Methodology to improve urban cadastral cartography in the Spanish Cadastre

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Are the legal boundaries vey different to the fiscal ones?

.............If you have a continuous map with legal and no legal parcels without gaps and overlaps........ then they must be very similars.

...if the map that Finland cadastre shows to users is de cadastral index map......if you want to improve the quality ............................ This means improve the quality of the cadastral index map
If there are the digital coordinates but they are different and less precise that the surveyor maps.............why not try to improve the digital ones,.......is possible?

Why to keep 2 different?

Digital It is continuous ......isn’t it more efective that one by one?

If the reliability is what users use

Is the reliability the legal boundary or the cadastral index map?
- Administrative Register (Ministry of Finances)
- Available to public policies and citizens requiring information from the Territory (by Law)

The cadastral description of the real estate will include its physical, economic and legal characteristics as location, cadastral code or ID, surface, use, crops, cartographic representation, cadastral value, titleholder, etc.
Main task for the Spanish cadastre: Valuation
Our values are the base for taxation
Main income for municipalities

The Cadastral GIS

The cadastre has information on all rural and urban parcels in a **homogeneous way, as a territorial continuum,**
Spanish law establishes that the Cadastre is a register describing rural and urban real estates.

- **Real Estate Identification data:**
  - cadastral reference, province, municipality, addresses or location.

- **Juridical data of real estate:**
  - Titleholders’ name and national identity number, addresses of titleholders and the notification address, date of acquisition and rights data....

- **Physical data of real estate:**
  - land area, buildings area, class of crops, coordinates, conservation status, use (legal and actual one), construction typology, year of construction.....

**Economic data of the real estates:**
value of land, value of construction and cadastral value, criteria and valuating module, real estate taxable value, exemptions and benefits.
Because we are a fiscal cadastre. We cannot have only information about the parcel or the building, we need more information. We need the information inside the building, the distribution of each property, the common areas etc...
For every building we have a document with scaled graphic representation of the properties forming an urban real estate building.

All the different floors and interior spaces are represented.

Also a digital photo of the building

This document is stored in the system as documental information and link up to parcel data by means of the cadastral reference.
Based on modeling by extrusion on the basis of cadastral mapping and the attribute of construction geometry to get the "z" component

Based on the generation of independent units models with the vector information of the cadastral sketch by plants
4D cadastre....3D + time
Cadastral Cartography

More than a century of cartographic works
• Topographic survey
• Photogrametry
• In 70’S urban maps over topographies maps
• In the 90’S to 2002
  • Orthophotography and field Works to update rural maps
  • Digital cartography
• From them digital maintenance

In 2004: cartography in internet
TOPOGRAFÍA CATASTRAL DE ESPAÑA.
PROVINCIA DE MADRID.
PARTIDO JUDICIAL.
COLMENAR VIEJO.
Ayuntamiento
Fuencarral.
Término
Fuencarral.

HOJA KILOMÉTRICA K.I.
Escala: 1:2,000 - 0,0003.
Las cuadriculas de líneas finas representan
áreas; las de líneas gruesas hectáreas.
las curvas de nivel equidistan cinco metros.

Situaciones.
From 2004 The cadastral maps are free and open to everyone for viewing and download, 24x7

Annual maps download: over 180 M
Cartography in electronic website

We have continuous cartography of all our territory of management (almost 500,000 km²) available through the electronic office, viewer that allows users to navigate from an overview of the complete territory to approach each one of the parcels and units and also through the map access to the most relevant alphanumeric characteristics of them.

https://www1.sedecatastro.gob.es/Cartograf/ia/mapa.aspx
The fiscal Cadastre has become a Multifunctional Cadastre

Legal security and fraud control in real estate traffic:
Location and identification of the properties.
The cadastral reference as "Real estate identifier" in deeds- Rg. Property / Taxation/ Contracts / Valuations

