

A GIS in Ancient Cartography

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Summary

The frame that set the Council of the European Union about the Digital Libraries has allowed to create important cartographic databases that are accessible on-line and give a response to the real demand among citizens and within the research community. We have developed an open GIS that surpasses the usual operativity of the traditional multiformat databases as it enlarges through the queries the way to get a more personalised information. This new methodology has been created with the aim of being implemented all around the European Union, and will allow the searches and analysis of the historical evolution of the territories and landscapes based upon the study of old cartographic documents.

Introduction

Ancient cartography, as well as old pictures, drawings and photographs, has not been used traditionally as a reliable source of information about the history and the evolution of the land and the townscape. Those graphic materials have been usually considered as ‘second order’ documents, mainly because of the difficulties that their interpretation can sometimes involve (Harley 1968) due to the different conventions that are applied in each case by the cartographer. But this is not the only reason why cartography is so seldom used in the historical searches, because there are other problems related to the difficulties of their localisation and visualisation that have to be considered.

Obviously, it is not easy to access to an original big size and small-scale map that is sometimes composed by several printed sheets; and it is also difficult to see properly the symbols employed in the map and read its texts when it is imposed to handle a reduced hardcopy or a low resolution digital image.

Although we find it is not essential to have an exhaustive knowledge of the context of each map to get a meaningful interpretation of it (Skelton 1965: 28; Andrews 2005), it is necessary to achieve some basic specific concepts on the theory of the cartographic expression and design (about map projections, symbols or representation of relief, for instance), because the lack of them can difficult the right interpretation of the document and distort the results of the investigations (Vázquez Maure and Martín López 1989: 1-10).

According to the strategies of the Council of the European Union about the European Digital Libraries considered as a common multilingual access point to Europe’s digital cultural heritage, and assuming that the ancient maps and plans are important cultural materials, in the last decade there have been created several cartographic databases that allow an efficient on-line accessibility.

Although the main spanish cultural offices are making a strong effort to digitise the public collections of historical documents, the problems posed by the different locations, techniques, sizes and preservation conditions, are delaying the prompt achievement of their diffusion. And we have to mention another problem that is associated to the difficulties of finding those maps, because they are frequently included into other documents or inside bundles of old papers, and remain yet undiscovered.

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Among those important initiatives we will emphasize the one created by the Institut Cartogràfic de Catalunya and those of the Portal de Archivos Españoles (PARES), that not only show low-resolution images of each map, but provide an accurate description of the document and the conditions of use.

There are also other experiences that integrate old maps into GIS as the *Gregoriano Cadastre* (Orciani et al. 2007) and the old cadastral maps of Utrecht (Heere 2006), but they are focused on a deep knowledge of the reconstruction of the old properties.

With the aim of widening the above mentioned strategies of the Council of the European Union, we have developed an innovative GIS based methodology in ancient cartographic documents, that allows to get the information from the relational cartographic databases that we have elaborated not only through the traditional queries, but applying the hypermedial concept.

But the final target of this project is to diffuse the old cartographic treasures that compose a relevant part of the Spanish cultural heritage, that actually remains unknown to the public and even to a great number of specialists (Chías and Abad 2006; 2008).

Contents and formats of the cartographic databases

To define the contents of our cartographic database we have decided to apply the concept of cartographic document in the wide sense of Harvey (1980: 7) and Harley and Woodward (1987: 1, xvi), that includes all kinds of maps, plans and charts at different scales (architectural, urban and territorial scales), as well as pictures and bird's-eye views (Kagan 1986: 18-26; De Seta 1996), with no restrictions due to techniques, functions or origins (Fig. 1).



Figure 1. José Pastrana, Escribanía de Zarandona y Balboa, cadastral map [*Carta topográfica de los términos de Villagonzalo-Pedernales y Renuncio, separados por dos hileras de mojones*], 1758 (Valladolid, Archivo de la Real Chancillería, Planos y Dibujos, Óleos 0014).

As we must also restrict the temporal and the geographical subject of the contents of the cartographic databases, we firstly decided to include all the historic documents that have been drawn before 1900, mainly because along the 20th century the cartographic production and techniques have very much increased in many senses and its study should be afforded separately. Secondly, the spatial restriction has been imposed to the search and we decided that the cartographic database should concern the actual Spanish territories.

Assuming all those circumstances, the former stages of our search have focused on finding, studying and cataloguing all kind of cartographic documents that are preserved in the main Spanish collections, archives and libraries.

As digital preservation implies copying and migration, it has always been considered in the light of IPR legislation (Commission of the European Communities 2005): the digitised funds of other libraries are precisely quoted and respect the conditions that have been established for consulting the documents by the rightholders. We also provide the links in case that the documents are included in other cartographic databases that can be accessed through Internet.

