Effective Management of Geographical Information in Map/GIS Libraries

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The effective management of geographical information is essential for many organizations and especially for Map/GIS Libraries which play a crucial role in providing access to a wide range of geographical data (print and digital) and tools for analysis and visualization. However, managing map and GIS collections can be a challenging task for librarians requiring careful consideration of data quality, and metadata interoperability in order to fulfill their purposes.

This paper aims to discuss the importance of geographical data and tools management in Map/GIS libraries in providing access to that kind of information. It will explore various topics related to Map/GIS collections including organizing spatial data, creating and maintaining metadata, and ensuring data quality. Significant Map/GIS collections regarding their catalog records will be highlighted. In addition, emerging trends and technologies will be explored. One important topic that the presentation will cover is interoperability achievement through cooperation in the management of geographical information.

Overall, the paper intends to provide valuable insights into effective Map/GIS management.

Key words: *Map/GIS Libraries, geographical collections, management, Map/GIS Librarians, geographical information*

1. Introduction

Geographical information plays a crucial role in various fields such as urban planning, environmental management, emergency response, economy, health, and many more. Technological advances facilitate the management and utilization of geographical information. As traditionally, libraries are those organizations that select, acquire, process, manage and diffuse information. Map/GIS libraries have become an essential component in managing and organizing geographical data effectively. Geographical information is a valuable commodity and must be managed and maintained properly so as to be used effectively in the present and the future (Porcal-Gonzalo, 2015). However, the efficient management of geographical information in Map/GIS libraries requires adequate planning, staff expertise, and resources.

In this paper some aspects of managing geographical information in Map/GIS libraries will be discussed and insights into effective strategies that can be employed to ensure the most effective use will be provided. The issues mentioned in this work arose from the international bibliography and the writer's observations in the Map/GIS Library field in Greece. Initially, the present work will refer to the characteristics and types of geographic information while it will focus on some major challenges in the management of geographical information that Map/GIS librarians should take into consideration. Further, suggestions derived from the international bibliography will be mentioned. Those recommendations are mostly addressed in Map/GIS Libraries that due to a number of reasons (lack of staff, budget, etc) sustain an underutilized geographical material and wish to turn their collection feasible and useful for their community and the external public.

The paper aims to raise awareness and discussions amongst librarians particularly in Greek libraries who are involved with Map/GIS data in order to improve their daily work and duties and subsequently the diffusion of geographic information to the users.

2. Characteristics of Geographical Information

Going back to the earliest civilizations people have always wanted to know where things were and keep records of the world around them. This requirement is still vital in allowing individuals to move between locations, manage their life, and make the most of the resources available to them (Walford, 2001, p.3). Geographic is the information that identifies the geographic location and characteristics of natural features and boundaries on the earth (Executive Office of the President, 1994, Section1b). It consists of facts, data, and/or evidence pertaining to events, activities, and things located on (or near) the surface of the earth (Bishop & Grubesic, 2016, p.1).

Masser in his work (1998) uses Cleveland's (1991) six identifications for information and suggests that they also can be applied to the geographic information as well. So, according to Masser geographic information sustains six unique qualities:

- Is expandable: geographic data often expand, while being degraded (e.g. census data)
- Is compressible: complex data can be summarized (e.g. the field of geodemographics which makes extensive use of a wide range of lifestyle classifications derived from a mass of small-area census statistics)

- Can substitute for other resources (e.g. replacing physical facilities)
- Is transportable (massive amounts of information can be sent around the world, almost instantly)
- Is diffusive (represents the immaterial characteristics of knowledge that set it apart from the material resources)
- Is shareable (Information may be shared and recalled, and it doesn't lose its value over time).

Apart from the above qualities Longley et.al. (2001, p.6) underline some technical reasons that justify why geographic information is special:

- It is multidimensional (because at least two coordinates must be specified to define a location, whether they be x and y or latitude and longitude)
- It is voluminous (since a database can easily reach a terabyte in size)
- It must often be projected onto a flat surface
- It requires many special methods for its analysis
- It can be time - consuming to integrate and analyse the many varied types of geographic information
- Although much geographic information is static, the process of updating is complex, and expensive,
- Display of geographic information in the form of a map requires the retrieval of large amounts of data.
- It can be represented in different ways on a computer, but the way in which this can be done can significantly affect the ease of analysis and the final results.

