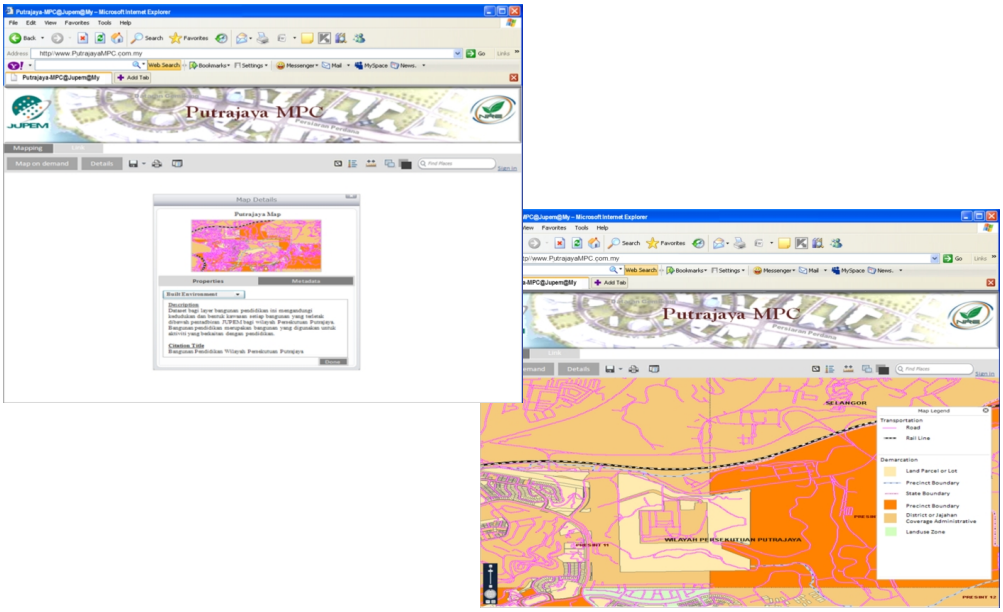


Figure 17: Proposed MPC OWA

4.0 CONCLUSIONS AND FUTURE DIRECTION

The key to the success of establishing MPC is to highlight that it will continually evolving in response to the changing humankind to land relationship and demands. MPC must be driven by the needs from the users that critically required for survey accurate large scale data. MPC will support effective land development and administration, increased and sustainable economic development activities, agricultural productivity, and environmental management. MPC able to support different levels of stake holders at local authority, state authority and national authority for multiple decision making processes and improved delivery system to the public. The pilot project towards the development of Survey Accurate MPC for Putrajaya will provide informative insight on the future direction in implementing nationwide MPC and new cadastral management in Malaysia.

REFERENCES

Abdullah Hisam Omar,HasanJamiland Ahmad Mohamed Zin (2007). Multipurpose Cadastre: Effectiveness and upgrading of GIS Layer Management System (GLMS). International Seminar on Geoinformation 2007. Johor Bahru.

AbdMajid A Kadir and Abdullah Hisam Omar (2005). Report on Pilot Project of Coordinated Cadastral System For State of Melaka.

Department of Survey and Mapping (2011). Final Report on E-Kadaster Project(2009).Kuala Lumpur

Department of Survey and Mapping (2011). Tender Specification JUPEM T08/2011, Kuala Lumpur

Malaysian Centre for Geospatial Data Infrastructure (2010). Final Report on Development of National Geospatial Data Centre, Ministry of Natural Resources and Environment,Putrajaya.

Malaysian Centre for Geospatial Data Infrastructure (2010). MyGDI The Enabling Platform Towards Spatially Enabled Government In Malaysia, Ministry of Natural Resources and Environment,Putrajaya.

Reforme Fonciere au Senegal

Samba NDONGO, Senegal

CONTEXTE :
SENEGAL (GEOGRAPHIE ET POPULATION) : (sources Banque Mondiale – BIRD)

- ° Superficie : 196.700 km²
- ° Population : 11,4 millions d'habitants en 2004
- ° Superficie agricole : 8.157.000 ha
- ° Terres arables : 2.460.000 ha
- ° Cultures pérennes : 47.000 ha
- ° Pâtures pérennes : 5.650.000 ha
- ° Zones forestières en 2000 : 8.898.000 ha
- ° Position géographique : pointe extrême ouest du continent africain,

Le Sénégal est comme un « nez » qui s'enfonce dans le « ventre » de l'Océan atlantique. Sa proximité avec les côtes américaines en a fait la zone de prédilection du commerce des esclaves durant la colonisation et, par voie de conséquence, la Capitale de l'Afrique Occidentale Française (AOF).
Son économie est essentiellement agricole. Sa population « jeune » et à forte composante féminine.
Il a une frontière Nord avec la Mauritanie, au Sud avec la Guinée (Conakry) et la Guinée (Bissau), à l'Est avec le Mali et à l'Ouest il est bordé par l'Océan Atlantique sur plus de 700 km de côtes.

CADRE JURIDIQUE :
DECRET 1932 : portant Régime de la propriété foncière dans les territoires de l'AOF. Ce Décret a surtout bénéficié aux Compagnies et Sociétés françaises établies sur les Côtes de l'Afrique.

La conséquence a été que ce régime n'a profité qu'à seulement 2% du territoire national contre 98% encore sous le régime coutumier à l'indépendance du pays.

De plus son caractère anachronique a fini d'exacerber les distorsions dans la gestion foncière. Du fait qu'il est surtout inadapté aux réalités sénégalaises. Ce qui nécessite sa mise en adéquation avec l'ordonnancement juridique du pays.

LOI SUR LE DOMAINE NATIONAL (loi 64-46 du 17 juin 1964)
Votée en 1964 parmi les premières lois de la République, sa mission consistait à combler le gap entre les zones urbaines et les zones rurales, entre la ville et la Campagne en vue d'un développement harmonieux et équilibré du pays.

Malgré sa portée historique, cette loi se verra heurtée aux survivances des coutumes qui lui résisteront et, qui continuent de lui résister.

Un certain nombre de décrets viendront s'ajouter à son application à la base de la déconcentration de l'Etat et de la décentralisation.

LOI 96-06 du 22 mars 1996 RELATIVE AU CODE DES COLLECTIVITES LOCALES

- Elle porte sur le transfert de neuf domaines de compétences aux collectivités locales y compris la gestion des terres.

Malgré ses avancées certaines dans le domaine du partage du pouvoir, les objectifs énoncés dans la loi sur le Domaine National n'ont pu permettre que plus de 90% du territoire échappât à la persistance du régime coutumier non suffisamment pris en compte dans l'optique gouvernementale.

LOI D'ORIENTATION AGROSYLVOPASTORALE

- C'es ainsi qu'en 2004, l'Etat sentit la nécessité de renfoncer son cadre juridique. Malheureusement cela s'est fait sans une réflexion et une prise en compte globales des préoccupations rurales. Ce qui aboutit, dès le vote de la LOI D'ORIENTATION AGROSYLVOPASTORALE (LOASP), à l'abandon de la partie foncière sous prétexte de ne pas retarder l'adoption de la dite loi par les députés qui n'étaient pas convaincus de sa pertinence.

LOI SUR LA REFORME FONCIERE

L'Etat entreprit alors d'engager cette réflexion. Une Commission fut mise sur pied pilotée par un Ministre d'Etat, Constitutionaliste et Professeur d'Université, bénéficiant de plus de 20 ans d'expériences gouvernementales.

Cette Commission réunit les Collectivités locales de tout le pays, les Acteurs de la Société Civile, Les Organismes des Communautés de Base, les Autorités en charge des Domaines du Cadastre et du Foncier, l'Ordre National Des Géomètres-Experts, etc. autour d'un Séminaire dit de ***« partage et de mutualisation foncière ».***

Ce séminaire fit l'Etat des Lieux de toute la Législation Foncière du Sénégal depuis 1932, ses forces et faiblesses et préconisa des solutions.

DIAGNOSTIC et EVALUATIONS:

FORCES ET FAIBLESSES :

- Absence de Cadastre Rural
- Non délimitation des différentes zones du Domaine National. Une des conséquences a été que le Président de la République a promulgué un Décret attribuant des Terres dont la totalité dépasse de très loin la superficie de l'ensemble de la Communauté Rurale de MBANE au Nord du Sénégal : *250.600* hectares de distribués, alors que la contenance de toute la Communauté Rurale, y compris les villages, les champs, etc. ne dépasse pas *190.600* hectares. Et les principaux bénéficiaires de ces terres ne sont rien d'autres que de hauts fonctionnaires de l'Etat que le Président a décidé de reconvertir en agriculteurs modernes : Le Premier Ministre, le Président du Sénat, des ministres d'Etat, des ministres, etc.
- Persistance du régime Coutumier sur plus de 90% du territoire national.
- Faiblesse des Investissements des Agriculteurs familiaux pour entretenir et fertiliser les terres faute de sécurisation foncière du bénéficiaire du « droit d'usage » : Ils ne bénéficient pas de garanties bancaires et financières.
- Absence de prise en charge réelle des femmes et des jeunes dans les distributions de terres
- Sérieux handicaps matériels et humains liés aux missions de gestion foncière des Communautés rurales.