To digitise the non-digitised funds we apply both the contact scanning and the non-contact photographic methods (Tsioukas, Daniil and Livieratos 2006), trying to minimize the distortion problems by digitising each sheet separately, although this process can not eliminate other problems in the final assemblage of the mosaic image.

The maps that are yet unpublished or remain unknown (for instance, those of the private collectors) if there is any legal obstacle that allows them to be shown, we offer a link to a high resolution image 1:1 that makes possible to see every detail and to read every name to analyse it properly.

The next step was to construct the relational databases over a commercial compatible platform. They have been designed as multilingual (there is an English version) and open ones to allow including new registers in the future and even adding new fields or tables, to update the contents to the new needs without damaging the existing ones. Moreover the concept 'relational' implies the possibility of crossing the data of the different tables and reducing their weights, making easier the data management and the queries.

According to this, our methodology includes three main tables, that are the following:

- 'Cartography', that contents all the registers concerning the cartographic documents and follows the ISBD Norms of cataloguing.
- 'Bibliography', that includes the complete bibliographical references that appear in the field *Bibliography* of the table 'Cartography'.
- 'Libraries, Archives and Museums', is the table that includes the complete references of the collections that have been visited, and that appear just as an acronym in both *Collection* and *Signature* fields of the table 'Cartography'.

The three tables have been designed sharing at least one field that allows crossing the datafiles and economizes data length in the databases.

The design of the table 'Cartography' joins both the descriptive and the technical data about each document, joining the perspectives of the historian and the cartographer. The items that have been included are the following (Fig. 2):

- *Place or Subject* (text field): Refers to the geographical place that is represented in the document and the province it belonged to, since the reform of 1831. To define clearly the territorial limits, the old councils or boundaries are also included. And to determine the original uses of the map, it is also specified if it is a general, thematic (geological, military, statistic, cadastral, etc.) or a topographical map or plan.
- *Date* (numerical field): as precisely as the document can be dated. If it is only an approximated date, it is quoted among square brackets.
- *Kind of Cartographic Document* (text field): it defines if it is a map or plan, a chart, a portolan or a view, or even a terrestrial globe.
- *Size* (text): width and high of the image in mm; it is also included the total size of the sheet(s) (or other supporting materials) and the number of pieces or sheets that compose the ensemble of the document.

Id	1	Library	AGS	Signature	M.P. y D., X-1, C.R., leg. 39-3-II
Subject	Aranda de Duero (Burgos)	Date	1503, s. XVI	Kind of Document	View
Title	"Villa de Aranda de Duero"	Size	528 x 598 mm		
Author	Unknown				
Scale	Without scale.				
Map projection	Perspective view of the town, showing the elevations of the buildings. Without orientation.				
Technique	Manuscript. Black ink and red aquarell on a sheet of paper.				
Description	Shows the urban structure inside the medieval walls, emphasizing the church and its square, as well as the 'Plaza Nueva' and the main doors of the town. Outside the walls are the bridge and the watermills. Every building has a red roof. Lettering in spanish of the main urban elements.				
Short history	The view comes from the Consejo Real.				
References	Sánchez Zurro 1991 /				

Image



Other remarks There is a facsimile edition printed in the 500th anniversary.

File creation 24/10/2007 **Operator** Abad **Link** http://pares.mcu.es/ParesBusquedas/servlets/Control_servlet?

Figure 2. One of the registers' filling card.

- *Collection* and *Signature* (text): the collection that preserves the document and the signature; the first one is quoted through an acronym and the second one is abbreviated according to the norms (its total extension can be consulted in the table 'Libraries, Archives and Museums'); if possible, it includes the link to other e-libraries or references.
- *Original Title* (text): quoted among inverted commas if it is literal, as it is written in the document; otherwise it is defined among square brackets through its main features.
- *Author(s)* (text): names of the author(s) if the map is signed; in case of ascription, the name(s) appear among square brackets; they can be also 'unknown'.
- *Scale* (text): it is defined graphically or as a fraction, detailing the different units employed; when there is no definition scale, appears 'without scale'.
- *Projection* (text): details the projection employed with its different elements: grid, references, orientation; it is also referenced the use of different projections, for instance profile or section added, axonometrics or perspective views, with their own distinctive elements, and even the case of large scale plans.