3. Types of Geographical Information

Geographical information can be represented in various ways, depending on the type of data and the intended use. The amount of data collected about the Earth today is enormous, and it comes from both new geographic information systems and more proficient data collection technological innovations. The last few years have seen the commercial availability of data from satellites with a resolution of one meter, and the ability of unmanned aerial vehicles to deliver aerial video over fast-changing focused scenes. Today, GPS technology is so widely used that it is even built into some wristwatches. The procedures for disseminating information and applying it have undergone significant modifications as a result of global networking and the ongoing creation of new application domains. Modern information systems are getting more heterogeneous and distributed (Fonseca, Egenhofer & Camara, 2002).

Geographical data, the facts relating to features that are spatially related to Earth's surface (Walford, 2001, p.6) consist of numbers, text, or symbols that are in some sense natural and almost context-free. Raw geographic facts, such as the temperature at a specific time and location, are examples of data (Longley, et.al., 2001, p. 6). Geographical data can be divided into two broad categories: spatial data (about geometry, location, shape, and relationships of geographical phenomena) and attribute or variable data describing or quantifying these features (Walford, 2001, p.5). The same researcher (Walford 2001, p.5) classifies the geographical data into four main categories:

- Remotely sensed data (they are derived from aerial photographs, satellite imagery, and laboratory equipment)

- Cartographic data (refers to information obtained from existing maps, which are themselves the result of processing and abstracting from data obtained by direct field survey and/or remote sensing.
- Administrative and statutory data (are sources that are the by-product of some administrative process or statutory requirement, which are useful for geographical analysis).
- Censuses and surveys (their purpose is to generate information for answering research questions or information that is not routinely required).

While historically governments had the authority and resources to collect large amounts of geospatial data, the expansion of the Geoweb, the widespread use of GPS devices, and the commercialization of the internet reduced significantly the cost of acquisition and democratized each citizen's ability to gather, share and distribute geographical information (Bishop & Grubesic 2016, p.3). Consequently, Map/GIS libraries sustain a wide variety of geographical collections such as maps (e.g. topographic maps, geological maps, soil maps, land use maps, population maps, land cover maps, vegetation maps, road maps), atlases, gazetteers, charts, aerial photos, geospatial data, cartographic reference, pictorial items, databases, journals, etc. (Vardakosta, 2022).

4. Challenges for libraries in managing geographical information

One common way of representing geographical information is through maps, which provide a visual representation of spatial data. Maps have the ability to capture a wide or less amount of spatial information to some degree and people use them daily in many cases e.g. travel, weather prediction, traffic, policy, natural disasters etc. (Ward Aber & Ward Aber 2017, p.1). The long history of cartography science indicates the existence of maps for millennia. Prior to the 20th century, governments were the producers of most of the maps, while they were mainly the subject of wealthy individuals' collections (Ward Aber & Ward Aber 2017, p.96).

In the 20th century, and after World War II a variety of reasons, mostly technical (e.g. increased production and use of cartographic materials, the advent of automated cartographic and telecommunication systems, growth of cartography and GIS academic departments, deposit programs) favored public's demand for maps and subsequently the development of Map/GIS Libraries (Vardakosta, 2022; Cowen, 2021). Map/GIS Libraries may just operate as independent administrative components, but they may also be a part of the library, as is the case for the majority of academic libraries (Larsgaard, 1998). Their legacy includes the obligation to deliver the information and make it accessible to the public. Being geoliterate and having the ability to comprehend geographical data is more essential than ever for a citizen in modern society. Furthermore, specialized users need guidance to efficient access to a wide variety of geographical data to accomplish their educational and research purposes.

Solar (2016) points out that georeferencing, the process of photographic materials, the transformation of traditional catalogs, and the born-digital cartographic materials have created a multitude of dilemmas for Map/GIS Librarians. Wang et.al. (2014) from a local perspective identified sharing mechanisms, financial support, technical challenges, and the allocation of professional staff resources as the potential demands for China's map collections. In the present paper challenges related to the management of geographical information and their impact have not been adequately examined in previous research

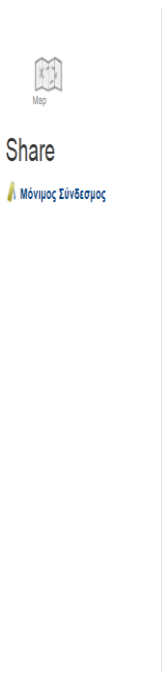
will be highlighted. So, the Map/GIS Librarians' expertise, the use of tools, the geo-information literacy programs, and the lack of Map/GIS collection publicity will be discussed.