- Absence d'outils pratiques de gestion.
- Absence de prise en compte des zones de pâturage et des ressources en eau pour les pasteurs, en proie à des conflits récurrents avec les Agriculteurs.
- Faible impact sur les objectifs d'aménagement du territoire en vue d'un développement durable, et la gestion des catastrophes naturelles telles que les inondations et la désertification.
- Exode rural de plus en plus persistant, renforcé par la méfiance de la Diaspora qui, faute de garanties, préfère investir en ville dans le foncier et l'Immobilier.
- Récurrence des conflits fonciers nés d'une gestion des terres de plus en plus décriée par les populations ; conflits souvent émaillés de meurtres d'hommes perpétrés par les forces de l'ordre sans aucune conséquence pour les auteurs.
- Découpages administratifs réalisés par l'Autorité du Président de la République sans s'en référer aux Collectivités locales. Toute résistance de la part de celles-ci conduit immédiatement à leur dissolution et à leur remplacement par une délégation spéciale. **L'article 37, alinéa 2 du Projet de Loi 12/2010** supprime toute opposition à l'immatriculation dont la seule prérogative revient in fine au Président de la République.
- Accélération de la spéculation foncière sur les meilleures terres notamment celles aménagées le long des fleuves, au Nord et au Sud du Sénégal : (sources Ministère de l'Agriculture)

. le fleuve Sénégal avec son potentiel 228.000 ha dont 75.000 aménagés et, seulement 45.000 cultivés ;

. le fleuve Casamance compte 70.000 ha irrigables dont 9000 aménagés et seulement 9.000 cultivés.

. la vallée de l'Anambé avec ses 8.000 ha irrigables, 600 aménagés et 300 cultivés.

. le Sénégal compte un potentiel de 3.800.00 ha de terres cultivables en zones pluviales. Seuls 2.500.000 ha en moyenne par an le sont pendant l'hivernage. Ce qui laisse une réserve foncière de 1.300.000 ha sous la gestion des conseils ruraux. Cette réalité va changer avec la nouvelle loi qui privilégie les détenteurs de capitaux notamment la Chine et l'Arabie Saoudite dont la presse a fait écho d'accords secrets avec le gouvernement pour des centaines de milliers d'hectares affectés à l'Agriculture d'exportation.

-Dans les villes, l'absence de réserves foncières a conduit à une occupation anarchique des sols, à l'obstruction des voies d'eaux suivies de conséquences incalculables telles que les inondations et autres catastrophes naturelles.

-En 2010, une **loi n° 11/2010** portant transformation des permis d'habiter et titres similaires en titres fonciers » a été votée dans le but de régulariser la situation foncière en ville. Les ruraux ont réclamé la leur. Ils attendent.

SOLUTIONS :

A COURT TERME :

- Simplification des procédures de garantie et d'accès à la terre. La première conséquence sera de fixer les jeunes ruraux et de réorienter les investissements de la Diaspora en milieu rural.

- Procéder à la réforme foncière qui tienne compte, et du grand nombre, et des contraintes vécues jusqu'ici en vue d'une modernisation de l'Agriculture dans l'optique du développement durable.

- Ainsi, procéder à l'immatriculation des zones de terroirs au profit des autochtones et, affecter les zones pionnières aux détenteurs de capitaux dans l'optique de la modernisation de l'Agriculture.

- Arrêter avec précision les limites pour chaque Collectivité Locale.

- Ouvrir des voies pastorales et des accès aux ressources en eau.

- Maintenir la priorité aux autochtones de bénéficier de l'immatriculation de leurs terres reconnues par le régime coutumier.

- Les forces productives du Sénégal ne peuvent pas se concevoir sans l'apport important des femmes (plus de 60 % de la population) et des jeunes (plus de 70% de la population) : opter pour des mesures de discrimination positive en faveur de ces couches dans l'optique d'un développement rapide et durable.

- Reprise des Commissions de lotissements.

- Déconcentrer la Commission de Contrôle des Opérations Domaniales (CCOD) en créant des Commissions Régionales et Départementales Des Opérations Domaniales ainsi que des Commissions Communales. Une telle charpente peut être coiffée par une Commission Nationale (CNOD).

- Associer l'Ordre National des Géomètres-Experts (ONGES) à toutes les étapes ainsi qu'au suivi de toutes les décisions en matière de gestion foncière

A MOYEN ET LONG TERMES :

- Erection d'un véritable Code Général de la Propriété Foncière.
- Mise en place d'un Observatoire National des Opérations Domaniales.
- Gestion participative et inclusive des populations

CONCLUSION

LA REFORME FONCIERE AU SENEGAL REVET UNE IMPORTANCE CAPITALE AU VU DU RETARD ACCUSE DANS LE DISPOSITIF LEGISLATIF ET REGLEMENTAIRE POUR UNE REELLE PRISE EN COMPTE DE PLUS DE 90% DU TERRITOIRE NATIONAL DANS LES OBJECTIFS DE DEVELOPPEMENT

CETTE URGENCE EST AUJOURD'HUI RESSENTIE PAR TOUS LES ACTEURS QUI MANIFESTENT LEUR EMPRESSEMENT A VOIR CE PROBLEME PRIS A BRAS LE CORPS PAR LES POUVOIRS PUBLICS.

L'ONGES S' EFFORCE D' Y APPORTER SA CONTRIBUTION EN MENANT UNE REFLEXION DANS CE SENS.

The European Measurement Code for the Floor Area of Buildings

Marc Vanderschueren, Belgium

1. INTRODUCTION

The ideal Code of Measuring Practice will give the public a clearer idea of how the area of buildings is calculated, while at the same time meeting the economic requirements of our society, providing professionals with a common language, guaranteeing the legal certainty of acts of law, facilitating an objective comparison between properties and allowing a standardised graphical representation of property.

Together with the European Commission, our French-Belgian working group of surveyors has undertaken a wide-ranging review aimed at establishing the most broad-based measuring code possible that would be applicable to all purpose-built premises, including housing, businesses, offices, industry, agriculture, plant and infrastructure. Our aim is to draw up standard definitions and rules common to all buildings, irrespective of their use.

We have adopted an approach based on clarity, accessibility and user-friendliness in keeping with our desire for transparency and intelligibility. The working group's objective is to propose a simple, fair, yet strict code.

When a measurement has been prepared in accordance with this Code, it will be followed by the reference CMS.

In the general interest, we are happy for the CMS area measure to coexist with other current market measures for a transitional period.

2. AIMS

Our aim is to meet the requirements of civil society in terms of:

2.1 TRANSPARENCY
2.2 LEGAL CERTAINTY
2.3 PLANIMETRIC REPRESENTATION
2.4 ECONOMIC REQUIREMENTS

3. GENERAL PRINCIPLES APPLICABLE TO BUILDINGS

3.1 REFERENCE AREAS

Definition of the three reference areas covered by this measuring code:

EXTERNAL AREA (or **SEM**) relates to the outer perimeter boundary of a building, including any external cladding, measured at floor level.

INTERNAL AREA (or **SIM**) relates to the interior perimeter of all construction features or fixed partitions, measured above skirting-board level.

Construction features are all the elements making up the shell of the building, e.g.: walls, pillars, supporting walls, breast walls, alcoves and recesses, window and door reveals.
The 'interior perimeter' of construction features is the directly visible, accessible and measurable perimeter.

CONSTRUCTED AREA (or **SDC**) is the difference between the external area and the internal area.

3.2 USE OF REFERENCE AREAS

EXTERNAL AREA
This is mainly used for town planning purposes or for the planimetric representation of the building.
It is also a unit of measure of the building rights attached to the plot.

INTERNAL AREA
This is mainly used as a reference unit of measure in valuation (price/m^2), property transactions (sales agreements, deeds, etc.), renting (price/m^2/yr) and building management.

CONSTRUCTED AREA
This is mainly used as technical data.

3.3 RULES ON MEASUREMENT

3.3.1 General principles:

SUBDIVISION OF THE BUILDING:
Buildings are divided into different levels or 'floors'.

UNIT OF MEASURE:
The unit of measure of floor area is the square metre, expressed to one decimal place in accordance with the mathematical rules for rounding.

ACCURACY OF MEASUREMENT:
All dimensions must be measured to the nearest cm.