- *Technique* (text): makes a distinction between manuscripts and printed maps, as well as the drawing surfaces and techniques, specifying the uses of colour.
- *Short History* (of the map, text): place of edition, editor, or if it is a part of a big compilation or atlas. It is also mentioned where it comes from or the precedent owners, and the date of purchasing.
- *Bibliography* (of the map, text): abbreviated and following the international system for scientific quotations ISO 690-1987.
- *Image* (object/container field): it is included a low resolution raster image in highly compressed jpg format of the cartographic document. By clicking on the image, it is possible to display a high resolution one in a *tiff* format that allows to see the details and to read the texts. If the map is composed by several sheets, it is possible to see each one separately (and to compose it apart).
- *Other Remarks* (text): in the case of a printed map, includes other collections that have a copy, or variations of the plate, as well as manuscript notes, etc.
- *Date* (of the catalogue, autom.).
- *Operator* (for future updates).

The table 'Bibliography' defines completely the abbreviations and acronyms used in the other tables. The quotations follow the ISO 690-1987 Norm. The fields are in this case:

- *Author(s)* (text).
- *Date* (of edition, numerical).
- *Title* (of the book, text).
- *Article's Title* (text).
- *Periodical or Book* (in case of articles or book chapters, text or link).
- *Publisher* (text).
- *Place* (text).
- *Volume* (numerical).
- *Pages* (text).
- *Quotation* (text): as it appears in the other tables.

Finally the table 'Libraries, Archives and Museums' makes possible to identify the acronyms used in the *Collection and Signature* field. It contains the following fields that complete the location of the documents:

- *Abbreviation* (text).
- *Signature* (text).
- *Collection* (text).

The GIS in ancient cartography

The GIS is supported by a commercial platform that includes a complete and easy to use computer-aided mapping module in a vector format and that is a standard with the maximal compatibility. The possibility of drawing our own cartography also avoids the problems derived from the import of graphic files through the *dxf* format.

The existing digital cartography has not been used because it would suppose a hard process to clean, verify and structure it topologically.

The cartographic base has been structured in data layers and sheets at a 1:200.000 scale, and we have selected the graphics format, the georeference and the symbolism according to the guidelines of the Instituto Geográfico Nacional, that ensure a proper understanding of both topographic and planimetric data as well as an easy connection to other existing or future GIS.

To implement the Gis, the connection of both cartographic, graphic and attribute data is made through an ODBC protocol.

The diffusion through Internet

Nowadays the web-based digital resources are quite frequent as a way to preserve and diffuse the cartographic heritage as well as to access to the modern cartography (Zentai 2006).

Previous experiences as the one implemented on the Greek region of Macedonia (Jessop 2006) have shown the potential of GIS accessibility through the web.

Our methodology has increased the possibilities of the usual queries that a GIS brings, just formulating them to the different databases separately or even crossing them; but to ensure the proper display of the cartographical information we have designed a filling card as one of the main printable output ways. This filling card includes also the adequate links to access to other e-libraries or references as it has been above mentioned.

The possibilities that the hypermedia concept brings on getting personalised information of the different data sets are an added value to the traditional queries system.

And as the IPR legislation has been considered from the starting point, in this case we must neither set other supplementary caution that restrict the access to the different data sets, nor establish different access levels.

Conclusions

According to the initiative of the Council of the European Union about the European Digital Libraries as a common multilingual access point to Europe's digital cultural heritage, and considering the ancient maps and plans as important cultural materials, we have developed an innovative GIS based methodology in ancient cartographic documents, whose essential values are:

- To create new cartographic relational, multiformat and multilingual databases that organise and unify the information that different archives and libraries have elaborated about their different funds, as well as to incorporate the dispersed and unknown documents that belong to non-digitised collections. This new information follows the ISBD Norm, and joins and completes the different approaches of the librarian, the historian and the more technical of the cartographer.
 - o The new databases join both already digitised materials as well as new information that we have directly produced in a digital format. These circumstances allowed us to get some mechanisms that facilitate the digitalisation of maps, to identify problems and to monitor bottle-necks (as those that appear handling big size maps).
 - o They allow also to preserve the original materials, that are usually fragile.
- The open GIS surpasses the usual operativity of the traditional multiformat databases as it enlarges through the queries the way to access to the different kind of data. But we have also disposed a new and personalised way to access to high resolution digital images of the documents by applying the hypermedial concept.
- On-line accessibility and diffusion through the Internet, as a response to a real demand among citizens and within the research community, always paying attention to the full respect to the international legislation in the field of intellectual property.
- This new methodology has been created with the aim of being an open one that allows being implemented in all the countries of the European Union.

The pilot experience about the Spanish ancient cartography that we present is also an example of the full application and the success of the methodology.

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Both are inscribed into our searchers' guidelines on the investigation of the cultural heritage through the application of the most innovative technologies, as GIS and multiformat databases, that set up an essential basis for the knowledge of the history of the territory, the landscape and the town. Since a decade our team is engaged on setting up different useful methodologies that are being implemented in the Technical School of Architecture and Geodesy of the University of Alcalá.

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