- **Map/GIS Librarians expertise**

The proliferation of maps and other geographical material (e.g. aerial views, orthophotos, census data etc.) generated the need for the data (both print and digital) to be processed in a way that makes the geographic information highlighted and retrievable for utilization by the specialized users. The skills needed by the Map/GIS Librarian are extremely varied as their role is changing and requires adaptability in keeping their collections and services useful (Weimer, Andrew & Hughes, 2008). Map/GIS Librarian is a promoted specialty of librarianship mostly in developed countries such as the U.S., Canada, the United Kingdom, and Australia (Vardakosta et.al., 2016). For this to become true local Library Associations play a crucial role as they offer opportunities for ongoing education and constructive guidance e.g. American Library Association sustains Map and Geographic Information Round Table- MAGIRT which supports Map/GIS Librarians. Despite the fact that Map/GIS Associations promote and encourage continuing educational opportunities, as Ward Aber & Ward Aber (2017, p.102) suggest based on significant researchers of Map & Geospatial Librarianship (Larsgaard, 1998; Abresch, Hanson, Heron & Reehling, 2008) it is the LIS programs that create career pathways and the curriculum to prepare students in order to meet current standards. Nevertheless, in some European countries like Greece, they do not sustain in their academic curricula (in both undergraduate and postgraduate) any course related to Map/GIS Librarianship.

- **Use of tools**

Solar (2016) and Vardakosta & Kapidakis (2013) identified and explored various tools in the management of geographical information and their effect on the most effective representation and access to geographical collections. The emergence of various forms of geographic representation as a result of the utilization of advanced technological innovations and analytical methods is a reflection of the difficulties that librarians ought to deal with (Abresch, Hanson, Heron, Reehling, 2018, p.6.). This condition indicates there are integrating responsibilities that the Map/GIS Librarian should take into account and involve the existing print and the natively digital geospatial resources. For example, for the cataloging of print maps the AACR2 standards may be used. But maps are graphic tools that receive their value in their graphic presentation of information, so they cannot be cataloged simply using the cataloging rules for books. So, for maps, we must be aware of their number, size, coordinates, and scale to sort out how much detail is available even before we see them (Hudson in Andrew, 2017, p.xii; Ward Aber & Ward Aber, 2017, p.99).
In the following examples, it is rather clear the lack of geographical information in the display of a map record in two different Greek Online Public Access Catalogue's (OPAC's) under the use of Anglo-American Cataloguing Rules (AACR2) (Fig.1 and Fig.2). Users will be informed about cartographic details like coordinates and scale only after they chose to open the MARC Record or the "Detailed Description" link. Yet, as can be seen in both cases (Fig.3 & Fig.4) the information regarding projection or geographic area is not used in coded form.



Share

Μόνιμος Σύνδεσμος

Συλλογ. Όργανο Γεωγραφική Υπηρεσία Στρατού

Συγγραφ

Τίτλος Γύθειον [Χάρτης] = Yithion / Γεωγραφική Υπηρεσία Στρατού.

Δημοσίευση [χ.τ.] : Γεωγραφική Υπηρεσία Στρατού, 1978.

Αντίτυπα

Τοποθεσία	Ταξιθετικός Αρ.	Τόμος	Κατάσταση	Ραβδοκώδικας	Δημόσια Σημείωση
UNIV THESSALY - CENTRAL LIBRARY	MAP 912.495 22		Στο Ράφι	004000052886	

Περισσότερα στοιχεία για το τεκμήριο

Περιγραφή 1 χάρτης : έγχρ. ; 76x56 εκ.

Σημείωση Περιέχει ευρετήριο όρων.
Περιέχει λεξικό όρων.