MEASUREMENT:
Floor area is always measured horizontally, even in the case of a non-vertical facade or sloping roof.
Measurable void areas, in particular accessible vertical passageways, are quantified and

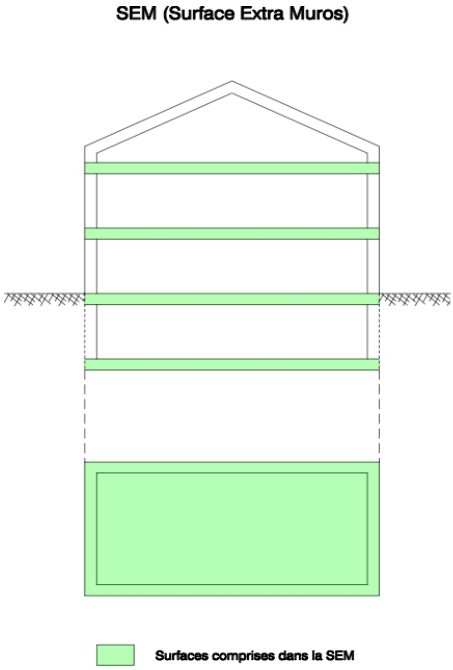
assessed according to function.

3.3.2 Measuring reference areas

EXTERNAL AREA **(SEM):**
The total external area of a building is the sum of the external areas of each floor.
The external area of a floor is the area of the closed polygon surrounding the floor the sides of which are formed by:

- the exterior faces of facade features delimiting the closed perimeter of spaces on the level concerned
- the centre line of party walls between different buildings
- the centre line of construction features separating different users or uses.

In basements, where it is not possible to measure the actual thickness of underground walls, the agreed view is that the external area is calculated by extending the exterior plane of the facade at ground-floor level downwards.



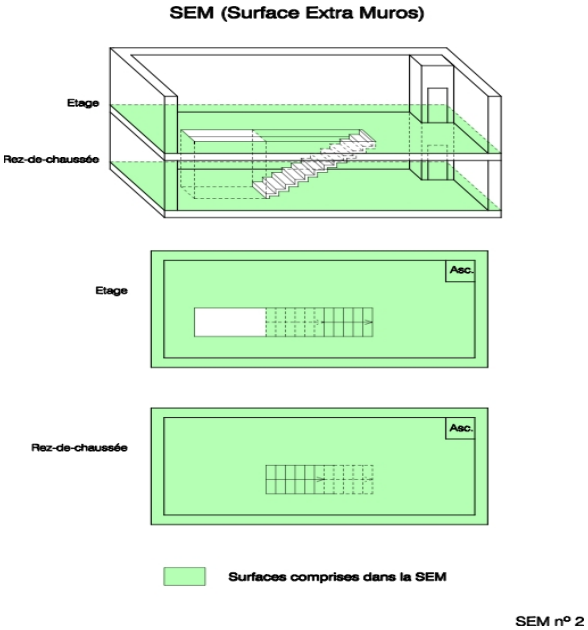
SEM nº 1

Key: SEM (Surface Extra Muros) = SEM (External area)
Surfaces comprises dans la SEM = Areas included in SEM

The external area **includes** the area of:

- technical areas serving the building that are directly attached to it or located on the roof

- usable roof space (easy access, floor present and not obstructed by beams)
- vertical openings within the limit of the projection of the staircase at the accessible level



Key: Etage = Upper floor, Rez-de-chaussée = Ground floor, Asc. = Lift

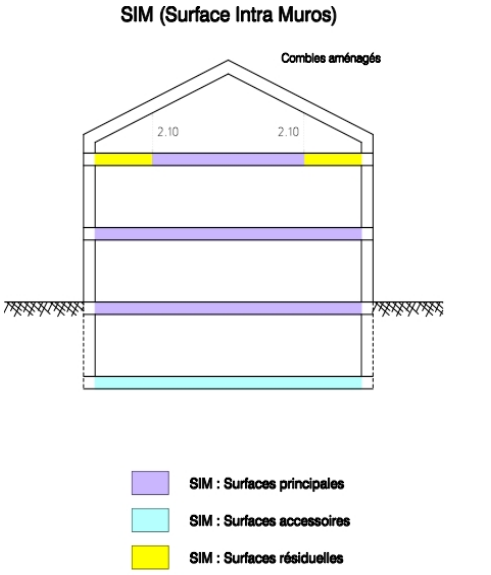
- voids created by chimney and service shafts
- balconies, upper floor terraces and loggias
- accessible walkways or passages between two parts of a building.

At ground-floor level, any area open to the side and covered other than by a roof overhang or decorative projection, is also included in the external area and measured on the basis of the vertical projection of the covering part.
At ground-floor level certain areas outside the building boundary may be subject to a specific measurement not covered by this Code if the areas concerned are intended for private use.

The external area **does not include** the area of:
- unusable roof space
- decorative voids, air shafts and atria
- decorative facade elements, whether recessed or projecting
- open outside emergency stairways
- walkways intended solely for servicing and maintenance
- inaccessible roofs (except for maintenance)
- access routes
- gardens.

INTERNAL AREA (**SIM**):

The total internal area of a building consists of all internal areas available for the direct or indirect use of occupants, excluding all fixed construction features and partitions.
The internal area is divided into four subcategories: primary areas, secondary areas, other areas and service areas (see 3.4).
Changes in the construction or form of occupation may result in changes to the above four areas. Any record of the areas should always therefore be dated.
The internal floor area of a building or the internal area of part of a floor is the sum of the areas of all possible closed polygons whose sides are formed by the visible internal faces of construction features such as facade walls, party walls, internal walls and screens, columns and fixed partitions.
The measurement of primary areas is confined to floor areas with headroom of ≥ 2.10 m.
The internal area of an upper floor terrace or balcony is calculated up to the internal vertical projection of the balustrade.
At ground-floor level, any covered area open to the side, other than a roof overhang or decorative projection, is also included in the internal area and measured on the basis of the vertical projection of the covering part.

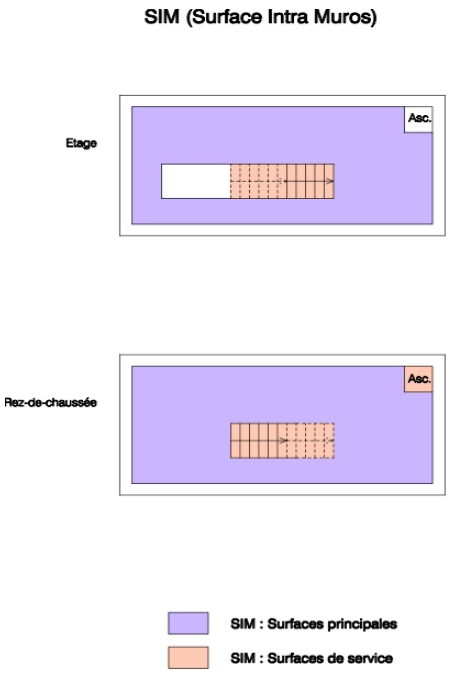


SIM n° 1

Key: SIM (Surface Intra Muros) = SIM (Internal area), Combles aménagés = Converted roof space, SIM: Surfaces principales = SIM: Primary areas, SIM: Surfaces accessoires = SIM: Secondary areas, SIM: Surfaces résiduelles = SIM: Other areas

The internal area **includes** the area:

- of maintenance areas and technical areas serving the building
- of cupboards
- under technical units with a removable housing
- under movable partitions
- of usable roof space, whether or not converted
- of stairwells within the limit of the projection of the staircase at the accessible level



SIM n° 2

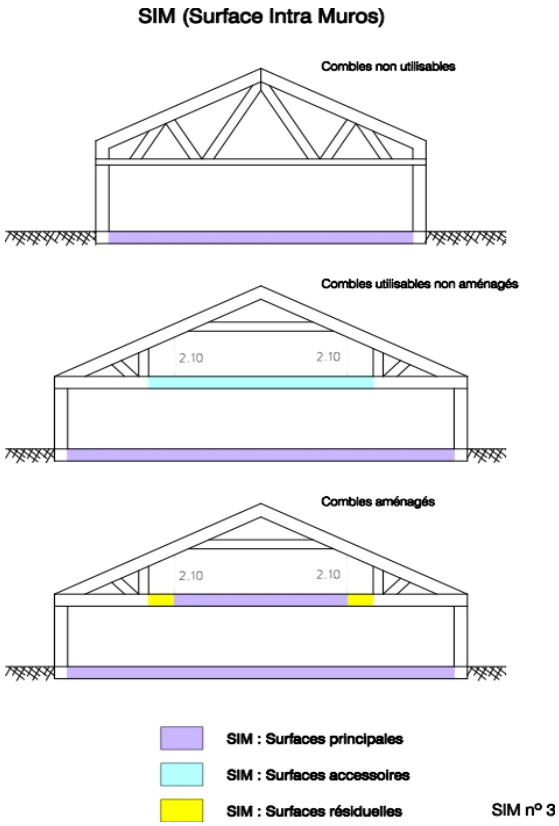
- of lift shafts, counted at the lower level served only

Key: SIM: Surfaces de service = SIM: Service areas

- covered passages closed along the side
- alleys and walkways between two parts of a building
- balconies, upper floor terraces and loggias.

