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"Map/GIS Libraries and Disaster Management Plans (DMPs)"

Climate change has garnered significant attention for its association with numerous physical disasters, both accidental and intentional, that have captured global interest. Although there is a substantial body of literature on disaster planning for public and academic libraries, the same cannot be said for Map/GIS Libraries.
As independent organizations or integral components of broader library collections, Map/GIS Libraries play a vital role in preserving critical geodata and infrastructure. Recognizing the pivotal role of Map/GIS Libraries in disseminating critical spatial information, this study emphasizes the pressing need for comprehensive disaster management strategies within these institutions.
This paper endeavors to evaluate the role of Map/GIS librarians in the development of a Disaster Management Plan (DMP). It will delve into the unique challenges and factors to consider when safeguarding these collections during various stages of disasters and discuss the optimal practices and innovative approaches for devising resilient DMPs that ensure the continuity of Map/GIS Library services. Moreover, this work aims to raise awareness among Map/GIS librarians about their role in DMPs development in an ever-changing world.
By underlining the significance of proactive planning and risk mitigation strategies, this paper makes a meaningful contribution to the broader discourse on disaster resilience within the Map/GIS Library community and adds to the relevant international literature.

Keywords: *Map/GIS Libraries, Disaster Management Plans (DMPs), climate change, Map/GIS Librarians*

1. Introduction

There is an extensive and well-documented body of scientific evidence suggesting that global warming is the result of human activities associated with the use of fossil fuels and the emissions of carbon dioxide and other greenhouse gases (GHGs) (Economides et.al, 2018: 13). Climate Change is the defining issue of our time and we are at a defining moment. From shifting weather patterns that threaten food production, to rising sea levels that increase the risk of catastrophic flooding, the impacts of climate change are global in scope and unprecedented in scale[1].
In an increasingly data-driven world, the importance of geographic information cannot be overstated. Geographic information is crucial to the lives of all people for two primary reasons: (a) practically every human activity has a geographic component, and (b) interpreting geographic information requires making difficult and complex decisions that are mostly unique. The common referencing framework that geographic information offers for integrating numerous diverse data sets from many different disciplines in the public and private sectors contributes to a substantial portion of its financial significance. These days, there are two opposing trends on the worldwide scene: the growing

[1] https://www.un.org/en/global-issues/climate-change

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commercialization of geographic information resources and the unrestricted data sharing among scientists working on global issues. Geospatial data can be "numbers, images, video or audio streams, software, and software versioning information, algorithms, equations, animations, or models/simulations" which have a spatial referent. They also include geographic coordinates (e.g., latitude and longitude) that identify a specific location on the Earth; and data that are linked to geographic locations or have a geospatial component (e.g., socio-economic data, land use records and analyses, land surveys, environmental analyses) (Vardakosta & Kapidakis, 2013).

Map/GIS libraries serve as critical repositories of spatial data that support a wide array of activities, from urban planning and environmental monitoring to disaster response and scientific research. These libraries house a diverse collection of resources, including physical maps, satellite images, geospatial datasets, and specialized software, which are essential for decision making and analysis across various sectors (Adler & Larsgaard, 2002: 901).

Despite their critical role, Map/GIS libraries are often vulnerable to a range of disasters, which can compromise the integrity, accessibility, and longevity of their collections. Natural disasters such as floods, earthquakes, and fires pose significant threats to both physical and digital holdings. In addition, man-made disasters, including cyber-attacks, data breaches, and hardware failures, can result in substantial data losses and operational disruptions. Environmental factors, such as humidity, pests, and improper storage conditions, further exacerbate the risk of degradation and damage to physical maps and documents.

The consequences of such disasters have been far-reaching. The loss of valuable geospatial data can hinder emergency response efforts, impede scientific research, and disrupt public services. Furthermore, the recovery process can be time consuming and costly, requiring substantial resources to restore damaged facilities and recover lost data.

This article aims to contribute to the growing body of knowledge on disaster management for Map/GIS libraries and to raise awareness among Map/GIS librarians about their role in the development of DMPs in an ever-changing world.

2. Disasters and Map/GIS Libraries

The most famous early library disaster was the destruction of the library of Alexandria's library in the third century AD. Other noteworthy losses include libraries burnt in the Great Fire of London, the Library of Congress burned by the British in 1812, libraries in the great Chicago fire, and those lost in the fire following San Francisco in 1906 (Doig, 1997:1). In the years after the war, where some of the important European map collections had been totally destroyed or partially lost, map historians tried to record these losses of cartographic heritage in a small series-report called "With Fire and Sword" in the professional journal *Imago Mundi* (Horst, 2021). As Doig (1997: 6) refers to, since the Second World War, disasters in libraries are more likely to be reported, and this happens not only because of the greater number of publications, archival material, or electronic sources that the library sustains, but also mostly because of the greater perceived importance of such institutions to the public.

