SIGCA. THE COMPUTERIZED MANAGEMENT OF THE SPANISH CADASTRE SPATIAL COMPONENT.

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Summary:

In 1988 the "Centro de Gestión Catastral y Cooperación Tributaria" (Cadastral Agency of Spain) of the Ministry of Economy and Treasury (Government of Spain), to execute its commitments to create and update the Cadastre, decided to organize a Cadastral Information System and a Geographical Information System to manage the spatial component incorporeted on it.

In 1995, the Cadastral Information System, and SIGCA, is running and it is a good example on how the GIS technology supports cartography and it allows to manage interactively the huge volume of cadastral information, based on 47 millons hectares of digital rural cartography on scale 1/5.000 and 1 millon hectares of digital urban cartography on scale 1/1.000.

At the present communication several components of SIGCA are analyzed:

- Organization and working methodology
- Structure and equipment
- Data typology and quality control
- Data updating
- Education and training
- Data diffussion and standards

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1.- The Spanish Cadastre as a Information System designed to data updating and diffussion.

The Law 39/1988 establishs:

"Cadastre is the set of information describing rural and urban real state by surfaces, location, boundaries, culture or use, quality, values and every physical, economic and juridical features".

Then, Cadastre is an organized real state inventory, as physical description of geographical objects related to a cartography.

In 1987 the Law charged to the "Centro de Gestión Catastral y Cooperación Tributaria (CGCCT)" to make and update the cadastral inventory, and tasks assigned were:

. To undertake the technical work of creation, updating and renewal the rural and urban land cadastre register.
. To analyze and coordinate the proper assessment systems.
. To manage and inspect real state taxes directly or by cooperation procedures agreed with local authorities.
. To produce and analyze statistical information relating to real state taxation.
. To establish and update the Cadastral Information System.

But data volume that must be manage by the Direction General of CGCCT is pointed up by the following figures:

. 10.907.284 urban lots or town properties.
. 32.171.483 buildings elements. These are every differentiate building element where it is possible to establish their building features and value.
. 21.818.039 taxation urban unit. Every one is the set of building elements in a town property pertaining to the same owner.
. 43.083.927 rural parcels. Every one is the set of connected areas of culture or use pertaining to the same owner.
. 57.600.184 rural subparcels, as every area, inside a rural parcel, with a specific culture or use.
. 7.998.279 rural owners.
. 998.500 Ha. of urban cadastral cartography on scale 1/1.000 o 1/500.
. 46.408.957 Ha. of rural cadastral cartography on scale 1/5.000.

These figures get us an idea on the amount of data that must be captured, checked, loaded and updated. This data volume can be processed only by the use of computer tools. This was considered from the first moment when CGCCT

was established, and that was the main reason to define in 1987 an Automatization Project of the CGCCT based on setting up computer equipments in every CGCCT local office.

Law sets that Cadastre making, updating and renewal will be carry out exclusively by State Government through the Direction General of CGCCT, directly or under agreements with Local Authorities, and this Cadastre will be establish as a data base ready to use by every Public Administration.

Reading the last paragraph we can point out that rural and urban real state forms basic land units whose integration could constitute a continuum of land information giving the higher degree of resolution to the whole country. Taking in consideration attributes of these land units: crops or use, building characteristics, values and other physical, economic and legal characteristics, we obtain a product of extraordinary interest given its usefulness in a broad spectrum of applications. This is the reason the Law orders to establish a cadastral data base open to different users, specially Public Administrations.

To carry out its commissions the "Centro de Gestion Catastral y Cooperacion Tributaria (CGCCT)" had to establish a system for cadastral data managing and diffussion. This system had to be organized as a Cadastral Information System. The nucleus of the Cadastral Information System is the Cadastral Inventory organized as a data base.

But data entry to this information system are real states and these are entities spatial referred, then they are geographic information, and the Cadastral Information System is a geographical information system.

The Cadastral Information System design was made in such a way that the very strong investment needed can be splited up several annual budgets. Then Cadastral Information System was designed as the integration of two subsystems, independent one to the other, but close related and converging at its development.

The first of these two subsystems is the Cadastral Management Information System (SIGECA), designed to implement the computerized cadastral management in every Local Office of the CGCCT. The nucleus of this system is the Cadastral Data Base that it holds alphanumerical data captured by renewal processes.

The second subsystem is the Cadastral Geographical Information System (SIGCA). It is charged to manage the spatial component of Cadastre. This subsystem has an extraordinary interest for broad spectrum of users, even not directly related to Cadastre.

2.- SIGCA (Cadastral Geographical Information System). Main characteristics.