The internal area **does not include** the area of:

- construction features and fixed partitions
- window and door reveals
- decorative internal voids and air shafts
- vertical service shafts or openings
- chimney flues



Key: Combles non utilisables = Unusable roof space; Combles utilisables non aménagés = Unconverted usable roof space; Combles aménagés = Converted roof space

3.4 DIVISIONS OF INTERNAL AREA

PRIMARY AREAS
All floor areas with a headroom ≥ 2.10 m associated with the principal uses of the building.

These include in particular:

- in housing: living areas (dining rooms, bedrooms), toilet areas (bathrooms, lavatories), interior spaces and passageways, storage areas, etc.
- in offices: work areas, meeting rooms, annexes, recreational areas, toilets, interior spaces and passageways, etc.

The primary areas may be subdivided in accordance with national legislation or under an agreement.

OTHER AREAS
All floor areas with a headroom ≤ 2.10 m associated with the principal uses of the building

SECONDARY AREAS
All floor areas regardless of height which are not consistent with the main use of the building

These include in particular:
- o underground storage and archive rooms
- o cellars
- o parking garages
- o unconverted usable roof space
- o balconies, upper floor terraces, loggias, etc.
- o passageways and non-enclosed covered areas (canopies, car-ports, etc.).

SERVICE AREA
All floor areas used for building services irrespective of height or occupation.

These include in particular:
- o lift shafts
- o stairwells
- o access ramps
- o maintenance areas and technical areas serving the building

(not included are technical areas for the use of an occupant which are regarded as annexes of the primary area).

The above breakdown relates both to private and common areas of the building. NB: The measurement of common areas applies only where there are several occupants of the building.

Agreed in principle by the working group

Jean-Marie Staquet
European Commission

Jean François Dalbin and Gérard Roulleau
Ordre des géomètres-experts français (French College of Chartered Surveyors)

Alain Moeyersons
UBG

Francis Gäbele and Raymond Gheldof
UBG and AGDP

World-wide inventory of the status of 3D Cadastres in 2010 and expectations for 2014

Peter VAN OOSTEROM, Jantien STOTER, Hendrik PLOEGER, The Netherlands,
Rod THOMPSON and Sudarshan KARKI, Australia

1. INTRODUCTION

In this paper, the background, set-up, and a preliminary analysis of the survey conducted by the FIG joint commission 3 and 7 working group on 3D-Cadastre[32], 2010-2014 is presented. The purpose of the survey is to make a world-wide inventory of the status of 3D-Cadastres at this moment (November 2010) and the plans/expectations for the near future (2014). Sharing this information improves cooperation and exchange of experiences and supports future developments in different countries and cadastral jurisdictions. The FIG working group will repeat the survey in four years time to evaluate the actual progress. In the questionnaire the concept of 3D-Cadastres with 3D parcels is intended in the broadest possible sense.

At the FIG Congress in April 2010 in Sydney it was decided to form again a working group on 3D-Cadastres in order to make further progress with the subject; see Section 2 for more details of this working group. The registration of the legal status in complex 3D situations will be investigated under the header of 3D-Cadastres. Starting point of the working group is the observation that increasingly information is required on rights, use and value in complex spatial and/or legal situations.

There are several 3D-Cadastre scoping options, which will be investigated in more detail by the working group, and the result will define the scope of the future 3D-Cadastre in a specific country:

1. What are the types of 3D cadastral objects that need to be registered? Are these always related to (future) constructions (buildings, pipelines, tunnels, etc.) or could it be any part of the 3D space, both airspace or in the subsurface?
2. In case of (subsurface) infrastructure objects, such as long tunnels (for roads, metro, train), pipelines, cables: should these be divided based on the surface parcels or treated as one cadastral object.
3. For the representation (and initial registration) of a 3D cadastral object, is the legal space specified by its own coordinates in a shared reference system or is it specified by referencing existing topographic objects/boundaries.

The working group will focus primarily on professionals involved in geo-information and cadastral issues in 3D. This community will also provide the contributors to the working group. Access to this interest group is open to all. Once the results become more tangible the FIG-community at large will be our public.

Within the working group the concept of 3D-Cadastres with 3D parcels is intended in the broadest possible sense. 3D parcels include land and water spaces, both above and below surface. However, what exactly is (or could be) a 3D parcel is dependent on the legal and organizational context in the specific country (state, province).

[32] In the past decade various activities have been conducted related to 3D-Cadastres. The start of the international awareness of this topic was marked by the workshop on 3D-Cadastres, organized by Delft University of Technology in November 2001. This was followed by virtually a session at every FIG working week and congress afterwards (stimulated by the 2002-2006 FIG working group on 3D-Cadastres).

2. RESEARCH TOPICS

The working group identified four main research topics:

- *3D-Cadastres and models*: It is important to realize that for registration, for storage/validation and for dissemination different models (all based on the shared ISO Land Administration Domain Model semantics) may be needed and different types of users are involved. The modelling aspect includes the question of which spatial (esp. height) and temporal information should be used and how different types of users may interact (i.e. produce, archive, edit, analyze, and visualize, edit) with 3D-Cadastre?
- *3D-Cadastres and SII*: The registration of legal objects (cadastral parcels and associated rights) and their physical counterparts (e.g. buildings or tunnels) result into two different, but related data sets, which can be very well accessed together via the Spatial Information Infrastructure (SII, sometimes also called SDI). This is already true in 2D, but even more so in 3D.
- *3D-Cadastres and time*: A 4D parcel is defined as the spatio-temporal unit against which (one or more) unique and homogeneous rights (e.g. ownership right or land use right), responsibilities or restrictions are associated to the whole entity, as included in a Land Administration system. Homogenous means that the same combination of rights equally apply within the whole 4D spatial temporal unit. Unique means that this is the largest spatio-temporal unit for which this is true. Making the unit any larger (in 3D space or time) would result in the combination of rights not being homogenous.
- *3D-Cadastres and usability*: The graphic user interface is an essential aspect when realizing 3D-Cadastres in practice. This includes investigation of interacting with true 3D cadastral data (specific user interfaces: 3D spatial and perhaps temporal aspects via animations or snapshot sliders). The existing quality of successful and popular user interfaces (e.g. Google Earth, see Figure 1) will be the starting point with specific attention for working with the main 3D legal object types (related to underground infrastructure and building/apartment complexes).

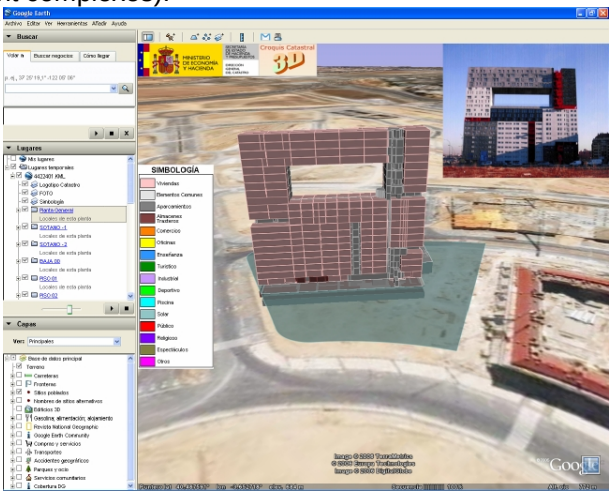


Figure 1. 3D visualisation in Google Earth (example Spanish cadastre)

A true 3D cadastral system with functions should be implemented and applied to demonstrate the possibilities in practice based on 3D visualization. How to distribute the 3D cadastral information to the citizens? How to represent and demonstrate the 3D geographic aspect?

The working group strives to obtain tangible results that have relevance to the cadastral practice. At the next FIG congress (2014) we want to publish a FIG publication on guidelines to establish 3D-Cadastres (a 'Primer on 3D-Cadastres'), addressing legal, institutional and technical issues. In 2011 a second workshop on 3D-Cadastres is planned (again in Delft, 10 years after the first workshop). In addition, at the FIG working weeks joint commission 3 and 7 sessions on 3D-Cadastes will be organized.
Communication during the projects will be done as much as possible by e-mail and via our dedicated website: www.gdmc.nl/3DCadastres.