There are many incidents of varying cause and scale from around the world to suggest that «*it won't happen here*» may not be the case (Matthews, Smith & Knowles, 2009). Well-publicized examples include the flooding in Florence in 1966 and its effect on the National Library (Fortson, 1992: vii), and Matthews, Smith & Knowles (2009: 69) refer to the destruction by fire of Norwich Central Library in England in 1994, and the devastating fire at the eighteenth century Anna Amalia Library in Germany in 2004.

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In addition to fires and floods, which are the most common disasters in libraries, other factors have the same consequences. For example, a hurricane damaged the University of Corpus Christi in 1970 (Fortson, 1992: vii), while the San Francisco earthquake of 1989 resulted in extensive damage to the Los Angeles Public Library and Stanford University Library. Hurricane Katrina destroyed many libraries in New Orleans, such as those at Dillard University, Southern University of New Orleans, and Delgado College's main City Park campus, while the damage to academic library collection was immense (Andy, 2008). Rapid mold growth at the University of Iowa Law Library in 2002 destroyed many rare books (Kraft, 2006). War and terrorism, such as, the terrorist attacks in the U.S. on September 11 2001, war in the former Yugoslavia, and Iraq (Matthews, Smith & Knowles, 2009: 69). Hoeven & Albada (1996) in research conducted for UNESCO and IFLA record that in World War I (1914-1918), during the German invasion, over 300,000 books, manuscripts, and books printed before 1500 (incunabula) were destroyed in the University Library of Louvain in Belgium. In South Australia, the Barr Smith Library at the University of Adelaide experienced a major flood in March 2005, when construction work damaged a water main on the North Terrace Campus, flooding the library and campus buildings with over 200,000 liters of water and 40 tons of mud (Garnett et al., 2018).

On Sunday, April 30, 2006 University of New Mexico's Zimmerman Library was on fire estimating that at least 30,000 volumes of journals on American history, Latin American studies, ethnic studies, southwestern studies, anthropology, social sciences, and humanities, and over 20,000 maps were lost (Halsted, Clifton & Wilson, 2014: 81; Lewis & Wilkinson, 2006). In present, Fondren Library in Houston University had recently been hit hard by a hurricane, resulting in water leaks affecting the map room located in the basement. This room houses their valuable maps but also contains collections of microfiche and microcards (A. Xiong, personal communication July 12, 2024).

Risks to libraries also include theft, as seen in the 1980s in the US, when James Shinn stole over $1 million worth of books from university libraries (Falciani, 2017), followed by Stephen Blumberg in the 1990s, whose stolen collection of rare books exceeded $5 million.

Another serious and not inconsiderable case of disaster for a map library is map theft. Thefts of early cartographic material from several major special collections in the USA and abroad have refocused attention on the age-old problem of security and theft prevention in libraries (Kovarsky, 2007). For example, Lidman (2002) describes the incident that the Royal Libray of Copenhangen had to deal with when they discovered that they had been subjected to map theft.

In Greece, among the disasters that storm Daniel provoked on September 2023 after hitting the Thessaly region was the destruction of the University's of Thessaly academic library[2]. On May 2024 on Lesvos island, the historical building of the Spiritual Center of Kalloni "Club Arisvi" was engulfed in flames turning to ashes rare books, paintings, maps, and manuscripts that bear witness to the history of the place[3].

3. Terminology & Definitions

In the context of library and information services the recommended classification that Robertson (2021, xx) suggest includes the word '***risk***' to indicate «*a single and specific threat such as fire, flooding, or theft. Synonymous with risk in the latter usage are*

[2] https://magnesianews.gr/volos/ena-chaos-sti-vivliothiki-toy-pth-exi-mines-meta-tis-plimmyres-eginan-poltos-ekatontades-vivlia.html [in Greek]
[3] https://www.voria.gr/article/lesbos-paranaloma-toy-pyros-i-istoriki-leshi-arisbi-stin-kalloni-kaikan-spania-arheia [in Greek]

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«danger» «peril» and «threat». An '***incident***' is a minor breach of security, a small loss of data, or a minor injury at a location while an '***emergency*'** describes one or more minor casualties, a small loss of data, or a minor injury at a location. A '***major emergency'*** stands for «a serious casualty or casualties, extensive damage to a building or equipment that will involve serious inconvenience or a power outage that disrupts operations for 24 hours».

