Southern Illinois University Carbondale

OpenSIUC

Research Papers

Graduate School

2013

Digital Heritage: Digitization of Museum and Archival Collections

Genevieve A. Horan
Southern Illinois University Carbondale, gen.horan@gmail.com

Follow this and additional works at: http://opensiuc.lib.siu.edu/gs_rp

DIGITAL HERITAGE:
DIGITIZATION OF MUSEUM AND ARCHIVAL COLLECTIONS

by

Genevieve Horan

B.F.A., University of Illinois Urbana-Champaign, 2010

A Research Paper
Submitted in Partial Fulfillment of the Requirements for the
Masters of Public Administration

Department of Political Science
in the Graduate School
Southern Illinois University Carbondale
May 2013

RESEARCH PAPER APPROVAL

DIGITAL HERITAGE:
DIGITIZATION OF MUSEUM AND ARCHIVAL COLLECTIONS

By

Genevieve Horan

A Research Paper Submitted in Partial

Fulfillment of the Requirements

for the Degree of

Public Administration

in the field of Political Science

Approved by:

Lorilee Huffman, Chair

Dr. John Hamman

Dr. Stephanie Pink

Graduate School
Southern Illinois University Carbondale
April 8, 2013

AN ABSTRACT OF THE RESEARCH PAPER OF

GENEVIEVE HORAN for the MASTERS OF PUBLIC ADMINISTRATION degree in POLITICAL SCIENCE presented on **April 8, 2013**, at Southern Illinois University Carbondale.

TITLE: DIGITAL HERITAGE: DIGITIZATION OF MUSEUM AND ARCHIVAL COLLECTIONS

MAJOR PROFESSOR: Lorilee Huffman

Abstract:

The purpose of this paper is to trace the utilization of computer technology within museums and archival institutions, and relate how they have adapted to survive in today's society that is obsessed with technological advancement. Beginning in the 1960s, computer technology started to integrate into the federal government and professional business sectors. Because of its success in these sectors, museums and archival institutions, began to gradually recognize the use of computers and associated technologies as a means to not only increase administrative productivity, but as a way to enable staff to delve deeper into their available collections through the automation of cultural heritage. This automation changed the way professionals accessed, interpreted and managed collections, and eventually led to technology's use as a method to connect with other institutions and the public. It is crucial to understand the transformations that took place with the incorporation of technology into museums and archival institutions through the adoption of best practices through a formalized guide. A model of this type of guide is included in the paper and covers a range of essential procedures and information utilized within a digitization project. However, one has to also understand the issues that have arisen because of technology's use and how they have been and can be resolved in cultural heritage institutions.

ACKNOWLEDGMENTS

I would like to acknowledge the hard work of my committee, most notably my committee chair,

Lorilee Huffman. Her advice and guidance have been invaluable throughout this process and I

would not have been able to complete this project without her support. Thank you as well to Dr.

Hamman and Dr. Pink for sitting on my committee and for their cooperation, assistance and

encouragement. Lastly, I would like to thank my family for their continual and unconditional

inspiration and support as I strive to achieve my goals.

TABLE OF CONTENTS

CHAPTER 1:

INTRODUCTION

Traditionally, museums and archival institutions have existed to procure, interpret, and

conserve cultural heritage. According to the International Council of Museums, a museum is,

> …a non-profit, permanent institution in the service of society and its development, open
> to the public, which acquires, conserves, researches, communicates and exhibits the
> tangible and intangible heritage of humanity and its environment for the purposes of
> education, study and enjoyment (ICOM, 2012).

Archival institutions are similar to museums in that they collect and maintain, yet focus on,

"noncurrent documentary materials determined to have permanent or continuing value" (Daniels,

1984). In terms of the holdings in museums and archival institutions, these can be seen as

cultural heritage, which refers to the legacy of physical and immaterial elements of a society or

place that have been passed-down to and preserved for future generations. The International

Council on Monuments and Sites regard, "customs, practices, places, objects, artistic expressions

and values" as well as built environments as representation of the scope of cultural heritage

(Alexander, 2008). These cultural heritage institutions strive to educate, promote and remember

the past through the collection, management and presentation of the objects and customs of

diverse places and societies. Since the first museum was established in Egypt in the 3rd century

BCE by Ptolemy Soter (367-283 BCE), a general and successor to the Macedonian King

Alexander the Great (356-323 BCE), museums began as academic institutions that employed

private collections as didactic tools (Werner, 2013). These institutions acted as repositories of

educational resources, from sculptures of philosophers to astronomical tools and scientific

specimens (Alexander, 2008). The public exhibition and interpretation of these artistic, historic,

anthropological and scientific objects opened-up a world of scholarship to diverse audiences. However, up until recently, the only way to experience these objects were through physical visits to museums and archival institutions. The advent of the digital era has changed the way the public and museum interact, and it has impacted the future of cultural and archival institutions' collection management methods.

The immersion of society into the world of technology altered the way the world worked (Smith, 1999). The proliferation of knowledge was now occurring faster than ever before and the federal government, as well as the professional business sector took note (Smith, 2000). As the discipline of computerization began to integrate itself in everyday life, a cultural transformation occurred. In the 1970s, despite the history of resistance with the presence of computer technology and its use in cultural heritage institutions, these organizations began to acknowledge the opportunities digitization offered. This was due in part, as a response to the technological and digital world that advanced into mainstream culture. Cultural heritage institutions began to employ the digital and organizational properties of computer technologies that were applicable in their administrative and collections management approaches (Hughes, 2004).

Computer technology began to appear in the federal government in the mid-20th century with the invention and construction of the earliest processors and computers. However, for many cultural heritage institutions, they were hesitant to use this early computer technology as it was viewed as foreign and costly, and required a not readily available specific skill set for the user to best employ the technology. Because of these issues, only the largest museum and archival institutions, such as the Smithsonian Institution (Washington, DC) with its diverse holdings and secure federal government supported funding, could afford the opportunity to employ them in the 1960s. In spite of these issues, the impacts of computer technologies and their capabilities of

digitization quickly became known within the museum community (Parry, 2004). In the 1980s

and 1990s, the recognition of these capabilities allowed cultural heritage organizations to

connect and communicate instantly, through their data recording software and the earliest

versions of the Internet. Digitization afforded institutions of all sizes the same opportunities for

scholarship, interpretation and the ability to connect with a virtual audience. The appropriation of

computers and appropriate software to undertake the processes of digitization greatly affected the

documentation and organizational work that was being executed by collections managers,

curators, educators and administrators alike (Reilly, 2000). The development of best practices in

a procedural and informational guide, when created, also equipped cultural organization staff

with standardized procedures as a means to consistently generate quality digital surrogates

throughout the process of digitization. The digitization of museum and archival collections not

only afforded these institutions the opportunity to better manage collections, but it also offered

them an opportunity to transmit knowledge and culture globally.