3. DESIGN OF THE QUESTIONNAIRE

The first page of the questionnaire contained a few notes (including an informal and a formal definition of a 3D parcel) and suggestions, which should be helpful during the completing.
The formal definition a 3D parcel is defined as the spatial unit against which (one or more) unique and homogeneous rights (e.g. ownership right or land use right), responsibilities or restrictions are associated, as included in a Land Administration system. As this definition is quite abstract, the questions were phrased with more descriptive and real world situations included to explain further.
The questionnaire specifically aims at clarifying the difference between 3D legal space (referred to as 3D parcel) and 3D physical objects. A 3D parcel is a 'legal object' describing a part of the space. Often there is a relationship with a real world/physical object, which can also be described in 3D, but this is not invariably the case. The questionnaire was framed to recognise the difference between these two types of objects and that the focus in the context of 3D-Cadastres is on 3D parcels (spaces of legal objects). The questionnaire was grouped in nine different thematic blocks: (1) general/applicable 3D real-world situations; (2) infrastructure/utility networks; (3) construction/building units; (4) X/Y Coordinates; (5) Z Coordinates/height representation; (6) temporal issues; (7) rights, restrictions and responsibilities; (8) Digital Cadastral Database and (9) Plans of Survey.
The first group of questions refers to the applicable 3D real-world situations to be registered by 3D parcels. It also addressed the types of 3D geometries, which are considered to be valid 3D representations for these parcels. The second group of questions refers to the situation where an infrastructure network is considered to be defined within the cadastre. The third group of questions refers to 3D properties that are related to constructions and apartment (condominium) buildings. The individual units are often defined by the actual walls and structure of a building, rather than by metes and bounds. The other 6 groups of questions are more or less self-evident. Finally, group 10 the contact details could be provided together with any other issue that was relevant, but not yet addressed by one of the earlier questions.

4. PRELIMINARY ANALYSIS OF THE RESPONSES

36 completed questionnaires have been received and they are all available at the working group website. From the completed questionnaires we received, a number of conclusions can be made. The first is that despite all the research in the past year the concepts "3D cadastre" and "3D parcels" are still ambiguous. The completed questionnaires offer therefore in the first place an overview of the very different ways in which systems of land administration deal with the third dimension of rights (or restrictions). Worldwide there are major differences in those systems, mostly the result of cultural and historical differences in background, and these differences influence the organizational, technical and legal aspects of land registration. Because of these differences, a comparison of the responses is not always easy.
A general conclusion is that in all jurisdictions, with the exception of Poland and Nepal, 3D parcels can be registered. But in most cases these 3D parcels are (or even limited to)

apartment units. That it is not possible to register 3D parcels other than apartment units in a specific land administration does not mean automatically that it is not possible to create rights that are limited in the third dimension. E.g. in the case of South Korea the respondent explicitly indicated that 3D boundaries of rights are possible by civil law, while cadastral regulation does not touch this subject. In the following paragraphs we give an overview of the preliminary analysis of survey results for several aspects.

4.1 Are all 3D parcels constrained to be within one surface (2D) parcel?

Most respondents replied on question 1.1 of the questionnaire that a 3D parcel must be located within the boundaries of a (2D) parcel. This does not exclude that the building to which the right refers may be situated on several land parcels. Possibly - as in the case of the Netherlands - a legal 3D description of right refers to various 2D land parcels. The responses are not always clear on the question what will happen if the land parcel is subdivided later. In Queensland it is the starting point that the 3D parcel must be within the boundaries of a 2D parcel, but this does not exclude that the 2D parcel may be subdivided later on. After subdivision the original 3D parcel continues to exist and therefore stretches out over two or more land parcels. In Norway and Sweden, 3D properties may be created that extend over or under different 2D parcels. In Finland this possibility is foreseen for the future.

4.2 Empty spaces or existing constructions?

An interesting question is whether registration of rights to empty spaces - such as air spaces or subsurface volumes - is allowed (e.g. to protect an existing panorama) or that the registered right compulsory refers to an existing or future construction. The responses shows that in most countries explicit rules for this do not exist, but also indicated that in general the rights will refer to a construction. Explicitly the possibility of registration of rights for empty spaces are mentioned in Australia and Canada (Quebec), In Finland this is limited to subsurface volumes. By contrast, Norway and Sweden the law expressly exclude this possibility. In these countries there must be a construction, or a building permit issued for future constructions before a 3D property can be registered. In Norway 3D parcels can be nullified in the case construction has not started building the construction that is going to be the 3D property three years after the building permit has been issued.

4.3 Boundaries of the 3D parcel

Generally the boundaries of 3D parcels refer to walls, ceilings and floors. The respondent for France expressly states that - in the absence of guidelines in this area - virtual boundaries would be possible. With respect to the z-axis (height) it appears that in the vast majority of systems directives on this issue does not exist or the height is not registered. Among the countries that do register the height (in survey plans or in a legal deed) it may be observed that Australia and France make use of an absolute level while in Canada (Quebec) and Sweden reference is made to a height relative to ground level.

4.4 Registration of 3D parcels in the cadastral database

3D parcels as such do not exist in any cadastral registration. The description of the 3D space will be found in the survey plans or in the legal documents. The standard seems to be that "floorplans" that the boundaries per floor are listed in the title deed or the appropriate public records (Land Book, Land Registry, public records) or survey plans but not in the cadastral database (map). It may be possibly a make a reference to the 3D parcel in the cadastral map

in the form of a 2D polygon in a single layer as in the case of Australia, Cyprus , Croatia (where is spoken of a “2.5D representation”) , Norway and Sweden.
In Italy 3D Cadastre in Italy is represented by the Cadastre of Buildings, that exists next to the “Land Cadastre”. This holds an inventory of every building. A very interesting system of 3D registration exists in Spain. Here on the cadastral map a 3D model of the buildings can be shown, including the boundaries of rights inside the buildings. But this is not a 3D representation of the actual height of the units. In fact the representation is based on a standard height of 3 meters from floor-to-floor.

4.5 Registration of cable and pipeline networks

Cable and pipeline networks occupy a special place within the registered 3D objects and rights. These networks often extend over several land parcels and thus have - apart from the height or depth of the structure - a 3D character of their own. In recent years the Netherlands introduced the possibility to register rights to all types of cable and pipeline networks. The networks have a cadastral number of their own. In Switzerland, especially in Geneva networks are included in the cadastral database in a similar way. In the Russian Federation, a network can be registered by the Land Registry, but in practice this is not done. In Kazakhstan, all networks are registered "as legal objects". However the respondent also mentions that underground networks are not registered but only shown on maps. Furthermore, in Canada (Quebec) cable and pipeline networks, rail networks are recorded in public registers (Register or real right of State resource development). It can be requested by the owner that the network is displayed on the cadastral plan, but this rarely happens. The network as such can not be found in the cadastral database, but indirectly through the land parcels in which the network is constructed. In other countries registration of networks does not happen, or is just possible in limited cases, as in Turkey where only high voltage power lines are registered in the cadastral database. Registration of other networks find place at municipal level, and combined with cadastral data. A general registration of (underground) networks does not exist in Norway, where telecommunications, water and electricity networks are not registered, but roads and railways are. Some jurisdictions have "utility maps” (Australia, Victoria) or a" utility register " as Croatia. In the latter country is expected that this register will be integrated in the cadastral database in 2014. Also in other countries we see developments towards the cadastral registration of networks, especially in Denmark, Hungary, Israel and Italy.

4.6 Developments in the short term

The purpose of the survey by the FIG Working group was not only to make a world-wide inventory of the status of 3D-Cadastres at this moment (2010/2011), but also to get an insight in the expectations for the near future (2014). However, the planned developments in the field of 3D cadastre for 2014 seem to be very limited. Whether this means that one is satisfied with the existing system of 2D registration, like the respondent for England and Wales expressly stated, remains unclear. The vast majority of respondents did not answer the questions one the expected situation for 2014. The most concrete developments seems to happen in Switzerland, where in 2014 the concept of 3D plots might be introduced, and Denmark, where the respondent mentions an ongoing discussion of 3D parcels should be recorded in the cadastre and a footprint on the cadastral map. Bahrain mentions the future representation of the apartments in the cadastral database. In recent years in Israel there has been much research into the development of a 3D cadastre and preparations aimed at legislation and it is hoped that this will result in practical changes.

5. CONCLUSION AND FUTURE WORK

As indicated, the solutions for registration of rights with 3D characteristics are very different. Broadly, one can observe that apartments are registered with drawings in the deed registration. But a true 3D registration in the cadastre does not exist anywhere.

