Chapter 4

Library, Archive and Museum (Digital) Collaboration

4.1 Digital Concept:

Libraries, archives and museums coexist in a variety of organizational settings and face increasing pressure to provide more integrated access to their collections. Universities and other large institutions have a vested interest in being able to share their holding of unique and rare materials from their various archives, museums, and special collections in a unified way with their community of researchers and learners. Integrated access to collections is just one example of how libraries archives and museums can maximize their efficiency and impact by working more closely together and how do these three communities respond to increasing economic and end user pressures for greater integration? Shared data, services, technological infrastructure, staff, and expertise can unlock greater productivity within institutions, as well as create online research environments more aligned with user's expectations.

Libraries, archives and museums collect, manage and share. Although the type of materials may differ, and professional practices vary, LAMs share an overlapping set of functions. Fulfilling these functions in collaboration rather than isolation creates a win-win for users and institutions.

We are a worldwide library cooperative, owned, governed and sustained by members since commitment to each other- that we will work together to improve access to the information ways to reduce costs for libraries through collaboration.
Archive and Archaeology Service has a library with a comprehensive collection of books. Journals and other publications concerning the history and archaeology. These include a large collection of grey literature reports produced through the modern development process. These often exist in only a few copies and are, therefore, largely inaccessible to a general audience.

4.1.1 Copyright

All reports that are produced via the development control process are considered to be within the public domain. However, Copyright restrictions (particularly with regard to ordnance survey mapping) or the inclusion of confidential or commercially sensitive information means that not all reports can be made freely available over the internet. Other reports have been excluded by request of the copyright holder. The metadata for reports that cannot be accessed online has been included.

The development of an online library can only be achieved if the organizations that supply data can be assured that their own rights are protected. Consequently, use of the library is covered by a variety of legal instruments to protect, our users and those who supply data to users.

4.1.3 About the library

The online archeaeology library provides a new means of access to the majority of the grey literature reports and number of reports for related sites in surrounding resions. It also includes reports form sites within the boundary city which are curated by the committee. The reports are available as PDF files and you will need Adobe reader to access them. PDFs of older reports have been produced form photocopies and are, therefore, not of the same quality as the modern digital documents.

4.2 Information Organization in Libraries, and Museums:
As cultural institutions libraries, archives, and museums (LAMs) share the mission to organize information objects, artifacts, and data for user access and enlightenment. While (LAMs) may follow different metadata standards and procedures to manage their collections and each type of institution has unique information organization and service concerns, digital technologies have enabled them to create, organize, preserve, and provide access to digital collections for global audience. Increasingly LAMs are converging in their information organization and management effort and the cultural silos created by libraries, archives, and museums are being integrated or rendered transparent for users. The proposed panel is designed to examine the convergence of information organization practices of libraries, archives, and museums; explore collaboration opportunities; and discuss the implications of LAM information organization practices for educating information professionals for these cultural heritage institutions.

There are five components (1) the use of a faceted classification to organize museum artifacts and support website development; (2) metadata design and applications for organizing and preserving information objects for several types of cultural institutions; (3) the development of the biodiversity heritage library and the involvement of libraries and non-library specialists in this effort; (4) analysis of descriptive standards used by cultural organizations and areas where libraries, archives, and museums can collaborate; and (5) collaboration among cultural institutions, especially in the technology environment.

4.2.1 Organisation information objects:

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Designing metadata for cultural institutions. Focus on the principles of
metadata design and application among various memory institutions in the
context of TELDAP that coordinates content digitization and preservation at
leading, museums, archives. Research institutes. And other content holders.

4.2.2 Digital Preservation: Strategies and Challenges

In recent decades, many major libraries and archives have established
formal preservation programs for traditional materials which include regular
allocation of resources for preservation, preventive measures to arrest
deterioration of materials, remedial measures to restore the usability of selected
materials, and the incorporation of preservation needs and requirements into
overall program planning.

A digital preservation system is a set of procedures, activities and
instruments that help to safeguard digital memory over time. This means to
preserve all the documents, both born-digital and converted to digital, in the long
term, preserving their content. Together with content, it is essential to preserve the information needed to guarantee, the reproducibility of the documents’ appearance as well as the connections with system, the whole digital archive.

On the one hand, the document has to preserve its intelligibility over time in technological environments that are different from the original ones, On the other hand, its integrity and authenticity must be safeguarded. The digital preservation cannot be restricted to the preservation of the individual digital document. It is mandatory to preserve all the descriptive and managerial information that can ensure the interpretation of the entire structured system (content, elements, and context). By digital preservation, mean the planning, resource allocation, and application of reservation methods and technologies necessary to ensure that digital information of continuing value remains accessible and usable.

4.3 Digital Preservation

Digital preservation refers to the various methods of keeping digital material alive for the future. Digital preservation typically centers on the choice of interim storage media, the life expectancy of a digital imaging system, and the expectation to migrate the digital files to future systems while maintaining both. Digital imaging technologies create an entirely new form of information from traditional documents. It is not simply another reformatting option in the preservation tool kit. Digital imaging involves transforming the very concept of format, not simply creating a faithful reproduction of a book, document, photograph, or map on a different medium. The power of digital enhancement, the possibilities for structured indexes, and the mathematics of compression and communication together fundamentally alter the concept of preservation in the digital world. These transformation, along with the new possibilities they place on information professionals, force us to transform library and archival services and
programs in turn. Preservation is not just only for paper/palm leaves. In the digital imaging environment it is indeed a matter of challenge to define what preservation means? The digital world poses significant challenges to, but does not eliminate the need for responsible, effective preservation. Digitization offers many advantages to organizations with large collection of documents/maps/microforms/ etc., information from these can be accessed by users directly without the human intervention. Information content in digital form can be retrieved by users remotely.

4.3.1 Type of Media for Preservation

(i) Micro form Media: (Microfilming/Microfiche)
(ii) Magnetic Media: (Hard Disk/Floppy Disk/Removable Hard Disk/Pen Drive)
(iii) Optical Media : CD-ROM / DVDs
(iv) Networking media : Internet is a cheap and economical medium, for preservation of information for longer and worldwide use.

4.3.2 Digital Preservation Strategies

Another strategy for preservation is to preserve digital information in the simplest possible digital formats in order to minimize the requirements for sophisticated retrieval software. As new media and storage formats were introduced, the data were migrated with out any significant change in their logical structure.

Although this strategy simplifies migration and may lower digital preservation costs by reducing the amount of customized reformatting needed as technology changes, it does not eliminate the need for regular migration of digital materials. Software and standards both continue to evolve and even repositories
with structurally homogeneous holding can expect to be required to migrate their
digital materials periodically.

Migration strategies that reformatting of digital materials to a simple
standard format usually eliminatesthe structure of documents and relationships
imbedded in databases. Computation capabilities, graphic display, indexing, and
other features often are lost, thus limiting future analytical potential.
Normalization to standard formats is not always technically feasible and it usually
is quite costly.

There are no established conceptual models or technical processes for
preserving multimedia works, interactive hyper-media, on-line dialogues, or many
of the new electronic forms being created today.

Digital preservation activities can broadly be divided into two components:
(1) activities that promote the term maintenance of digital image, and (ii) activities
that provide continued accessibility of its contents. Several strategies have been
proposed but it is unlikely to find a single solution that is appropriate for all data
types. A set of digital preservation strategies can be applied depending on the
lifespan of a digital object as mentioned below:

(i) Long-term preservation: continued access to digital materials, or at least to
the information contained in them, indefinitely.
(ii) Medium-term preservation: continued access to digital materials beyond
changes III technology for a defined period of time but not indefinitely.
(iii) Short-term preservation: access to digital materials either for a defined
period of time whie use is predicted but which does not extend beyond the
foreseeable future and/or until it becomes inaccessible because of
changes in technology preservation in the digital world is a challenging
task for librarians and archivists.
4.3.3 Benefits of Digital Preservation

(i) Legal: National legal frameworks often require organizations to provide adequate records of business processes, communications and many other types of data for many years after their creation.

(ii) Accountability & protection from litigation: Recent legal cases have shown the importance of being able to search and recover archived emails, quickly and in a legally admissible manner.

(iii) Protecting investment: The valuable intellectual assets of organizations are increasingly in digital form. This data represents both intellectual property and a considerable investment of time, effort and money.

(iv) Reuse: Repositories of digital information and the tools to mine, analyse and repurpose them represent a society’s intellectual capital. Effective and affordable digital preservation solutions are essential to transfer digital data into valuable assets for specific users.

Hence, the purpose of preservation is to ensure protection of information of enduring value for access by present and future generation. Libraries and archives have served as the central institutional focus for preservation now many major libraries and archives have established formal preservation programmes for traditional materials which include regular allocation of resources for preservation, preventive measure to arrest deterioration of materials, remedial measures to restore the usability of selected materials and the incorporation of preservation in to overall planning. Digital preservation raises challenges of fundamentally different nature, which are added to the problems of preserving traditional forma materials. In digital preservation planning, resource and preservation methods and technologies to ensure that digital preservation value usable and accessible.
4.3.4 Challenges for Preserving Digital Contents

Although, the digital technology offers several advantages over their print counterpart, it along with other associated internet and web technologies are in a continuous flux of change. New standards and protocols are being defined on a regular basis for file formats. Compression techniques, hardware components, network interface, storage media and devices. The digital contents face the constant threat of “techno obsolescence” and transitory standard. Magnetic and optical discs as a physical media are being re-engineered continuously to store more and more data. There is a constant threat of backward compatibility for products including software, hardware and associated standards and protocols that were used in the past. The challenges in maintaining access to digital resources overtime are related to notable differences between digital and print based material. Some of the important challenges for preserving digital contents are:

(i) Dynamic nature of digital contents.
(ii) Machine dependency.
(iii) Fragility of the media.
(iv) Technological obsolescence.
(v) Shorter life span of digital media.
(vi) Format and styles.
(vii) Copyright and intellectual property rights (IPR) issues.

