Survey Accuracy 09/11/2011

Furthering Dialogue on 'Towards Cadastre 2034'

Renewed debate on the nature and role of the cadastre was sparked in 2010 through the forums of FIG 2010 in Sydney, Australia, and GIM International. Six design elements for 'future cadastres' were discussed, one of them being 'survey accuracy'. The wide range of responses regarding this design element implied that the topic required further clarification. Here, we hope to provide such clarification and further the dialogue on 'Towards Cadastre 2034'.

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The six design elements proposed to the FIG 2010 forum were: 'survey accuracy'; the move towards property objects; implementation of 3D and 4D aspects; ability for real-time updates; global connectivity; and incorporation of natural, social, or fuzzy boundaries in cadastres. It was emphasised that these were mere starting points, intended to generate a much wider debate within the global land administration and cadastral science community.

The Invited Reply

GIM International, through Mathias Lemmens, furthered the debate and invited input from international experts. The range of views can be summarised as follows:

- The six proposed design elements were primarily relevant in highly urbanised areas where accurate, detailed and real-time information are essential
- Globalisation forces tended to suggest that transnational connectivity of cadastral data would be required
- Modelling of natural boundaries such as rivers, shores and forests could move from crisp to fuzzy in the cadastral realm, but
- Completely different 'cadastral' needs arose in developing and rural areas: design elements in such contexts are much harder to prescribe.

The responses of Dr. Keith Bell ("Supply driven, techno-centric approach: spatial accuracy") and Dr. Clarissa Augustinus ("Current accurate approach is not the solution") prompt further consideration of the issue of 'survey accuracy'.

The Perception of 'Uncertainty-averse'

'Accuracy' is a sensitive issue and closely linked with the archetype of a land surveyor: an uncertainty-averse person. Consider the World Bank ECA Land Assessment Report of 2009, which heaves sighs about "Surveyors who are unreasonable and insist on very outdated methods or extreme technical accuracy in survey work. It is slow, painstaking work [...] because [...]

methodologies and procedures are overly complex." In her PhD dissertation on 'Modelling Causes of Cadastral Development', Maria Silva (Aalborg 2005) reports how, in 1993, the government of Portugal asked the former Institute of Geography and Cadastre to establish the Agricultural Parcel Identification System for the country, as required by the EU. The land surveyors of the Institute declared it would need EUR500 million and 100 years for completion. The government then - out of desperation - commissioned the Earth and Space Institute, who fixed the job within four years using aerial photography and orthophotos. Rather than being dictated by fear of uncertainty and inexactness, the discussion on 'survey accuracy' was led by considerations of how Moore's law of 1965 (named after Gordon E. Moore, founder of Intel: "Processing speed and memory capacity doubles every two years") would affect our surveying tools.

Development in the field of global navigation satellite systems, with undistorted GPS signals, is rapid, as demonstrated by Galileo, GLONASS and COMPASS (China), and regional and local systems such as the Beidou (China), IRNSS (India), and QZSS (Japan). In view of the pressure of the climate-change debate, such developments are likely to continue; average sea-level changes of millimetres per year require observation technologies as precise as can be - a daily walk to the shoreline in one's rubber boots with a tape measure will not suffice. Together with the short-term availability of high-precision Earth-observation satellites, one might reasonably expect that, in 2034, high precision will be handed to us on a 'silver platter'. The question therefore is not whether to be in favour of high-precision survey methods, since they will presumably be the new standard, but how eager one is to apply the tools in a purposeful way.

A Strategic Issue

The FIG 2010 paper articulated that many countries operate a digital cadastral database. Apart from a few countries that resurveyed all boundary points, most countries digitised their existing cadastral maps: a method that added coordinates of cartographic precision to boundary points. The data managers now face the problem of adjusting new high-precision coordinates to the low-accuracy coordinates. Up until now, newly acquired, better-quality measurements have been adjusted in line with the existing but inaccurate coordinates, making them as bad as the old ones rather than upgrading the existing ones to reflect the newly surveyed ones. Even at cartographic level, problems may occur. To find an answer to the question, 'Is my boundary coinciding with my neighbour's fence, as I always assumed, or is it one metre beyond, as the maps now tell me?' citizens may lay the digitised old cadastral map over new maps or precise aerial imagery. To avoid mistrust, the Dutch Kadaster, for instance, spent EUR50 million on adjusting boundary lines on the digitised cadastral map in line with the topographic lines of the new large-scale topographic base map. Other examples of such projects include the Korean

Cadastre Survey Corporation (KCSC) considering resurveying all cadastral boundaries in the country, as they did earlier in Quebec (Canada), and as Daniel Roberge discussed in his reply. Therefore, 'survey accuracy' is obviously a strategic issue for land administrators. We suggest it requires careful thought, whatever the chosen accuracy requirements are.