Θέμα ΤΟΠΟΓΡΑΦΙΚΟΙ ΧΑΡΤΕΣ -- ΕΛΛΑΔΑ -- ΓΥΘΕΙΟ (ΛΑΚΩΝΙΑ)
ΓΥΘΕΙΟ (ΛΑΚΩΝΙΑ, ΕΛΛΑΔΑ) -- ΧΑΡΤΕΣ, ΤΟΠΟΓΡΑΦΙΚΟΙ

Παράλληλος Τίτλος Yithion

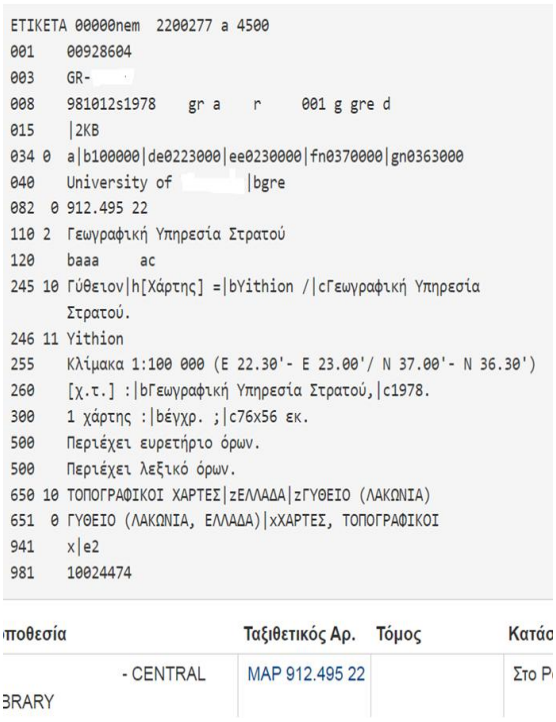
Fig.1

Φύλλον Σπάρτη

Συλλογικό Έργο:	Ινστιτούτο Γεωλογικών και Μεταλλευτικών Ερευνών (Ελλάδα), Ινστιτούτο Γεωλογίας και Ερευνών Υπεδάφους (Ελλάδα) (επιμελητής εκδόσεως.)
Άλλοι συγγραφείς:	Φιλιππάκης, N. (γεωλόγος.), Richard, R., (γεωλόγος.)
Μορφή:	Χάρτης, Βιβλίο
Γλώσσα:	Ελληνικά
Έκδοση:	[Αθήνα] : Το Ινστιτούτο, 1969.
Σειρά:	Φωτογεωλογικός χάρτης της Ελλάδος. Photogeological map of Greece.
Θέματα:	Γεωλογία > Ελλάδα > Χάρτες Geology > Greece > Maps
Συλλογή:	Χάρτες

Τεκμήρια Περιγραφή Παρόμοια τεκμήρια Λεπτομερής προβολή

Fig.2



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082  0 912.495 22
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120    baaa     ac
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       Στρατού.
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300    1 χάρτης :|bέγχρ. ;|c76x56 εκ.
500    Περιέχει ευρετήριο όρων.
500    Περιέχει λεξικό όρων.
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651  0 ΓΥΘΕΙΟ (ΛΑΚΩΝΙΑ, ΕΛΛΑΔΑ)|xΧΑΡΤΕΣ, ΤΟΠΟΓΡΑΦΙΚΟΙ
941    x|e2
981    10024474
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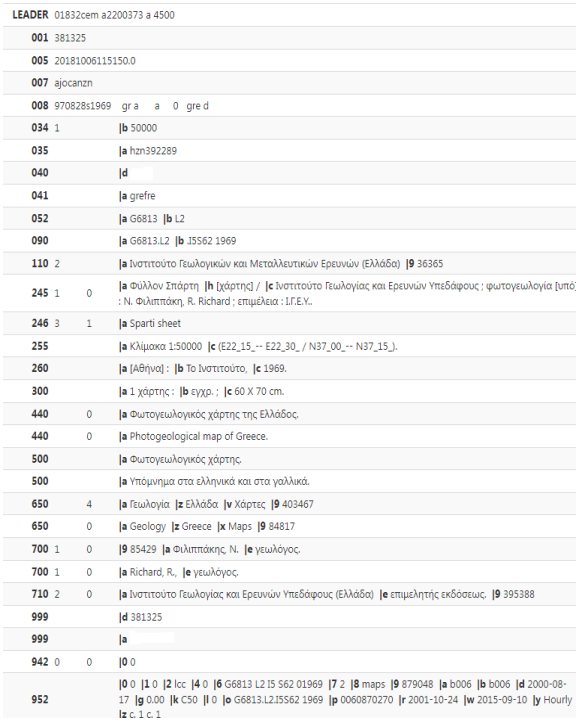
ποθεσία	Ταξιθετικός Αρ.	Τόμος	Κατάσ
- CENTRAL BRARY	MAP 912.495 22		Στο Ρ