Techniques for 3D data acquisition, management and distribution will be within reach. The next step is to optimally exploit this in order to meet the growing information needs in 3D cadastres, matching specific organizational and legal contexts. The international approach of the FIG working group hopes to make an important contribution to reach this, by the publication of "Primer on 3D-Cadastres" providing guidelines for specific contexts and implementations, addressing legal, institutional and technical issues.

REFERENCES

- Fatih Döner, Rod Thompson, Jantien Stoter, Christiaan Lemmen, Hendrik Ploeger, Peter van Oosterom and Sisi Zlatanova (2010). 4D cadastres: First analysis of Legal, organizational, and technical impact - With a case study on utility networks. In: Land Use Policy, Volume 27.
- ISO (2011), ISO 19152. Draft International Standard (DIS), Geographic information — Land administration domain model (LADM), Geneva, Switzerland, 20 January 2011.
- P.J.M. van Oosterom, J.E. Stoter, E.M. Fendel (Eds.) (2001); Proceedings International Workshop on 3D Cadastres, Registration of properties in strata, Delft, November 2001, published by FIG
- S. Karki, R.J. Thompson, K McDougall (2011): Analysis of 3D Cadastral situation in Australia, Unpublished Paper, 2011

BIOGRAPHICAL NOTES and CONTACTS

Peter van Oosterom obtained an MSc in Technical Computer Science from Delft University of Technology, The Netherlands. In 1990 he received a PhD from Leiden University'. From 1985 - 1995 he worked at TNO-FEL in The Hague, The Netherlands. From 1995 - 2000 he was senior information manager at the Dutch Cadastre. Since 2000, he is professor at Delft University of Technology. He is chair of the FIG working group on '3D-Cadastres'.

Jantien Stoter defended her PhD thesis on 3D Cadastre in 2004. From 2004 till 2009 she worked at the International Institute for Geo-Information Science and Earth Observation, ITC, Enschede, the Netherlands. Since October 2009, she fulfils a dual position: one as Associate Professor at Section GIS technology at OTB and one as Consultant Product and Process Innovation at the Kadaster. From both employers she is posted to Geonovum.

Hendrik Ploeger studied law at Leiden University and the Free University of Amsterdam, The Netherlands. In 1997 he finished his PhD-thesis on the subject of the right of superficies and the horizontal division of property rights in land. He is associate professor at Delft University of Technology (OTB Research Institute) and holds the endowed chair in land law and land registration at VU University of Amsterdam.

Rod Thompson has been working in the spatial information field since 1985. He is principal advisor in spatial databases. He obtained a PhD at the Delft University of Technology in December 2007.

Sudarshan Karki is senior Spatial Information Officer, Cadastral & Geodetic Data of the Department of Environment and Resource Management, Queensland Government, Australia. He completed his professional Masters Degree in Geo-informatics from ITC, The Netherlands in 2003 and is currently doing Master of Spatial Science by Research at the University of Southern Queensland.

Peter van Oosterom and Jantien Stoter
Delft University of Technology
OTB, Section GIS-technology
P.O. Box 5030
2600 GA Delft
THE NETHERLANDS
Tel. +31 15 2786950
E-mail:
P.J.M.vanOosterom@tudelft.nl

Hendrik Ploeger
VU University Amsterdam, Faculty of Law &
Delft University of Technology
OTB, Section Geo-Information and Land management
P.O. Box 5030
2600 GA Delft
THE NETHERLANDS
Tel.: + 31 15 2782557
Email: h.ploeger@otb.tudelft.nl

Rod Thompson and Sudarshan Karki
Queensland Government,
Department of Environment and Resource Management
Landcentre,
Main and Vulture Streets,
Woolloongabba
Queensland 4102, AUSTRALIA
Tel. +61 7 38963286
E-mail: Rod.Thompson@qld.gov.au

ISO 19152 is at Stage of Final Draft International Standard

Christiaan LEMMEN and Peter VAN OOSTEROM

1. INRODUCTION

The development of LADM to an International Standard is an initiative of FIG. This standardisation is a comprehensive, extensive, formal process with a continuous review and a continuous, creative approach to find common denominators in land administration systems and included data sets. FIG submitted the LADM as a New Work Item Proposal to ISO/TC 211 in 2008.

The Final Draft International Standard (FDIS) covers basic information related to components of land administration (including water and elements above and below the earth surface). It includes agreements on data about administrative and spatial units, land rights in a broad sense and source documents (e.g. deeds or surveys). The rights may include real and personal, informal rights as well as indigenous, customary and informal rights. All types of restrictions and responsibilities can be represented. Overlapping claims to land may be included. The draft standard can be extended and adapted to local situations; in this way all *people land relationships* may be represented. This can be supportive in the development of software applications built on database technology.

LADM describes the data contents of land administration in general, based on a practical approach. The roots are in FIG's Cadastre 2014 (Kaufmann and Steudler, 1998).

Implementation of LADM can be performed in a flexible way; the standard can be extended and adapted to local situations. External links to other data bases, e.g. addresses, are included. Legal implications that interfere with (national) land administration laws *are outside the scope of the LADM.*

The LADM has been designed and validated in an *incremental approach*. Initial versions in different stages have been discussed during several FIG and other events.

2. WHERE ARE WE NOW?

In 2010 the LADM has been published as a Draft International Standard (DIS) by the ISO (ISO, 2011), as ISO 19152.

Participating Members of ISO/TC 211, Geographic Information, did comment on the DIS and brought their votes on continuation of the development of LADM. The result of this voting round was positive.

Earlier voting rounds resulted also in positive support, see table 1.

It is clear from this table that support for LADM is growing. The DIS was approved with only two negative votes[33]. This means that the LADM is in the stage of Final Draft International Standard now. The Editor will process the received comments and observations into an updated draft. This updated draft will be discussed with the Editing Committee. Then further comments and observations will be processed before the updated draft will be sent to ISO for publication on 7 November 2011. This publication is related to *final voting*. If the result of final voting is positive the International Standard will be published in 2012, about 4 years after the approval of the New Working Item Proposal. This would be a mile stone for FIG.

Voting ISO 19152	New Working Item Proposal (NWIP) 2 May 2008	Committee Draft (CD) 12 October 2009	Draft International Standard (DIS) 27 June 2011
Approve	15	22	26
Disapprove	6	3	2
Abstain	4	4	4
Not Voted	7	3	0

Table 1: LADM Voting results

LADM can be a shared basis for data from different Land Administration Systems. The Draft International Standard includes informative example cases with people and land relationships demonstrating the flexibility of the draft standard. Further, the relationships with the INSPIRE (Infrastructure for Spatial Information in the European Community, (INSPIRE, 2009)) Cadastral Parcels model and LPIS (Land Parcel Identification Systems – this is a part of the Integrated Administration and Control System established by the European Union Member states) are described in annexes. 3D Cadastres are covered in such a way that these seamlessly integrate with existing 2D registrations.

3. PACKAGES OF THE LADM IN THE DRAFT INTERNATIONAL STANDARD

LADM, as a product, is a conceptual schema. LADM is organized into three packages, and one subpackage. (Sub)packages facilitate the maintenance of different data sets by different organizations, e.g. Land Registry or Cadastre (each with their own responsibilities in data maintenance), operating at national, regional or local level.

The three packages are: Party Package, Administrative Package and Spatial Unit Package. The Surveying and Spatial Representation Subpackage is one subpackage of the Spatial Unit package.

4. IMPLEMENTATION AND USE IN PRACTICE

When the LADM is finalised as an International Standard it can be used for as a basis for the design of Land Administration Systems. Modelling facilitates appropriate system development (and reengineering) and, in addition, it forms the basis for communication between different systems in different (parts of) organisations. This use of LADM in practice means that now, finally, application design can be based on GIS and database technology. Of course there is no difference if open source or commercial GIS and/or Database Management platforms are

[33] This project is parallel with CEN, and there LADM was approved with one negative vote as a Draft International Standard.

used for this purpose. When using standards, information can be exchanged in heterogeneous (commercial and open source) and distributed environments
Several country profiles have been created (some of them included in an annex of the draft standard) and other model use is being conducted e.g. the Land Parcel Identification Systems or the Social Tenure Domain Model (Augustinus, et al 2006, FIG 2010). A part of the LADM SpatialUnit Package has been used in the INSPIRE Data Specification on Cadastral Parcels. The idea is that LADM will be fully integrated in this specification after its acceptance.

