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## First approaches to the usability of digital map libraries

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### *Summary*

The Internet is a powerful tool providing different online communication options on geographic approaches. In addition to searching, geoportals provide tools to visualize, explore and download information. Cartographic heritage contained in the Digital Map Libraries (DML) stands out as an exceptional case within the generic frame of a Spatial Data Infrastructure (SDI). There are useful and basic similarities between the global reality of an SDI as a distributed geoportal and a DML; conformance to standards, agreements and services. However, some technological and policy considerations must be taken into account apart from the characteristics common to all SDI in any thematic field. On a first approach to these peculiarities, it is necessary to search different ways to present old maps preserving the original information needed by researchers, without reducing visual quality and Web potentiality. As a specific geoportal in cartographic heritage, some usability recommendations should be taken into account when designing navigation browsers in the DML, apart from the application functionalities. Usability will play an important role to succeed in the provider-citizen communication process. Some specific experiences have been carried out in this field so far, trying to include the DML services in a local SDI prototype and introducing a first approach to visualization methodology. Conclusions are presented at the end, in order to carry out an in-depth study in the future.

## Introduction

To close the gap between citizens and governments in a new style of knowledge-based society, institutions are making certain deals and taking decisions in order to approach information in a new way. The incorporation of the geographic component, as a main part, into data and information normally used can result in geo-knowledge, a new kind of information related to territorial domains.

Digital management of geographic information is taking its first steps and further advancement is expected in the development of a new society based on geographic knowledge. The Internet is a powerful tool providing different online communication options on geographic approaches.

Why are spatial portal (geo-portal) functionalities so useful to manage old cartography? These portals provide tools to search or find spatial information. The spatial search tools may display a map and allow users to define boundaries of an area of interest. In fact, users can often combine spatial searches with a range of textual parameters.

Historians and documentary experts need to remotely access every existing information that can be compiled in a single place to facilitate access and comparison. They have established a number of well-defined international standards, and they have assembled cata-

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logues using similar harvesting techniques. ISO 23950 (Z39.50) and Open Archive Initiative (OAI) are the most popular standards for spatial metadata harvesting. However, in addition to searching, geoportals provide tools to visualize, explore and download information.

Apparently, that is not very useful to users who normally work with catalogues and metadata. However, the fact is that geographic browsing functionalities are essential to “play with maps” and it indirectly helps to disseminate old cartography throughout society. So far, old maps were reserved to high cultural level people with specific interests, but now geographic technologies are helping the whole society to easily re-discover old cartography.

We must deal with new peculiarities when designing Digital Map Libraries (DMLs), depending on specific kinds of users and contents. In the end, usability plays an important role to succeed in the provider-citizen communication process.

### **Spatial Portals**

The common practice allowing citizens to get in touch with geographic information is the use of the so called spatial portals aka geoportals. They are defined as websites enabling entrance to several resources related to geo-information. Such resources are varied and define the type of geo-portal which has been created.

Spatial portals could be classified into catalogue portals, application portals and enterprise portals (the integration of spatial data with business enterprise solutions). [1] All facilitate access to geospatial information, but in different ways.

In the catalogue variety, the portal arranges metadata records into a consistent and searchable way with the aim of creating and maintaining indexes or catalogues describing information that is available through services. The users can make queries based on some metadata parameters. These portals are useful when catering to a wide variety of services and providers. In the case of catalogue portals providing map browsing tools, they tend to be more generic.

Application portals combine information services into Web-map services that are generally focused on a particular task or application, but they do not normally have metadata catalogues. They provide efficient access to data and services according to user needs. Application portals are structured in User Interfaces that guide users to the specific services they need.

Digital Map Libraries fit right in between the two types described above. They should be designed by combining the variety and potentiality of catalogue services and the efficient access of the application portals.

Geospatial One-Stop (2002) was part of a wider e-government initiative of the USA Office of Management and Budget “to improve coordination, access, clarity and speed of the delivery of geographical information in the government-citizen communication”. It came with a clear motto: “Two clicks to content”. [2]

The Geospatial One-Stop philosophy should be also the first step towards the goal of a Digital Map Library making possible to search and assembly data and services from various sources in a fraction of time. In fact, usability plays an important role to succeed in the provider-citizen communication.