  This paper aims to explore and understand the complexity of digitization and the

implications of the automation of cultural heritage. To do this, the research for this paper is a

combination of the use of literature relating to cultural organizations and computer technology,

and experience based on the culmination of years of knowledge about cultural institutions

acquired not only from coursework and personal studies, but from work in museums and related

organizations. Throughout my undergraduate time at the University of Illinois pursing a degree

in Art History and International Arts, and the past two years at Southern Illinois University

Carbondale as a graduate student in the MPA program with a Museum Administration

concentration, I have established a strong foundation in museum studies and related scholarship.

Past work experiences such as my internship at the Art Institute of Chicago and involvement

with Leslie Hindman Auctioneers (Chicago) have facilitated first-hand experience with

collections management and have increased my passion for museums and archival collections,

and their effective use of computer technology in creating digital heritage.

CHAPTER 2:

DIGITAL HERITAGE

Computer technologies emerged in the 1950s, in the federal government and private business sector and then in educational and research institutions, and steadily began to advance in terms of capability, accessibility and affordability throughout the 20th century (Hughes, 2004). The earliest stages of computer technology utilized large, cumbersome mainframe computers that were operated by the use of numerical calculations and basic quantitative analysis, which led to the numerical coding of information through binary code[1]. This code development led to the realization that computers could gradually process larger amounts of information based on the storage space available on the computer and on external drives. To meet the need to process more data, mainframe computers were constructed with larger amounts of storage space and memory, as well as faster processing speeds and computational capabilities to insure that the demands for processing were met (Britannica, 2013) offering more flexibility to connect and share information and data.

These early technologies led to the evolution of databases and other software platforms for the organization of metadata, documents and images. The concept metadata, includes the information about data that is utilized to "organize, locate, manipulate and otherwise work with data when it is not necessary or desired to actually deal with the data itself," such as the content, origin and quality of the data (BELUG, 2006). Metadata is an important factor of digitization, which is "the act of scanning [or photographing] analog documents into digital form, that results in a digital copy being made available to users via the Internet or other means for a sustained

---

[1] Binary code is the numerical coding process, in which information or analogue content is transformed into a series of 0's and 1's. Once the information is coded, it can then be read and transferred in any number of ways, on CD-ROMs, external hard drives, and through computer and Internet applications (Hughes, 2004).

length of time," as it allows for the user to gain pertinent information about digitized images and accompanying information (U.S. National Archives, 2008).

Decades of computer technology advancement in processing and computer monitor display technologies resulted in the development of personal desktop computers introduced to the general population in the 1970s, and digital technologies and accessories such as cameras and scanning that began to see widespread use in the 1970s and 1980s (Britannica, 2013). In terms of cultural heritage institutions, computer and digital technologies allowed for the information pertaining to cultural heritage objects to be better organized by storing object records and images electronically, leading to a means that could eventually allow the sharing of information within and between institutions, as well as with the public.

In the early stages of data management, systems programs and databases were developed to facilitate the establishment and organization of files and included databases such as IBM's Information Management System (IMS) introduced in 1966 and the Semi-automated Business Research Environment (SABRE) that appeared in the early 1970s (Quickbase, 2013). The development of these initial databases provided the means to create cultural heritage collections management software. These collection-related software programs, and the perpetual improvements in computer technologies, have aided in the digitization of objects, specimens and related archival materials found in museums and archival institutions. Collection management software has also empowered these organizations to share their collections with other institutions and the public through digital heritage.

To understand the importance of computerized collection management, it is important to understand the concept of digital heritage, which allows for cultural history and traditions, and scientific specimens to be conserved and maintained through the utilization of technology. The

United Nations Educational, Scientific and Cultural Organization (UNESCO) describes digital heritage as,

> …computer-based materials of enduring value that should be kept for future generations. Digital heritage emanates from different communities, industries, sectors and regions. Not all digital materials are of enduring value, but those that are require active preservation approaches if continuity of digital heritage is to be maintained (UNESCO).

As stated previously, the digitization of collections opened the door to the expansion of shared knowledge. This allowed curators and collections managers the ability to create enhanced procedures for the systemization and organization of objects and specimen records and related information. Instead of staff using hand-written or typed information related to objects and specimens that was generally organized in some institution-specific filing system, they were able to input this information digitally creating centralized information that was more easily retrievable (Matassa, 2011). Depending on the collection management software used and what it offered in terms of data management, digitization could allow for the creation of records for each individual object that might include information regarding object description, provenance, condition as well as the current location and photograph/s. If the software allowed, these records could then be tagged with keywords for details such as dates, places and other contextual particulars. This not only meant that additional information regarding the collections could be catalogued and linked with images of the objects, but the procedures for locating and obtaining that information, as well as the artifact itself, were streamlined within and across the range of museum and archival institutions (Keeney, 2000).

The process of digitization also provides a means for metadata and images to be distributed globally with the help of computer technology and the Internet. This ability creates an efficient method for this digital heritage to create meaningful connections and ideas that can be shared in an instant. While the sharing of heritage through digitization seems like the ideal

concept to expand collection access, there are many technical and legal issues that may arise, including the issue of the "value" of a digitized artifact (Smith, 1999). These issues have been argued and contemplated since the first appearance of computer technologies in cultural heritage institutions in the 1960s.

While there are many positive aspects to digitization of collections, as discussed above, cultural heritage institutions were not especially eager to take on such invasive and costly projects for their own internal use, let alone for online public access. As Lindsay MacDonald (2006) illustrates, even during the late 20th century institutions were worried about the impacts digitization would have on their visitor numbers, as well as the possibility that these technologies would, "dilute the authenticity of the public experience of the collections and pose a threat to real scholarship." As also mentioned previously, technology was unchartered territory in most of these heritage-focused institutions in the later half of the 20th century. Only a few of these institutions, such as the Smithsonian, had the funds to purchase the technology and support the skilled staff needed to understand and operate computers and associated software.

The idea of cultural heritage institutions creating online access to collections would have been futile in the early use of computer and related technologies, since most of the public in the mid to late 20th century did not own or have access to personal computers. And, as for the ones who did, the personal computer technology and the Internet Service Providers that they used may not have been able to handle the bandwidth of the data that digital heritage requires (Kenney, 2000). It was the lack of funds, the fear of the unknown and new technologies, and the processes of computer automation that slowed the introduction of these technologies within many cultural institutions (Parry, 2004). Within museum and archival institutions there was also very limited

knowledge of what constituted metadata, as well as a lack of space for digital records and files on the hard drives manufactured during the 1960s (Britannica, 2013).

