Rebuilding the cadastral map of The Netherlands, overall concept & communication on geometric quality

Eric HAGEMANS, Anouk HUISMAN-VAN ZIJP,
The Netherlands

Key words: cadastral map, communication, (visualization of) geometric quality, automation

SUMMARY
The Dutch Cadastral Map has been around since the early 19th century and fits the designed goal perfectly: it is a complete and topological correct index to the cadastral registration. However, the so-called graphic quality of about half a meter doesn't show on the map and it doesn't seem to be enough in a future where people want to use it as a map and zoom in and establish the exact location of their boundaries themselves. The related uncertainty of the parcel size is also an issue. Therefore Kadaster defined a wish for a cadastral map with better geometric quality and clearer communication about its quality.

It quickly became apparent that to be able to create such a map the original field documents must be used. Technically and financially it is a very big challenge to automatically digitize these documents. After a market survey we started a research project in 2017 where many different aspects (legal, communication, geodetic, organizational, etc.) were studied. The focus however was first on the most critical aspect: the question whether the millions of original analogue field documents could be read automatically. Two companies realized a proof of concept in which they proved that it is possible, but not 100% automatically. We continued by contracting experts from both companies who, together with our own staff, succeeded in building a prototype that is able to both read the documents and connect them together to a new geometry of a cadastral map. The solution is based on artificial intelligence.

Field documents
A field document contains the surveyors sketch of the measurements. The content of a field document is very complex, it is usually handwritten and with a flexible map scale. Extracting structured information from such documents demands different steps for an automatic algorithm: image improvement, line detection, point definition, recognition and reading of measurement numbers and the link between these numbers and two points (begin & end). The result of this process is a digital drawing on scale with structured measurement data. In this process manual checking and correction is still needed.

Geodetic concept
A second large process is the positioning of this line pattern in the national reference system and the connecting of the different field results to each other. The geodetic concept is based on the Delft method of testing where quality control is performed in all steps of the process. This starts with the adjustment and testing of the measurements of the many small survey projects individually, of which the measurements are stored in the field documents. After georeferencing the survey projects grow together by connecting them using corresponding points in the overlap between the projects. These corresponding points are often cadastral stones, iron pipes or corners of buildings. All measurements are weighted and the so-called idealisation precision is accounted for in relation to the type of point. With every newly added project the redundancy improves, the network is re-adjusted, and the

measurements are statistically tested. In this way the geometric base for the new cadastral map is being built while errors in the measurements are eliminated.

The main challenges in building the geometric base for the new cadastral map are: the large number of field documents and the variability of their content, the relatively large number of errors in combination with an average redundancy in individual survey projects that is quite low, and how to cope with the limitations in network size as a nation-wide integral adjustment is not feasible.

Currently we are in the middle of a pilot project in which we will produce about 5 to 10 thousand digitized field documents to create a new cadastral map geometry in order to get decision support information. We are already busy preparing a new infrastructure to store the new geometry called Reconstruction Map (not yet being the current cadastral map).

Communication with the public
Now that the technical solution is in the making, the next step is to coach the public in using and understanding the current cadastral map and the new reconstruction map properly, so making the public understand the geometric quality of the data shown. This poses a big risk of damaging the public confidence in the Kadaster. Because although we are improving on the quality of our data in this project, the public for the first time will become aware of the quality of the data and therefore might perceive it as a quality loss. Therefore a good communication strategy plays a key-role in this process.

The legal and communication aspects are being examined at this moment. We are developing an introduction process with a public awareness campaign and legal answers to difficult questions with the change of parcel sizes as the most delicate one. Also the concept of do-it-yourself reconstruction is developed. At the moment we are moving from research to decision making, so we are still in the process of describing all the benefits for society.

Communication on geometric quality
Explaining geometric quality to the public is not easy because it is the result of a mathematical process. The challenge is to make clear what the result of your actions is, to explain it as simple as possible while still using correct descriptions. De-mythification of the used methods is therefore needed.

A simple example of explaining is by using a reliability strip: a zone in which the searched boundary can be found. For the current cadastral map such a strip is half a meter wide in urban areas and one meter in rural areas. This way you have an easy story for connecting the boundary representation on the current cadastral map to the real life situation. For the newly built and improved cadastral map it is important to explain what quality can be expected. We know the standard deviation (σ) of the absolute position (compared to the national coordinate system) is at least 5cm. This means a strip of 2σ = 10 cm minimum, and with a 95% reliability (4σ) even 20 cm!

What we want the public to understand, is that people should expect a 10 cm strip and not 1 cm or even better quality. While this may disappoint some persons, we feel strongly that open communication on this subject will be appreciated in the end. As a preparation for that we already show more metadata about the geometric quality in the current map.

Besides the reliability strip, we are currently designing a system of classification of the quality so the public can have a better overview of the geometric quality. This classification will be derived from

the quality aspects that are stored to individual points. We already developed some default schemes to describe difficult situations in an easy way.

As the examples above show, there are many ideas on communicating the cadastral data quality, but this is still an ongoing process. Although these strategies are being developed specifically for this project, they can also be used on other spatial Key Registers in the Netherlands, because the same issues with understanding data quality exist there as well.

Eric Hagemans
Overall architect KKN program

Anouk Huisman – van Zijp
GIS-expert and Dutch representative QKEN

BIOGRAPHICAL NOTES

Eric Hagemans has been working as a geodetic specialist and innovation advisor at Kadaster in The Netherlands since 2014. He is responsible for the content of the KKN program and for the innovation of cadastral surveying and corresponding registrations. Before he worked as teacher and manager at the University of Applied Science in Utrecht and as geodetic engineer at the engineering companies Arcadis and Sweco. He studied geodesy at the Technical University in Delft.

Anouk Huisman – van Zijp is a member of the production and innovation team of the Key Register Topography at the Dutch Kadaster and as such a representative at the Eurogeographics Quality Knowledge Exchange Network (QKEN). She earned her Master of Science in Geomatics at Delft University of Technology and has worked both nationally and internationally in the geo-information field.

CONTACTS

ir. Eric Hagemans
Kadaster
Hofstraat 110
7311 KZ Apeldoorn
THE NETHERLANDS
tel: 00 31 88 183 45 87 (office)
tel: 00 31 6 21 71 20 49 (mobile)
mail: eric.hagemans@kadaster.nl

ir. Anouk Huisman - van Zijp
Kadaster
Hofstraat 110
7311 KZ Apeldoorn
THE NETHERLANDS
tel: 00 31 88 183 38 40 (office)
tel: 00 31 6 52 48 19 13 (mobile)
mail: anouk.huisman-vanzijp@kadaster.nl