To define SIGCA as an information system it was necessary:

- To take into account:
  . The organization and working methodology of Cadastral Offices, so that the System would be integrated in such organization and every body would get involved.
  . Education and training of computer and cartographical specialists and people, in general, managing cadastral data.

- To establish:
  . The conceptual data model more suitable for data updating and query and, at the same time, providing the capability to get good performance on Cadastral Management large-scale processes.
  . The definition of cadastral data base schema and data loading from renewal and updating processes.
  . The computer technology more suitable. Both hardware and software: operating system, data base management system and GIS tool.

- To develop:
  . Specific software (applications and procedures) to update and manage cadastral data.

We will look how it is solve each one of these topics.

2.1.- Organization and working methodology of CGCCT.

The "Centro de Gestión Catastral y Cooperación Tributaria" (CGCCT) is a Direction General of the Secretary of Treasury in the Ministry of Economy and Treasury.
CGCCT territorial structure is:

. Direction General, located in Madrid, as the CGCCT headquarters.
. 16 Regional Branches, with a Regional Manager each one. There are a Regional Branch every Autonomous Region, less Navarra and Basque Country.
. 65 Local Branches, with a Local Manager. There are a Local Branch every Province or main town.

The Cadastral Information System is running in the same way in every Local Branch of CGCCT. At Local Branches every task is performed by computer terminal working at the

local data base.

At present, CGCCT organization IS an information system, because it has 3220 people working and they are working with the cadastral data base using 2320 computer terminals.

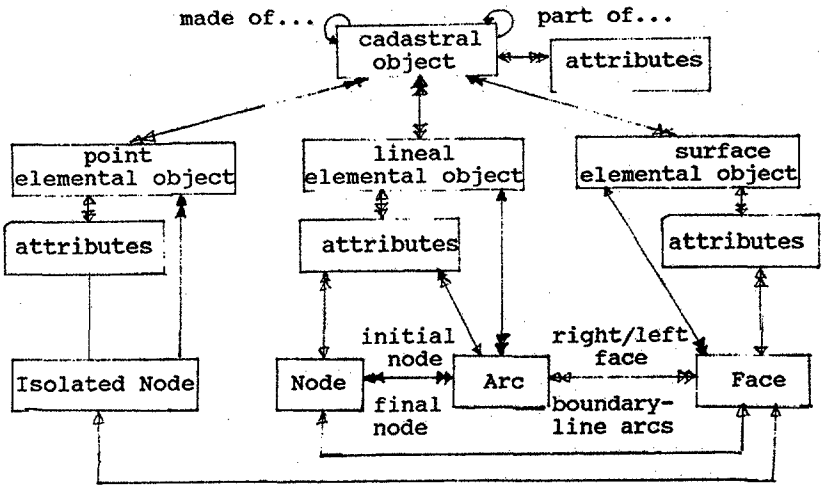
2.2.- Specialist training.

CGCCT people has a good training on basic concepts and CGCCT provide them an specialized training to know and manage the new tools they must use. Since 1989 more than 34 ARC/INFO intensive courses have been organized for more than 326 technicians. Also UNIX and relational data base management systems courses.

2.3.- SIGCA conceptual data model and standards.

SIGCA conceptual data model is the one "topological vector". It considers geographical objects as "digital representation of all or part of the individualized geographical entity".

Geographical objects are composed of elemental objects and these of topological primitives (node, arc, face). Through these the topological relationships about coincidence, inclusion or connectivity are established.



The type of cadastral objects managed by SIGCA are:

. Urban blocks
. Urban lots
. Urban sublots
. Street axes
. Rural cadastral polygons
. Rural lots
. Rural sublots
. Urban infrastructure
. Administrative boundaries
. Heights
. Hydrographic network
. Communication routes
. Sheets and ortophotos partition

2.4.- SIGCA hardware and software (Computer equipment to manage SIGCA).

Hardware and software of the Cadastral Information System:

. At the headquarters in Madrid:

.. Fujitsu M780R, mainframe, 128 MB memory and 50 GB on disk.
.. Hewlett Packard 9000/T500,four processors, 1 GB memory and 12 GB on disk.
.. Siemens Nixdorf Targon 35/70, 96 MB memory and 10 GB on disk.
.. 7 Hewlett Packard 9000/720 (WS), 32 MB memory and 1,3 GB on disk.
.. 2 IBM Risc System 6000/530 (WS), 16 MB memory and 1 GB on disk.

. At the 65 Local Branches:

.. Hewlett Packard 9000/G40 or F20, 128 MB memory and 6 GB on disk.
.. Hewlett Packard 9000/720 (WS), 32 MB memory and 1,3 GB on disk.

. There are 750 PC (microcomputers).