As these computer systems technologies expanded over the next several decades, they soon pervaded the culture of developed nations worldwide. Computers and mobile phones were no longer just utilized by the various levels of government and the professional business sector, but the general public was readily using these technologies. This use led to options for customization, greater flexibility for usage and up-to-date technology to meet these demands. These technological advances allowed for greater and faster access to digital records and information within museums and archival repositories. As a result, these advances allowed them to realize the automation of their collections and develop the ability to share their digital heritage both within the institution and with other institutions, as well as the public.

As the technologies of computer automation continue to advance, the applications and possibilities for sharing information have become infinite. Digitizing collections and archival materials enables institutions to conserve, preserve, interpret, and educate. Expanding access to collections and primary source information facilitates the development of new educational and research possibilities (Smith, 1999). Before digitization, it was only during scheduled exhibitions, through outdated slides, and permission for special access that researchers, educators and the interested public would have the ability to view and study historically and culturally important objects and scientific specimens and their related archival materials. Digital metadata and imaging brought these items to a wider community of users, not just scholars, by eventually offering collections to the general public. With these virtual offerings, the public did not need special permission or to even pay a price to see objects, artifacts and specimens, all that was necessary was a suitable Internet connection that could download the cultural heritage offerings

efficiently and effectively. The automation of objects and specimens also afforded a greater opportunity for scholars to access crucial information, in order for them to further their research and scholarship. Once cultural objects and scientific specimens could be shared on such a substantial scale, the world was introduced to many smaller, yet significant institutions not previously recognized. The automation of digital heritage within cultural organizations enabled greater systemization of collections management and processes, provided equalization of access, and museum and archival recognition.

CHAPTER 3:

COLLECTIONS

Museums and archival institutions exist because they aim to acquire and preserve culturally and scientifically significant objects, artifacts, and specimens. Museum collections are defined as,

> …an accumulation of objects…formed around any of a variety of parameters. They may be centered upon a medium or technique, a certain period or group of artists, or a subject, for instance; or they may be encyclopedic, as can be the entire collection of a large museum. Museums typically have both permanent collections and traveling collections (Dunn, 2000).

While archival collections are viewed as the, "records, personal papers, and artifacts in any form or media…accumulated by a person or organization…and preserved because of their continuing value" (U.S. National Archives, 2008). The objects chosen by these institutions to be cataloged into their collections are selected because they aid in the understanding of cultures, both past and present, and support their institutional mission. These collections represent a wide breadth of beauty and cultural value, but most often they are chosen for what they represent and stand to teach (Keene, 1998). Collections are imperative to these institutions, because without them, they would be unable to perform the basic functions found in most of these institutions' mission statements or statement of purposes that focus on exhibition, preservation and conservation, and research and interpretation. In regard to museums, they initially began as research institutions for those within philosophical and scientific fields to better understand as well as theorize and deduce information regarding conceptual and contextual information. On the other hand, archives began as physical spaces to accumulate primary source historical documents and records to be kept over time (Alexander, 2008). It is within the vast collections of museum and

11

archival institutions that curators, researchers and educators are able to expand their knowledge through the exploration and investigation of the primary sources found in these institutions be it the objects, artifacts and/or specimens and their related documents.

Types of collections and their uses vary among institutions. The nature of what museum and archival collections house depends on the classification of that institution and its mission. For example, some museums are more general and focus on two or more disciplines to create diverse collections, while other museums are very specific as to what their statement of purpose and collecting is. Collections exist, in order to be utilized in various ways and by a multitude of individuals with differing goals. It is widely recognized that collections in museums, and in some instances archives, are employed to display carefully curated exhibits for educational purposes. While display and/or education are generally two of the main goals for museums and archives, preservation is also a major objective for the management of these collections. Without these institutions and their interest in preservation, many of the world's most culturally important objects and artifacts may not exist today.

Research and scholarship are also principle interests in collecting everything from fine art to scientific specimens and related documents in museums and/or archives. Not only are these items meant to be viewed, but they are also meant to be closely studied, in order to better understand who created the work and what the artifact or specimen might be and where it might have originated (Matassa, 2011). Whether it be cultural heritage staff, scholars or simply an interested party, these items and their related documents provide information for the present by helping us better understand the past and the development of world cultures and our natural environment.

The educational use of items housed in museums and archives communicate the importance of the past and aid to diffuse clichéd ideas about these institutions, as being inaccessible. Increased access, either through educational and interpretive departments or an online presence, has allowed educators, students, families and individuals, the opportunity to learn about the past in the classroom and at home, as well as inside the physical museum. The educational use of collections reflects the didactic principles traditionally found in museums (Hooper-Greenhill, 2007). The concept of a didactic institution is one that intends to educate and inform the public, particularly with a moral or social motivation (Oxford, 2013). Museums accomplish this through exhibition and interpretation exploring what their collections communicate about the world. Interpretation and research revolving around museum collections has, in the past, generally been carried out by curators, professional authors, researchers, college and university students, and professors. However, the current interpretive options for museum visitors have become inclusionary. Today, museum programming affords students of all ages the occasion to use critical thinking strategies to better understand the objects they see at these museums, giving them the opportunity to become part of the interpretation and research process (Reilly, 2000).

Traditionally, access to collections in museums and archives has been restricted to those who work within the institution or visiting scholars doing research through the professional examination of the collection and related documents. It is this problem with access that has aided in perpetuating the stereotypes concerning museums and archives for whom they are truly meant. This issue is one that cultural heritage institutions have strived to overcome through educational programming, increased exposure in the public and by the creation of online opportunities for access. The increased public presence and the new inclusionary learning opportunities have

helped these institutions to expand on-site visitation, and through the use of websites and online collection offerings, museums and archives have captured a virtual audience, as well (Matassa, 2011). By offering online institutional information and digital cultural heritage, those cultural institutions that have followed this pathway of access have added a heightened experience for both the on-site and virtual visitor. The use of digital heritage enables these users to virtually visit the museum first to learn about the available exhibits, programming and collections, and in some instances curate their own online collections of their favorite art, artifacts and specimens. As the virtual and digital computer domains expand, so does their potential for use by museums and archival institutions.

Public access to share one's digital heritage should be one of the major goals that a cultural institution might consider for an online presence. However, another major goal is the unlimited opportunities this method of access offers as a means to advertise and promote the institution. Online information offers the public, and other organizations, museums and corporate institutions alike, the ability to view the details of the available collections as well as upcoming events. It can also be a method to potentially attract donations of items and further aid museums and archives in their objectives of collecting and raising funds for preservation, conservation, exhibition and education, which can be costly and if possible, financed by outside sources (Reilly, 2000).