## Usability Principle

The organization of the information in a website or an Intranet is one of the success factors or failure depends on. The organization systems are classified into organizational schemata and structures. Schemata of organizations point out the shared characteristics of the elements, which integrate the contents and the influence of the logical joining of these elements. On the contrary, structures of organizations define the relationships among content elements and the groups of such elements. [3]

Web usability arises from the birth and development of the Internet as a way of communication. Web programming languages have enabled the implementation of new functional and powerful interfaces, although these are more complex to handle and use by users. Thus, usability is defined as “the capacity of software of being understood, learned and used by the user on specific usage conditions”. [4] This results in tangible benefits for the organization, such as cost reduction, increase in the number of visitors and improvement of the organization’s image. [5]

Concerning usability, the heuristic evaluation is a method created to find design problems in a User Interface. A reduced number of evaluating people is required who will examine the interface and decide whether it fulfils a series of usability principles known as heuristics. [6] [7]

Some common usability mistakes made in the process of a website design, especially when applied to geoportals, are: use of frames, (content management tools are better), unwarranted use of visual effects, pages without linking to the initial page, excessive use of scroll bars, lack of design of a suitable site map, lack of search options into the navigation system, non-updated information, and excessive downloading time, among others. [8]

## Classification Of Web Maps

The Web is a very interesting way to present and spread spatial data. It constitutes a virtual, independent, matchless basis regarding its capacity of reaching an infinite number of users at a minimum cost. Besides, it offers new techniques and possibilities of use with respect to traditional paper maps, such as the multimedia integration.

Nevertheless, on a first approach to the peculiarities of old cartography publication on the Internet, a barely advantageous classification is found. A schema of map classification for the Web (Kraak, 2000) [9] indicates that the classification of ancient maps is barely advantageous. His classification is within the static type since they are scanned maps arising from the original ones, made on paper and predestined to their visualization. On the one hand, they give a very exact idea of the original since they transmit all available information the scanned maps. On the other hand, it is common to have to deal with several problems, such as low quality, file size or excessive density of information which preclude reading on screen.

It is necessary to search different ways to present old maps preserving the original information needed by researchers, without reducing visual quality and Web potentiality.

The key lies on the georeferencing process which allows overlapping, linking and manipulation of modern geographic information. The quality of the scientific document is preserved and the visualization is improved by way of this process. Unfortunately, this solution cannot always be considered for old cartography.

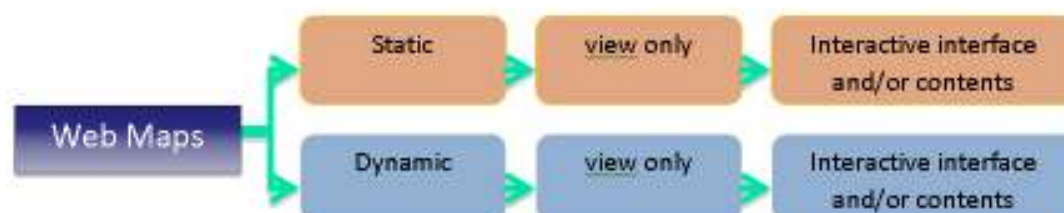


Figure 1: Classification of Web maps (from Kraak, 2000).

From a technological point of view, several technologies and geoportal map publication languages are found. The HTML languages are the most commonly used on the Internet for presenting any type of documents, but it becomes an unsuitable language whenever another kind of information is presented. With the aim of creating a more general language capable of encompassing other purposes, the W3C [10] Consortium has developed the XML language, from which SVG (Scalable Vector Graphics) language has been derived. This language enables the Internet display of vectorial images as an alternative to the Flash language which is not based on standards.

Language could be adapted to the objectives and the needs of the project. Nevertheless, interoperability through standard achievements constitutes a main requirement for the distributed access to Digital Map Library resources, following the principles of Spatial Data Infrastructures (SDI).