Density of media to record information has increased exponentially over time while its longevity to store the information has decreased proportionately. Density of media to store information is inversely proportional to its longevity. Take for example, clay tablets, you can write only a few sentences on a clay tablets, but it can survive for centuries, papyrus, paper with printed papers, has greater density of storing information, but has lesser longevity in comparison to
clay tablets. The magnetic media and optical media have highest storage capacity, but are highly fragile and therefore longevity for these media is much lower.

4.3.5 Digital Preservation and Copyright

Digital preservation, however, starts with copying. At a minimum, files need to be copied from obsolete or decaying media, such as 8” floppy disks or 5” floppies, to current storage media. Good preservation practice requires much more, including making multiple copies of files. Digital documents may need to be changed from WordStar to WordPerfect to Word format, or perhaps even converted to PDF or XML format. When digital documents are displayed in a computer, they are copied from the storage medium into the RAM memory of the computer where it is then displayed digital preservation and access is all about copying.

In copyright law, copying is known as “reproduction,” and it’s one of the exclusive rights of the copyright owner. The right to publicly display a work is also an exclusive right of the copyright owner, as is the right to make an adaptation, known as a “derivative work”. Our desire to keep digital information around for the future runs smack into the exclusive rights of the copyright owner.

Copyright and other intellectual property rights (IIPR) have a substantial impact on digital preservation. Preservation of digital materials is dependent on a range of strategies which has implications for IPR in those materials. Consideration may need to be given not only to content but to any associated software. Permission may be very challenging e.g. for web archiving or digital art.

4.3.6 Preservation of Digital Information in India.

Digital preservation involves copying the digital information into newer media before the old media become so obsolete that the data cannot be
accessed. This is referred to as copying or refreshing. In this process integrity of
digital information is preserved. It is clear that the life of a medium determined
the period of time for which the information recorded on the medium is stored
safety without loss. The first is the more conservative approach is where the
original technological environment is fully preserved for decoding the digital
information in the future. This approach divided into two preservation techniques.
The first if to preserve the working replicas of all computer hardware and
software platforms for future use. The second is to program the newer computer
system to emulate on demand the older obsolete platforms and operating
systems. Digital preservation raises challenges of a fundamentally different
nature. Which are added to the problems of preserving traditional format
materials. Digital preservation strategy and challenges has been vital issue since
long time. The Digitization is milestone an new opening in the history of library
system. To keep digital collection live for long time, it requires a proper plan and
policy, threats and inactive in the form of transforming technology. Considering
both simultaneously, possibility of success in digital preservation remains
favourable. Digital preservation have to face lot of new challenge in future.

Digital preservation is a cost-intensive of continuing nature. Library,
archives, or museum cannot make a decision to adopt digitization with long-term
preservation and storage of research collections without deep and continuing
commitment to preservation by the parent institution. The mandate of the parent
institution. The necessary financial and technological commitments to maintain
digital contents and to migrate it to future generations must be an organizational
commitment. Failure to address to the well-defined digital preservation problems
and strategies may result in loss of valuable digital data and may contribute to
cultural and intellectual loss resulting in exorbitant costs for recovery, if at all
possible. Librarians are compelled to meet the research challenge to resolve the
conflict between the creation context and the use context to facilitate digital
information preservation. Digital resources, undoubtedly have several advantages over its analogue counterpart, however, preservation is definitively not one of them the fact that the risk of loss of data in digital form is much greater than any other physical form is well understood and addressed to. Long-term preservation of digital information is plagued by short media life. Obsolete hardware and software, slow reading time of old media. And defunct websites.

4.3.7 Preserving Cultural Heritage For Future Generations:

Preservation is about linking the past with the future. It is about passing on cultural knowledge and information from one generation to the next. Preservation is about making heritage available of current and future generation – either in its original format or in some useable way. Over the centuries many societies have preserved their cultural heritage in a variety of ways. These have ranged from maintaining oral traditions, to keeping manuscripts and cultural materials, art and artefacts, and maintaining archaeological sites.

In India, the National program that aims to preserve the knowledge held in millions of Indian manuscripts for benefit of future generations. Many of the original Indian manuscripts lie in libraries, archives and private collections- brittle, decaying and crumbling year by year. And the ancient knowledge contained in Indian manuscripts is extraordinary. Dating back to the time of the Vedas, this knowledge covers a broad range of subjects ranging from architecture to Ayurvedic medicine, yoga and philosophy, literature and drama, economics to applied sciences. Not only is this knowledge the extraordinary ancient heritage of India, it is ultimately a vital part of the memory of the world.

Preservation reformatting, the copying of information from to another, is a key international preservation strategy. It saves the original from further damage. It also provides a copy that can be used long after the original has crumbled to dust.
Examples of techniques that have been used for preservation reformatting include transcription, photocopying, 'conventional' photography, microfilming and digitisation. Each technique or 'tool' has its own advantages.

4.3.8 Microfilming technology

Microfilm is a preservation tool. Its has stability and its long life expectancy. Microfilm can be expected to last up to 500 years if it is: Manufactured and processed to international quality standards on polyester film Stored under optimum environmental conditions- including temperature and humidity. By comparison, digital information has a far shorter life expectancy due to its instability and the rapid changes in software and hardware. In 500 years’ time who will be able to decipher information from a floppy disk? Who will even know what a floppy disk is? Who can now read information stored in computer punched cards used in the 1970’s and 5 ¼ inch floppy disks used up until the early 1990s? In 500 years’ time all the technology that people will need to read the information microfilm is a simple magnifying glass.

Microfilm is also an economical long-term storage option. Film an item once, store the masters correctly and, with a life expectancy of 500 years, microfilm is a prudent, value-for-money investment.

In comparison it is likely that digital information will cost more to preserve over time, with continual migrations. However further research needs to be undertaken in this area, as these costs are difficult to predict. Microfilm has security benefits also. Once filmed, an image on microfilm cannot readily be manipulated unlike digital files that can be so easily altered or deleted.

Though digitisation is sometimes loosely referred to as preservation, it is clear that, so far, digital resources are at their best when facilitating access to information and weakest when assigned the traditional library responsibility of
preservation. Because digitisation is a type of reformatting, like microfilming, it is often confused with preservation microfilming and seen as a superior, if as yet more expensive, form of preservation reformatting. Much is gained by digitising, but permanence and authenticity, at this juncture of technological development, are not among those gains..

The reasons for the weakness of digitisation as a preservation treatment are complex, having to do with both the difficulty of ensuring the persistence of digital information over time and the challenges of meeting standards of reliability of provenance and authenticity. The preservation of digital information is compromised by the physical fragility of the magnetic media on which the information is often recorded.

From a preservation point of view digital resources decay rapidly, have a very low data redundancy, must be managed separately from their carriers, must be managed proactively and contemporaneously. Require externally provided metadata, have no artefactual value, any cost more to preserve over time and need to be used to exist. In contrast, traditional resources decay slowly, have very high data redundancy, must be managed with their carriers, may be managed reactively and retrospectively, carry with them their own metadata, have potential for high artefactual value and cost less to preserve over time. Failure to recognise and act on these differences may result in our society being plunged into digital Dark Ages.

4.4 Microfilming

Microfilming is widely established across the world as a tried and true reformatting strategy. Its standards are rigorous and well developed. In many countries there are well-established systems in libraries for recording and documenting what has been microfilmed through various union catalogues and registers of microfilm masters.
Recognising the importance of microfilming and the need to have well trained microfilmers, comprehensive microfilm training materials have been recently developed by the national library of Australia and the State library of south Australia. They are available free under the auspices of IFLA (the international Federation of library associations ) and the national library of Australia as either PDF files, CDRom or in hard copy.

The effects and advantages of digitisation as a reformatting tool need little elaboration. Digital information has completely transformed the way we communicate and how libraries and archives work. Digitisation is an excellent tool for providing increased access to information by a global audience. Depending on the digitisation software and technologies the user is not restricted to a straight linear sequence of a microfilm format. Digitisation is a superior option for reproducing half tones, photographs and coloured originals.

Digitisation is an excellent medium for access to information. Digital surrogates can make the remote accessible and the hard to see visible. They can bring together research materials that are widely scattered about the globe, allowing viewers to conflate collections and compare items that can be examined side solely by virtue of digital representation. Through image processing, one can even transcend the limits of the human eye.

As other conference papers will highlight, to ensure a coordinated approach to digitization, libraries, archives, private individuals, businesses and organizations need to work together to establish standardized systems for recording and documenting what is and what has been digitized, similar to the principles already established for documenting microfilm copies. This will ensure that reformatting efforts are complementary and not duplicative. Librarians are well placed to assist with the development of such systems.

4.4.1 Combination of digitizing and microfilming
By combining two reformatting tools—microfilming and digitizing—it is possible to gain the best of both worlds. Microfilm technology offers the long-term preservation base, while digitizing provides all the advantages of flexibility and access. Microfilm becomes the long-term preservation platform, and the launching pad—digitization the rocket and satellite, broadcasting across the world.

4.4.2 Hybrid options

a) Digitizing from microfilm

Digital converting of microfilm images involves scanning the microfilm using appropriate hardware and software systems. The high volume microfilm scanners are produced by a number of commercial firms a number of smaller low-volume microform scanners are also available.

Factors which impact on the quality, rate and cost of digital image

Building on this work, it is possible to identify key factors which impact on the quality, rate and cost of digital image capture.

The quality of the microfilm is a key factor and of course ultimately the quality of the original materials itself.