In relation to the management of archival materials, just like the management of non-archival collections, it is essential to follow procedures that lead to careful planning, organization and documentation to best care for these materials. No matter the size of the heritage collection, the protection and preservation of each object, artifact, specimen and archival item should be maintained throughout its lifetime both within the organization and outside of it. A solid and

progressive set of best practices concerning the inventory, documentation, storage, handling, display, and accessibility to the museum's catalog of information is necessary to ensure proper collections management. These best practices are standardized procedures for museums and archival organizations that have been developed to ensure the safekeeping and handling of objects. The formation of best practices in museums was formally promoted by the American Alliance of Museums (formerly the American Association of Museums) in 2010, as it offered guidelines for excellence in operations. To insure the adoption and use of these best practices, there should be a type of procedural manual that aims to establish a consistent set of standards and methods for the various types of work done throughout collection management, including digitization. For an example of this type of manual, please see the Appendix for "A Guide of Digitizing Protocols and Best Practices: Photographs, Slides, and Negatives."

The methods and concepts introduced in a best practices manual include very detailed information that will cover the various procedures and methods, from start to finish. A manual should begin with a statement of purpose and introduction that is comprised of an overview and definition of digitization as well as the objectives of the project. Guidelines and standards for the work of digitization should also be made very clear to ensure consistency throughout the project. Overviews of handling procedures and proper use of technology must also be incorporated to guarantee the safety of the objects and proper use of necessary equipment. Lastly, an outline or flow chart of the entire process aids in visualizing the steps and procedures necessary. In order to develop a best practices procedure for digitization, such as the one found in the appendix of this paper, a great deal of research on similar institutions and their policies will enable one to create solid and established set of guidelines to utilize throughout the digitization process. As discussed earlier, these best practices cover every major aspect that can be identified for the function for

which the procedures are developed and are significant to the work being done as these methods have consistently resulted in superior quality work and now act as a model for a wide-range of institutions (Oxford Dictionary, 2013).

The concept of collections management, defined as "a range of skills and functions required to look after cultural collections,"[2] is a relatively new management tool in cultural heritage institutions (Matassa, 2011). It was proceeded by simple manual cataloguing systems kept by various members of a cultural heritage institution with no set standardized criteria. It was not until the mid 20th century that museums and archival institutions began to introduce more systemized record keeping through the creation of the position of museum registrar in the 1970s. Registrars were first utilized within European cultural institutions and shortly thereafter in the U.S., and were tasked with managing all aspects of cultural objects and artifacts from their organization and record keeping, to dealing with loan agreements and ensuring they are properly stored and cataloged using standardize procedures (Matassa, 2011). Before collections management and its best practices were institutionalized, curators and registrars attempted to keep the collections and associated information organized, but never before had it been broken down into various procedures that included an understanding of ethical and legal concerns (Matassa, 2011). Today, the physical and legal protection (such as laws pertaining to the ownership, usage and cultural sensitivities of specific materials) of collections involves both specific and generalized knowledge of varied practices and methodologies to best care for each individual piece to ensure its safekeeping for the future.

There are a multitude of procedures and guidelines to be followed when managing museum and archival collections. As noted previously, there has been a recent push to create

---

[2] ["…range of activities relating to documenting, moving, storing and displaying objects of cultural significance"] (Matassa, 2011)

standardized methods or best practices with accompanying procedural manuals to ensure that cultural heritage is cared for and utilized appropriately. These same practices are necessary and may even be seen as even more critical when attempting to use technology to photograph and digitize objects, artifact and specimens, and other archival materials. Collections managers not only have to concern themselves with the physical objects, but they also have to manage the digitized surrogate (Keeney, 2000). When working with digitized collections that are to be placed online, a whole new assortment of issues may arise from legal considerations regarding copyright and fair use, to regulating access and download standards.

Employing computer and digital technologies to create records for museum and archival institutions can benefit these organizations. However, it not only open-ups their collections to a wider audience, but it also creates issues that come along with any type of increased access and visibility. If museums and archival institutions execute collection digitization in a careful and organized way following best practices, the opportunities for the organization of collections, and their use in education and research can be infinite.

CHAPTER 4:

WHY DIGITIZE AND HOW DO YOU START?

The choice to utilize computer and related technologies to digitize collections is one that museums and archival institutions did not go about haphazardly. For those institutions that took on the involved task of digitizing, there were instrumental factors in place that influenced them to accept the importance of automation and to acknowledge the ways in which it could positively affect all aspects of their organization, including everyday work and scholarship. One of the factors was the recognition of the role technology played in the cultural and information revolution that led to major advancements in communication and coordination within all facets of life and business (Smith, 1999). As the general public became more and more inundated with technology in their everyday life, museums and archives were recognizing the need to keep current with the most up-to-date technologies. This adaptation of technology in cultural heritage institutions enabled them to not only succeed during the technology revolution, but it also altered the way in which these institutions interacted with each other and with other resource and research oriented establishments, as well as the public.

As computer technologies steadily advanced in terms of the physical electronics and software available, cultural institutions recognized the major changes they could make in collections management by using technology in the systemization of collection processes and access. While the costs were daunting in terms of purchasing hardware and software, and paying for the staff time needed to digitize, granting agencies began to aid museums and archival institutions by funding projects that focused on open and increased access (Reilly, 2000). For example, from 1995 through 2000, the Illinois State Board of Education grant program,

"Museum in the Classroom," awarded the University Museum at Southern Illinois University Carbondale, a grant to work with K-12 Illinois schools to use Museum objects to develop student-created websites. During this project, the Museum not only presented collections online via the student developed websites, but it also was able to hire project staff to oversee the technology and software purchased to make sure the project could meet the project's needs. To do this, the Museum acquired the current collection management software, EmbARK by Gallery Systems, in 1997 (Huffman and Munson, March 2013). This project showed how in museums, collections were now not only focused on the objects themselves, but the accompanying details, building collections of informational data and knowledge (Keene, 1998). Computer databases and software emerged as competent organizational tools offering the ability for images and data to be directly linked to build these collections of information data and knowledge facilitating important connections within collections. In turn, they empowered the cultural institutions to work together to proliferate their collections and expertise.

Computerized collections and associated information opened a window to a diverse range of opportunities. As discussed previously, museum and archival collections were mainly created to conserve, research, educate, and if the institution does so, exhibit, but as objects were digitized, access and the possibilities of what the public could do and learn became immeasurable. Once collections were made available to the public, through the use of websites and software programs that allowed users to interface with the digitized objects, there was a greater sense of involvement and inclusion with the sponsoring institution. Online access was not only available to the larger museums and archival institutions, but to the small and in many cases unknown cultural heritage institutions and even private collections, as well as non-public research repositories. This online presence allowed users of the Internet to discover a variety of

cultural and archival institutions and the many options they offered for learning. These opportunities provided increased visibility both within the United States and internationally, as the access to the Internet spread and became more widely available in developed countries all-over-the-world.