The FAO Solutions for Open Land Administration (SOLA) project will promote affordable IT-systems that enable improvements in transparency and equity of governance. Started in June 2010, SOLA is a three year trust fund project, funded by the Government of Finland. Through the development and re-use of open source software, it aims to make computerised cadastre and registration systems more affordable and more sustainable in developing countries. Three countries (Samoa, Nepal and Ghana) have been identified for pilot implementation of the software. The LADM is being used as input for SOLA developments; see www.flossola.org**.**

5. CONCLUDING REMARKS

A first step in the direction of domain modeling of LA has been made with LADM. Data needed for Land Administration in a broad sense can be represented in the LADM. There will be a next voting round within ISO on the further development of LADM. But in some countries, country profiles are already under development. It is expected that there will be a future need for the development of other non-LA domains. Within LADM these non-LA domains are explicitly indicated as external classes, such as persons (parties)[34], addresses, valuation, taxation, land use, coverage, physical utility networks, etc. Within the European Union, some of these domains are treated in INSPIRE, but certainly not all. Here lies an important role for FIG at a global scale (and in relationship with ISO).

The requirements from future land governance stem from improving registration of public restrictions, registration of public benefits, registration practices with regard to public land, registration of 'public goods' and its spatial extents and policy implications. In the past, there have been more publications on the anticipated developments of Land Administration, see (Van der Molen, 2003) and more recently (Bennett et al, 2010; Lemmens, 2010a; Lemmens, 2010b). The expected further requirements for the next decade are support of: mature information infrastructures to serve society; dynamic process models with updating/participation by actors; 3D, 4D and 5D that is, space, time and scale integrated in Land Administration; spatial design applications; new rights, restrictions and responsibilities; international semantic web-based seamless registration; monitoring applications and community driven cadastral mapping. LADM can bring support here from a modeling perspective.

REFERENCES

Augustinus, C., C.H.J. Lemmen and P.J.M. van Oosterom (2006). Social tenure domain model requirements from the perspective of pro - poor land management. 5th FIG regional conference for Africa : promoting land administration and good governance. Accra, Ghana.

[34] Party may be an external class in LADM, this may relate to population register or company register. If this can not be implemented as external class it can be a LADM class. The same is valid for other external classes as mentioned in LADM.

Bennett, R., Rajabifard, A., Kalantari, M., Wallace, J., and Williamson, I. (2010). Cadastral Futures: Building a New Vision for the Nature and Role of Cadastres. FIG Congress 2010, Facing the Challenges – Building the Capacity. Sydney, Australia.

FIG (2010). The Social Tenure Domain Model. FIG Publication 52.

INSPIRE (2009). D2.8.I.6 INSPIRE Data Specification on Cadastral Parcels – Guidelines. 2009-09-07.

ISO, 2011. International Organisation for Standardization. Geographic information – Land Administration Domain Model (LADM). Draft International Standard. Geneva, Switzerland.

Kaufmann, J. and D. Steudler (1998). Cadastre 2014. A vision for a future cadastral system. FIG XXI International Congress. Brighton, U.K. FIG, Copenhagen, Denmark, 1998.

Lemmen, C.H.J. and P.J.M. van Oosterom (2006). Version 1.0 of the FIG Core Cadastral Domain Model. XXIII FIG Congress. Munich, Germany.

Lemmens, M., editor (2010a). Towards Cadastres 2034: Part I – International experts speak out. GIM International (invited reply), 24(9): 41-49.

Lemmens, M., editor (2010b). Towards Cadastres 2034: Part II – International experts speak out. GIM International (invited reply), 24(10): 37-45.

Van der Molen, P. (2003). The future cadastres - cadastres after 2014. FIG Working Week 2003. Paris, France.

BIOGRAPHICAL NOTES

Christiaan Lemmen holds a degree in geodesy from Delft University of Technology, The Netherlands. He is director of the FIG International Bureau of Land Records and Cadastre OICRF. He is an assistant professor at the Faculty of Geo-Information Science and Earth Observation (ITC), University of Twente, and an international consultant at Kadaster International. He is chair of the Working Group 7.1 'Pro Poor Land Management' of FIG Commission 7, 'Cadastre and Land Management', and contributing editor of GIM International.

Peter van Oosterom obtained an MSc in Technical Computer Science in 1985 from Delft University of Technology, The Netherlands. In 1990 he received a PhD from Leiden University for this thesis 'Reactive Data Structures for GIS'. From 1985 until 1995 he worked at the TNO-FEL laboratory in The Hague, The Netherlands as a computer scientist. From 1995 until 2000 he was senior information manager at the Dutch Cadastre. Since 2000, he is professor at the Delft University of Technology (OTB institute) and head of the section 'GIS Technology'. He is the current chair of the FIG joint commission 3 and 7 working group on '3D-Cadastres' (2010-2014).

CONTACTS

Christiaan Lemmen
University of Twente. Faculty of Geo-Information Science and Earth Observation (ITC)
P.O. Box 6
7500 AA Enschede
THE NETHERLANDS
E-mail: lemmen@itc.nl
Web site: www.itc.nl

Prof Dr. Peter van Oosterom
Delft University of Technology
OTB, Section GIS-technology
P.O. Box 5030
2600 GA Delft
THE NETHERLANDS
Tel. +31 15 2786950
E-mail: P.J.M.vanOosterom@tudelft.nl
website http://www.gdmc.nl

Spatially Enabled Societies

Daniel STEUDLER, Switzerland

1. SPATIAL NEEDS OF OUR SOCIETIES

When looking at media reports from the last 6-12 months, there are many examples of where sound land information and good land administration and management systems are needed.

In developing countries, there are diverse needs for good land information for improving and dealing with issues such as urban sprawl, pollution, overpopulation, traffic congestions, and inefficient transport systems, all of which can only be managed with proper information. Disaster management is another example where landholders can be protected with secure and appropriate land information. Well operated land registration systems can provide the basis for preventing hazards, for predicting floods, and in post-disaster situations, for supporting reconstruction. A further example in developing countries is land grabbing, which is often not being recognized, but is the effect of a weak definition and documentation of land ownership rights.

Those examples from developing countries show urgent needs for efficient land administration and management systems based on sound spatial land information. In developed countries at the same time, there are important needs to have reliable spatial information as well. Due to the density of the population and the land-use, existing cadastral system in such countries are to be extended to also accommodate information that reflects these situations. One example is the discussion of 3D Cadastres i.e. the extension of cadastral systems with the 3rd dimension in order to document the definition of ownership rights in condominiums.

In this same context, the paradigm of landownership rights extending up in the sky and down to the centre of the earth might not apply anymore and needs discussion. In urban areas, street or railway tunnels might be built 10-20m below existing properties and buildings. What is the legal situation when those landowners would like to drill their 100m bore holes for geothermic heating? Such facts as well as public-law restrictions that potentially impact on the use of the land need to be documented in order to keep the land market transparent. Traditional cadastres documenting private-law rights can be extended in order to accommodate such land related issues.

There are many challenges and needs of our national societies. They are increasingly also of global scale and impact on all our lives. The spatial location and land information is in most cases crucial for responding to those needs; and while ownership information is not the sole information, it is more often than not at the core of the solution.

2. POTENTIAL PROVISIONS OF LAND ADMINISTRATION AND LAND MANAGEMENT SYSTEMS

Over the last 15-20 years, the topic of cadastre and land registration has been discussed extensively. The FIG-statement on the cadastre (FIG, 1994) established that the "cadastre assists in the management of land and land use, and enables sustainable development and environmental protection." In the 1990s the UN-ECE (1996) coined the term "land

administration" in order to express the broader need and use of land information for managing the land as an asset. The Bathurst Declaration concluded in 1999 that sustainable development is the key driver influencing the Humankind to Land relationship and that it needs sound land administration (UN-FIG, 1999).

2.1 Land administration and land management in context

Land administration and management are serving the particular needs of societies as discussed in section 2.1. A spatially enabled society certainly needs well organized and efficient land administration and land management systems. The context of administration and management and their respective tools and methods are illustrated in Figure 1.

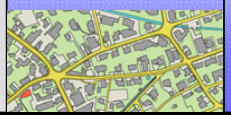
Tasks	Land related activities	Tools / Methods
Strategy • visions and objectives	**Land policy**	• political activities
Management • measures and projects for the implementation of the policy	**Land management** 	• land-use planning • land consolidation • land reallocation • melioration • landscape develop-ment • land recycling
Administration / Documentation • handling of spatial information, data analysis, data visualization • cadastral operations, data modelling, data acquisition, data maintenance, data distribution	**Land administration and cadastre** 	• monitoring • navigation • geoinformation • land registration • cartography • surveying • geodesy

Figure 1: The broader context of land documentation, land administration and land management (adapted from Kaufmann, 2008).

2.2 Elements of a land administration system

A land administration system has originally been defined by the UN-ECE as the "processes of determining, recording and disseminating information about the tenure, value and use of land when implementing land management policies." The land administration system is a basic foundation for the spatial enablement of a society and is considered to include land registration, cadastral surveying and mapping, fiscal, legal and multi-purpose cadastres and land information systems (UN-ECE, 1996).