Table: Factors which impact on the quality, rate and cost of digital images

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<tr>
<th>Microfilm feature</th>
<th>Impact on quality of the digital image</th>
<th>Impact on rate and cost of the digital image</th>
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<tr>
<td>Preparation</td>
<td>• Preparation of a bound volume e.g. disbanding, flattening, careful repairs results</td>
<td>• Preparation of a bound volume e.g. disbanding, flattening, careful repairs results in a higher quality</td>
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in a higher quality microfilm image, and hence a higher quality digital image. microfilm image, and can significantly reduce the cost of setting scanner parameters.

| Polarity                         | • Negative microfilm yields higher quality images than positive film | • Faster scanning speed  
|                                 |                                                                | • Less clean – up of image during |
| Background of copyboard         | • Document edge detection during scanning of the negative is easier if images are filmed on a black background. |
| Density                        | • Medium contrast (Dmax 0.9) to high contrast (Dmax 1.3) film results in higher quality images than low contrast film (Dmax 0.8)  
  • Fogging around frame edges or across frame impacts on quality of scanned image | • Density variation has no impact on the cost of conversion but may slow down the scanning rate if there are density changes rate if there are density changes within the microfilm  
  • In this case post – processing clean up costs may increase |
| Resolution                     | • High contrast microfilm produced to a QI level of 5 has the | • The better the quality of the images, the easier (faster) the conversion |
equivalent digital resolution of at least 800 dots per inch (dpi).
- May not be necessary to achieve this level as most scanning currently ranges from 300 to 600 dpi
- Poor focus and low resolution impacts on quality of scanned image.

| Reduction ratio | • The lower the reduction ratio, the better the quality of image  
|                 | • Accurate recording of ratio is crucial for reproduction at original size  
|                 | • Variations in reduction ratio cause problems |

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**Table: Factors which impact on the quality, rate and cost of digital images cont.**
As a useful guide, the Research Libraries group has recently produced the RLG guidelines for Microfilming to support digitization.

The resulting digital images can be displayed as high quality images, or the next can potentially made accessible by keywords using OCR. However OCR software is not always successful with certain alphabets or fonts.

In India, there are a number of organization that are scanning from microfilm – many for other countries.

Many different projects have explored opportunities for digitizing from microfilm. Examples include the times newspaper (Reading 2002), other british newspapers http://paperspast.natlibngovt.nz, and the early Australian Cooperative digitization Project in these programs systematic records have been kept about what is digitized to enable collaborative approaches to preservation and prevent costly duplication.
b) Microfilm from digital copies

Apart from digitizing from the microfilm it is possible to produce microfilm copies from digital images.

New electron – beam (e-beam) technology can convert digital data into microfilm as well as offering the potential to deliver high quality digital data into microfilm as well as offering the potential to deliver high quality digital and microfilming masters from a single manufacturing process. The technology is successfully being used for books journals and manuscripts.

c) Microfilming and digitising

A new generation of cameras has been developed which are capable of both microfilming and digitising. One such example is the zeutschel hybrid camera and there are now an increasing number of different models on the marketplace. Enables microfilm and digital images to be taken as a single operation. Or individually the modular designed camera has a book cradle and the largest model enables filming/scanning of documents up to AO size such as maps, plans and architectural drawings.

Reformatting:

Reformatting takes place within the overall preservation unit that is also responsible for other strategies such as environmental monitoring, providing protective enclosure, integrated pest management, repairing and conserving individual items and preparing them for exhibitions.

Reformatting is just in a bow comprised of a whole range of options that may be used to preserve an item. The complex decisions about preservation priorities and the kind of options for various categories of materials are made within the intellectual and ethical framework of the library’s collection development policy. The newspapers date back to the mid 19th century, many of them in long runs of titles that span over 50 years. They are on poor quality
paper with high lignin content and which is deteriorating rapidly. There is no point in trying to preserve the original artefact. Reformatting is the preferred preservation strategy. Microfilm has been identified as the best long term preservation option for these long runs of titles.

In the case of newspapers that we are filming now with the hybrid camera it is also possible to create digital images as well as microfilm images of the same newspaper. This is an area that needs further research and development. It has great potential for the future and offers the options of microfilming whole runs at the same time or microfilming and selectively digitising e.g. front pages that are high demand. In the reformatting unit, the state library follows a hybrid approach, drawing on the benefits of both conventional microfilming and digitising. Microfilming and digitising staff have the same generic job descriptions. How every microfilming and digitising technologies are important and complementary reformatting tools for preservation. Both have their strengths and weaknesses. Microfilming is a well-established technology with rigorous international standards that ensure the longevity of imperilled knowledge. Digital technology makes that knowledge extraordinarily accessible. Together they can provide a powerful, stable and flexible tool-kit to ensure the long-term preservation of cultural heritage for the benefit of future generations. Libraries, archives and other organisations will need to work together to ensure a coordinated national and international approach to ensure that reformatting efforts are complementary and not duplicative.

Time is running out. The brittle books and manuscripts are crumbling and turning to dust in many cases we will only have this one chance. We need to use the best of the latest available technologies. We also need to be prudent and cautious and we cannot afford to work in isolation. It is fitting that this international conference on digital libraries is taking place in the ancient land of
India in the context of the recent launch of the Indian National Mission for the preservation of manuscripts. This conference has the potential to be a catalyst for encouraging and development best practice approaches to reformatting internationally.

India is often called the land of origin. India has the capacity to lead the world in best practice reformatting strategies. Drawing on its IT expertise to combine the strengths of digital and microfilming technologies systems for documenting and tracking copied items.

4.5 Information technology and Cultural Heritage:

The increasing use of information technology (IT) has revolutionised the entire gamut of library and information services. Some activities, which could never have imagined earlier, became reality with the advent for IT. Digitisation is one of such activities that changed the entire concept of the ways in which scholars, students, and the general population find and use scholarly information and its dissemination. Especially, in preservation of cultural heritage, digitisation has shown a new ray of hope. Simultaneously, with the method of digitisation of contents, the knowledge lying underneath old and rare books can be made accessible to the outside world. However, there are several issues while adopting digitisation as a method of preservation of cultural heritage, which need to be addressed properly.

For the sake of convenience, the issues pertaining to digitisation as a method of preservation of cultural heritage may be grouped under the following broad categories:
(1) Managerial Issues
(2) Technical Issues
(3) Financial Issues
(4) Human Resources
(5) Preservation of Cultural Heritage

(1) Managerial Issues

(1.1) Need for Digitisation

The most question before undertaking digitisation process is whether there is at all a need for digitisation. A library should not be cared away by its enthusiasm for achievement of technological superiority. Digitisation is one exercise, which should not be undertaken by a library simply because some other library is doing this. Thus, the first and the foremost task are to make a feasibility study before embarking upon any digitisation project.

(1.1.1) Feasibility Study

The initial task of the feasibility study is to establish the aims of the projects, which should be initially derived from some form of user-needs assessment. The feasibility study includes the following aspects.

- Find out what your users expect and hope for from the digitisation process.
- Once the user's needs are clearly understood, the aims of the project can be established and matched with an appropriate work flow procedure, budget and timescale.
- It is quite normal for there to be some compromise between what would like to provide and what can be produced within the time and budget. These compromises are consciously made and that all interested parties agree on what is to be delivered before the project is started. In some cases the feasibility study might show that a
project will be impossible to complete even with a compromised set of aims and deliverables. Here, it is always best to decide not digitise and leave the task until technology or the costs have improved enough to make the digitisation a more viable task.

- A feasibility study can also test the proposed capture process and ensure that there are no unconsidered challenges, such as the original works being unavailable or too delicate to digitise. A risk assessment study can be undertaken, which should highlight possible problems and suggest methods of dealing with them.
- Evaluating the resources: the feasibility study must address issues of financing. No digitisation project should proceed without ensuring that it has sufficient resources to undertake, complete and support the project into the future. During the time of evaluation, particular attention should be given to issues such as time, budget, copyright, infrastructure, staff, institutional support and sustainability.

(1.2) Selection and Identification of Material

It is one of the most important activities of a research library is supposed to undertake before taking up the task of digitisation. While making selection it should be always be mind that digitisation requires proper selection enteric. For example, the documents selected for digitisation must be rare (not easily available elsewhere), useful and preferably old enough to have passed the range of copyright period. Moreover, the intellectual content of the proposed digital material should be properly examined to ensure that the whole exercise should not go waste.

For deciding upon the selection criteria, have put forth some questions and examine the materials in the light of those questions. The questions were more concerned with the intellectual content of the source materials and their usability with the resultant enhancing accessibility by means of digitisation.
Some physical attributes of books and photographs to be considered at the time of digitisation moreover, the national library of has adopted sound selection criteria which will help on the matter. These attributes both physical and content-wise may be used as yardsticks at the time of selection and identification of documents for digitisation.

(1.3) Planning

Like all the projects, planning forms the backbone of the digitisation project. While planning for the digitisation project the following pertinent factors should be taken into consideration.

(1.4) Managing the Workflow

The entire workflow process in a digitisation project, if done in-house, is given in the diagram below. It all starts with the need for digitisation and ends with providing access to the digitised materials to the target audience. Even after providing access, activities such as preservation of digitised materials and their maintenance go on continuing on recurring process. Such ongoing activities are not covered in the following diagram.

(1.5) Choice of Suitable Technology

Various hardware and software options are available for digitisation of contents. Thus, it is important that keeping in view the objectives of the project and also the most appropriate option should be considered by the library concerned. Details about technology options are given later in the article.

(1.6) Copyright, Intellectual Property Right and Licensing data Protection
Copyright is an intellectual property right (IPR). It is an automatic right given to creators of original material that allows them to control copying, adaptation, issuance of copies to the public, performance and broadcasting. The copyright holder of any image before it is digitised.

In order to protect the intellectual property rights of the creators or the authorized persons/bodies, most of the countries in the world have enacted copyright legislation which makes it mandatory to seek the permission of the copyright holder for reproducing the work in any format including digitisation. The contents of original property rights are very important and complicated issues that need to be examined at the time of digitisation. To make the matters complicated, copyright acts of different countries provide different time spans for literary, dramatic, musical and artistic work till which date. The copyright given to an appropriate agency will remain in vogue. For example, in India, the copyright subsists sixty years from the beginning of the calendar year next following the year in which the work is first produced (India, Ministry of Law, 1957). If a proposed digitising project involves materials in the public domain the work can proceed. If the source materials are protected by copyright but rights are held by institution or appropriate permissions cannot be secured, the work can move ahead. However, if permissions are not forthcoming; the materials cannot be reproduced and the focus of the project must change (Hazen, Horrell, Merrill-Oldham, 1998). The legal strictures, applicable to a particular product will vary depending on the country in which the project is based, the country in which the source materials are produced and prevailing international agreements.