### Considerations In Digital Map Libraries (Dml)

There are useful and basic similarities between the global reality of an SDI as a distributed geoportal and a DML; conformance to standards (e.g. geographic metadata: ISO 19115 [11], Dublin Core [12]); agreements (e.g. local, regional, national or international level; INSPIRE Directive [13]); and services (e.g. Open Geospatial Consortium [14]: Web Map Service [15], Web Feature Service [16], Catalogue Service on Web [17], etc). However, there is a number of technological and policy considerations to be taken into account apart from the characteristics common to all SDIs in any thematic field. Cartographic heritage contained in the DMLs stands out as an exceptional case within the generic frame of an SDI. [18]

Maps catalogued in libraries have been usually described according to generic bibliographic metadata schemata such as the MARC standards [19] (UNIMARC, MARC21, IBERMARC, etc.). They are not always comprehensible by traditional geoportals which use geographic standard templates, so it is necessary to define the appropriate gateways for these descriptive profiles to be understandable among themselves.

The risk of deformation of documents of historical interest against the advantages of their publication together with other data in the Web should be also taken into account during the georeferencing process, dealing with the image distortion that could not be facetious for some scientific users. This should be taken into account considering that distinct kinds of users would utilize cartographic funds for different purposes. Providing bounding box approximate coordinates is generally recommended to avoid image distortion.

Additional information about the themes and the age in which the maps were created will be of great help to those documentary experts who have to link these maps to the historical events which took place on that age. That is related to the usability rule of providing a Webmap and a Help menu.

### Geographic browsing in DML

As a specific geoportal in cartographic heritage, some usability recommendations should be taken into account when designing navigation browsers in the Digital Map Libraries. The aim of these recommendations is just to help users in the navigation, apart from the application functionalities. [20]

#### a) Communication user/map

The users need to know that their computer is set up for their requirements. A change in the pointer shape, the colour information zone or the object shape may be needed.



Fig. 2: Menu option selection; Textual mode and Icon mode [21]

#### b) Simultaneous selection

The simultaneous activation tools constitute a great help. A functional relationship with the browser must be provided when activating layers or moving the mouse. Thus, a more complete information of the visualized phenomenon could be obtained, before opening the map (e.g. through frames or colour changes.)



Fig. 3: Simultaneous map selection: by general menu and through frames. [21]

c) Dynamic timelines

Dynamic timelines and dynamic labels are especially useful, since they establish a functional correspondence with the browse objects. Nevertheless, the timeline design is hard to pin down since contents are not distributed constantly along a chronological line. Besides, the reader needs to know not only that the events happened in an ordered way but also the quantification of temporal distance between phenomena. Thus, each case should be studied carefully.

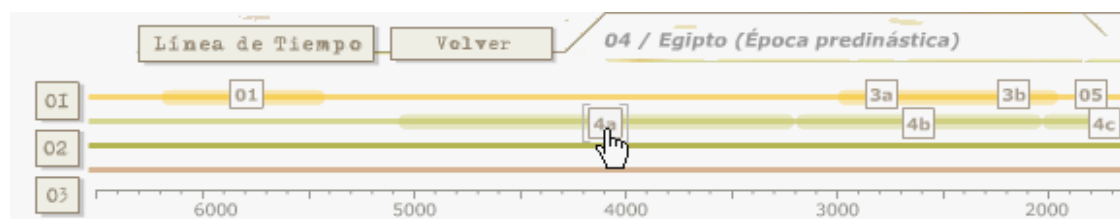


Fig. 4: Dynamic map selection by timelines. [21]

d) Hidden information

By moving the pointer over a selected point, written information will appear, which, if permanent, could hinder the reading of another piece of map information.



Fig. 5: Secondary data visualization in small scales. [22]

e) Selective information

Traditional maps include the printing of all available information about the piece of land represented on the map. The possibility for the user to choose a feature to be observed, without others hindering the reading, can be achieved through the activation-deactivation of information layers.



Fig. 6: Management of information layer visualization. [21]

f) Spatial information

Navigation on the map allows quick framing of a specific geographic place, increasing or decreasing the visualization scale, helping and guiding the user as he handles the geographic browser.



Fig. 7: Dynamic navigation tools; change of location and scale. [21]

g) Information modification according to scale

The visual perception is selective with regard to the visual size variable [23], so this could be used provided that longer texts may disappear as the reader gets closer to the land. This process of selective hidden information provides a cleaner and more attractive image.