The use of computer technologies to digitize collections began with simple file management and machine-readable catalogues in the 1960s (Matassa, 2011). Libraries were some of the very first cultural institutions to employ computer technologies and they aided in proliferating the concepts of automating collections (Parry, 2007). The procedures to digitize have rapidly progressed since then, but the process still calls for careful consideration and attention to detail.

In order to "digitize" objects, artifacts, specimens and archival materials, several steps must be taken in acknowledgement of best practices, beginning with the photographing or scanning of the items. Art objects, historical and cultural artifacts, and scientific specimens can be delicate in nature and can only be handled in specific ways, so this process is limited in terms of options for digitization. Because of the fragile nature of certain materials only a single photograph or scan can be made, in order to not harm the item by deteriorating it further through handling or exposure to the light emitted during imaging. As a result of this awareness, there is a general rule of only scanning or photographing an object one time to minimize the stress on the object (Kenney, 2000). The creation of a digitized surrogate aids in the preservation of fragile objects and artifacts, even though it is an additional file or record for administrators to look after and maintain. These surrogates can be employed to "replace or reduce the use of deteriorating or vulnerable originals" to, as mentioned above, lessen any unnecessary stress to the object from any movements it may make (Kenney, 2000). Once an item is captured in one of these methods,

the image or the "master file" that has been created with the highest possible criteria in order to be used over time, can be uploaded to the computer via camera or scanner, so the image can be manipulated and added to a database with related information and details (Kenney, 2000). This uploading process necessitates very careful detailing. The creation of specific computer files and folders allows for exhaustive options for organization and systemization of the uploaded digital files. The very basic concept of digitization allows for a surrogate of the actual object to be created for use through the in-house database or online. This allows the institution to digitally increase internal administrative access to the collections and to exhibit the piece to the public online expanding the possibilities for utilization of the collection (Kenney, 2000).

Digitized collections present a multitude of options for use both internally and externally within museums and archival institutions. The most apparent ways to employ automated collections include records management, research and access (Reilly, 2000). These possibilities allow collections administrators the opportunity to utilize a larger portion of their collections, due to the fact that the objects are easier to locate through the inventory location field, can be cross-referenced more easily, and have the potential to be researched more accurately. The potential for research and interpretation is also increased as greater visibility of the available objects assists in producing new and diverse programming and exhibits. Online collections also allow museums to present the range of their catalog as well as feature specific individual works with detailed descriptions and interpretations (Reilly, 2000). A well-tagged and comprehensive collection will enable the institution to generate significant and newly formed connections between items and interpretations that may have never been noticed before. These opportunities allow for greater exploration and appreciation of both well-known and little known objects, artifacts and specimens. Opening-up collections to the general public, through the use of online

databases and websites, supports the global development of knowledge and introduces new ideas and examples of the humanities and sciences to anyone who can connect to the Internet (Hughes, 2004).

The benefits of digitization far outweigh any difficulties it may cause. Although there are issues that may stand in the way of automating a collection, such as matters of copyright, consent for use of human subjects in media, cultural sensitivity in terms of appropriateness of use, and other moral or legal considerations, with careful planning and research these problems can be easily resolved (Hughes, 2004). These issues of selection range from matters of legality, available technology, and marketing, all issues that can affect which objects are chosen to be digitized and how they are presented to the public (Reilly, 2000). These concerns come into question during the selection process and should be kept current in the digitizers mind throughout the process. With the appropriate legal permissions and consent forms, and the understanding of cultural sensitivities, most institutions will have few real issues with the digitization of their collections.

The creation of online collection databases not only strengthens and expands access to the actual collections, but it also facilitates new knowledge and exploration by the public. One way in which digital collections involve the public is through the conception of personal exhibits and collections. Through the use of specific museums' websites, one example is the Art Institute of Chicago, users are able to "save" their favorite objects and create their own individual galleries to keep for themselves or exhibit to other users. Of course, research, analysis, and advertisement are other ways online collections are utilized. The digital imaging process allows for very high quality images to be created that allow users to zoom-in, if the sponsoring organization's web-based software allows it. This zooming-in allows one to see the smallest

details of objects, artifacts and specimens that they would not normally have the opportunity to examine. These options pave the way for various educational opportunities and allow users of all ages to explore cultural and archival institutions collections online in any setting. Possibilities such as these reveal the exciting contemporary options heritage-based institutions are offering, in order to grow their audiences and increase their approachability and access to other organizations and the public.

CHAPTER 6:

DISCUSSION AND RECOMMENDATIONS

This research paper has revealed the history as well as the many contributions computer and digital technologies have afforded cultural institutions. Beginning in the 1950s, the establishment of computer and related technologies has transformed culture worldwide. The progression of these technologies has led to personal and convenient transportable electronics that connect users to anyone and any information they may need in an instant (Smith, 1999). While these advancements developed over time, more recently they have been improving at an astonishingly fast rate. It is these advancements that have given museums and archival institutions the opportunity to integrate computers and supporting software into their collections management procedures and everyday tasks. These technologies, in many ways, make collections management easier, but there are also a number of important considerations to remember. It is crucial that anyone working on the digitization of cultural and natural heritage undertake a considerable amount of research on how to create digitized collections, as well as how they are and can be utilized. Examining the ways in which users interface with the digitized collections will enable those creating the digital images and records to best understand what should be accessible and the appropriate information to accompany it. Any possible legal, ethical and cultural sensitivity issues should also be investigated before any digitization is undertaken, in order to protect the institution and the cultural groups or individuals and their families that the material represent. Finally, a manual of best practices with standardized procedures, such as the one presented in the paper's Appendix should be created to successfully guide the digitization process within cultural heritage institutions.

The process of computer automation is not inexpensive and necessitates many hours dedicated to researching the choice of the appropriate technology and software needed to meet the institution's needs (Reilly, 2000). It also involves an investment of time to experiment with the technology to become familiar with its capabilities, and to create an organized, preferably written, digitization procedure that takes into account the materials being digitized and how they are to be used (Kenney, 2000). The methods of computer and digital systemization are a significant undertaking and should be managed by those who are very much interested in learning new and exciting approaches to collections management. In the future, museum and archival institutions should continue to incorporate new and advanced technologies, in order to draw an innovative and contemporary audience, and enhance collection research by maintaining up-to-date data and publishing significant cultural objects. By employing progressive technologies, museum and archival institutions will continue to thrive in a world where the culture is perpetually evolving and technologies are ever present in the daily lives of the audience members.

