The Use of Panoramic Photos in the Production Process of Topographical Data

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SUMMARY

In 2010 the Netherlands' Cadastre, Land Registry and Mapping Agency (Kadaster) started a pilot on the use of panoramic photos in the production process of topographical data (TOP10NL). The pilot serves two goals: to make the existing production process more efficient and to increase the actuality of the topographical products of the key registry on medium and small scale topography (BRT).

The pilot shows the value of panoramic photos in relation to the current production process of topographical data. The main advantage is the realization of an integrated work process which can be executed mainly at the office. The need for field survey is reduced and the impact on the IT infrastructure of Kadaster is relatively low. The main disadvantage of panoramic photos is the coverage; only photos taken from public roads photos are available.

SAMENVATTING

In 2010 is het Kadaster begonnen met een pilot om panoramische foto's te gebruiken in het productieproces van topografische data (TOP10NL). Dit dient twee doelen: het efficiënter maken van het productieproces en het verhogen van de actualiteit van de producten van de basisregistratie topografie (BRT)

Uit de pilot blijkt het gebruik van deze panoramische foto's van toegevoegde waarde te zijn op het huidige productieproces. Het grootste voordeel is dat er een geïntegreerd werkproces ontstaat dat grotendeels op kantoor uitgevoerd kan worden. De noodzaak voor veldverkenning is afgenomen en de belasting op de IT infrastructuur van het Kadaster is relatief klein. Het grootste nadeel van panoramische foto's is de dekking; alleen foto's genomen vanaf openbare wegen zijn beschikbaar.

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1. INTRODUCTION

The Netherlands' Cadastre, Land Registry and Mapping Agency (Kadaster) has an essential role in the Dutch Spatial Data Infrastructure and the system of Dutch key registries. Among other tasks Kadaster is responsible for the maintenance of the key registry on medium and small scale topography, the *Basisregistratie Topografie* (BRT).

1.1 Topographical products

The Netherlands has two spatial key registries for topography. Apart from the BRT the key registry for large scale topography is currently in development. This key registry is called *Basisregistratie Grootschalige Topografie* (BGT). The production and maintenance of the BGT is decentralized, with shared responsibilities for multiple governmental institutions.

The BRT is the Dutch key registry for medium and small scale topography and is maintained solely by Kadaster. The Ministry of Infrastructure and the Environment is client of the BRT and oversees Kadaster on the financial and legal aspects of the BRT. The use of the BRT is mandatory for all governmental bodies in the Netherlands and it is widely used in other sectors like utilities, transportation and defence. The medium to small scale products of the BRT are used for analysis as well as orientation.

The BRT is in a transitional phase towards a multi-scale object oriented database. It consists of multiple products suitable for different scale ranges. The largest scale in the BRT product range is TOP10NL, with a scale of 1:10,000. The object-oriented TOP10NL is the base from which all other BRT products are derived. These other products of the BRT include vector and raster products. Currently there is no direct linkage between TOP10NL and the large scale topographical key registry (BGT), as the latter is still under development.

Figure 1. Extract of TOP10NL: Canals of Amsterdam (Kadaster 2012)

1.2 Goals

In the program plan for the BRT 2011-2012 strategic goals are formulated (Kadaster 2011). These goals are divided into three classes: meeting (new) legal obligations, more efficiency and product improvement. This paper will focus on two (sub)goals. The first goal is to make the production process of the BRT more efficient, the costs of maintenance should be reduced with 25 percent. The second goal is to achieve a higher actuality of all BRT. A production cycle of maximum two years is required. This meets the expectations of both the Ministry of Infrastructure and the Environment as well as the customers of the BRT.

2. CURRENT PRODUCTION PROCESS

The TOP10NL database is maintained by updating the existing database for changes in the landscape. This is achieved by integrating external data, field surveying and interpretations of aerial photos into the existing database. The bulk of the production process of TOP10NL is based on digitizing aerial photos, a common methodology for the production of medium and small scale topographical maps (Heywood 2006).

2.1 TOP10NL updating process

TOP10NL is updated by a reviewing cycle. The Netherlands (total land area of 41,528 square kilometers) is divided into map sheets. An average map sheets measures 10 by 6.25 kilometers equaling 62.5 square kilometers. Updating is executed per half map sheet, comprising 31.25 square kilometers. At any given moment a geographical continuous area

consisting of between 70 and 100 half map sheets (between 2187.50 and 3125.00 square kilometers) is under revision. This is roughly 6.5 percent of the total area of the Netherlands.

The main part of the updating process is based on aerial photos. It is executed by comparing aerial photos with the current TOP10NL data. The detected changes in the landscape are edited in the database.

2.2 Use of aerial photos

The aerial photos that are used in the updating process are produced by a commercial aerial surveying company. There are two types of aerial photos: orthophotos and epipolar photos. Both types originate from the same base aerial imagery. These base images are taken from an airplane with a high resolution perpendicular mounted photo camera.