Once a document is digitised, aspects pertaining to ownership of digital material also are taken into consideration. Some countries like the United Kingdom have made appropriate changes in their copyright act to cover digitised images (TASI 2002 – 03).
The laws governing Intellectual property rights, such as copyright and data protection are continually revised to meet changing circumstances and technologies. It is important that any digitisation project (and its host institution) fully considers these issues and develops appropriate strategies, both for gaining copyright clearance for works they digitise, as well as protecting the intellectual rights (IPR) within their own collections.

(1.7) **Resource management and access rights**

Once the materials are digitised, the next important part on the part of the digitising library is to decide upon controlling access rights to digital materials. It has to be decided whether the library wishes to throw upon its digitised collection over the world wide web for wider access or restrict these to its users within the campus or other selected groups by means of controlling mechanisms. Also it has to be decided if the material is to be used only for teaching/learning process or make the same ready for a wider use.

(1.8) **Quality Control**

Quality control, both in terms of physical as well as content, should be maintained to the optimum level at the time of digitisation. Sustainability of a digitisation project largely depends upon the quality of the database and the master copy. Quality in selection of hardware and software, quality in capturing, standard way of storage, quality control in indexing by means of selecting a standard metadata scheme, and quality in designing a user interface should be maintained. Quality assurance procedures which collections want to carry out should be judged. According to the needs of the individual collections themselves.

(2) **Technical Issues**
In order to digitise, technical infrastructure requires substantial framework because digital technology changes rapidly. Converting collections into digital images begins with careful planning and evaluation, and it is necessary to accomplish the basic prerequisites with reference to perspective of users needs and from the view of libraries that are responsible for selection/prerequisites with reference to perspective of users needs and from the view of libraries that are responsible for selection/preparation, convert/catalog (metadata), preservation, distribution/provide an access and maintain overtime.

(2.1) hardware
(2.2) software
(2.3) storage requirements
(2.4) file formats
(2.5) Access

(2.1) hardware requirements
Any investment either on software or hardware must be treated against the understanding that the technology will become obsolete in the near future. For digitisation, choice of equipment primarily depends on type of material one plan to scan and how the staff is familiar with that, scanning, storing, indexing and displaying all require variety of equipment’s.

(2.1.1) Scanners
Selection of scanners depends on type of material on eintends to scan. The purpose of the scanning is to increase the access to collection and keep a digital copy of the original document for preservation. Scanners are of different types. They are sheetfed scanners, drum scanners, flatbed scanners, slide, film and transparencies scanners and microfilm scanners

While purchasing a, number of decisions have to be made regarding the selection of a scanner. They are
Bit depth | Higher the bit depth of the scanner that better image quality. If the image scanned at a bit depth of 8, it supports up to 256 colours. The minimum bit depth for decent image quality is 24 (16.5 million colours). Next available bit depths are 30, 32, 36, 42, 48, etc. for ex: one plans to buy a scanner for slides and transparencies 36bit are the appropriate one.

Resolution | Resolution of a scanner is measured in pixels per inch or dots per inch. More pixels mean better image quality. Optical resolution range viz. 300X600DPI, 1200X1200dpi, 1200X2400DPI, 2400X2400DPI, 4800DPIX4800DPI, etc.

Speed | It is as little as 28 sec for 4x6 – inch photo, 48 sec for OCR letter- size black and white text, but it varies based on the speed of the scanner, bit depth, resolution, size of the scanning document, etc. speed of the scanner is more important when you are digitizing in large scale

Scan size | 8.5X11 in, 8.5x11.7 in, 8.5X14 in, etc.

Optical density | The normal density ranges from 0.0d to 4.0d density

Other factors | Size of the scanner (scan area), automatic sheet feeder and interface

(2.1.1.1) Type of scanning
Type of scanning depends on type of material we are planning to scan. For ex: black & white (bitonal) scanning is suitable for printed text. Grayscale is suitable for photographs and colour scanning is suitable for documents are in colour.

(2.1.1.2) Selection of a scanner based on material types

Scanner Suggestions for Various Material Types
<table>
<thead>
<tr>
<th>Single leaf, regular size, flat materials</th>
<th>Single leaf, oversized, flat materials</th>
<th>Bound materials</th>
<th>Transparent media</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flatbed scanner</td>
<td>Oversize flatbed scanner</td>
<td>Digital camera with book cradle</td>
<td>Slide scanner</td>
</tr>
<tr>
<td>Sheetfed scanner (if non brittle)</td>
<td>Sheetfed scanner (if non brittle)</td>
<td>Right angle, prism, or overhead flatbed scanner</td>
<td>Film scanner</td>
</tr>
<tr>
<td>Digital camera</td>
<td>Digital camera</td>
<td>Digital camera</td>
<td>Multi format flatbed scanner</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Digital camera</td>
</tr>
</tbody>
</table>

(2.1.1.3) Checklist about scanners

- Flatbed scanners are popular and flexible and widely used in digitisation projects, it is best to scan textual documents.
- Sheetfed scanner for someone who intends to scan a lot of documents to produce as editable text. The sheetfed scanners generally equip with an automatic document feeder (ADF).
- Slide scanners support minimum resolution of 2400dpi with 32bit depth. Slide scanners often used by libraries and publishing industry.
- Drum scanner is less used for digitisation because it stresses on the document and also affects the document.
- Scanning at the highest resolution appropriate to the informational content of the originals and at an appropriate quality to avoid rescanning. (Rhodes, 1999)
- Risks of heat and light should be taken into consideration and its impact on documents, keep in mind that the requirements are vary for digitisation of text documents, audio, image or combination of all (hybrid).

(2.1.2) Digital cameras
Digital camera is often used to digitize over-sized materials, bound volumes and artifacts. Cameras are of two categories based on resolution and cost.

Low resolution digital cameras are relatively inexpensive cameras are used to create thumbnail images for World Wide Web.

High-resolution digital cameras are costly, but it is best to digitize specialized collection Viz. drawings, paintings, handicrafts, etc.

Advantages are many if we use high-end digital cameras Viz. focusing mechanism, high resolution, sharpening, optical zooming and it is adequate enough to take a digital snap of large books.

(2.1.3) Servers

A powerful and dedicated computer(s) is the basis for digitization and image projects. Servers are of different kind and are priced from thousand repees to lakhs of rupees. The library has to select the one, which has more storage hard disk, more RAM and better processor. More RAM is required because sometimes scanned images are of big size and are often opened using image editing software for further editing. High processing speed is also required to retrieve images from the database. The computer should also be equipped with all types of back up devices such as CD re-writable, DAT devices etc.

A big monitor has necessary for image editing and manipulation. It should be not less than 17”. 21” monitors are more suitable for viewing for viewing and editing images.

(2.2) Software requirements

(2.2.1) Capture software
Image creation is the process of creating a digital image. Image creation software is bundled with scanner in most of the cases it helps to communicate with hardware (scanner) to capture image. Few images editing software like adobe image ready and adobe Photoshop has both the options like scanning option as well as image editing capability. Capture software designed to work based on plug-in, a driver interface such as TWAIN OR ISIS, helps in selecting brightness, contrast, resolution, scan type etc. and it has image saving options Viz. TIF, JPG, PNG, GIF, etc.

A scanned document is nothing more than a picture of a printed page. It cannot be edited or manipulated or managed based on their contents. OCR (Optical character Recognition) programs are software tools use to convert scanned images into text, searchable file, retaining the attributes as similar as in the original document (PDF). The latest versions of software support in capturing a document as well as converting scanned images into text. Keeping in mind the objectives and budget, the most appropriate capture software should be selected.

(2.2.2) Image editing software

The image editing software(s) is required for further manipulation of the scanned image in accepted standards, to remove unwanted spots, strains and creating other derivatives of the images to access through Web or Internet. The two important features to be considered in image editing software are optimization and creation of surrogate images such as GIF, JPEG or PNG.

The choice of image editing software is based on the level of image manipulation desired and the level of expertise of staff. Some image editing software, such as adobe Photoshop, Paint Shop Pro are very advanced, and may require some time training to learn (Rhodes, 1999). Evaluation versions of some of these are also available for the purpose of evaluation.
(2.2.3) Generation of thumbnails

It is a kind of software that supports in automatically generating bunch of images from one format to another format and convert as thumbnail images. This type of software is useful for perform the same operation in bulk. Data about the images along with thumbnails will get generated from the database, and the thumbnail is linked to original scanned image or derivative images along with thumbnails will get generated from the database, and the thumbnail, is linked to original scanned image or derivative image to be used for viewing the full image.

(2.2.4) Retrieval tools

Tools are available for creation of metadata, Indexing, searching and retrieving information from the database. Few web-based commercial retrieval tools are available such as Alchemy, CONTENT dm, and Imara. In addition to this, free digital software tools such as Greenstone digital Library (GSDL), Dspace, Kepler are available for organizing, indexing and searching digital documents. however, free tools need bit expertise in their customization to meet the requirements of the project.

(2.3) Storage requirements

Digitized images must be saved in durable storage device for backup and recovery. These can be used latter for further manipulation and creation of derivative images from the originals. Scanned images are stored in a stable medium after scanning of a document is completed which may be treated as master copy. Commonly used devised for storage are

- DAT cassettes
- SIP drives
- CDs and DVDs
(2.4) File Formats/Image Storage Formats

(2.4.1) Digital Master

Digital master image is a source directly scanned or photographed from the original document. It should be signify as accurate as possible to represent the original document or it can be like WYSIWYG (what you see is what you get) image of source material.

(2.4.2) Image File Formats

The objective of the digitisation is to provide an access to digitised collection either on the Internet. GIF, JPEG and PNG are being commonly used on the Web, because these formats are supported by most of the web browsers. Therefore, derivative images are created from digital master image for access and viewing.

