Improving Cadastral Quality Management as a foundation for Citizen's Trust

Bar-Maor, Netherlands

Key words: Cadastre, Quality, GIS

SUMMARY

Cadastral datasets often suffer from quality issues, common issues are demonstrated from publicly available datasets and include: topological issues, misalignment, attribution blunders, measurements blunders and poor (or unknown) spatial accuracy. For authoritative cadastral data to be adopted, it must be easily accessible, current and provide quality metrics to citizens and stakeholders.
Different parcel types (or 'RRR') should have different properties and behavior which is enforced by a configurable rule engine. Errors are created when the rules are executed to produce a clear operational pictures and metrics of the issues at hand. Each error type can have a set of predefined fix methods that can be applied automatically to thousands of errors. More complex issues can be addressed by providing a step by step workflow. Certain errors can be marked as exceptions for maximum flexibility.
The system should also be able to prevent bad data from being created in the first place without be too constrictive. Finally, the cadastral data, together with the issues, is shared with citizens and stakeholders in real time as a visual map that can be consumes on any type of client: desktop, web and mobile devices..

Improving Cadastral Quality Management as a foundation for Citizen's Trust

Bar-Maor, Netherlands

1. MODERN EXPECTATION FROM A CADASTRAL SYSTEM

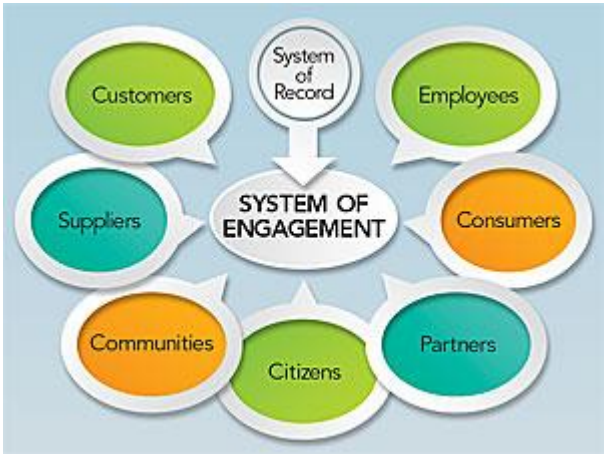
Most cadastral agencies are mandated by law to be the authoritative source for cadastral data. Since no other organization can compete for providing these type of services, many agencies have allowed their organization to fall behind modern expectations.
Would a person checking their bank account expect to get the balance a few months after the requests, in a format that can only be read by special tools and special professionals, without the ability to provide any feedback and with a questionable degree of reliability? Of course not. Cadastral systems must step up to modern expectations:

- **Current** – ability to easily access and view data in real time.
- **Reliable** – data provided must be reliable and communicate ambiguities and conflicts.
- **Transparent** – while some properties of the cadastral objects are confidential by law, many are not. Greater transparency into the information and the processes, the motivation behind each step can ease the pressure by setting the expectations for the duration each step takes.
- **Easy to interpret** – providing raw data in cryptic formats that can only be understood by a handful of licensed professionals hinders economical development. The data needs to be accessible from any device and served as an information product that is easy to use and understand. While regulation might mandate a black and white map with traditional symbols, the public would expect to be able to locate themselves using the location on their smart phone, see a colorful map that is meaningful and use meaningful basemaps.
- **Feedback** – a good system is a system that is open for criticism and allows the public to report issues. Many modern navigation systems include this type of features which allows the data providers to improve their keep up with changing reality which in turn improves the public trust in their system.
- **Quality indicators** - cadastral data is not homogenous in nature. Communicating the metadata for quality such as data source, expected spatial accuracy, known issues and conflicts are just as important for trust building. With increasing resolution and spatial accuracy of imagery it has become very easy anyone to detect issues in the cadastral data.
- **Best practice** – cadastral processes have to well defined, documented and support educated decision on every level. When different outputs are generated with the same inputs by two different cadastral experts, it results in mistrust in the process. This also means it makes it hard to automate.

- **Constraints** – a good system is a system that prevents bad data from being created. New data is evaluated and rejected when it does not meet criteria. It is more cost effective to reject bad data from coming in than to try to detect it and make a decision at a later point of time. This can occur from the data collection process in the field (collecting a new coordinate) to more complex processes such as digital submission.
- **System of systems** – since there is usually one authoritative source for cadastral information, any other system that uses cadastral information should have access to relevant data and use it when curating other datasets (E.g. zoning, administrative boundaries). Another aspect is to easily integrate the cadastral system to other systems and makes other relevant data easily accessible. Examples of such systems include an ERP system, document management system, registration, evaluation, billing system.
- Insights – cadastral data can be mined to yield many insights if properly mined. Identifying trends and hotspots, areas that require quality improvements can save resources and help mobilize resources to where they are most needed. Providing insights to stakeholders and the public can also help the land to be used most effectively.
- **Timely** – many of the processes used today use a set of isolated tools/systems making it hard to monito rand estimate how much a process would take. Automating key steps and monitoring them can shorten the duration for a process while keeping all parties informed. Saving time means existing resources can be used more effectively. Do more and better with less.
- **Engagement** – a good system is a system that engages to provide immediate benefits. 'Adopt a parcel' can be used to encourage an entry point to crowd source cadastral details, taking pictures of geodetic control points and other relevant cadastral physical evidence. Engaging the public not only benefits society but also build up trust.