CHAPTER 7:

CONCLUSION

Through the information provided in this paper, it is clear that the digitization of archival material and objects, artifacts and specimens is the most contemporary and popular management technique in use by museums and archival institutions today. The endless possibilities offered by an online presence through websites and digital heritage communicates the importance of computer technologies in cultural organizations, as they progress and strive to survive during the continual technological revolution. As recognized by the proliferation of advanced technologies and digital platforms in society, technology is only going to continue to improve and inundate our lives in every aspect. It is evident that museums and archival institutions were and continue to be very perceptive in their incorporation of computer-based technology within administrative and collections management functions including the digitization of cultural heritage. With the aim of assuring that this digitization process operates efficiently and effectively, a manual of best practices of standardized procedures needs to be formally adopted, such as the model guide offered in this paper.

Computer technology and the advent of digital electronics and applications afford users of all ages the ability to connect with other people and institutions internationally, and share information from across the globe. This type of association and correspondence has proliferated knowledge of global cultures and expanded the opportunities for education to even the most remote places. The integration of technology into cultural heritage institutions does have negative aspects, as online access has the power to minimize the importance of seeing the real object. Instead, this object is replaced with a visual surrogate that is only a two-dimensional

representation and no matter the quality of the photographs, can still diminish the subtle nuances of the actual item. Cultural heritage institutions must acknowledge the monetary as well as "visual" costs, digitization has on the objects and the institution itself. To help counteract these issues museums must understand the expenses of the actual process of digitization and the possibilities of the loss of value of the object as seen through the digitized surrogate. Online collections should not only encourage people to virtually visit the website, but draw people into the physical institution, from the careful selection of what from their collection to include online to the promotion of programming and other events and exhibits the museum or archive has to offer.

The world of technology and digital innovation will continue to progress and will enable users to develop new ways to communicate and share knowledge. Our world heritage is an invaluable resource and through the digitization of objects, artifacts and specimens, it will enable past and present cultures to survive for future generations to experience and learn from. Digital heritage has become an important aspect of society and those museum and archival institutions that employ computer and digital technologies endeavor to not only connect with the world, but to offer their users a proliferation of knowledge of diverse cultures, peoples and their manmade and natural environments.

REFERENCES

Alexander, Edward P. and Alexander, Mary. (2008) *Museums in Motion.* New York: Alta Mira Press.

Bellevue Linux Users Group (BELUG). (2006). *Metadata Definition.* The Linux Information Project. Retrieved April 4, 2013 from http://www.linfo.org/metadata.html.

Encyclopædia Britannica. (2013). *Computer Technology (Analogue and Digital).* Retrieved 3/4/13 from http://www.britannica.com/EBchecked/topic/130429/computer.

Daniels, Maygene F. (1984). *Introduction to Archival Terminology.* Archives and Record Management Resources. Retrieved April 4, 2013 from http://www.archives.gov/research/alic/reference/archives-resources/terminology.html.

Dunn, Heather. (2000). *Collection Level Description - the Museum Perspective.* D-Lib Magazine*,* September 2000 Volume 6 Number 9 ISSN 1082-9873. Retrieved April 5, 2013 from http://www.dlib.org/dlib/september00/dunn/09dunn.html#ref1.

Hooper-Greenhill, Eilean. (2007) *Museums and education: purpose, pedagogy, performance.* London: Routledge,

Huffman, Lorilee and Munson, Susannah. (March 2013). Discussion of records management and grant funding for The University Museum, Southern Illinois University. Carbondale, IL.

Hughes, Lorna. (2004). *Digitizing collections strategic issues for the information manager.* London: Facet Publishing.

Hughes, Lorna. (2012) *Evaluating and Measuring the Value, Use and Impact of Digital Collections.* London: Facet Publishing.

International Cultural Tourism Charter (ICOMOS). (2002). *Principles And Guidelines For Managing Tourism At Places Of Cultural And Heritage Significance.* ICOMOS International Cultural Tourism Committee.

Keene, Suzanne. (1998). *Digital Collections: Museums and the Information Age.* Boston: Butterworth-Heinemann.

Kenney, Anne R. (2000). *Technology: Mainstreaming Digitization into the Mission of Cultural Repositories.* Collections, Content and the Web. Retrieved April 5, 2013 from http://www.clir.org/pubs/reports/pub88/reports/pub88/pub88.pdf.

Matassa, Freda. (2011). *Museum Collections Management.* London: Facet Publishing.

Parry, Ross. (2007). *Recoding the Museum: Digital Heritage and the Technologies of Change.* London: Routeledge.

Macdonald, Lindsay. (2006). *Digital Heritage: Applying Digital Imaging to Cultural Heritage.* New York: Butterworth-Heinemann, Elsevier.

Oxford Dictionary. (2013). *Best Practice.* Retrieved April 6, 2013 from http://oxforddictionaries.com/us/definition/american_english/best%2Bpractice?q=best+practices.

Quickbase. (2013). *A Timeline of Database History.* Retrieved 03/11/2013 from http://quickbase.intuit.com/articles/timeline-of-database-history.

Reilly, Bernard. (2000) *Collections: Museum Collections Online.* Retrieved April 5, 2013 from http://www.clir.org/pubs/reports/pub88/reports/pub88/pub88.pdf.

Smith, Abby. *Putting Culture Online.* Collections, Content and the Web. Retrieved April 5, 2013 from http://www.clir.org/pubs/reports/pub88/reports/pub88/pub88.pdf.

Smith, Abby. (1999). *Why Digitize?* Council on Library and Information Resources. Retrieved April 5, 2013 from http://www.clir.org/pubs/reports/pub80-smith/pub80.html.

UNESCO. (n.d.). *Concept of Digital Heritage.* Retrieved 02/15/2013 from http://www.unesco.org/new/en/communication-and-information/access-to-knowledge/preservation-of-documentary-heritage/digital-heritage/concept-of-digital-heritage/

U.S. National Archives and Records Administration. (2008). *Strategy for Digitizing Archival Materials for Public Access, 2007-2016.* Digitization at the National Archives. Retrieved April 5, 2013 from http://www.archives.gov/digitization/strategy.html.

Werner, Robert. (2013). *Ptolemy I Soter.* Encyclopædia Britannica. Retrieved April 6, 2013 from http://www.britannica.com/EBchecked/topic/482132/Ptolemy-I-Soter/5967/King-of-Egypt.

APPENDIX

A Guide of Digitizing Protocols and Best Practices: Photographs, Slides, and Negatives

Developed by Genevieve Horan
Spring 2013

I) INTRODUCTION

This guide will aid in the development of an online collection aiming to digitize a variety of 2 dimensional ephemera including photographic, negative and slide images. For this project minimum guidelines for imaging digitization specifications have been adopted. Adherence to these guidelines ensures the quality, consistency, and longevity of these valuable resources.