. Every computer is ruuning in UNIX operating system, and ORACLE data base management system.

. Every work station (WS) is operate by ARC/INFO GIS.

2.5.- Software for cadastral managing.

Since 1988, CGCCT has developed specific software to manage cadastral data.

It is remarkable the software for Cadastral Management with more than 900.000 sentences, and the Cartographical Managing System establishing an user interface based on ARC/INFO GIS and performing:

- Data capture
- Data checking and control
- SIGCA loading
- Data updating
- Spatial management
- Plotting
- Cadastral analysis

3.- SIGCA data loading.

SIGCA is a cadastral geographical information system, and Cadastre, in Spain, is under a renewal process. This process is running from 1982 and it is finished at the urban area but it is not finished yet at the rural area.

First step at cadastral works are topographical and cartographical works.

There are two ways to carry out cartographical works:

3.1.- The way for Urban Cadastre.

* Maps on scale: 1/1.000 or 1/500
* Projection system: U.T.M.
* Photogrammetrical and tachymetrical methodology
* A cartographical serie

Urban cadastral maps are made, but the main part was made as analogical maps. For SIGCA data loading these analogical maps are digitized. New cartography is made through analytical stereoplotting. Standards for cadastral cartography digitizing or stereoplotting contains rules for coding and structuring data.

3.2.- The way for Rural Cadastre.

* Ortophotomaps on scale 1/5.000 or 1/2.000
* Flight scale 1/20.000 or 1/15.000

At present maps base for Rural Cadastral Renewal are got by:

a) Making ortophotomaps in scale 1/5.000

b) Identifying and drawing on ortophotomaps parcels and geographical entities.
c) Identifying and drawing on ortophotomaps municipalities boundaries.
d) Identifying and drawing on ortophotomaps geodetic signals, photogrammetrical and control points.

These ortophotomap are digitized by private companies under contract, according the Standars established by CGCCT.

4.- Present situation of SIGCA data loading.

4.1.- Urban areas computerized cartography.

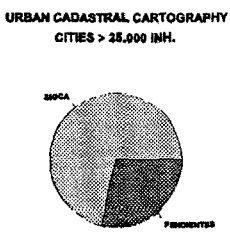
At present, it is loaded in SIGCA, or it is at loading process, 433.648 Ha. of urban cartography, in 1/1000 or 1/500 scale.

This Cartography is the cartographical reference for cadastral data of:

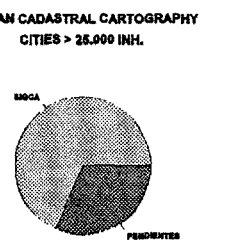
. 472 municipalities. That is the 6,25% of total number
. 11.237.282 urban cities. 49,45% of total, and
. 19.378.499 inhabitants. 54,10% of total.

But this computarized cartography includes the main cities and towns. The most municipalities with more than 25.000 inhabitants or more than 10.000 urban units are included :

. 222 municipalities. 63,61% of 349 municipalities over 25.000 inhabitants or 10.000 urban units.
. 9.389.944 urban units. 68,50% of 13.707.114 urban units
. 17.063.809 inhabitants. 71,49% of 23.868.409 inhabitants