Fig. 8: Symbology variations according to visualization scale. [21]

#### h) Information Transparency

The possibility of transparency allows two information layers to be visible at the same time, additionally providing for visualization of the background layer. The user is able to easily understand the extension of two different geographic entities which are coincident in space but dissimilar in time.



Fig. 9: Transparent layers visualization: modern and old cartography mixed. [24]

### Online Examples

#### *The Digital Map Library Prototype*

Some specific experiences have been carried out in this field, trying to include the DML services in a local SDI prototype. In the case of the DML of the Canary Islands, [25] the creation of an Internet portal with access to a Map Server and a catalogue containing the scarcely accessible historical maps and plans of the Canary Islands was studied in depth. Visualization and query tools were used from standardized OGC Services (WMS, WFS, CSW), allowing visualization and comparison of any maps as well as access to their metadata. The HTML/JavaScript interface allows visualizing the requested results sent to the server.

A first approach to visualization methodology, consisted of working with the approximate coordinates of the map corners (bounding box). For every processed image a shapefile was generated. Polygonal limits of this file include the approximate contour of the map. For those images including plans and construction sections, the appropriate shapefile geometry is just a point. The external cartographic base is combined with raster and vector layers which can be visualized through the Web interface, including the island contour and the tiles generated with the document contours.



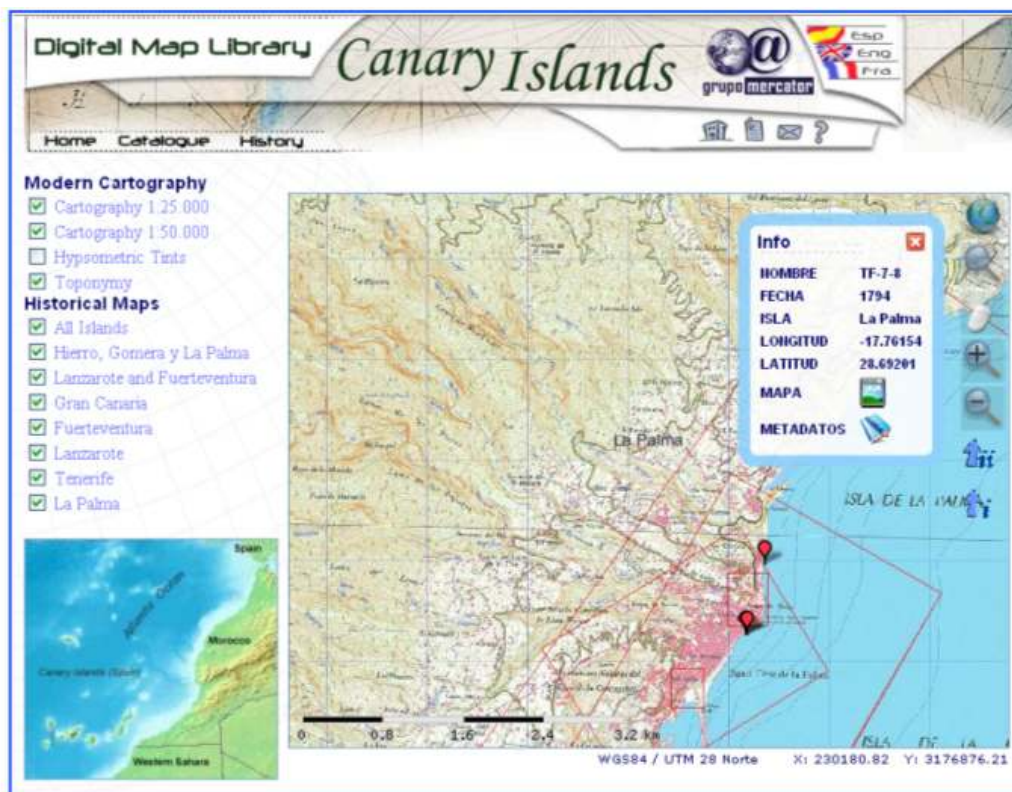


Fig. 10: Digital Map Library Prototype of the Canary Islands [24]

This application allows different types of search with the approximate contour of each map, and over the cartographic base. Thus, the searching tools provide the document's visualization and metadata in a new pop-up window.