The following table gives information about image formats and its characteristics:

<table>
<thead>
<tr>
<th>Image Format</th>
<th>TIFF</th>
<th>GIF</th>
<th>JPEG</th>
<th>PNG</th>
<th>PDF</th>
</tr>
</thead>
<tbody>
<tr>
<td>.tiff, .tif</td>
<td>.gif</td>
<td>.jpeg, .jpg</td>
<td>.png</td>
<td>.pdf</td>
<td></td>
</tr>
<tr>
<td>Suitable for master Image</td>
<td>Suitable for thumbnail</td>
<td>Access as full image</td>
<td>Access as full image</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 – bit bitonal; 4- or 8 –bit grayscale</td>
<td>1-8 bit bitonal, grayscale, or colour</td>
<td>Suited for delivery on the web</td>
<td>1-48 bit palette colour</td>
<td>4 bit grayscale;</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lossy compressi</td>
<td>Lossless compressi</td>
<td>8-64 bit colour</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Lossless: ITU – T.6, LZW. JBIG</td>
<td></td>
</tr>
</tbody>
</table>
8 bit format
• Suited for low resolution (72)

24 - bit colour
• Suited for delivery on the web
• Old browsers not supported

Retain the same format of the original

(2.4.3) File management System

File Management system (FMS) or Image management system (IMS) will help to organize images in order to keep track of files for preparing descriptive information (metadata) about image. Images are organized in a simple way of in folder(s) or are stored as hierarchical file system, and complex way of storing in database(s).

Characteristics of FMS

• Organizing files in a folder(s), folders to be created under main directory should be assigned a meaningful name for easy identification.
• File names to be simple and indicative.
• Database driven method of managing files is suitable for larger collection where details of the images stored in a database.
• If the image is stored in a database, it is possible to give authorization to particular user to manipulate, search, retrieve and access.

(2.5) Access to digitised collection

Collection of digitised materials has to be organized, described, and indexed so that digital objects, as per the needs of the user, would be easily retrieved, with well designed user interface for browsing and searching the digitised collection from a variety of index points would be possible. The user interface should be designed in such a way so as to match the institution’s policy pertaining to access rights.

(3) Financial Issues

Digitisation involves a huge investment which most of the library and information centres in India may not be able to afford, but there are good number of ongoing efforts to make available valuable cultural and heritage resources to educators at all levels. Thus, proper costing analysis of digitisation projects has to be made and issues such as potentiality of cost savings, revenue, and fund mobilization have to be taken care of.

(3.1) Costing of digitisation project:

The costs involved in a digitisation project may be categorized as:

(3.1.1) manpower costs
(3.1.2) Process costs (including equipments)
(3.1.3) Overheads

(3.1.2) Process Costs
Process cost is cost involved in hardware and software requirements. For the purpose of developing a full-featured digitisation unit, the main hardware requirements are computers, scanners, digital cameras, storage devices and image capturing and editing software. Let us consider the lifespan of above hardware and software is 3 years, after which we need additional investment of upgrading software and hardware on a recurring basis.

(3.1.3) Overhead costs

Overhead costs such as electricity cost, cost for space, stationery, and other indirect costs which may come to 10 to 15% of the total cost.

For example, the library of the Gokhale Institute of Politics and Economics, Pune, has a collection of around 1000 books which are old and considered rare, and published between 1680 and early 19th century. Let us assume each book has 150 to 200 pages. The total number of pages of 1000 books comes to about 180000. If the library wishes to digitize its rare collection employing three persons; the costing may be calculated as under:

Manpower cost

(4) Human Resources

Human resources or manpower form the backbone of any digitisation activity. Proper human resources management is vital for launching and sustainability of a digitisation project. Human resources planning depend on whether the library is going to undertake the digitisation in-house or outsource the same. In case of a digitisation project being executed in house, staff costs and overheads often eat up the budget unless a good estimation is done beforehand. Thus, cautious approach has to be adopted in recruitment, development, and determining pay structure of the staff involved in digitisation. Proper manpower planning requires identification of jobs, job analysis, job description, and job assessment. The project team may be a blend of
management professionals, IT professionals, and library professionals. An ideal digitisation project may require following categories of professionals:

(4.1) Managerial Staff
(4.2) Technical staff
(4.3) Operational staff

(4.1) Managerial staff
A digitisation project manager's main job is to ensure completion of the project with achievement of the desired objectives, in the stipulated time and within the stipulated budget. He is the person responsible for success or failure of a digitisation project. The qualifications required for the post may be as under:

- Detailed knowledge of the technical processes involved in setting up a production facility, including image capturing processes, benchmarking, workflow, production of metadata, quality assurance.
- Knowledge of a wide range of formats of original materials, their handling and their optional digitisation requirements.
- Experience of training of scanning operatives in a production environment.
- Good interpersonal skills.
- Knowledge of copyright, intricacies.

(4.2) Technical staff
Technical staff are responsible for handling the technical operations like scanning, optical character recognition process, digital photocopying, setting and placing the digitised material in appropriate format.

(4.3) Operational staff
Besides managerial and technical staff, a digitisation project may need some operational staff for handling documents, re-keying the data wherever digital photocopying and scanning is not possible.
In case the library is going to outsource the digitisation work, human resources development and planning required for the maintenance and sustainability of the database of digitised resources.

Manpower development and training is very important component of digitisation project. This is useful for ensuring sustainability of a digitisation project, because of rapid obsolescence of technology and the emerging complications thereof.

(5.2.1) Technical Strategies

There are various procedures that can be used to ensure that a collection’s digital information is kept alive through changes in technology. The sections below outline some of the main techniques used to preserve digital assets. It should be noted that there is still a debate about which of the following strategies is the most effective and efficient.

The following are technical approaches to preserve digital materials.

(5.2.1.1) Technology preservation

(5.2.1.2) Technology emulation

(5.2.1.3) Data migration

(5.2.1.4) Data refreshing

(5.2.1.1) Technological Preservation

Technological preservation emphasizes that good working models of all equipment, including hardware and software, used to digitise materials and providing access to the digital files will need to be preserved. There are obvious disadvantages to this approach. Firstly, it may be costly and time consuming. Secondly, it require use of only standard and acceptable hardware for the preservation. It can therefore be seen that technological preservation alone
cannot provide a viable long-term preservation strategy and it will need to be used in conjunction with other strategies to be considered truly reliable.

(5.2.1.2) Technological Emulation

The essential idea behind emulation is to be able to access or run original data and software on a new or current platform this is done through running software on the new platform that emulates the original environment is stored alongside the digital data itself.

One advantage of emulation as a preservation strategy is that the data files themselves are not altered in any way. Thus, emulation retains not only the intellectual content of digital information, but also somehow the functionality of the original.

However, emulation can also be considered an expensive strategy as it requires a large outlay in cost initially to create the emulator and then again whenever a new platform requires a new emulator. Nevertheless. Emulation is beginning to be seen by many as the best solution for truly long-term preservation through the many platforms that are likely to be seen in the future.

(5.2.1.3) Data Migration

Data migration in simple terms means copying the digital data from its present media to a newer one, thus keeping the data continually stored in an up-to-date form that continually keeps pace with any changes in technology.

This approach appears pleasantly simple, however, it does carry with it various disadvantages. Firstly, data migration can threaten the integrity of the data itself. Through repeated migration, there is a higher chance of image data becoming lost or corrupt in the process. Secondly, it is difficult to predict how frequently migration will need to take place, because of the uncertainties so far as technological changes are concerned, thereby making it impossible to do the
costing. With most digital image collections, data migration is found to be a necessary but very expensive and time-consuming process. In spite of these shortcomings, data migration is almost universally used within any reliable digital preservation methodology.

(5.2.1.4) Data Refreshing

The process of data refreshing is often mistakenly thought of as a preservation strategy. It is an important part of the preservation any digital collection, but it must be used in conjunction with one of the three main strategies. Data refreshing is the process of copying data from one set or copy of the digital media to another of the same kind. By transferring data to a newer copy of the media the preservation prospects of the data are greatly increased. Refreshing is an important part of the preservation of every digital project, but by itself offers no answer to any problems brought about by the technological obsolescence of the chosen media or the infrastructure supporting it. Data refreshing cannot be seen as anything other than a short term solution to protect data until it is migrated to another media.

The entire process of digitisation, if monitored and executed will prove to be a boon for the research community. One important factor to be considered is that of acceptability of digitised material by the users. A study was conducted in Burdwan University to ascertain acceptability of these in digitised form among faculty (Bandyopadhyay, 2001). Similar studies may also be conducted in different institutions. Thus, while digitisation, the focus should be to retain originality of the material to the maximum possible. The objective... is not to scan at the highest resolution and bit depth possible, but to match the conversion process to the informational content of the original no more no less.”
4.6 Preservation in Library and Archival Science

**Preservation** is a branch of library and information science concerned with maintaining or restoring access to artifacts, documents and records through the study, diagnosis, treatment and prevention of decay and damage.[1]

It should be distinguished from conservation, which refers to the treatment and repair of individual items to slow decay or restore them to a usable state.[2] Conservation is occasionally used interchangeably with preservation, particularly outside the professional literature.[3]

Preservation as a formal profession in libraries and archives dates from the twentieth century, but its philosophy and practice has roots in many earlier traditions.[4]

In many ancient societies, appeals to heavenly protectors were used to preserve books, scrolls and manuscripts from insects, fire and decay.

- To the ancient Egyptians, the scarab or dung beetle (artifact) was a protector of written products. The scarab was also used as a holder or medium for personal name seals. A figurine of a scarab would be carved out of stone, and then on the smooth stomach of the scarab, the engraving of a seal was made. Later, this oval image was used for the representation of the cartouche, or name/title seals.[5]

- In ancient Babylon, Nabu is the heavenly patron of books and protector of clay tablets. Nabu is the Babylonian god of wisdom and writing, and is the patron of the scribes, librarians and archivists. Nabu’s symbols are the clay writing tablet with the cuneiform writing stylus. He usually wears a horned cap, and often stands with his hands clasped together, in the ancient gesture of priesthood. Nabu engraves the destiny of each person, as the Gods have decided, on the tablets of sacred record. Thus, Nabu has the
power to increase or diminish, at will, the length of human life. The image of Nabu is also one of the images on the brass doors designed by Lee Lawrie, entitled, “A History of the Written Word,” on the John Adams Building of the Library of Congress. The figures on the doors also include: Thouth, an Egyptian god; Ts’ang Chieh or Cangjie, the Chinese patron of writing; Nabu, and Akkadian god; Brahma, the Indian god; Cadmus, the Greek sower of dragon’s teeth; and Tahmurath or Tahmuras, a hero of the ancient Persians.