Fig.3



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260			|a [Αθήνα] : |b Το Ινστιτούτο, |c 1969.
300			|a 1 χάρτης : |b εγχρ. ; |c 60 X 70 cm.
440		0	|a Φωτογεωλογικός χάρτης της Ελλάδος.
440		0	|a Photogeological map of Greece.
500			|a Φωτογεωλογικός χάρτης.
500			|a Υπόμνημα στα ελληνικά και στα γαλλικά.
650		4	|a Γεωλογία |z Ελλάδα |v Χάρτες |9 403467
650		0	|a Geology |z Greece |x Maps |9 84817
700	1	0	|9 85429 |a Φιλιππάκης, N. |e γεωλόγος.
700	1	0	|a Richard, R., |e γεωλόγος.
710	2	0	|a Ινστιτούτο Γεωλογίας και Ερευνών Υπεδάφους (Ελλάδα) |e επιμελητής εκδόσεως. |9 395388
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Fig.4

Bishop et al. (2013, p.300) as mentioned in Ward Aber and Ward Aber (2017, p.99) use the concept “metaloging” in order to capture the vital need for proper metadata use in geospatial data records that supports searching and accessing those data that created through remote sensing, image processing or GIS software. Additionally, the change in format and delivery as in the case of the digitized maps which are hosted in a repository as a part of digital collection requires the same critical use of the proper metadata so as information to be preserved and accessible.

- **Lack of Geo-Information Literacy programmes**

Fundamentally all libraries are educational institutions that instruct and guide people in their communities about information. While sharing certain general and specific objectives with information literacy (such as information search strategies and critical evaluation of sources), geo information literacy additionally brings up some unique challenges, such as the need to search for maps and GIS data and assess the reliability and features of spatial data and representations (Peterson, 2005, p.19). Although information literacy standards and frameworks are quite well formed, yet special collections like geographical collections lack such a framework (Widener & Reese, 2016).
Vardakosta (2022) and Bishop & Grubesic (2016, p.153) refer to the various instructional activities such as assignment guidance, incorporation of geo-information literacy into the curriculum, series of events, etc., that academic libraries provide. Yet, such instructional and guidance actions aiming to empower users in finding, accessing, and using geographical information have not been provided in European countries such as Greece. In general, as it is absent from relevant European Map Libraries research (Millea, 2008; Smits, 2005; Campbell, 2000) seems that has not been adequately examined.

- **Inadequate promotion of the Map/GIS collections**

While in the early decades of the map collections development in academic libraries was a matter of great interest in recent years, a less relevant discussion has been observed (Kilfoil, 2002). Maintaining the resources required for the collection (e.g. space, preservation activities, and software) is a challenge for libraries especially as budgets continue to shrink. Therefore the promotion of the Map/GIS library's holdings turns into a significant task (Ward Aber & Ward Aber, 2017, p.242). Traditionally all libraries maintain a website that lists their collections, and other information about their operation. However, the usual mention of the word «maps» in the material types that the library sustain is not enough to attract the user's interest. Finally, there are also cases where while the library maintains a map collection this type of material does not appear on its website in the material type section.

5. Best practices in managing Map/GIS in libraries

Along with technological advances, libraries must adjust to decreased budgets, staff reductions, and increased user demands. As a result, librarians are forced to reorganize and restructure their departments in order to take on new duties and responsibilities (Millea, 2005).
Taking into account the aforementioned challenges regarding the manipulation of geographical information in Map/GIS Libraries the following actions are being proposed:

- *Decision to catalogue geographical material*

The most common material in Map/GIS Libraries is the maps. Maps, like all library resources, offer a variety of information, both recent and historical. The development of a map collection, as well as the space and personnel required to preserve it, represent significant time and financial commitments. In order for maps, and any other material, to

have the maximum visibility and subsequently to be used, must be cataloged (Andrew & Larsgaard, 2011, p.414). The standards (MARC21, AACR2, RDA, BIBFRAME, Linked Data e tc.) will define the interoperability and the collection's utilization.