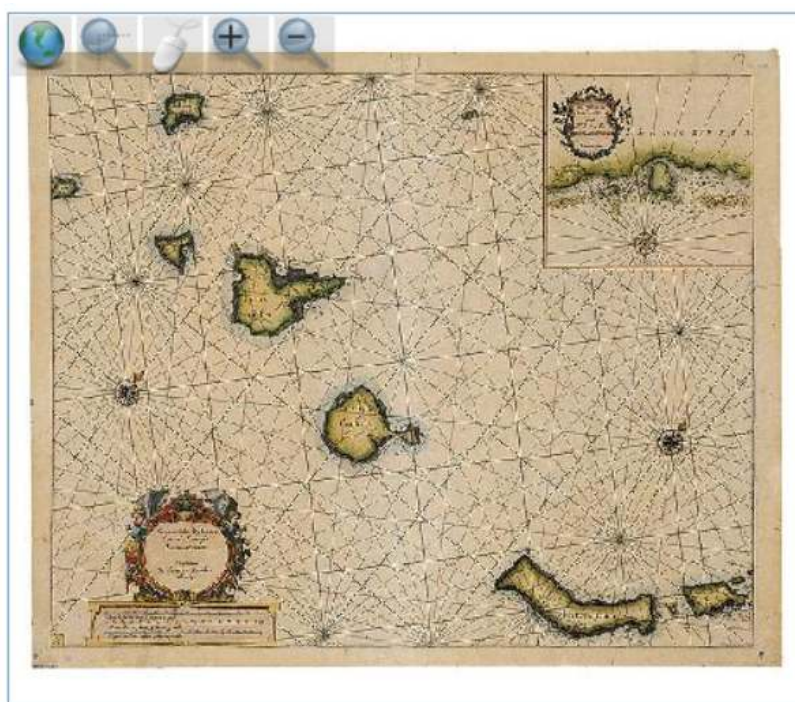


Fig. 11: Pop-up window to browse through an old map [24]

Besides, the metadata of the maps are included in a geographic catalogue [26] that is accessible from the Homepage. Thus, it is possible to include advanced searches with the GeoNetwork OpenSource software, in accordance with the ISO23950 Standard. [27]

### *The DIGMAP Project [28]*

DIGMAP works towards the goal of becoming the main international information source and reference service for old maps and related bibliography. The software solutions produced with relevant standards and technology can be reused in other digital libraries, for standalone services, or as components integrated with other digital libraries. [29]

The targeted users of the services are citizens, students, scholars, teachers, professionals in libraries, archives, and technology, as well as institutions intending to provide similar services, such as other national, university and research libraries, archives, etc. Therefore the User Interface should be designed with the appropriate usability rules and user profiles.

### *Usability approach to the DIGMAP Portal*

The preliminary DIGMAP Portal draft design offers both geographic and textual browsing options from the Homepage. Thus, the most useful services are provided to users according to each profile.