- In Hindu beliefs, Ganesh (Ganesvha or Ganapati) is the elephant-headed god of learning and new enterprises. As the god of wisdom, he knows all. Since he has the head of an elephant, he also has the reputed memory of the elephant, and thus does not forget anything. His statue is placed over the doors of and entrances of many buildings in India and Sri Lanka, including most libraries. Ganesh is the scribe who wrote the Mahabharata (“Great Epic of the Bharata Dynasty”) from Vyasa’s dictation. Ganesh is credited with inventing the Sanskrit alphabet, and he broke off his right tusk to make the first pen. As the inventor of the alphabet, as a scribe, and as a keeper of wisdom and knowledge, Ganesh is credited as a patron of libraries, librarians and book sellers and buyers.

- In Arabic and other eastern societies, sometimes a traditional method to protect books and scrolls was a metaphysical appeal to “kabi:Kaj,” the “King of the Cockroaches.” By appealing to the king to protect a manuscript, cockroaches of less nobility (or lesser insects) would refrain from intruding on documents which could be eaten by the king only. Since many manuscripts were made with fish-glue, starch-paste, leather and other tasty substances, insect appetites were a constant and never ending problem to Arabic books and scrolls.[6] A similar technique from Syria was to name the first and last page of a document or manuscript “The page of the King of the Cockroaches”, in the hope that the Cockroach King will
control all other insects. Translated appeals include “O Kabi:kaj, save the paper!”, “O Kabi:kaj, save this book from the worms!” and “Okabi: kaj, do not eat this paper!”[7] “In Maghribi manuscripts, the word appears in its evidently corrupt form, “kaykataj” and is clearly used as a talisman… and mentions, after a certain Muhammad al-Samiri, that when one writes “kayatataj” on the first and last folio of the book, one can be sure that worms will not attack it.” [8]

- There are three saints in the Christian church that are closely associated with libraries as patrons. Saint Lawrence is an early saint of the church, who seems to be more respected in European libraries than those in the Western Hemisphere. Saint Jerome is most often considered the patron saint of libraries in the US and Canada. [9] Saint Catharine of Alexandria or Catherine of Alexandria is most often considered the patroness of libraries in the Orthodox tradition.

- In some Christian monasteries, prayers and curses were placed at the end of books to prevent theft, or to damn the thieves. Frequently called a “book curse”, these were placed in the book to deter theft. “For him that stealeth a book from this library, may it change into a serpent in his hand and rend him. May he be struck with palsy, and all his members blasted. Amy bookworms gnaw his entrails, in token of the worm which dieth not. And when at last he goeth to his final perdition, let the flames of Hell consume him forever.

In library science, preservation is treated as an active and intentional process, as opposed to the passive sense of preservation that might be applied to paleontological or archaeological finds. The survival of these items is a matter of chance, from an information science perspective, while the preservation of them after their discovery is a matter of intentional activity.
Human record-keeping arguably dates back to the cave painting boom of the upper Paleolithic, some 32,000-40,000 years ago. More direct antecedents are the writhing systems that developed in the 4th millennium B.C. Written record keeping and information sharing practices, along with oral tradition, sustain and transmit information from one group to another. This level of preservation has been supplemented over the last century with the professional practice of preservation and conservation in the cultural heritage community.

Oral tradition or oral culture, the transmission of information from one generation to the next without a writing system.

1. Antiquarian practices, including scribal practice, burial practice, the libraries.
2. Medieval practices, including the scriptorium and relic collection
3. Renaissance and the changing conception of artists and works of art
4. Romantic movement’s imperative to preserve

4.6.1 Environmental controls

Environmental controls are necessary to facilitate the preservation of organic library materials and are especially important to monitor in rare and special collections. Key environmental factors to watch include temperature, relative humidity, pests, pollutants, and light exposure.

In general, the temperature is, the better it is for the collection. However, since books and other materials are often housed in areas with people, a compromises must be struck to accommodate human comfort. A reasonable temperature to accomplish both goals is 65-68F however; if possible, film and photography collections should be kept in a segregated area at 55F.

Books and other materials take up and give off moisture making them sensitive to relative humidity. Very high humidity encourages mold growth and
insect infestations. Low humidity causes materials to lose their flexibility. Fluctuations in relative humidity are more damaging than a constant humidity in the middle or low range. Generally, the relative humidity should be between 30-50% with as little variation as possible, however recommendations on specific levels to maintain vary depending on the type of material, i.e. paper-based, film, etc.[18] A specialized dew point calculator for book preservation is available.[19]

Pests, such as insects and vermin, eat and destroy paper and the adhesive that secures book bindings. Food and drink in libraries, archives, and museums can increase the attraction of pests. An integrated pest Management system is one way to control pests in libraries.

Particulate and gaseous pollutants, such as soot, ozone, sulphur dioxide, oxides of nitrogen. Can cause dust, soiling, and irreversible molecular damage to materials. Pollutants are exceedingly small and not easily detectable or removable. A special filtration system in the building’s HVAC is a helpful defense.

Exposure to light also has a significant effect on library materials. It is not only the light visible to humans that can cause damage, but also ultraviolet light and infrared radiation. Measured in lux or the amount of lumens/m², the generally accepted level of illumination with sensitive materials is limited to 50 lux per day. Materials receiving more lux than recommended can be placed in dark storage periodically to prolong the original appearance of the object.

Recent concerns about the impact of climate change on the management of cultural heritage objects as well as the historic environment has prompted research efforts to investigate alternative climate control systems to replace or supplement traditional high-energy consuming HVAC systems as well as the introduction of passive preservation techniques. Rather than maintaining a flat line. Consistent 24/7 condition for a collection’s environment, fluctuation can
occur within acceptable limits to create a preservation environment while also thinking of energy efficiency and taking advantage of the outside environment.

Bound materials are sensitive to rapid temperature or humidity cycling due to differential expansion of the binding and pages, which may cause the binding to crack and/or the pages to warp. Changes in temperature and humidity should be done slowly so as to minimize the difference in expansion rates. However, an accelerated aging study on the effects of fluctuating temperature and humidity on paper color and strength showed no evidence that cycling of one temperature to another or one RH to another caused a different mechanism of decay.

4.6.2 Decision making and criteria

Making a proper decision is an important factor before starting preservation practices. Decision making for preservation should be made considering significance and value of materials. Significance is considered to have two major component: importance and quality. “Importance” relates to the collection’s role as a record, and “quality” covers comprehensiveness, depth, uniqueness, authenticity and reputation of the collection. Moreover, analyzing the significance of materials can be used to uncover more about their meaning. Assessment of significance can also aid in documenting the provenance and context to argue the case for grant funding for the object and collection.

Forms of significance can be historically, culturally, socially, or spiritually significant. In the preservation context, libraries and archives make decisions in different ways. In libraries, decision-making likely targets existing holding materials, whereas in archives, decisions for preservation are often made when they acquire materials. Therefore, different criteria might be needed on different occasions. In general, for archive criteria, the points include: 1) the characteristics of a record (purpose, creator, etc.); 2) the quality of the information in the record; 3) the record in context (part of a series or not); 4)
potential use and possible limitations; and 5) the cost against the benefits from its existence. For library criteria, the following are evidence of significance: 1) uniqueness, 2) irreplaceability, 3) high level of impact – over time or place, 4) high level of influence, 5) representation of a type, and 6) comparative value (rarity, completeness, integrity relative to others of its kind).

4.6.3 Selection

Since the 1970s, the study of understanding the needs of the library is inherently important to the survival of archives and libraries. In order for the preservation of a collection to survive for a long time it is important that a systematic preservation plan is in place. The first step in planning a preservation program is to assess the institution’s existing preservation needs. This process entails identifying the general and specific needs of the collection, establishing priorities, and gathering the resources to execute the plan.

Because budget and time limitations require priorities to be set, standards have been established by the profession to determine what should be preserved in a collection. Considerations include existing condition, rarity, and evidentiary and market values. With non-paper formats, the availability of equipment to access the information will be a factor (for example, play back equipment for audio-visual materials, or microform readers). An institution should determine how many, if any, other repositories hold the material, and consider coordinating efforts with those that do.

Institutions should establish an environment conducive to preservation changes, involve staff, and create an understanding among administration and staff. The first steps and institution should implement, are to establish a policy that defines and charts the course of action and create a framework for carrying out goals and priorities. There are three methods for carrying out a preservation survey: general preservation assessment, collection condition surveys, and an
item – by item survey. General condition surveys can be part of a library inventory.

Selection for treatment determines the survival of materials and should be done by a specialist, whether in relation to an established collection development policy or on an item by item basis. Once an object or collection has been chosen for preservation, the treatment must be determined that is most appropriate to the material and its repository. If the information is most important. Reformatting or creation of a surrogate is a likely option. If the artifact itself is of value, it will receive conservation treatment, ideally of a reversible nature.

4.6.4 Research and testing

With old media deteriorating or showing their vulnerabilities and new media becoming available, research remains active in the field of conservation and preservation. Everything from how to preserve paper media to creating and maintaining electronic resources is being explored by students and professionals in library and information science. The two main issues that most libraries tend to face are the rapid disintegration of acidic paper and water damage (due to flooding, plumbing problems, etc. Therefore, these areas of preservation, as well as new digital technologies, receive much of the research attention.

4.6.5 Preservation of Cultural Objects

One instance in which these decisions may get tricky is when the conservator is dealing with cultural objects.

