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DIGITAL TECHNOLOGIES IN CONSERVATION OF CULTURAL HERITAGE: DIGITIZATION AND VALUES

Digitisation makes the invisible to become visible¹
(Pandey and Misra 2014, 137)

Abstract. Digital technologies have ultimately changed the way our society works. Nowadays, there is not a single aspect of life we can imagine without the use of computers, smart phones and other digital devices. Heritage institutions are not an exception, and they shouldn't be. Digital technologies have, although slowly, found their way into the domain of cultural heritage. The advantages of digital technology were first used to create digital documentation, information and photographic databases, but also for the research of materials and cultural heritage environment. Digital documentation also includes conservation documentation, thus forming an enormous body of information, which is easily shared and distributed. This ease of access and exchange of information is one of the greatest values of digital files, promoting development of the profession and professionals, at the same time giving the opportunity to the broader public to use it for various purposes. However, do these endless possibilities for creating, processing and using digital files create a different perspective of the concept of the values of cultural heritage? What are the values of a digital document in conservation of cultural heritage? Does the value of cultural heritage play important role in the process of digitization?

Keywords: digitization, conservation, digital technologies, values, integrity, cultural heritage, cultural assets.

1. Introduction

Digital technologies have entered our lives with the appearance of first personal computers, which have completely changed the functioning of our society. With the expansion of personal computers, came also the development of the first digital cameras, who quickly replaced the paper as the most dominant image support. Linking the computers into a global, world wide network, or the invention of internet, represents the third pillar of modern society. These three discoveries have led to exchange of information at incredible speed and enabled the access to enormous base of knowledge with no special skills required. At the same time, digital and digitized funds available on internet are growing at an exponential rate. Today, we live in a world where even computers have become obsolete in the chain of demand and access to information. Embodying all three revolutionary technological inventions of the 20th century, smart phones have become, together with social networks, the basic tool for functioning in digital world [1].

¹Pandey, Prabhat and Roli Misra, Digitization of Library Materials in Academic Libraries: Issues and Challenges, Journal of Industrial and Intelligent Information, 2:2(2014)

Institutions for protection of cultural heritage are safeguarding a significant part of cultural and research content, which have a remarkable potential for dissemination of existing and creation of new knowledge. Although research and communication functions are inherently embedded in these institutions, improving and expanding the access to this content through digital technologies is not developing at expected pace. It is estimated that by 2015 only 17% of cultural heritage, kept in European heritage institutions, is digitized[2]. One of the reasons lies in the fact that successful digitization requires a careful planning – digitization strategy which includes all its aspects, from scanning and photographing, through processing, storing, creating a backup system, creating an information system, input of metadata and long-term preservation of databases' carriers, to creating and sustaining a good relationship with the public. However, on a world wide level, digitization has been present for decades and its significance justifies all the financial, technological, technical, professional and other requirements.

Republic of Serbia has in recent years recognized and defined the importance of digitization, by passing new laws and other documents. Law on culture[3] mentions promoting the application of new technologies in culture and promoting the process of digitization and development of digital research infrastructure, in cultural heritage and art domains. Guidelines for digitization of cultural heritage in the Republic of Serbia[4] quotes that proposed national Strategy for development of culture 2017-2027 recognizes digitization as an important tool for preventive conservation of cultural heritage, securing better visibility, high-quality presentation and promotion of national cultural heritage. Guidelines for digitization of cultural heritage [4], page 3 also define the term digitization “Digitization is a comprehensive process which includes, but not limited to: development of a complete digital catalogues of cultural heritage, transformation from analog to digital form of cultural heritage assets and their related documentation; development of tools and instruments, including the legal ones, for various kinds of processing and protection of digitized cultural heritage; long term preservation of digitized cultural heritage, including solving problems of obsolete and changing physical carriers and recording of digital information; development and connecting software and hardware network of information systems on digitized cultural heritage; securing the permanent and reliable access to digitized material, as well as optimal and safe use of these materials for different purposes, according to the predefined frame; multimedia representation of digitized cultural heritage.”