Social and aid policies
Energy reports
Policies, infrastructures, services

• Urban planning, land use
• Networks of services and supplies
• Agrarian, environmental, building features
• Other rights, limitations and restrictions
• Risk maps, civil protection, emergencies
• Linking or support of statistical data (geo-statistics)
The fiscal Cadastre has become a Multifunctional Cadastre

This multiple use of the cadastre introduces requirements:

- New attributes and characteristics
- Link of the basic unit (cadastral parcel, building, real estate) with other object or attributes
- Necessity of geo-referencing and location of the events, acts, business and in general phenomena that occur in the territory

Need of a greater homogeneity of information (standardization and interoperability)
Need of access and exchange of cadastral information
Need to ensure a minimum quality of the cartographic data
To give real estate traffic greater legal certainty by incorporating the georeferenced graphic information of the parcels in the Property Rights Registry,

- the cadastral map as the basis of its graphic representation,
- allowing simultaneously the updating and correction of the cadastral data.
The cadastral cartography is the basis of the Property Rights Registry

Once the cadastral data is coordinated by the Property Rights Registry, the delimitation, location and area of cadastral data are considered to be true for all legal purposes.

It oblige us to improve our quality
The cadastral cartography

- COMPLETE and UPDATED
- CONTINOUS
- OFFICIAL, IT HAS PRESSUMTION of CERTAINTY
- GIVES TRANSPARENCY AND SECURITY TO REAL ESTATE TRAFFIC
- OBTAINED ACCORDING TO STANDARD IN COLLABORATION
- WIDELY USED, PUBLIC, FREE, ACCESIBLE.

Atribute quality control
Graphical quality control
Topological quality control
Cadastral basic data / Daily updating

Urban Cadastre

- 1.062.636 ha maps 1/1.000 o 1/500
- 12 M de buildings
- 14 M cadastral parcels,
- 39 M urban units
- **6.500 real estate updated daily, 480 new constructions**

Rural Cadastre:

- 47.387.942 ha maps a 1:5.000
- 39,2 M parcels
- **2.500 real estate updated daily**
Compulsory Declarations of titleholders

Institutional collaborators
- AGRICULTURAL MINISTRY
- NOTARIES
- PROPERTY RIGHTS REGISTRARS
- SPANISH TAX AGENCY

Collaboration agreements with municipalities and local and regional authorities

Communications and supply of information from public administrations and other organisations; Public Domain managers, expropiations, land consolidation, highways, railways, etc.
In addition, the management and maintenance model can increase the differences:

- Plurality of actors: surveyors, architects, others
- Different sources of information:
  - sketches, photos, plans, maps, of different quality, scale,
  - Different procedures.

**Consequence:**
the quality of the data can be very different.
In Spain there are not licensed surveyors and it is not obligatory to mark boundaries in the ground.

But any alteration of the real estate must be declared to the cadastre.

Mostly, when the parcels have physical changes, it is a surveyor who include the new coordinates in the cadastre contracted sometimes by citizen but mostly by other public administration.
New cartographic tools

• Change in cartographic technology: GIS, WEB services.
• Evolution of measuring devices: Decrease in size, costs, times, increase precision.
• Photogrammetry: multispectral sensors, cameras and digital images, automated processing, automatic correlation.
• Orthophotos, true ortho, LIDAR, mobilemapping
• Satellite images: Quality, frequency, resolution
• Change detection tools,

All this technology has improved the processes of data collection and also our ability to inspect changes or detect errors
### Normas y estándares de calidad: exactitud posicional

<table>
<thead>
<tr>
<th>Exactitud posicional</th>
<th>Compleción</th>
<th>Presencia y ausencia de fenómenos, sus atributos y relaciones.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consistencia lógica</td>
<td>Consistencia lógica</td>
<td>Grado de adherencia a las reglas lógicas de la estructura de los datos, atributos y relaciones.</td>
</tr>
<tr>
<td>Exactitud temática</td>
<td>Exactitud temática</td>
<td>Exactitud de atributos temporales y de las relaciones temporales de los fenómenos.</td>
</tr>
<tr>
<td>Usabilidad</td>
<td>Usabilidad</td>
<td>Cumplimiento de unos requisitos.</td>
</tr>
</tbody>
</table>