Stieve, Stone & Pape (2010) in their effort to develop the map collection of the John Hay Library followed a three-stage approach in which the cataloging process was the starting point. Map cataloging and the systematic process of digitized maps and GIS data consists of a major administrative operation for the Map/GIS Libraries. Libraries like Stanford [1],[2] Harvard[3], University of Florida[4] (Fig.5 & Fig.6), and numerous other academic and various types of libraries are using OPACs to reach their clientele. They count on the use of standards as well as the Map/GIS Associations committees' work has focused on the publishing of guidelines[5] to facilitate the cataloging process amongst the Map/GIS Librarians. Despite the fact that similar guidelines have been developed by the writer[6,7] for the cataloging of the cartographic material of the Greek libraries tailored to the currently used standards (AACR2 and MARC21) however, it seems that Greek librarians didn't pay special attention to its use.

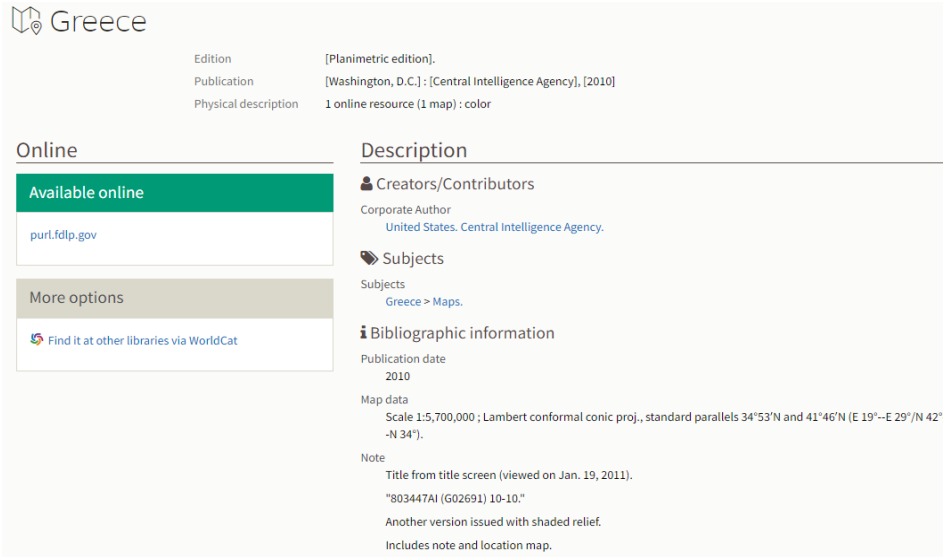

Fig.5

[1] https://searchworks.stanford.edu/
[2] https://earthworks.stanford.edu/
[3]https://hgl.harvard.edu
[4] https://uflib.ufl.edu/find/
[5] https://www.ala.org/ala/magert/meetingsa/ch3handout.htm
[6] http://eprints.rclis.org/30000/1/MapCataloguing_Vardakosta_HUA.pdf [in Greek]
[7] http://ahileas.lib.ntua.gr/istologio/ilsas/cataloguing/procedures/%ce%ac%ce%bb%ce%bb%ce%bf%ce%b9-%cf%84%cf%8d%cf%80%ce%bf%ce%b9-%cf%85%ce%bb%ce%b9%ce%ba%ce%bf%cf%8d/ [in Greek]