In the field of conservation of cultural heritage², various techniques and digital technologies are applied to facilitate planning and implementing of conservation process – research, remedial conservation, restoration and preventive conservation, as well as dissemination of data related to heritage, thus contributing to the integrity and the overall value of cultural heritage. In the context of conservation, integrity of an object can be described as an unbreakable bond between object's material nature, his function or use and the message it carries. If the object suffers a change which makes it look different from the assumed original appearance, then the inherent message also changes [5]. By creating a complete documentation on conservation of cultural good, we preserve and enrich the body of information yielded by the object, hence his integrity as well. It is necessary to emphasise that digital record also has its own value, because it's treated as a source of information about the heritage, with absolute integrity of the data it

²At the 15th Triennial Conference, held in 2008. in New Delhi, ICOM CC adopted a resolution on a terminology for conservation to facilitate communication between professionals and with public. It includes the definitions of terms conservation, preventive conservation, remedial conservation and restoration. (<http://www.icom-cc.org/242/about/terminology-for-conservation/#.XPobf62B1Bw>)

consists of. It has to faithfully represent the original object (e.g. photographs), with limited processing of digital data.

2. The use, purpose and contribution of digital technologies to the conservation of cultural heritage

Contemporary theories and practical research, interpretations, presentation and conservation of cultural heritage are, and should be, constantly evolving and adapting to certain aspects of social, scientific, cultural and economic context of the society. We can take the example of the overall, fast and diverse development of digital technologies which have increasing influence on its application in conservation [5].



Figure 1. UV photography with digital camera gives immediate results that are an indispensable part of deciding on the choice of conservation treatment
 “The girl next to the falconer”, author Erne Nađ, City museum Sombor

Digital technologies can facilitate and stimulate research and development of cultural heritage conservation. First and the most obvious application is in the area of non-invasive examination of cultural goods, which makes them indispensable in remedial conservation and restoration of cultural goods. Just to name a few examples: photographing objects under normal and raking light to record true colours and surface properties of an artwork; UV fluorescence and IR reflectography, to identify old restorations, varnishes and underdrawings; x-radiography, for studying all the layers of materials; 3D modelling and photogrammetry; using of total stations, for precise GPS positioning; high dynamic range, high resolution (photo-stitching), extended depth of

field photography, etc. These techniques provide the information on the state of the object, production details, structure and potential interventions on the object, which are essential for reaching optimal decisions in conservation. It should be noticed that some of these photographic techniques (like raking light, UV, IR photography, etc) (Figure 1) were used even before the age of digital photography, however, they required a lot more resources, and most importantly, time. Sometimes it took days to get to view the results, while today, digital photographs are instantly available. The specific treatment of digital images can further facilitate the process of planning in conservation. For example, mapping of object for various intents (structure, materials, degradation, etc) becomes a tool condition assessment and efficient planning of conservation-restoration treatment.

One of the most common tasks of preventive conservation is monitoring of climatic parameters in immediate environment of cultural heritage. Not so long ago, museum professionals used analog thermo-higrographs, which recorded data with ink on paper templates. On these devices, the recorded values of temperature and relative humidity were immediately visible, without additional equipment, but in a very limited time frame (7 or 30 days). With the introduction of electronic devices, reviewing of recorded data became slightly more complicated, but the processing of data became fast and simple. Despite the fact that digital data requires the use of computers and presents an important challenge of preserving digital documents, it significantly contributes to development of climate monitoring for cultural heritage.



Figure 2. Projected "digital restoration" of Mark Rothko's murals in Harvard University.
<https://www.artforum.com/print/201506/light-repairs-a-roundtable-on-the-restoration-of-mark-rothko-s-harvard-murals-52269>

Digital technologies are also very useful for monitoring the condition of cultural assets and correlating them with environmental monitoring. Combining these two aspects can lead to identifying degradation mechanisms and more efficient research into causes of decay and incidently adapted mitigation techniques for reducing risks of deterioration of cultural heritage objects. Correlating the actual degradation effects to real environment conditions was until recently one of the least developed parts of

preventive conservation, but, now receives a lot of attention, with the focus on creating predictive degradation models.

Digital record balances well two, seemingly opposed, goals of heritage institutions: provide access or achieve optimal conservation of heritage objects. This dilemma can also be expressed with a question – how to reconcile the needs of today and future users of cultural heritage. This balance is actually very hard to achieve, usually giving advantage to one of the two functions. The extreme examples are most dangerous, when, in order to create attractive displays and reach maximum number of visitors, institutions completely ignore basic principles of preventive conservation (inadequate security procedures, lighting, showcases, etc). The opposite example is equally bad, when, due to inadequate conditions in exhibition halls and research rooms, the objects never leave their storage areas.