2.2.1 Orthophotos

Orthophotos are aerial photographs taken at a straight angle. By means of transformations the source images are adjusted for topographic relief, lens distortion and camera tilt. Multiple photos are mosaic-ed together into a seamless file that forms a continuous surface. The end result is a geometrically correct orthophotomosaic with respect to map scale and projection. This product has a spatial resolution of 10 centimeters. Because the orthophotos are adjusted for topographic relief it is the ideal base to digitize ground level elements like terrain, water and roads.

2.2.2 Epipolar photos

Epipolar photos are produced from the same images as the orthophotos. Instead of using transformation techniques to make an orthophotomosaic out of different images, two adjacent images with a spatial overlap of 60 percent are used as input. With the use of specialized hardware and software, depth can be perceived by the operator. This makes epipolar photos the ideal source for digitizing buildings. Like the orthophotomosaic, the spatial resolution is 10 centimeters.

2.3 Topographical field surveying

In some situations the use of aerial photos is not sufficient enough to detect changes in the landscape. For example the terrain is obscured by trees or high structures. In these cases a view from street level is needed to achieve a more complete overview of the lay-out of the landscape.

These unclear situations are marked in the database during the update process of the half map sheet and are later examined in the field survey. By using a field computer these locations can be edited on site. This is a very time consuming and therefore expensive part of the production process of TOP10NL.

3. PILOT PANORAMIC PHOTOS

In 2010 Kadaster started a pilot to use panoramic photos in the production process of TOP10NL. These images are intended to help interpret the landscape at the office, thus reducing the need of field surveying.

3.1 Panoramic photos

The term panoramic photo is used to describe 360-degree panoramic photos that are taken from street level, approximately 1.80 meters from ground level. This panoramic photo is a single seamless and spherical photographic file in which can be panned and zoomed in all directions. Through navigating a clear overview of the landscape can be obtained. The panoramic photos are geographically referenced, so they can be used in a GIS environment.

Figure 2. Example of a panoramic photo: Groningen Central Station (Cyclomedia 2012)

The panoramic photos are bought from a commercial company, the same company that also provides the aerial imagery. They offer panoramic photos covering the whole of the Netherlands. These panoramic photos are taken from public roads and waterways, with a specialized camera mounted on a boat, a car or a tricycle that follows linear routes. The distance between two recordings is five meters. All the public roads in the Netherlands are covered yearly, resulting in an actuality for each location of maximum a year. Each year approximately 25,000,000 recordings are made in the Netherlands. This results in an average of 600 recordings per square kilometer. The historical recordings are also stored and can be used to track changes in the landscape over time.

Figure 3. Surveying car with photographic equipment (Cyclomedia 2012)

3.2 Application of panoramic photos in the updating process

The review and updating process of TOP10NL is still based on aerial photos. Per map sheet changes in the landscape are detected on aerial photos and altered in the database. When a situation can not be clearly interpreted from the aerial view, panoramic photos of that location are opened in a web browser. Combining an areal view with a street level view provides a good method to interpret the landscape and edit the changes in the TOP10NL database within an office environment.

3.3 Advantages of panoramic photos

The incorporation of panoramic photos in the production process of TOP10NL results in an integrated work process. Because more of the landscape can be interpreted at the office behind the computer, there is less need to execute field surveying. This has positive effects on both the hours spend per half map sheet as well as a more effective and controlled planning schedule.

The panoramic photos are produced by an external data provider that also hosts the database and the website from where they are viewed. This minimizes the impact on Kadaster's own IT infrastructure. Also, by reducing the need for field surveying with the use of field computers and checkout mechanisms, it lowers the pressure on the IT infrastructure of Kadaster.

3.4 Disadvantages of panoramic photos

Panoramic photos are, just like aerial photos, a temporary representation of the landscape. Although the panoramic photos are acquired from the same company that supplies the aerial photos, the recording dates of those two datasets are not similar. This is a result of different production processes and according planning. The difference in recording date can become problematic with changes in the landscape that occurred in between these two recordings. In these situations the aerial photos are leading. Interpreting the landscape by means of field surveying is in that respect more correct and up-to-date.

The benefit of an external supplier is a disadvantage as well. Kadaster is depending on the quality and stability of the provider's IT infrastructure. Also the data specifications are controlled by the supplier. For example only roads that are paved and publicly accessible are

covered by panoramic photos. Unpaved and (semi-)private roads are not covered. This results in a lack of panoramic photos in areas like forests, while in forests the use of panoramic photos is explicitly helpful because of the covering canopy.

4. CONCLUSIONS

The use of panoramic photos in the production process of TOP10NL is of additional value. Combining these street level images with aerial photos creates an integrated updating process that can be executed at the office. The need for field surveying is reduced. This helps achieving the two described goals: a more efficient production process and a higher actuality.

4.1 Future developments

The results of the pilot are very positive and Kadaster is continuing the use of panoramic photos.. The shortcomings need to be addressed. There are two main focus points. First, a stable and controlled IT infrastructure needs to be realized. Secondly, the product specifications need to be more aligned with the requirements of Kadaster. For example a higher coverage rate for unpaved and (semi-)private roads is welcomed.

The use of panoramic photos in the topographical production process at Kadaster will be prolonged until 2014. It is regarded as an important factor to achieve more efficiency in the production process as well as assuring an actuality of all BRT products of maximum two years.

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BIOGRAPHICAL NOTES

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