Disaster is defined as *«…any incident which threatens human safety and/or damages, or threatens to damage, a library's buildings, collections, contents, facilities, or services»* (Matthews and Eden as referred in Matthews & Feather, 2017) and as «any damage to the building(s) or equipment that will disrupt operations for more than 48 hours, any natural event (e.g., high winds, winter storm, earthquake) that disrupts transportation or communications for more than 48 hours, or any serious loss of vital data (e.g., borrower data that have been lost) (Robertson, 2021: xx).

By ***recovery*** Robertson (2021: xx) means «*the full restoration of facilities and collections, and the staff members' return to normal work schedules*».

4. Classification of risks in libraries

Disasters in academic libraries comprise several possible events broadly categorized as either *natural* or *human-caused disasters*. Numerous categories and lists of disaster types at the micro level exist in the literature, such as weather-caused, unexpected outcomes or secondary disasters, mass movement, geographical, and human-caused disasters. Each category overlaps considerably with one or more other categories. For example, weather-caused disasters might include water damage and flooding from heavy rains, river overflow, levee breaking, typhoons, tsunamis, and hurricanes, which can lead to unexpected outcomes or secondary disasters such as mold outbreaks and/or pest infestations (Wilkinson, Lewis & Dennis, 2010: 39).

Robertson (2021: 26) identifies seven main categories of risks that can be occurred in a library environment:

1. *Natural risks*: e.g. severe weather, wildfires, flooding, earthquakes, epidemics and pandemics.
2. *Technological risks*: e.g. power outages, telecommunications failures, gas leaks, toxic spills.
3. *Human-caused risks*: e.g. human error, strikes and protests, the outbreak of war, the loss of technical expertise, problems in managerial and professional succession.
4. *Security risks*: e.g. sabotage, data theft, social engineering, hostile instrusions, malware.
5. *Proximity risks*: e.g. accidents and other negative events on major thoroughfares, railway derailments, and fires in neighboring structures.
6. *Crises*: e.g. events involving negative media coverage arising from any of the above risks.
7. *Enterprise risks*: e.g. problems arising from negative legislation, hostile takeovers, political strife, and econo0mic downturns.

The causes of disasters in digital libraries can be accrued to various factors. According to Altman et al. as they are referred to Ifijeh et.al., (2016) can be broadly categorized into the above:

1. *Physical threats*: e.g. age, storage facilities, fire and some natural disasters; could also be as a result of failure of some of the information technology media and infrastructure used in the digital libraries
2. *Technological threats*: e.g. hacking, lack of data back-ups, computer virus attack.

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3. *Human threats*: disaster or damage caused by humans in the digital library systems due to cases of incompetency or sabotage.
4. *Institutional threats*: mission change, change of legal regime and economic failure.

The most common hazards that may lead to a disaster according UNESCO's, ICOMOS & IUCN «Managing Disasters Risks» manual (2010: 1) are as follows:

• Meteorological: hurricanes, tornadoes, heat-waves, lightning, fire.
• Hydrological: floods, flash-floods, tsunamis;
• Geological: volcanoes, earthquakes, mass movement (falls, slides, slumps);
• Astrophysical: meteorites;
• Biological: epidemics, pests;
•Human-induced: armed conflict, fire, pollution, infrastructure failure or collapse, civil unrest and terrorism;
•Climate change: increased storm frequency and severity, glacial lake outburst floods (GLOFs).

5. Disaster Management Plan for a Map/GIS Library: Literature review

Analog materials such as books, manuscripts, documents, photographs, maps, and artifacts are preserved because of their historical or evidential values, and their age makes them especially fragile. In addition, their uniqueness makes them impossible or extremely challenging to replace, so the attitude toward disaster management in archives must therefore be one of proaction and not reaction (Flaherty, 2002:111). Moreover, small institutions hold important archives, maps, transactional records, and other documents, which are irreplaceable artifacts in cultural, governmental, and community contexts. The modest budgets of many small towns and rural organizations fail to provide a fair notion of their importance in preserving our national heritage (IMLS, 2019: vi).
Digital resources, services, and networks have had a considerable impact on the patrons and wider society that the library serves. Digitization has allowed institutions to preserve electronic records, images, catalog records, and other items. Libraries contain 73% of the USA's digital collections, including most digital texts and geospatial files, according to the Institute of Museum and Library Services (IMLS). However, the incidence of major disasters continues, and terrorism and war threaten cultural institutions globally[4].
The IMLS survey (2019: 37) demonstrated that 85% of geospatial media files were reported by libraries in the USA, while historical societies held approximately 15% of content by volume of geospatial media.
The extent of bibliographic research on DMP for a Map/GIS Library revealed a large number of libraries in the U.S. that sustain such a document (for example University of Washington Libraries[5], University of Michigan Library[6], Cornell University Library[7], Harvard University Library[8]). On the other hand, researchers from India (Nongrang & Khongtim, 2021), Malaysia (Ismail et al., 2023), and the Philippines (Superio, Alayon & Oliveros, 2019) point out that academic libraries do not have a disaster management plan, they are unprepared for any disaster, and librarians lack knowledge and skills in disaster management. The same findings were revealed by Idiegbeyan-Ose et al., (2018), who reviewed the literature on disasters experienced by libraries in some developing nations