(1) All actions of the conservation professional must be governed by an informed respect for cultural property, its unique character and significance and the people or person who created it. “this can be applied in both the care and longterm storage of objects in archives and institutions.
While recognizing the right of society to make appropriate and respectful use of cultural property, the conservation professional shall serve as an advocate for the preservation of cultural property. “This statement speaks to the conservator’s need to balance his or her duty to conserve objects and maintain a collection with society’s right to have access and use of objects of their own cultural/religious purposes. While it is obvious that member of a religion should be able to have access to an object or text that has spiritual value to them, it would be against the conservator’s ethics to then allow that object to incur damage from such use. The conservator should make sure that the care of the object is kept in mind when access to an object is granted. The object should remain in the best condition possible not only so it is preserved for prosperity, but also so that it can be studied by researchers and by members of the cultural or religious group that created it.

It is important that preservation to be respectful of cultural property and the societies that created it, it is also important for them to be aware of international and national laws pertaining to stolen items the conservation professional should be cognizant of laws and regulations that may have a bearing on professional activity. Among these laws and regulations are those concerning the rights of artists and their estates, occupational health and safety, sacred and religious material, excavated objects, endangered species, human remains, and stolen property.”

In recent years there has been a rise in nations seeking out artifacts that have been stolen and are now in museums. In many cases museums are working with the nations to find a compromise to balance the need for reliable supervision as well as access for both the public and researchers.

With all these issues of respect and cultural sensitivity to consider, conservation and preservation issues are sure to arise. The care of cultural and
sacred objects often affects the physical storage or the object. For example, sacred objects of the native peoples of the Western United State are supposed the be stored with sage to ensure their spiritual well being. The Idea of storing an object with plant material is inherently problematic to an archival collection because of the possibility of insect infestation. When conservators have faced this problem, they have addressed it by using freeze dried sage, thereby meeting both conservation and cultural needs.

Some individuals in the library science community have explored the possible moral responsibility to preserve all cultural phenomena, in regards to the concept of monumental preservation. Other advocates argue that such an undertaking is something that the indigenous or native communities that produce such cultural objects are better suited to perform. Currently, however, many indigenous communities are not financially able to support their own archives and museums.

4.6.6 Standard functions of preservation programs

- Collections Care refers to the general maintenance and preventive care of a collection as a whole. This can include activities such as security, environmental monitoring, preservation surveys and more specialized activities such as mass deacidification.

- Conservation refers to the treatment and repair of individual items to slow decay or restore them to a usable state. Conservation is occasionally used interchangeably with preservation. Particularly outside the professional literature.

- Digital preservation refers to the digitally stored information. This should not be confused with digitization, which is a process of creating digital
information which must, in turn, be digitally preserved. Means of digital preservation include refreshing, migration, replication and emulation.

- Disaster Preparedness (RT: disaster Plan/ Business Continuation/Disaster Recovery/Disaster Mitigation Plan) refers to the practice of arranging for the necessary resource and planning the best course of action to prevent or minimize damage to a collection in the event of a disaster of any level of magnitude, whether natural or man-made.

- Reformatting refers to the practice of creating copies of an object in another type of data storage device. Reformatting processes include microfilming and digitization.

4.6.6.1 Media specific issues and treatments

(i) Books
- Sizing
- Leather Binding

(ii) Ephemera and Realia

Paper
- Acid-free paper
- Japanese tissue
- Mummy paper
- Paper splitting

(iii) Parchment
- Parchment repair
- Preservation of Illumainated Manuscripts

(iv) Moving image
- Film preservation
- Video recording

(v) Sound recording
- Preservation of magnetic audiotape
(vi) Oral history preservation

(a) Language Preservation

(b) Visual material

(c) Still Photography

Architectural reprography, a variety of technologies and media used to make multiple copies of original drawings or records created by architects, engineers, mapmakers and related professionals.

4.7 Libraries

Limited, tax-driven funding can often interfere with the ability for public libraries to engage in extensive preservation activities. Materials, particularly books, are often much easier to replace than to repair when damaged or worn. Public libraries usually try to tailor their services to meet the needs and desires of their local communities, which could cause an emphasis on acquiring new materials over preserving old ones. Librarians working in public facilities frequently have to make complicated decisions about how to best serve their patrons. Commonly, public library systems work with each other and sometimes with more academic libraries through interlibrary loan programs. By sharing resources, they are able to expand upon what might be available to their own patrons and share the burdens of preservation across a greater array of systems.

4.7.1 Archival repositories and special collections

Archival facilities focus specifically on rare and fragile materials. With staff trained on appropriate techniques, archives are often available to many public and private library facilities as an alternative to destroying older materials. Items that are unique, such as photographs, or items that are out of print, can be preserved in archival facilities more easily than in many library settings. Because
so many museum holdings are unique, including print materials, art, and other objects, preservationists are often most active in this setting.

**Legal issue**

Reformatting, or in any other way copying and item’s contents, raises obvious copyright issues. In many cases, a library is allowed to make a limited number of copies of an item for preservation purposes. In the United states, certain exceptions have been made for libraries and archives.

There is a longstanding tension between preservation of and access to library materials, particularly in the area of special collections. Handling materials promotes their progression to and unusable state, especially if they are handled carelessly. On the other hand, materials must be used in order to gain any benefit from them. In a collection with valuable materials, this conflict is often resolved by a number of measures which can include heightened security, requiring the use of gloves for photographs, restricting the materials researcher may bring with them into a reading room, and restricting use of materials to patrons who rare not able to satisfy their research needs with less valuable copies of an item. These restrictions are annoyances to the hands of the public.

There is also controversy surrounding preservation methods. A major controversy at the end of the twentieth century centered on the practice of discarding items that had been microfilmed. A similar concern persists over the retention of original documents reformatted by any means, analog or digital. Concerns include scholarly needs and legal requirements for authentic or original records as well as questions about the longevity, quality and completeness of reformatted materials. Retention of originals as a source or fail-safe copy is now a fairly common practice. Another controversy revolving around different preservation methods is that of digitization of original material to maintain the intellectual content of the material while ignoring the physical nature of the book
further, the modern language association’s committee on the future of the print record structured its “statement on the Significance of Primary records” on the inherent theoretical ideology that there is a need to preserve as many copies of a printed edition as is possible as texts and their textual stings are, quite simply, not separable, just as the artificial characteristics of texts are as relevant and varied as the text themselves, just as the artifactual characteristics of texts are as relevant and varied as the text themselves.

Many digitized items, such as back issues of periodicals, are provided by publishers and databases on a subscription basis. If these companies were to cease providing access to their digital information, facilities that elected to discard paper copies of these periodicals could face significant difficulties in providing access to these items. Discussion as to the best way to utilize digital technologies is therefore ongoing, and the practice continues to evolve. Of course, the issues surrounding digital objects and their care in libraries and archives continues to expand as more and more of contemporary culture is created, stored, and used digitally. These born-digital materials raise their own new kinds of preservation challenges and in some cases they may even require use new kinds of tools and techniques.

4.8 Development of a 4D – webgis for Archaeological Research

4.8.1 Documentation:

Recent technological advancements are resulting in new archaeological applications of LIDAR (Light detection and ranging). One common use is archaeological prospection: another is to use 3 D models acquired from LIDAR to reconstruct ancient architecture and landscapes (in our case the UNESCO world heritage site of copan, Honduras). A new and promising use for LIDAR is 4D – webgis where LIDAR – generated 3 d models are combined with temporal
information geographic information systems (GIS) Functionality for documentation and analysis of archaeological functionality for documentation and analysis of archaeological sites on a web platform. Two and three dimensional data and models of different type and resolution can be interactive analysis and visualization tools permitting archaeological analysis in a georeferenced system that facilitates interactive and collaborative research. Spatial and temporal queries of accessibility and visibility, settlement plans, and artefact distributions that were previously performed in 2D or 2.5D views would be possible in the 3D environment.

Usage obstacles such as plug-ins or Java applets to realize web based 3D visualization will soon disappear due to developments of web standards like HTML 5 and WebGL. Standards based 3D visualization in web browsers will offer potential for more interactive. Responsive webgis applications in many domains. Currently many JavaScript libraries are developed on top of the WebGL standard with foci on different purposes. As highlight, for cultural Heritage applications it is important that such libraries support the interoperability of different 3D modelling tools and maintain the chromatic and reflectance characteristics of the models. Further, to be able to visualize and analyse archaeological 3D data in conjunction with spatial data a library must support common geodata formats and OGC standards to enable the development of a real 3D webgis.

Currently such a library is not available. There are various open-source WebGL Globe APLs like Open WebGlobe, Cesium, webGL Earth or Ready Map 3D that support the display of geodata. But none of them meet the requirements typical of cultural heritage such as visualizing highly detailed laser scanned objects or building interiors. However, there exist libraries like cubic VR, SceneJS, C3DL or three.js that support a wide range of rendering effects for a detailed visualisation of object characteristics. While they support various 3D
4.8.2 Archaeological representation of time

An archaeological GIS needs to be able to query and visualize objects that belong to and cross-cut different time periods; however, a major problem in archaeology is that objects may be dated using different techniques. This can lead to ambiguous classification with varying accuracy and non-comparable temporal classifications.

The MayaArch 3D project focuses on the archaeological site of company where dating is based on C–14 dates, obsidian hydration. Different ceramic typologies, dates from, hieroglyphic inscriptions, Maya calendric cycles, and architectural stratigraphy.

The current W3DS discussion paper [5] specifies a time parameter that can be specified in ISO 8601 format. This functionality of W3DS allows a combination of bounding box-based spatial selection and a temporal selection to query a spatio-temporal defined 3D scene. Additionally, predefined attributional query filters could be used by defining server styles for a layer that then could be determined in another parameter.

As a default, the ISO 8601 format uses the pregorian calendar, which means that an additional transformation service or client side intelligence will be necessary to translate the dates and periods from the Maya calendars or other categories and concepts into standard dates.

Archaeology and digital library evaluation

Traditionally, archaeologists gather large amounts of material from a site. Describe it, and then present their finding. This focus on the collection itself is
akin to many evaluation studies of digital library services. The usage data are collected, and described much in the same way that archeological artifacts were collected, tagged, and grouped through traditional archeology. Many contemporary digital library evaluations published today fall into this gather and describe cycle.