Figure 3. The “real” conservation state of Mark Rothko’s murals in Harvard University.
http://c.o0bg.com/arts/theater-art/2014/05/20/harvard-rothko-murals-seen-new-light-with-revolutionary-new-projection-system/UspSbL0csFjeM2cwSflKON/story.html?p1=Article_Related_Box_Article_More

Digital technologies erase the dilemma between forementioned functions, and even create a symbiotic relationship, which benefits both. On the one hand, access to digital documentation drastically reduces the need for physical manipulation of objects, thus reducing the risks of degradation (wear) and consequent investment in their conservation-restoration [6]. When there is no frequent need for actual handling of objects, they stay in the stable environment of storages. In this way, more rigorous conditions can be achieved for sensitive objects, without the fear of disturbing them. On the other hand, objects kept in these optimal conditions are ready to be exhibited or used for other communication or research purposes, without additional investment.

Digital projection was also successfully used as a restoration tool. In 2014, Harvard Art Museums opened the exhibition of Mark Rothko murals, painted in 1961-

1962. These murals were commissioned for the canteen of the Harvard University, where they were displayed until they were moved to storages, because of severe loss of colour due to effects of daylight. Restoration with conventional methods was ruled out. However, the team of art historians, conservators and scientists from Harvard Art Museums and MIT Media Lab, created a software which projects the part of faded colours on displayed artworks, recreating the murals in their original colours, as they appeared when they were created.³(Figure 2 and Figure 3) This project was completed without touching the object, using digital technologies, restoring original colours, pixel by pixel. Visitors were also given the opportunity to experience the actual appearance of faded originals, every day at 16 h, when the projectors with digitally restored colours were turned off.



Figure 4. Apps that use changed reality have become a common part of a visit to many world museums (New Acropolis Museum)

https://ec.europa.eu/budget/euprojects/file/chessrecoloringpeplophorosatacropolismuseumjpg_en

³<https://www.harvardartmuseums.org/visit/exhibitions/4768/mark-rothkos-harvard-murals>(accessed 9.12.2018)

This is one of the fine examples of a measured use of digital technologies for upgrading the visitors experience, without intent of replacing the classical object based exhibition approach. Another way of enriching the content offered to users is by using 3D modelling of objects and creating virtual tours. With nothing more than a smart phone and a specific software application, museum public is able to see not only how the object looks like now, but also how it looked when it was created and used. This experience can be improved with additional information (photographs, text, animation, etc) which is often interactive and engages people much more than a simple label of an exhibit. (Figure 4)

3. The value of a digital object⁴

Digital technologies facilitate the process of documentation, research, conservation, usage, presentation and managing of cultural heritage. Their contribution has become integral part in heritage management. As a result, their application is determined by the professional and ethical codex and frameworks that refers to every segment of the process, from preparation, through creation, to usage and management of digital objects. Integrity and value of digital object are based on verifiability of its credibility. Integrity of the digital object, and by this its value, is achieved by implementation of professional principals in every phase of digitization of heritage documentation. The Regulations on specific requirements for digitization of cultural heritage defines order of operations in the digitization process [7] :

- Determination of digitization priorities
- Developing plans and programs of digitization
- Selection and preparation of heritage object and its documentation
- Creation of digital record
- Entry of digital record and related metadata into information system
- Management of digitized cultural heritage
- Quality control of digital object
- Preservation of digital object
- Providing accessibility of digitized cultural heritage

This is done for a good reason. Let's take digital photography for example. Due to accessibility and overall presence of digital photographic technology, broadest public is familiar with many functions and capabilities for creation, usage and editing digital photography with intent to change the image. However, these principals of quick and easy recording and processing should not and cannot be applied to photography used for documenting cultural heritage. In heritage, photography has various uses in research, curative and preventive conservation, inventory, education, publication etc. and this is why digital photography needs to be a credible source of information about heritage, and a part of a wider knowledge context.

In order to ensure equal quality of every digital record, digitization procedures need to be standardized so that various elements of digitization – hardware, softwares, file compatibility, as well as digitization project and resources (financial, experts etc.), could be combined to achieve best result. For recording movable heritage objects, it is necessary to develop working procedure that relates to camera and lens selection,

⁴The phrase “digital object” is used according to the definition provided in The Regulations on specific requirements for digitization of cultural heritage, clause 2, stating that digital object consists of digital record and metadata on cultural heritage object, that identifies and describes it.

lighting equipment, background, shooting point, use of calibration charts etc. to ensure that photographs of one object recorded in different times (for example, before and after conservation treatment) represent credible source of information about that object.