Towards 'Idealisation Precision'

In countries where land information systems, as Clarissa Augustinus states, of completely different design are necessary, three aspects of accuracy still have to be addressed. Firstly, most would agree with the final conclusions of Mathias Lemmens: putting money into cadastres in areas - many of which are remote - where no problems exist with tenure security and where there is little reason for government to bother citizens with land taxation, land use planning or resource-management measures is most likely wasted effort.

Secondly, in other areas, where recording of many types (although not explicitly mentioned in the paper, we are fully aware of legal pluralism: private, customary, public, informal) of property rights is useful, and - in 2034 - measurement tools provide high precision as a standard, it still needs to be understood that the final precision of a surveyed boundary point is not only dependent on the precision that the survey tool delivers, but also on the precision with which the boundary can be identified. This so-called 'idealisation precision' differs for the corner of a stone house, a ditch and the middle of a river (Figure 1). The nature of the boundary thus largely determines the point precision achievable. Hence, using precise measurement devices does not necessarily mean that the boundary can be surveyed at millimetre level, and this was not the intended suggestion of the FIG 2010 paper. Instead, these tools make modelling possible: on the one hand, high survey-tool precision is delivered and we can manage complex 3D urban spaces and, on the other hand, boundaries can still be modelled and defined as they feature in some developing countries: at the appropriate level of 'survey accuracy'.

Land Conflicts

Thirdly, in many countries the judicial system is clogged with land conflicts. In the 2003 World Bank Policy Research Paper 'Land Policy for Growth and Poverty Reduction', Klaus Deininger states:

"...In line with the impact of land rights on economic outcomes and environmental sustainability, insecurity of land rights can have a disastrous impact on social relations and governance. For example, land conflicts account for a huge share of court cases in countries such as Mexico, Nicaragua, Sri Lanka, Cambodia, and Ghana. In Cambodia, more than 50% of all court cases and 85% of all cases presented to the Commission on Human Rights were related to land. Even in Indonesia, land disputes are reported to account for 65% of all court matters. Land disputes clog up the courts in Ghana and Niger, impairing the ability to provide effective justice in other areas as well. The large amount of unresolved land conflicts, together with arcane planning regulations, have long been identified as a serious impediment to (foreign) investment and development on what are often the most valuable lands in the country. In Central America, unresolved conflicts imply not only that many of the most productive (rural and urban) areas remain unutilised."

The overarching conceptual problem here is the difference between the notion of the law of what a boundary is and the physical feature in reality. As the law presumes a boundary as a line on earth without dimensions, it does not accept that the boundary can be 'here, but may be also there...'. Explanations about idealisation precision, survey precision and reliability strips are normally wasted on judges. A short story (written by the late Dutch novelist Harry Mulisch) contains an amusing example: since a car-accident victim lies exactly on the black line on the map representing the 2.5-metre-wide boundary between two municipalities, neither municipality is willing to send an ambulance. The story is of course fictional but it illustrates how surveyed boundaries promote fewer land conflicts than a survey line which may be highly inaccurate or even absent.

Concluding Remarks

Debates on 'survey accuracy' are not new in the field of cadastral science and land administration. Over recent decades, costly land administration interventions and their mixed outcomes have resulted in the term 'survey

accuracy' being confused, misused and politicised. This should not stop us from entering into dialogue: developments in measurement tools will be an important determinant for the makeup of any future cadastres.

Acknowledgements
The authors would like to acknowledge the assistance of Mathias Lemmens in helping them to put this article together.

Further Reading
- Bennet, R., Rajabifard, A., Kalantari, M., Wallace, J. 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, 11th-16th April 2010, pp. 1-15.
- Bennett, R., Kalantari, M., Rajabifard, A., 2010, Beyond Cadastre 2014: Let the Dialogue Begin, *GIM International*, vol. 24, no. 7, pp. 25-27; reprinted in: G*IM International*, FIG Special Issue, May 2011, pp. 7-9.
- Lemmens, M., 2010, Towards Cadastre 2034, Part I, *GIM International*, vol. 24, no. 9, pp. 41-49; Part II, *GIM International*, vol. 24, no. 10, pp. 37-45; reprinted in: *GIM International,* FIG Special Issue, May 2011, pp. 11-23.

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