1.1 System of Record, System of Engagement, System of Insight

Cadastral systems have been using GIS technology for decades as a system of record. In today's world , however, that is not enough. To make the system of record more valuable, the information it holds must be shared with a broader audience in a collaborative way. In other words, the system of record needs a system of engagement. A system of engagement allow more people and stakeholders to share and understand complex data and provide the benefits of geography. To engage more people the system of record needs to also include ready to use apps, content, capabilities and GIS infrastructure so everyone can visualize, analyze, and collaborate using maps – anytime, anywhere and on any device.
Systems of records are good in collecting and maintaining information. System of engagement empower everyone by providing access and understanding, within the organization and externally.



A system of engagement leverages a system of record and impacts more people within and across organizations.

2. BUILDING A SYSTEM FOR THE NEXT 20 YEARS

2.1 Service Oriented Architecture

Service oriented architecture (SOA) using services to access data and information products. Cadastral systems always consist of multiple business system, SOA also makes it easier to ingrate between the systems without locking them down. The service can be seen as a contract between the systems and as long it is not violated each system is free to get upgraded.

Services also allow information to be ascendible on anywhere on any device at any time. Using standard formats that can be easily used, there is no longer the need to connect to the actual data. Instead, users connect to an abstract form of the information, in form of a layer, map or application.

A service based environment is also used to manage identity and privileges, user have to authenticate first. Managing the groups, roles and permission is centralized and statistics can be derived for system optimization.

Using services is already a common daily practice for many of our daily life from email cloud services to checking the balance of our bank account. We can access this type of information from any type of client, in real time without saving a local copy.

SOA also reduces the amount of ETL (Extract Transform Load). There is no reason to download a stale copy of the data when it is always available

Service can be shared in different formats and meaningful apps to drive adoption. Transactional operations can also be exposed as services, thus moving the 'heavy lifting' from the client to the servers.

New services and meaningful apps can be introduced in an agile manner based on the rapidly changing needs of society and the professional community.

2.2 Fit for All

A cadastral system has to be built for a specific purpose and business requirements, known as 'Fit for Purpose'. A good system however can be readily available, configurable and adapted to changing requirements. A good system can provide the tools to grow along the continuum of requirements for 3D, coordinate based cadastre, parcel lineage and many other aspects that can change over time as the system matures. A good system does not lock down the organization but grows with it.

2.3 Assigning behaviors for the RRR

Different parcel types or spatial units, can have different behavior, such behavior can be modeled through a set of rules that either prevent bad data from being created and/or validates existing data against the set of rules. The parcel engine defines parcel behavior which can be relates to spatial relationships (e.g. – can certain parcel type overlap) and attributes (e.g. – is the legal area too different from the calculated area or geometry). When a parcel 'misbehaves' errors are generated by the parcel engine. Each error is associated to typical fix methods and in some cases certain fix methods could be applied automatically for specific scenarios. And since we are dealing with cadastral systems, it is fair to assume there are also exceptions, in which case errors could be marked as such.

2.4 Configurable system that improves over time

Many cadastral agencies are locked to technology from 20 and more years ago. This is usually a result of heavy customization which not only prevents the organization from meeting modern requirements but also puts the data at risk. A preferred system is a system that is configured and can keep up with updates on a routinely basis. Such a system can keep up in future advances in technology that cannot be anticipated at the moment.

2.5 Security and authentication

Another key aspect to building trust in a system is knowing who can access and modify the information. A good system of record requires identity to audit changes. Groups and roles define access level and every edit: insert, update and a delete are tracked. Using roles makes it easier to manage permissions and make sure only certain groups can modify the data. Abstracting the information through services also reduces the number of resources that have access to the backend database, thus reduce the security risks. Through data encryption, use of PKI (public Key Infrastructure) a certificates the system can be secure.

2.6 4D - trusted over time

Cadastral systems a time dependent and change over time. Parcels chave over time due to record driven workflows (merge, splits, subdivision etc.) as well as due to quality driven workflows such as using improved coordinates for control points and running constrained weighted least squares adjustment. For the data to be trusted, changes over time should be transparent and anyone should be able to display any moment of time. The ability to view the information in 2D or 3D for any given time improves trust as well as quality and efficiency.

2.7 Vetted by the Crowd (stakeholders)

Agencies need to adopt an agile mentality, engage the stakeholders to better understand how and why the information is needed instead of making false assumption. Catering to requirements by stakeholders will ensure the system becomes more relevant.

2.8 Conclusions and future work

A new GIS infrastructure is being developed in Esri to address the business needs for the next 20 years. It uses state of the art service oriented architecture and cutting-edge technology. It will provide the tools to access, access and fix cadastral information. Increasing quality and transparency is key for public and stakeholder trust.

REFERENCES

Hagemans, H.J. 2017, ***The Cadastral map of The Netherlands improved***

Land Information New Zealand, 2014. ***Cadastre 2034: A 10-20 year Strategy for developing the cadastral system. New Zealand Government.***

ICSM 2014, ***Cadastre 2034 Powering Land & Real Property, Cadastral Reform and Innovation for Australia - A National Strategy***

Enmark, Slliford Bell, Lemmen, McLaren 2014, ***Fit-For-Purpose Land Administration***

Storer, J. 2004. ***3D Cadastre . Delft, The Netherlands.***

BIOGRAPHICAL NOTES

https://www.linkedin.com/in/barmaor/

CONTACTS

Amir Bar-Maor
Esri
Stationplein 45
Rotterdam
NETHERLANDS
Tel. 00 31 10 217 77 88 ext. 1953
Email: abarmaor@esri.com
Web site: www.esri.com