Process of editing digital record is also defined by the professional codex. There are many possibilities to edit digital record like photography in accordance with different purposes like heritage inventory, conservation treatment, printed publication or presentation on bigger formats, science research and data exchange etc. This targeted usage of digital photography is a reason why professional regulations do not exclude editing photography but require that master copy is kept intact, in raw format, as an archive record from which edited and converted files are extracted.

Digital object credibility also requires creation of descriptive, administrative, structural and technical metadata, that refers to heritage object as well as the digital record [8], page 106. Metadata have significant role in the process of enabling greater accessibility of heritage documentation to professionals and broader public, that aim to expand knowledge and heritage promotion. Digital records are open for data exchange if their metadata are structured according to regulations and there are several protocols developed for the specific type of cultural heritage.

These regulations are best met with usage of information management systems that includes metadata, file formats, work protocols, file naming procedures, backup files, distribution and other segments of creation and usage of digital documentation[9].

4. Value of heritage object as a factor in conservation and digitization

The use of digital technologies in conservation of cultural heritage is largely determined by financial resources, heritage institution's mission and its status on the national level. Experience and practice teach us about importance of planning conservation and digitization. Planning for conservation includes defining priorities that are based on the value of heritage object and its value influences not only decision whether conservation treatment will be implemented or not, but also how it will be implemented [10]. Value of heritage objects has the same effect on the sequence and the scope of digitization project. The Regulations on specific requirements for digitization of cultural heritage[7], in clause 6, also provide directives for determining priorities according to available resources and the following criteria:

- Significance of a heritage object
- State of conservation, regarding preservation level, sensitivity to manipulation, stability of the media;
- Frequency and level of usage;
- Collection integrity and extent of documentation;
- Limitation in access to heritage object;
- Characteristics of heritage object (form, size, shape, type of material) according to technical and human resources in the process of digitization;
- Approval of the owner;
- Other planned activities.

These directives for digitization process partially coincide with the ones for planning conservation of heritage. They directly link the value of cultural heritage object with the value of a digital object. Ideally, every heritage object would receive conservation treatment and digitization of an equal quality. However, in a broader

socio-economic context, in which conservation is carried out, technologies used for research, conservation-restoration treatment and preventive conservation are determined by the assessment of value of a heritage object [11]. Regardless of the value of an object, digitization process must not go below determined standards, in order to make the digital document a credible source of information about the heritage object.

Digitization also includes document transformation from analog to digital form. Since heritage institutions store great amounts of documentation from decades or even centuries of existence, value of a document and its content have a decisive role in decision making process. There are many cases where document value has changed over time. Analog document, original carrier of information about cultural heritage (photography, plans, maps, diaries, publications etc.) can surpass its original purpose and itself become a cultural heritage object. This transformation can occur for several reasons – techniques and technologies of its creation, significance of the author/creator, broader context, disappearance or decay of the original object, significance of the content etc. The state of a document or the usage intensity can also contribute to the priority for digitization and/or conservation. In this context, digitization is also a measure of preventive conservation because it reduces the need for the object manipulation while making it available for interested users.

5. Conclusion

Digital technologies have become basic tools in conservation and usage of cultural heritage because they facilitate and enhance basic activities in documenting, presenting and preserving heritage and they significantly contribute to research, promotion and availability of the body of knowledge.

In the process of using digital technologies and digitization of cultural heritage, the concept of value plays a central role. It is clear that the value of heritage object represents the basis for planning of conservation and digitization activities. Digital technologies provide the opportunity to test and confirm the value of humanistic approach to open access and knowledge dissemination of common cultural heritage. They make it possible for public to connect and interact with cultural heritage in a manner adapted to contemporary way of life. This validates the role and position of cultural heritage and public in the development of our society.

Digital technologies offer a lot more options and functions comparing to those actually used in conservation of cultural heritage (digital 3D microscope, false color analysis etc.). The choice of applied technologies are mostly influenced by finances, but also by professional policies on creating and using heritage documentation. Heritage professionals have to abide by those rules, which implies permanent education on topics like information technologies, which until recently were not closely related to traditional heritage formation in Serbia. It also confirms the need for interdisciplinary approach to cultural heritage in order to achieve the aim of research, conservation and promotion of cultural heritage.

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