4.8.3 New archeology

New archeology came out of the realization that the collection of more artifacts was not leading to higher level understanding of phenomena. This caused a shift in thinking from what was found to why it was there. There was a leader in moving the field toward using hypotheses to guide the collection of artifacts. Thinking about these explorations from the viewpoint of generalizable hypotheses can guide Internet archeologists to move from artefact collection and description to building knowledge.

This collecting of more and more artifacts and aggregation represents the current state of many digital library evaluation projects. Reports that look at data from only a single service, with no consideration of larger implications, librarians and researchers are collecting more and more artifacts, but lack the structure to pose larger questions that could be explored through data.

This need to move from a practical gather–describe evaluation toward a hypothesis based exploration to improve the science of librarianship has been voiced explicitly and implicitly by other library scientists. Library and information science fosters little research that is intended to produce knowledge for the sake of knowledge” [4] and instead focuses on the gap between the generalizable research of library scientists and the applied action research desired by librarians. He argues for the need for ways to increase the impact of action research on libraries. Many significant large scale library evaluations and find that most of them draw conclusions only about individuals or specific groups of
Combining the frameworks: The Hypothetico- Deductive – Inductive (HDI) scientific cycle

This cycle, was applied to archaeology by south, (1997) and provided the bridge between traditional and new archaeology. Traditional archaeology focused on describing and finding patterns within the data, and new archaeology started with a problem and sought data to support or refute hypotheses.

South presented the stages of the HDI cycle as:

- Induction (pattern Recognition),
- Theory (lawlike Generalty),
- Deduction (Logical Analysis),
- Prediction (Hypothesis), and
- Verification (Testing) [5].

In an archeological site, just as in the logs of a digital library, there is a large amount of data available. The first step is to collect samples of data from around a site and explore those data for patterns. This is where bibliomining is important. Bibliomining is the application of tools from data mining and bibliometrics to discover non-trivial and useful patterns in large amounts of data. Inspired by these patterns, the researcher creates basic generalizations about the data. Research questions are created to explore the hypotheses, and then additional data are gathered to test those hypotheses. These data may come from the same source or may require different sources. This method may support or refute the hypotheses, which has the effect of building the knowledge base for the field.

4.8.3.1 Postmodern archaeology
Postmodern archeology, one from of postprocessual archeology, eschews the process that produces generalizations about a culture and instead focuses on the individuals within that culture any culture is made up of individuals, each of whom makes his or her own life decisions. In order to understand a culture, a researcher must understand the individuals who make up that culture.

Due to the focus on users by information science researches such as Dervin and Nilan (1986), there is considerable research on the importance of users in artifact–based evaluation in the library evaluation process. Importance of involving users to learn about both the relevance and usefulness of the resources retrieved from a system. The holistic framework for library measurement in Table 1 (Nicholson, 2004) shows the relationship between bibliomining, or the internal view of the use of the system through data-based artifacts, to other areas of measurement, which include:

- The internal view system, which focuses on what information services are offered;
- The external view of the system, which involves users to learn if the information provided matches the request by a user; and
- The external view of the use, which involves users to learn if the information was useful to the user in meeting the information need.

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<tr>
<th>Perspective</th>
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<td><strong>Internal (Library System)</strong></td>
<td><strong>System</strong></td>
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<td>Standards</td>
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<td><strong>External (User)</strong></td>
<td>Aboutness</td>
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<td>Usability</td>
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The important focus for postmodern Internet archeology is the bottom row (the External/user view). One advantage in examining current information resources is that users of the system are still available to be involved in the evaluation process. There are several scenarios for involving in the evaluation:

- If a login procedure is used, the actual users may be available to discuss how well the results matched the query and how useful the information was in meeting their need. In order to capture these views, a survey immediately after interaction with the system will prevent relevance decisions from changing over time.
- If there is no login procedure, building in elicitation methods during the process of information delivery may help to capture the relevancy decisions of a user. Asking for an e-mail address at this time and following up with a survey about the usefulness of the information can capture the needed data.
- Another approach is to locate research subjects that are typical users of the system. These users can either be given queries or can search on their own needs, and then measures can be collected through this process. This is the least desirable scenario, but may be the only one available.

While bibliomining can aid in the understanding of what patterns of usage exist, it cannot aid evaluators in understanding with documents people find relevant (as compared to what document they used). In addition, the results from bibliomining are constrained by the system used; if a feature is not offered by a system, no information will be gathered about that feature. This is why bibliomining, like archeology, cannot produce the truth, as the truth about the information-seeking situation lies within the individual doing the seeking. Bibliomining can only recover the facts about what interactions an individual has had with the system and cannot recover anything about the user’s mental state. Therefore,
gathering these other measures allows the researcher to bring in qualitative elements to the quantitative biblomining process.

Adding postmodern archeology to the existing hypothetico–deductive-inductive cycle allows researchers to move beyond the data in the system to gain a better understanding of user. Processes have been separated from products in south’s cycle in order to better fit the needs of a digital library. By employing the full cycle, researchers can move from describing to improving the knowledge base about library users. The significant processes of this cycle are:

Collection: Gathering artifacts about services, users, and visualization,

Deduction: Logical analysis of patterns to produce generalization,

Prediction: Creation of hypotheses from generalities, and

Testing: Research developed to test hypotheses involving both data and users.

A important note is that can never know that user was thinking and experiencing from only the artifacts in the system; even talking to the user after the process will not provide an accurate portrayal of the thought process that the user went through. Just as an archeologist does not know the truth about the people who lived in a culture, we cannot know the truth about our users from only their artifacts. We must work directly with users in order to test our hypotheses about their behavior.

This resulting archeological framework of explanation is fundamentally an application of the traditional scientific process. Librarians and others providing Web-based information resources do not regularly use hypothesis-based research projects when evaluating their services. The result is that the science of librarianship has not grown and developed as other sciences have grown. The benefit of using the archeological approach is that it may aid those not
accustomed to the scientific method to conceptualize how this method applies to their own information services.

Archeologists recognize that their craft is as much art as science, as giving meaning to a collection of artifacts requires a number of assumptions and guesses and does not provide the truth about the mental state of the users. We can draw an essential point from this for exploration of digital libraries and other Web-based information resources. Collections of data-based artifacts tell us an important part of the story, but the discovery of these patterns through bibliomining is just the beginning. By developing generalizations, creating hypotheses about library use, and testing those hypotheses through research involving data and users, researchers can move beyond descriptions and advance our understanding of users of digital information.

The choice of information sources and information channels is dependent on multiple factors ranging from broad contextual factors to the personality of an individual. The availability of resources, tasks – in – hand and personal preferences all affect the decision of what is an appropriate information resource and how it is used at any given moment. Besides the immediate explicit constraints and expectations to produce a concrete result such as writing a book or completing a course, implicit instrumental and personal motivations have an impact on the in spite of the rather prevalent consensus that human information behavior consists of not only information seeking, but also of information use, a deeper concern for understanding usage aspects of human information practices is a relatively new one. Information use has been discussed from the perspective of organizations as a part of the context of information seeking, but as choo writes *information needs and uses* studies have added significantly to our appreciation of how people seek information (emphasis added), most of the efforts to model and understand human information behavior have focused on explicating human information seeking behavior. Spink and cole emphasise an
important fact that the entirety of human interactions with information is not merely seeking, but is actually composed of additional components such as organization and use of information resources.

Social and cultural contextuality is a central aspect of information activity reflected in the literature. A variety of conceptual tools and approaches has been introduced to grasp the complexity of contextuality. Spink and Cole present a tentative version of an integrated model of the information behavior, which combines the three typically used approaches: everyday life information seeking, information foraging and problem–solution perspective mostly as academic researchers in investigations of information practices humanities and social science researchers.

4.8.3.2 Empirical study methods

The present study was conducted in the context of an empirical investigation of the information use of Nordic archaeologists. The material consists of twenty-five thematic interviews of Finnish and Swedish archaeology professionals conducted in 2004. The empirical data were collected by using an adapted version of a semi–structured interviewing called thematic interview. The approach is based on the focused interview of Merton et al.

(1) Free form thematic discussion and storytelling in the spirit of creative interviewing. The information were asked to tell about their work and what they did when they went to work in the morning.
(2) Active semi–structured interview with the objective of inducing structured reflection in order to inform the interviewer.
(3) Reflection. The informants were asked to tell about information seeking in a specific case of producing archaeological information.
(4) Semi–structured interview. The interviewees were asked about their motivations and he objectives of their work.
(5) Imagination exercise. In the exercise the informants were asked to express their wishes and thoughts about information resources, which would be ideal to support their work.

The practical analytical work progressed by constructing a theory on the basis of discernible patterns (schema) in the discussion between the interviewer and the interviewee focusing on formal work duties (what the informants have to do their own preferences (e.g., I think it is nice to add some anecdotes to spice up my report) and patterns of information use (why some kind of information is used, what is the purpose of using a specific kind of information).

4.8.3.3 Labour, work and action in archaeological information use

Individual archaeologists worked with a great variety and combination of duties. For example, as the study demonstrates an archaeologist might be involved in field work, academic research and infrastructural (in a colloquial substrate-like sense) development [Anna] (each of the 25 individuals were assigned a nickname, which is written inside brackets in citations and references). To exemplify the notions of labour, work and action in the research material, we refer here to two contexts of archaeological information activity discussed with several informants. The first example is about an archaeological investigation report and its complication. The second one is about giving an archaeological expert opinion on a land use project.

4.8.3.4 Archaeological investigation report

During a fieldwork project, archaeologists investigate an archaeological site: they document their findings and during a post-investigation phase write up the final archivable versions of their notes. The final stage on an investigation project is to compile a report, which documents the investigation process and its results. Investigation reports are a central information resource in archaeological work. Regardless of their limitations reports were seen as primary sources of
archaeological information on any particular excavation and site. [Everyone]. Secondary publications such as journal articles were often seen as abridgements, which do not give enough information on the subject matter. They don’t necessarily give the facts, they are shorter and more descriptive.