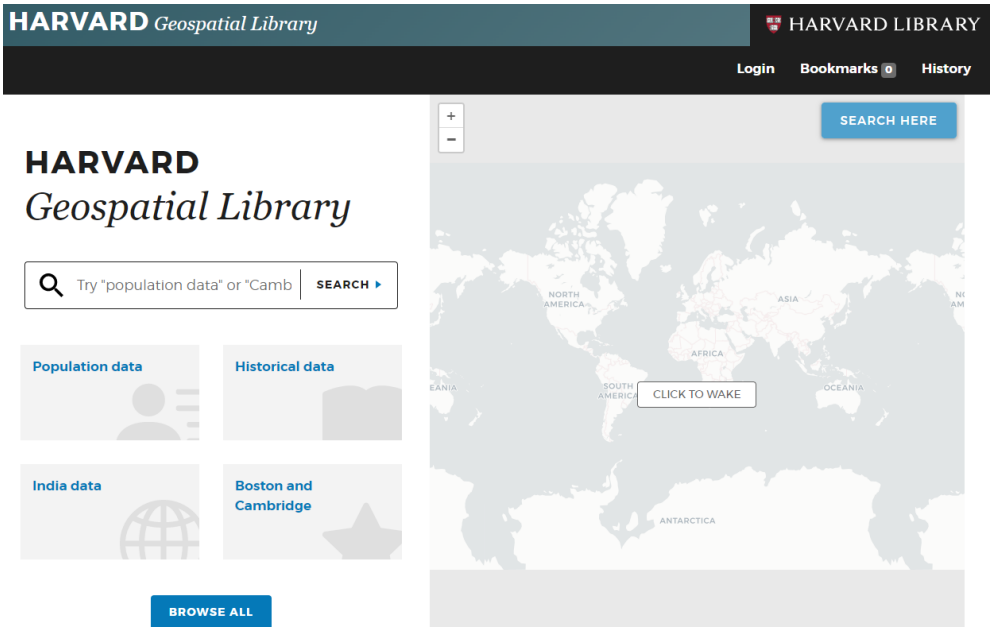

Fig.6

- *Collaborative partnerships*

The cooperation among Map/GIS Libraries and/with other Institutions for a range of activities related to geographical information has repeatedly been referred to as a major good practice (Vardakosta, 2020; Vardakosta, 2021). As happened in the case of the Ontario Council of University Libraries (OCUL) (Trimble et.al., 2015) the members of the collaborative schema may work together for a range of important issues such as cooperative cataloging, geoinformation literacy projects, access to digital content or the facilitation of technical infrastructures. Additionally, collaborations with other Map/GIS Libraries and other institutions comprehend the administrations' commitment to collaboration goals fulfillment.

The Greek Academic Geographical Libraries Group[8] is worth mentioning as an example of libraries' collaboration. So far, Group's work is related to actions that support librarians' awareness of the management of geographical information and its use in covering users' informational needs. Workshops, lectures, and the decision for cooperative cataloging practices emerged from members' collaboration. Additionally, the long-term cooperation of the Aristotle University Academic Library with the Laboratory of Cartography and Geographical Analysis[9] has delivered exhibitions, books, conferences, and research projects. Nevertheless, much has to be done as the current situation in academic libraries (lack of staff, budget cuts, lack of technological infrastructures) leads to a relatively slow process of development that relies upon a volunteer basis.

[8] https://greekgeolibraries.webador.com/
[9] http://cartography.web.auth.gr/cartogeolab/index.html

- *User support and outreach*

The goal of the Map/GIS Libraries is to provide access to their geographical content. Users have no interest in the content they don't know that their library sustains or they don't know how to approach it and retrieve the information they need. Information professionals in the light of technological achievements and the rapid growth of geographical content, guide users on how to locate, define, select, and obtain geographical information for covering their educational or research needs (Bishop, 2016; Boxall, 2008).

Starting with the ease and simplicity there are a number of actions that librarians are familiar with and could carry out to increase the value of the collection. This can be done by promoting the importance of maps in every discipline. For instance, informing users of any new geographical material arrives, running searches for geographical material from the collection applicable to various disciplines, and promoting the so far unused cartographic material to faculty and students may be some of the ways that librarians could use (Youngblood, 2006). Collaboration with librarians is becoming more and more essential as more disciplines use primary sources and engage with special collections and archives (Widener & Reese, 2016).

Collaborative activities are considered to represent a successful dynamic approach to the promotion of geographical information. So, Geo-information literacy programs could be developed or applied cooperatively.

Conclusions

Libraries are dynamic organizations that constantly adapt to technological and social changes in today's world. As the interest in cartographic and GIS data is growing their value is obvious in collecting, protecting, managing, organizing, circulating, and promoting geographical information. Moreover, their existence is empowered by the educational and training role they possess and their obligation to guide their users to the efficient use of the geo-information.

The paper outlined challenging issues concerning the everyday life and activities of the information professionals working in Map/GIS Libraries as long as discussed some best practices for their advancement.

Since the Greek Librarian community seems to recognize the need for the advancement of Map/GIS Librarian there is much to be hopeful of.

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