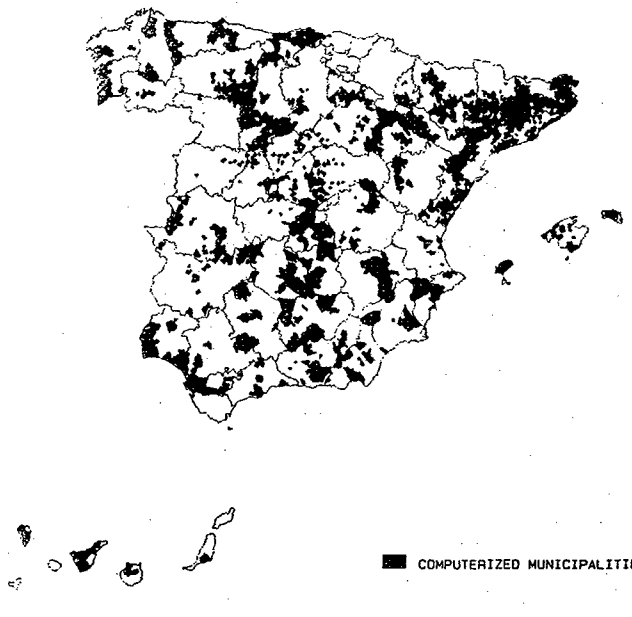


By Inhabitants



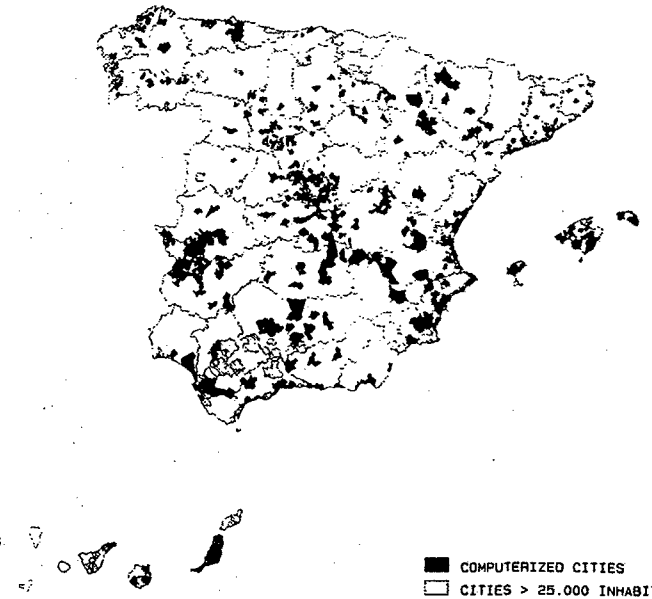
By Urban Units

COMPUTARIZED RURAL CADASTRE CARTOGRAPHY



COMPUTERIZED MUNICIPALITIES

COMPUTERIZED URBAN CADASTRAL CARTOGRAPHY



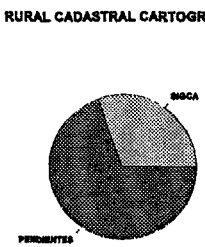
COMPUTERIZED CITIES

CITIES > 25.000 INHABITANTS

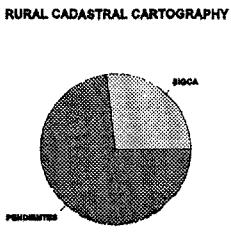
Then we can say that the main part of urban cadastre is computarized and we must mantain this in a computerized way.

4.2.- Rural areas computerized cartography.

At present, it is loaded in SIGCA, or in load process, 13.255.615 Ha. of rural cartography at 1/5000 scale. This is the cartographical reference for cadastral data of . 2341 municipalities. 31% from 7552 municipalities And it is the 27,17% from the 48.783.341 Ha. of rural surface in Spain (less Basque Country and Navarra).



By municipalities



By Ha.

5.- Main users of SIGCA.

Cadastral data and cadastral value of real state are used as a basis of 5 taxes in Spain:

. Income tax (IRPF) (State tax)
. Wealth Tax (State tax)
. Transfer of ownership tax and (Regional tax) state duty.
. Real State Tax (IBI) (Local tax)
. Terrain capital gains Tax (Local tax)

Then main users are treasury authorities from the three levels of government. This taxation application is

the main reason to establish the Cadastral Geographical Information System (SIGCA). The expenses to create SIGCA are recovered by a better control on taxation.

But these are not the only users. SIGCA is used by:

. Regional Governments for regional planning and statistical anallysis.
. Local Authorities for local and regional planning, public works, etc.
. Electrical, gas, telephone and water companies for planning and control of distribution network.
. Engeneering companies for public works.
. Consulting companies for bussines aplications:
    .. Distribution networks
    .. Location analysis
    .. Environmental analysis
    .. etc.
. People, in general, to define and demonstrate theirs ownership on a real state.

6.- SIGCA data diffussion.

The Spanish Government has establish some rules for cadastral data diffussion:

- Royal Decree 1485/1994. It establishs that:

    . Every one has the right to consult and get from data base cadastral data related to real state he is the owner or he has a close relationship.

    . Every one can get from database physical features or aggregated economic features of cadastral real state.

    . Personal data from database will be given only to Public Administration or researcher under conditions.

- Governmental Order, that it defines types and prices for data access.

7.- Final remarks.

As a conclusion we must point out that CGCCT's experience executing the new spanish cadastre during last ten years advises:

a) Real State Cadastre must be organized as a Geographical Information System.
b) Data are the most important component of the Cadastral Information System.

By consequence it must be organized in such way that everything can be replaced:

- Data capture technology
- Computer technology
- Specialists and staff
- Personnel

but data ever remain and it must be updated.
c) Computer technology must be as compatible as possible. It must be easily replaceable.

In a large cadastral information system hard- and software budget is less than 5 % of the total budget.
d) When the cadastral information system must manage a huge data volume it is very advisable to consider private companies collaboration in data capturing and updating.
e) Every person at the organization must be integrated in the information system to be sure the system is properly operating. Continuous training is the way for getting it.