- NMAS - National Map Accuracy Standard (USGS 1947)
- EMAS – Engineering Map Accuracy Standard (ACSI 1983)
- ASPRS – Spatial Accuracy Specifications for Large Scale Topographic Maps (ASPRS 2006)
- NSSDA – National Standard for Spatial Data Accuracy (FGDC 1998)
- Método Francés (Orden Ministerio de Equipamiento 2003)
- STANAG 2215: Standardization Agreement, Evaluation of land maps, aeronautical charts and digital topographic (STANAG 2002)
- NORMAS ISO 19157
Improvement of positional accuracy

Some considerations:

• Making new more accurate cartography is very very expensive....impossible

• Improve the accuracy and precision of a map, it is also expensive

• The precisions and scales of the cadastral cartographies must be reasonable and proportional (urban, rural).

• A plan of a parcel, a specific demarcation of a piece of land , .........................................................is not the same as doing all the cartography of the country.

• There are already proven programs to improve the positional component (PAI)
One of the current strategic objectives of the D.G. of the Cadastre

Purpose:
Provide the cadastral cartography of all the characteristics that allow compliance with the provisions of Law 13/2015

Improvement objectives:

• Correction of the cartography in its component of positional accuracy.

• Adjustments necessary to improve the agreement between the cadastral parcel and the reality.

First urban cartography
First step

Study of positional accuracy of urban blocks
Contract private surveyor companies.
Big investment. All territory

• study of errors
• 2018-2020
Previous conceptual analysis: PRECISION, TOLERANCE, ERRORS

• PRECISION: The accuracy of CATASTRAL CARTOGRAPHY responds to the scale and technique used in its survey and to the techniques of subsequent maintenance:

• TECHNICAL TOLERANCE MARGIN: Accuracy of the graphic measurement according to the scale of representation. Defined in catastral regulation

• ERRORS OF GYRATION AND DISPLACEMENT: Between the plot and the cartographic support base used.

• POSITIONING ERRORS: Between the coordinate of the plot and the measurement on the ground

• Cadastral Survey
  • On restituted topographic basis.
  • On images basis (orthophotos, aerial photo)
  • From documents (reparcelling, projects, etc.)
  • other

Now
Better basic information
The national Plan of Aerial orthophotography (PNOA)

It is a decentralized and cooperative production between the different administrations

Aims to obtain digital aerial orthophotographic images with resolution 10, 25 or 50 cm

With an update period of 2 or 3 years, depending on the zones.

Aerial photography is the obligatory basis for the realization of cartography and geographic information: land occupation, urban planning and territorial planning, cadastre, forest management, hydrography, etc.

Using the same Photogrammetric data, we also achieve a perfect geometric and temporal coherence of the cartographic and geographic databases existing in all the administrations.

7,6 M euros each 3 years
A single photogrammetric flight and rigorous data processing are carried out in compliance with the technical specifications agreed upon by all the participating public administrations that co-financing the production.