Horisberger (2010) proposes a set of basic elements that a land administration system consists of. Those basic elements are:

- **cadastre** with the basic entity "cadastral object", i.e. land parcels, built objects, topographic objects, or administrative areas;
- **land registry** with basic entities: ownership rights, rights holders

- **land valuation** with basic entities of land market value, regulations, based on land parcel information
- **public-law issues** with basic entities of restrictions (with spatial extend) and legal and political provisions.

It is of course possible that a land administration system has more elements than those four basic ones mentioned above. A society through its adopted land policy would have to define these other elements depending on the need. What is important is that all these elements have a link to the geographic location as they are documenting issues happening at a specific geographic location.

2.3 Legal and institutional independence of topics

The different elements of a land administration system are often managed by different institutions. Those institutions have to take care of their own data and information, and are often not prepared to share it with other institutions. However, from a holistic society point of view, data sharing is very much needed in order to make best use of the information. The integration and linkage of spatial information is exactly what can be called the spatial enablement of a society.

The integration and sharing of geoinformation can be imagined as a specific infrastructure being set-up, which is named "spatial data infrastructure" (SDI). The organization of land administration data then needs to follow some basic principles:

- the principle of legal independence (Kaufmann and Steudler, 1998);
- the use of the same geodetic reference framework;
- the use of the same standardized data modelling concept.

The principle of legal independence allows independent data management and independent data responsibilities avoiding institutional take-overs. Data owners only have to provide copies of their spatial data into the spatial data infrastructure, where it can be accessed and used by many (compare Figure 3). The proposed structure of such a framework has not a purely technical background; it is rather a conceptual way of organizing spatial data to allow the different institutions to remain independent and thus help to overcome the fear of being merged with others.

The spatial data infrastructure is of course a whole research area in itself. But there are two technical preconditions that this infrastructure has to satisfy in order that data and information can be used for the benefit of the whole society. These two preconditions are that spatial data are to be held in a common geodetic reference framework and that they are all defined in a common data modelling concept (compare Figure 2).

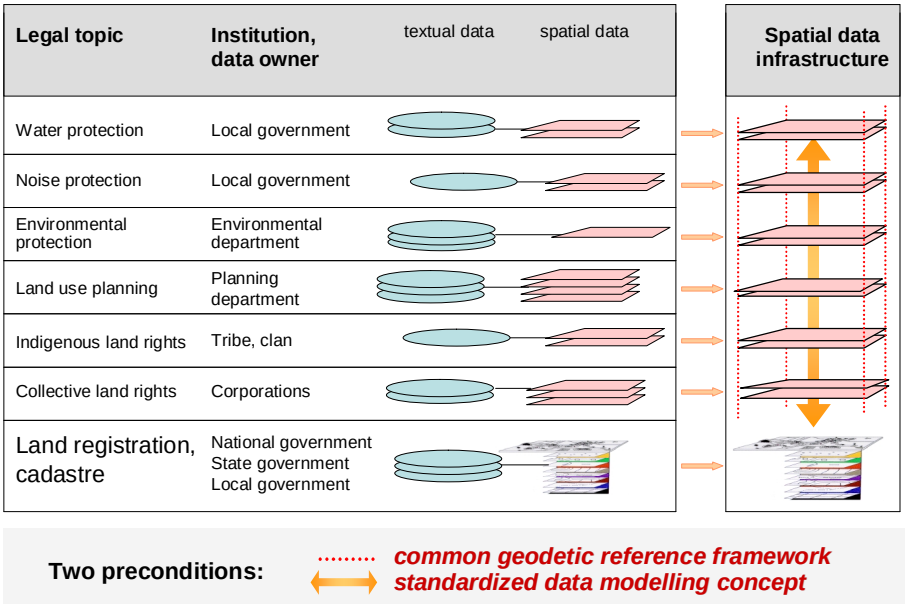


Figure 2: Legal independence of topics and sharing of spatial information through the concept of spatial data infrastructure.

3. DEFINITION OF THE TERM «SPATIALLY ENABLED SOCIETY»

The FIG Task Force on «Spatially Enabled Society» suggest the following definition:

A spatially enabled society – including its government – is one that makes use and benefits from a wide array of spatial data, information, and services as a mean to organize its land related activities. Spatial enablement is a concept that adds location to existing information and thereby unlocks the wealth of existing knowledge about the land, its legal and economical situation, its resources, potential use and hazards. Information on landownership is thereby a basic and crucial component to allow for correct decision-making. Such data and information must be available in a free, efficient, and comprehensive way in order to support the sustainable development of society. It therefore needs to be organized in such a way that it can easily be shared, integrated, and analysed to provide the basis for value-added services.

Following this definition, six key elements are suggested that make a society spatially enabled:

- **legal framework** for basic geoinformation;
- **positioning infrastructure** for the common reference framework;
- **common data integration concept:**
  - standardized data modelling;
  - independent information administration (to allow independent responsibilities, principle of legal independency);
- **network infrastructure** to enable sharing and integrating spatial data through the spatial data infrastructure SDI;

- **landownership information** as one of the basic information topics;
- **data and information:**
    - official, complete, comprehensive, updated;
    - accessibility of data i.e. public sector information initiatives;
    - virtual geographic information (VGI), web 2.0 possibilities.

In terms of spatially enabling a society, there are further issues that need to be considered, namely the **educational framework**, the **technical and institutional development of spatial data management**, the **development of awareness on all levels of society** (citizens, institutions, and decision-makers, the **development and applicability of land management tools** in order to make best use of spatial data.

REFERENCES

FIG (1995). Statement on the Cadastre. Report prepared for the *International Federation of Surveyors* by Commission 7 (Cadastre and Land Management), FIG Publication No. 11, 22 p. ISBN 0-644-4533-1.

Horisberger, J.-L. (2011). Land Administration as an effective and efficient public service. Contribution to Training session in Vienna, 24-26 Jan.

Kaufmann, J. (2008). *The Boundary Concept: Land Management Opportunities for Sustainable Development Provided by the Cadastre 2014 Approach*, FIG Working Week 2008, Stockholm, Sweden.

Kaufmann, J. and D. Steudler (1998). *Cadastre 2014 – A Vision for A Future Cadastral System*, with working group 7.1 FIG Commission 7, 51p., www.fig.net/cadastre2014.

UN-ECE (1996). *Land Administration Guidelines*. Meeting of Officials on Land Administration, UN Economic Commission for Europe. ECE/HBP/96 Sales No. E.96.II.E.7, ISBN 92-1-116644-6, 111 p.

UN-FIG (1999). *The Bathurst Declaration on Land Administration for Sustainable Development.* Report from the UN-FIG Workshop on "Land Tenure and Cadastral Infrastructures for Sustainable Development", Bathurst, NSW, Australia, 18-22 October.

Williamson, I., Rajabifard, A. and Holland, P. (2010). *Spatially Enabled Society.* Proceedings of the XXIV FIG International Congress, Sydney Australia, 11-16 April.

CONTACT

Dr. Daniel Steudler
Swiss Federal Directorate for Cadastral Surveying
Seftigenstrasse 264
CH-3084 Wabern
SWITZERLAND
Tel. +41-31-963 2482
Email: Daniel.Steudler@swisstopo.ch
Web site: www.cadastre.ch and www.swisstopo.ch

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Sekretariat der Gesellschaft: Dipl.-Ing. Karl Haussteiner, Tel.(01) 21110-2311, Fax (01) 2167551, Schiffamtsgasse 1-3, A-1020 Wien.

Schriftleitung: Dipl.-Ing. Stefan Klotz, Tel. (01) 21110-3609, Dipl.-Ing. Ernst Zahn, Tel. (01) 21110-3209, Dipl.-Ing. Andreas Pammer, Tel. (01) 21110-5336, Schiffamtsgasse 1-3, A-1020 Wien. Fax (01) 2167551, E-Mail: vgi@ovg.at.

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Kadaster International
P.O. Box 9046
7300 GH Apeldoorn
The Netherlands

T: (+31) 88 18 33 052
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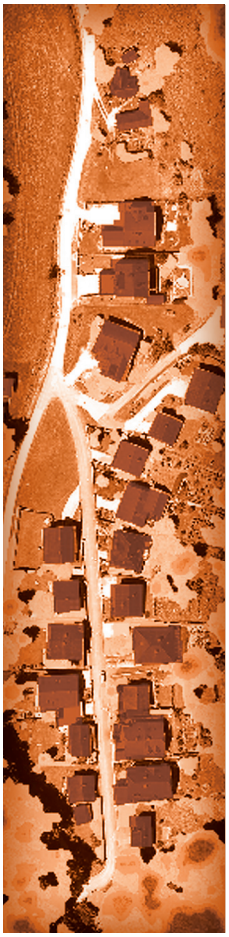

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