[4] https://onlinegrad.syracuse.edu/blog/emergency-preparedness/
[5] https://lib.uw.edu/wp-content/uploads/preservation_disaster_unit-plan.pdf
[6]https://www.lib.umich.edu/about-us/policies/disaster-response-and-recovery-plan-library-collections/
[7] https://chinapreservationtutorial.library.cornell.edu/content/response-and-recovery/
[8] https://preservation.library.harvard.edu/emergency-preparedness

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such as Egypt, the Philippines, Nepal, Jamaica, Nigeria, and Malawi. They concluded that disasters could be prevented and better managed in libraries if precautions and recommendations were implemented.

UNESCO recognized the fact that cultural and natural properties are increasingly affected by natural disasters without being taken into account in related global statistics while the number of World Heritage properties that have developed a proper disaster risk reduction plan is surprisingly low. That's why the International Centre for the Study of the Preservation and Restoration of Cultural Property (ICCROM) developed a resource manual to help protect World Heritage sites (UNESCO, ICOMOS & IUCN, 2010).

Disaster Management Plan for a library is a point of interest for international library associations. IFLA, the leading representative of Library Associations, in 2003 carried out an international survey addressing the national libraries worldwide to find out how many of them held DMPs. The results of the survey were extremely disappointing as out of the 179 responded libraries only 39 maintained a DMP. For this reason, IFLA in 2006 decided to prepare a basic manual focusing on the main points to be considered when drawing up a disaster plan. The proposed plan is deployed in 4 stages: 1. Prevention, 2. Preparedness, 3. Reaction, 4. Recovery (McIlwaine & Varlamoff, 2006).

The Australian Library Association (ALIA) following the same philosophy in the categorization of procedures has developed a guide for each of the four stages of a disaster[9]. The American Library Association (ALA) maintains a specific link on its website titled "Disaster Preparedness" that includes a variety of related links that are available to librarians to inform and assist in developing a disaster preparedness plan[10].

In particular, the Map and Geospatial Information Round Table (MAGIRT) the round table in the American Library Association that leads and inspires information professionals at all levels of expertise in their work with map and geospatial information resources, collections, and technologies in all formats, through community, education, and advocacy, has developed the «*Map Collection Security Guidelines*»[11] to «*allow librarians and curators to better assess their map collections, prepare security proposals for their administrations, and provide a more secure environment for their map collections*». The specific guidelines though, are focused on map thefts as maps in atlases and books are often very valuable and especially vulnerable. The removal of a map or two is not immediately apparent when the volume is returned; it is often difficult to know if a volume contains all of its constituent parts since few collections, if any, have the time or staff to inventory all of their maps and illustrations. The same focus on map theft follows the Map Curator's Toolbox of the British Cartographic Society in which security issues and several links are at the librarian's disposal[12].

To the best of our knowledge, the literature regarding the safety and preservation of maps is quite sufficient (Weeshies, 2014; MAGERT Task Force on Library Security for Cartographic Resources, 2010; Jones-Eddy & Zwinger, 1988). Nevertheless, there is no adequate bibliography on the disaster management plans for the Map/GIS libraries and the librarians must rely on the broader –if exists- DMP for the library.

[9] https://read.alia.org.au/alia-guide-disaster-planning-response-and-recovery-libraries
[10] https://www.ala.org/advocacy/disaster-preparedness
[11] https://www.ala.org/sites/default/files/rt/content/publicationsab/Map%20Coll%20Security%20Guidelines.pdf
[12] https://www.cartography.org.uk/the-map-curators-toolbox-8

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6. Disaster Management Plan components

Disaster planning comprises a series of procedures, plans, programs, and other measures that enable people and organizations to prepare for, respond to, and recover from negative events of all kinds (Ferguson, 2021: xx).

Kahn (2003: 3) defines the **Disaster Management Plan** «*as the procedures by which a group of trained individuals respond to a disaster and determine the best way to recover damaged materials so that a return to normality can resume as soon as possible*".