<table>
<thead>
<tr>
<th></th>
<th>GSD Vuelo (cm)</th>
<th>GSD Ortofoto (cm)</th>
<th>Exactitud planimétrica de la ortofoto</th>
<th>Exactitud altimétrica del Modelo Digital del Terreno</th>
<th>Paso de malla</th>
</tr>
</thead>
<tbody>
<tr>
<td>PNOA 50 cm</td>
<td>45</td>
<td>50</td>
<td>RMSE&lt;sub&gt;x,y&lt;/sub&gt; ≤ 1,00 m</td>
<td>RMSE&lt;sub&gt;z&lt;/sub&gt; ≤ 2,00 m</td>
<td>5mx5m</td>
</tr>
<tr>
<td>PNOA 25 cm</td>
<td>22</td>
<td>25</td>
<td>RMSE&lt;sub&gt;x,y&lt;/sub&gt; ≤ 0,50 m</td>
<td>RMSE&lt;sub&gt;x,y&lt;/sub&gt; ≤ 1,00 m</td>
<td>5mx5m</td>
</tr>
<tr>
<td>PNOA 10 cm</td>
<td>9</td>
<td>10</td>
<td>RMSE&lt;sub&gt;x,y&lt;/sub&gt; ≤ 0,20 m</td>
<td>RMSE&lt;sub&gt;x,y&lt;/sub&gt; ≤ 0,20 m (con LiDAR)</td>
<td>1mx1m</td>
</tr>
</tbody>
</table>

Características Técnicas
The positional accuracy of cadastral cartography shall be calculated by reference to the orthos of the *Plan Nacional de Ortofotografía Aérea* (PNOA):

- It's official and ensures compliance of the quality controls
- It covers the entire territory
- Accuracy: is considered the minimum standard for cadastral purposes.

Other cartographic products of best quality metric may be used. Prior authorisation by the cadastre.
Study of positional accuracy of urban blocks

The surveyor company must provide:

• Vectors of transformation: identification of homologous points between the cadastral maps and reference cartography or orthophoto reference. Block by block.

• Zones: homogeneous zones of set of blocks with its parameters of transformation for its rectification.

• The level of correspondence of the cadastre with the physical reality
For this, the discrepancies found will be classified according to their typology. Catalog of incidents

• Quality by municipality: prioritization of action.

SHP file, with the homologous points captured in the cadastral cartography and in the reference data source.
After the Study

- We will know the quality of metric positioning of each block of each municipality in the urban cadastral cartography.

- We can evaluate which actions or new cartography must be done

- Before carrying out correcting works, we can notify N+R of the mismatch in each area so that they can take it into account.

- In the zones that are susceptible to transformation we will know what parameters can be applied to make an automatic transformation in all layers of cartography
### Resumen de resultados

<table>
<thead>
<tr>
<th>Total recintos</th>
<th>Total vectores</th>
<th>Manzanas validas</th>
<th>Manzanas transformables</th>
<th>Manzanas mal catastradas</th>
<th>Manzanas no transformables</th>
<th>Recintos con omisiones</th>
<th>Recintos con comisiones</th>
</tr>
</thead>
<tbody>
<tr>
<td>NUM_RE</td>
<td>NUM_VE</td>
<td>NUM_MZ_CK</td>
<td>NUM_MZ_TR</td>
<td>NUM_MZ_NP</td>
<td>NUM_MZ_KO</td>
<td>NUM_OMI</td>
<td>NUM_COMI</td>
</tr>
<tr>
<td>137</td>
<td>527</td>
<td>60</td>
<td>55</td>
<td>17</td>
<td>5</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

### Análisis de parámetros de transformación y residuos

<table>
<thead>
<tr>
<th>Número recintos con masas transformables</th>
<th>Número vectores</th>
<th>Longitud media de vectores</th>
<th>Media RMS vectores</th>
<th>Media RMS transformaciones</th>
</tr>
</thead>
<tbody>
<tr>
<td>NUM_RE TR</td>
<td>NUM_VE TR</td>
<td>LONG M VE</td>
<td>RMS M VE</td>
<td>RMS M TR</td>
</tr>
<tr>
<td>55</td>
<td>234</td>
<td>0,764</td>
<td>0,382</td>
<td>0,363</td>
</tr>
</tbody>
</table>
This is only the first step, the diagnosis.

Then we should decide which blocks are transformed automatically.

Notification to the owners and attention to the allegations ... new surfaces, new values.

Blocks not transformable, individual analysis and field work

And the extend the study to rural áreas, more difficult.
Thanks for your attention!!

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