II) DIGITIZING: AN OVERVIEW

Cornell's Moving Theory Into Practice tutorial, defines digital imaging as: "electronic snapshots taken of a scene or scanned from documents, such as photographs, manuscripts, printed texts, and artwork. The digital image is sampled and mapped as a grid of dots or picture elements (pixels). Each pixel is assigned a tonal value (black, white, shades of gray or color), which is represented in binary code (zeros and ones). The binary digits ("bits") for each pixel are stored in a sequence by a computer and often reduced to a mathematical representation (compressed). These measurements are used for printing and digital imaging purposes (UC, 2009).

Digital images come from many sources, including photographs, maps, textual documents, artwork and are created in one of two ways. They can be scanned from analog material, photographed using a digital camera or images can be generated digitally (originally created in a digital format such as a word processor like Microsoft Word).

Digital images are composed of pixels, or tiny picture elements. Increasing the number of pixels improves image quality. Resolution is a measure of the number of pixels used to render an image and is expressed as "pixels per inch" (ppi) or "dots per inch" (dpi). Resolution can also be measured by the total number of pixels on the longest side of the image or digital material. Each pixel has a tonal value: black, white, shades of gray, or color. The number of tones available to create the image is called bit-depth. For example, an image scanned in 8 bit-depth can use up to 256 colors or shades of gray.

Digital images are saved in file format or the structure by which data is organized in a file. Common file formats include TIFF (Tagged Image File Format), JPEG (Joint Photographic Experts Group), GIF (Graphics Interchange Format), BMP (BitMapped), and JPEG-2000. Some file formats remove redundant information to reduce file size, known as compression. Best practices suggest saving digital images in an uncompressed file format, such as TIFF, to begin with and if necessary duplicate files can be created.

A rule of "scan once" should be followed. A master file should be created and then derivative or access files should be generated utilizing varying technical and file formats.

III) GUIDELINES FOR CREATING DIGITAL IMAGES:

- Bitonal (black and white, line art) – One bit per pixel representing black and white. Bitonal scanning is best suited to high-contrast documents such as printed text.

- Grayscale (black and white photograph) – Multiple bits per pixel representing shades of gray. Grayscale is suited to continuous tone documents, such as black and white photographs.

- Color - Multiple bits per pixel representing color. Color scanning is suited to documents with continuous tone color information.

Spatial resolution measures the frequency at which individual pixels or points are sampled and is commonly referred to as "dots per inch" (dpi) or "points per inch" (ppi). Higher resolutions take more frequent samples of the original and contain a more accurate representation. Since higher resolutions are capturing more information, files sizes also increase.

There is not one best resolution to use in scanning a variety of collection materials. Spatial resolution should be adjusted based on the size, quality, condition, and uses of the digital object. See Guidelines by Source Type for specific spatial resolution targets (CDP, Western States, 2003).

Metadata:

Descriptive Metadata	Metadata that describes the intellectual content of a resource.
Administrative Metadata	Metadata that includes information about ownership and rights management.
Structural Metadata	Metadata that describes relationships between multiple digital files, such as page order in a digitized book or manuscript.
Technical Metadata	Metadata that describes the features of the digital file, such as resolution, pixel dimensions, compression, etc.

*http://www.mndigital.org/digitizing/standards/imaging.pdf
University of Colorado Digital Library, Digitization Best Practices, Version 1.0 Last revised: August 2009

Digital Imaging Terms

Bit Depth: the tonal or signal resolution that determines maximum number of shades of gray or colors in a digital file.

Color Mode: refers to whether the image is black and white, grayscale, or color.

Grayscale: images that consist of a single channel and can be 8-bit (256 levels) or 16-bit (65,536 levels). Color images consist of 3 or more grayscale channels that represent color and brightness information and may be either 8-bits or 16-bits. Common color modes are RGB, CMYK, and LAB color.

Compression: a process that eliminates redundant data to create a smaller digital file size.

Pixel Array: a measurement of the spatial resolution or the amount of information in an image file expressed as the number of pixels on each dimension of the image.

Resolution: a measurement of the spatial resolution, written as pixels per inch or ppi. The term "dpi" refers to printer resolution or dots per inch and is often used interchangeably for ppi.

Minimum Guidelines:

	Resolution (Minimum)	Bit Depth	Color Mode	Archival File Format	Online File Format
Items that are black and white of shades of gray	300 ppi	8-bit	grayscale	TIF	JPEG
Items containing color	300 ppi	24 bit	RGB color	TIF	JPEG

Guidelines for negatives and film:

	Pixel Array	Resolution	Dimensions	Bit Depth	Color Mode	Archival File Format
Rectangular B&W	3000-4000 pixels across the long dimension	300 ppi	10 inches on the long dimension	8-bit	Grayscale	TIF/ JPEG
Rectangular Color	3000-4000 pixels across the long dimension	300 ppi	10 inches on the long dimension	24 bit	Color	TIF/ JPEG
Square format B&W	2700 pixels across the long dimension	300 ppi	10 inches on the long dimension	8 bit	Grayscale	TIF/ JPEG
Square Format Color	2700 pixels across the long dimension	300 ppi	10 inches on the long dimension	24 bit	color	TIF/JPEG

IV) Process of Digitization

Process visualization:
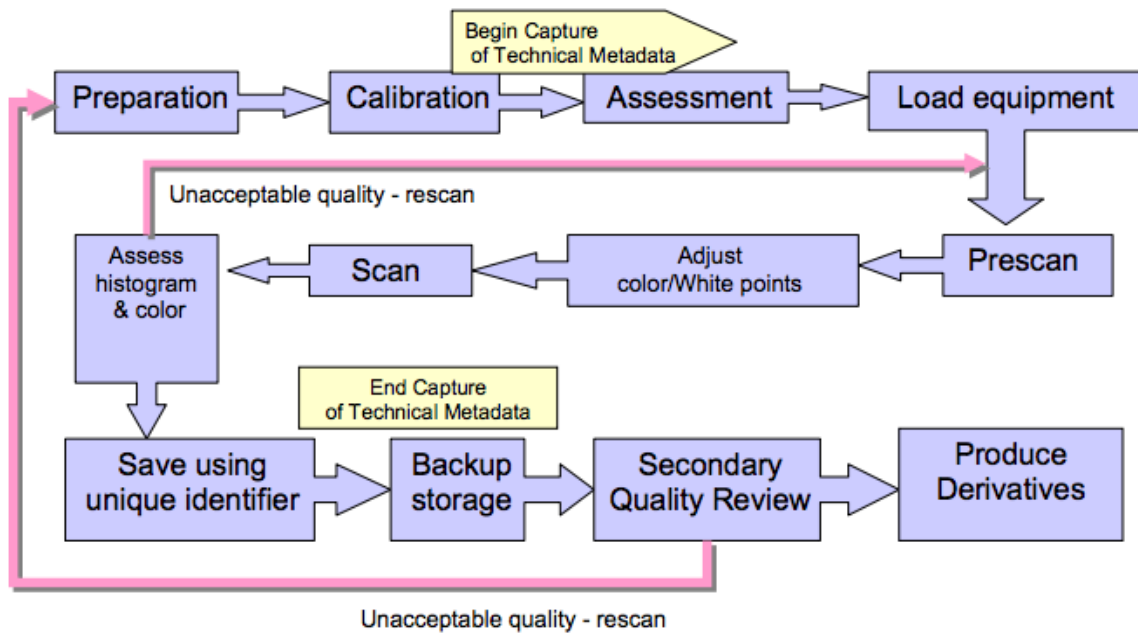
Steps in digitization process:
- Inventory
- Establish appropriateness for digitization
- Determine File Naming
- Create Folders
- Digitize using proper equipment and software
- Save and save again on appropriate file storage platforms
- Make any necessary changes to images
- Save and save again on appropriate file storage platforms
- Import into data management software with accompanying data