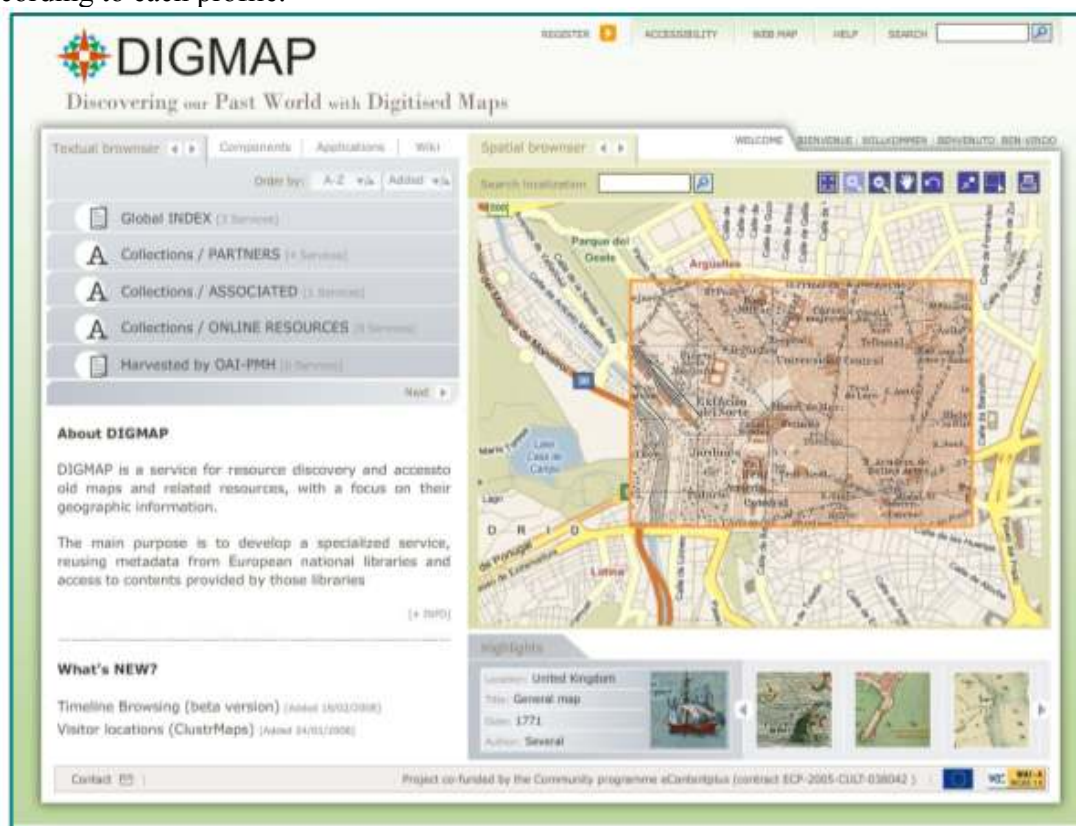


Fig. 12: DIGMAP Portal draft design.

Likewise, the use of frames in the complementary design is avoided with the use of content management tools. Hence, by forgoing the use of scroll bars, navigation becomes easier and tidier.

In the Highlights Section (on the bottom) some samples are presented from the indexing service with a brief description (to distinguish them from a non-functional banner). The use of arrows give dynamism, allowing visualization of the map icons recently charged or updated to the system.



Fig. 13: Browsing through an old map inside the DIGMAP portal

External resources, such as exhibitions, should be displayed within a small visualization space separate from the internal services. Only in these cases, the use of new emerging windows is strongly recommended to avoid the loss of communication with users. The “Site map” and “Help” buttons are programmed in the portal, as well as the completion of the accessibility standards.

The User Interface will offer a browsing environment for humans. However, a definitive design is currently under way (June 2008). It will explore paradigms inspired by Google Maps, Virtual Earth, TimeMap [30] and other similar systems and previous research efforts. [31] Some of the specific functions that will be provided by the User Interface include timeline visualizations, clustering of related resources and advanced geographic information retrieval mechanisms. [32] This interface will also include a module for handling user questions, which will likely be developed by extending an existing forum system.

## Conclusions

- Geoportals are useful tools of knowledge transfer related to Geographic Information through valuable interfaces.

- After the approaches made to the DIGMAP Project framework, it is possible to conclude that Digital Map Libraries conform to most of the usability rules that have been widely agreed on for Spatial Portals so far.
- To maintain the historical and geometric rigorousness of maps in Digital Map Libraries, we should highlight the greater importance of metadata at large than the georeferencing as such.
- In this sense, the georeferencing process may alter maps, and many of their qualitative features may get lost. This fact should be borne in mind and the user profiles taken into account.
- Further steps must be taken to research into the potential users of Digital Map Libraries, as well as their specific requirements.
- A new schema of geographic integration of the historical contents must be reasoned and heuristically assessed in order to carry out an in-depth study of Digital Map Library usability within the Spatial Data Infrastructure framework.

### **Future Work**

A better understanding of the DMLs potential users as well as the continuation of the project work related to geoportal usability suit the line of work of the DIGMAP Project, which is expected to be concluded by the end of September, 2008.

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