A disaster control plan is according Matthews & Feather (2017) «*a clear, concise document which outlines preventive and preparatory measures intended to reduce potential risks, and which also provides details of reaction and recovery procedures to be undertaken in the event of a disaster to minimise its effect*».

Once the plan is written, the staff who will act as team leaders must be trained so that they will be able to act effectively if disaster strikes (Doig, 1997: x).

Manchester Metropolitan University Library and Special Collections developed their first emergency management plan in 1994 in response to the tragic fire at Norwich Central Library, which destroyed over 100,000 books and thousands of historical documents. Norwich Central Library didn't have an emergency plan at that time. When the fire department entered the building to try to salvage and recover materials, they unintentionally removed easily replaceable materials before the rarer objects that weren't given priority for salvaging. This event made clear the need for a comprehensive emergency plan, which is currently a mandate for all archives, museums, and libraries (Hughes & Draper, 2019).

Disaster Management Plan for Map/GIS libraries involves a holistic approach encompassing the four key components that Library Associations (IFLA, ALIA) and researchers (e.g. Matthews, Smith & Knowles, 2016) suggest and mentioned earlier: prevention, preparedness, response, and recovery. Each of these components plays a crucial role in safeguarding library resources and ensuring continuity of operations in the face of potential disasters.

1. **Prevention** involves proactive measures to reduce the risk and impact of disasters. This includes conducting risk assessments to identify vulnerabilities, implementing structural safeguards such as fire-resistant storage and flood barriers, and ensuring optimal environmental controls to protect physical collections (McIlwaine & Varlamoff, 2006: 10; Matthews, Smith & Knowles, 2016). Additionally, digital preservation strategies, such as regular data backups and the use of cloud storage, are essential to safeguard digital assets.
2. **Preparedness** focuses on planning and training to ensure readiness for potential disasters. Developing a comprehensive disaster management plan, conducting regular training sessions for staff, stockpiling emergency supplies, and establishing clear communication protocols are critical activities that enhance preparedness. In terms of disaster preparedness, mitigation is the process of reducing the risk of loss or harm (Flaherty, 2021: 34).
3. **Response** entails immediate actions taken during and after a disaster to minimize damage and ensure safety. Activating the disaster management plan, conducting rapid damage assessments, mobilizing resources to protect collections, and providing timely updates to stakeholders are key steps in an effective response.
4. **Recovery** involves restoring normal operations and mitigating long-term impacts. This includes repairing facilities, restoring digital systems, utilizing backup data to recover lost information, conducting post-disaster evaluations to identify lessons learned, and providing mental health support for staff affected by the disaster.

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7. Conclusions

Climate change is one of the greatest and most complex challenges the international community has to deal with today and in the years to come. Climate change, is now receiving considerable attention and in the cultural heritage sector. Lessons from severe natural disasters may well be worth considering by countries which have to date been less affected by them, in terms of both mitigation and recovery (Matthews, Smith & Knowles, 2016).

Furthermore, after the events of September 11 which were caused by an unpreceded act of terror, it became clear that standard, proven emergency management plans and responses turned out to be the most effective way of dealing with the disaster (Matthews & Feather, 2017).

In that framework it seems that many libraries do not yet understand the benefits of having a formal disaster management strategy.

As McIlwaine & Varlamoff (2006) state individual institutions' conditions could vary significantly and, therefore, will impact how they formulate a plan towards disaster preparedness. Besides, «*No single plan suits all*». Each library is different, each situation is unique, but using the manuals that Library Associations propose will help Map/GIS librarians to develop their own DMP specifically for covering their needs. The University of New Mexico Zimmerman Library affected earlier by flood in the underground science and engineering library and this incident had prompted the creation of a disaster plan and the formation of a recovery team. As a result, the library was prepared to handle a disaster of the magnitude of the fire (Gugliotta, 2007).

Historically, map libraries served as custodians of cartographic collections, providing researchers, urban planners, and government agencies with valuable geographic information. Today, these institutions have embraced digital technologies, offering access to dynamic, real-time geospatial data. The development and implementation of robust disaster management plans are vital for the protection and resilience of Map/GIS libraries. By adopting a comprehensive approach that integrates mitigation, preparedness, response, and recovery, these libraries can safeguard their invaluable resources and ensure the continuity of operations in times of crisis.

Ideally, no library would ever have to face a disastrous situation; however, the reality is that many will. Every geographical area of the world faces environmental challenges (e.g. hurricanes, tornados, tsunamis), and any library can suffer from localized disasters (e.g. mold, flood, computer hacking, terrorism). Libraries by their nature are democratic services, offering valuable resources to the public. Preparing for disasters of any scale ensures that libraries can continue to offer their services even if they are challenged.

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