Process outline:
1. Determine appropriateness of image choice
    a. Guidelines:
        i. Cultural sensitivity
        ii. Condition of image, negative or slide
        iii. Possible copyright issues
2. Employ established equipment for digitization
    a. Slide scanner for slides
    b. Flatbed scanner for photographs and negatives
    c. Scan image
        i. Remember - scan once rule
3. File Naming
    a. Create folders

   b. Use appropriate naming processes
  4. Digitize image
    a. Save original image in assigned file in TIFF format
    b. Assess image and make any corrections necessary in appropriate software/file naming conventions
    c. Ensure each change to the image is noted and saved individually in designated file
    d. Save copies as JPEG files
    e. Make sure each file is backed up on external drives and Cloud/Dropbox online digital storage
  5. Import image into designated software and create record
    a. Label and describe each item
      i. Date
      ii. Location
      iii. Context
    b. Include physical location
  6. SAVE, BACKUP, SAVE AGAIN

V) STORAGE: PROPER HANDLING AND STORAGE

Archival Storage Accessories:
Print File 35-7B 35mm Negative Preservers
Gaylord- website has everything necessary for preserving photo negatives and slides

Current storage system:
20th century plastics NOW Century Photo
Proof File (Ocala, FL)- nothing about this company online, may have changed names/been bought by another company

Storage:

The ideal temperature and humidity are different for different materials. The maximum temperature and optimal range for relative humidity for long-term storage of various materials are: for black and white photographic prints, 64° F and 30% - 50%; for color prints, 36° F and 30% - 40%; for black and white film with a cellulose ester base, 36° F and 30% - 50%; for black and white film with a polyester base, 70° F and 20% - 50%; for color film, 27° F and 20% - 40%; for paper documents, 72° F and 40% - 55%;. Ideally, the fluctuations in temperature will be less than 2 degrees and fluctuations in relative humidity will be less than 5%.

Typical cardboard boxes, file folders, envelopes, and plastic containers all release acidic gases and other chemicals that cause photographic materials to deteriorate over time. These chemical reactions occur slowly and may not be noticed over a relatively short time period. Also, any stickers or notes utilized that employ a glue or other sticky material in order to adhere, will most likely permeate archival quality storage and can damage paper and photographic materials.

Ideally each slide, negative and photograph would be housed separately in its own container or envelope. Plastic sleeves should not be used unless they are open on one or both sides to allow for gases to escape over time. Paper envelopes may be used since they allow for any possible damaging gases to escape since they are fairly porous. Polypropylene plastic sleeves should be used to separate slides and negatives. This type of archival material is necessary to preserve the original image or item for possible future use. Ensure that all materials are housed in archival quality sleeves, boxes, folders to guarantee the collections will be maintained in good condition.

Handling:

Proper handling of archival items is imperative. Proper handling of archival materials includes washing hands, wearing appropriate gloves and reducing contact with the photographs, slides and negatives.

Proper research should be conducted in order to ensure that any and all materials are appropriately handled. Most photographic materials should be handled gently and with gloves. Other archival materials should be handled very carefully, and to make certain you do not come into contact with any hazardous materials make sure you know what it is you are handling and the proper handling techniques.

Best practices References:

Colorado Digitization Program. (2003). *Western States Digital Standards Group Digital Imaging Working Group Western States Digital Imaging Best Practices Version 1.0 January 2003.* Retrieved on 01/30/2013 from: http://www.mndigital.org/digitizing/standards/imaging.pdf.

IFLA Core Programme. (1992). *Care Handling, and Storage of Photographs: Information Leaflet.* Preservation and Conservation International Federation of Library Associations and Institutions. Updated May 22, 2012. Retrieved 1/25/2013 from http://www.loc.gov/preservation/resources/care/photolea.html.

Preserving History: How to Digitally Archive and Share Historical Photographs, Documents, and Audio Recordings. Retrieved 01/25/2013 from http://archivehistory.jeksite.org/chapters/chapter1.htm.

University of Colorado Digital Library. (20090. *Digitization Best Practices, Version 1.0 Last revised: August 2009.* Retrieved 1/27/2013 from: http://www.library.cornell.edu/preservation/tutorial/intro/intro-01.html.

Additional available references for digitization project best practices and procedures:

http://www.aam-us.org/resources/ethics-standards-and-best-practices/characteristics-of-excellence-for-u-s-museums/collections-stewardship
http://cool.conservation-us.org/byauth/roosa/roosa1.html
http://archivehistory.jeksite.org/chapters/chapter1.htm
http://www.digitizationguidelines.gov/guidelines/DigActivities-FADGI-v1-20091104.pdf
http://coalition.westbeyondthewest.ca/digitization-resources/best-practices/
http://www.webjunction.org/documents/webjunction/Best_Practices_and_Planning_for_Digitization_Projects.html
http://www.nps.gov/archeology/collections/future_pr.htm
http://www.mndigital.org/digitizing/standards/imaging.pdf
http://www.in.gov/library/files/dig_imgst.pdf
Federal Agencies Digitization Guidelines Initiative: http://www.digitizationguidelines.gov/still-image/

VITA

Graduate School
Southern Illinois University

Genevieve Horan

Gen.horan@gmail.com

University of Illinois Urbana-Champaign
Bachelor of Fine Arts, History of Art, International Arts Minor, May 2010

Title:
Digital Heritage: Digitization of Museum and Archival Collections

Major Professor: Lorilee Huffman