

KEEPING THINGS THAT WORK

Preservation aspects of digitization

YOLA DE LUSENET

yola.de.lusenet@bureau.knaw.nl

Abstract - Digitization makes collections in libraries and archives available to new user groups and has great potential for new types of research. However, digitization is driven by use and the question is whether it also contributes to preservation of collections. In the case of materials which are of interest to only a small group of specialists it would be optimistic to expect these will be digitized at all, as there are more economical options for their preservation and use is too low to justify digitization. In such cases digitization is even less attractive because digital materials, as opposed the microfilm, require constant maintenance in order to remain accessible, which further adds to the costs. For scholarly research it is important that preservation of traditional materials is not abandoned, or collections not selected for digitization may be neglected and finally disappear from sight altogether.

Keywords - preservation, digital preservation, research collections, libraries, archives

1. OF OLD AND NEW CARRIERS

On November 1, 1999 a historic debate took place in the House of Commons in the United Kingdom. A proposal had been formulated by a parliamentary committee to move to a more modern information carrier for recording the Acts of Parliament. The proposal had already been accepted by the House of Lords, unanimously. However, in the House of Commons a fierce debate broke out about the durability of different information carriers, the dangers of fire and lack of security, the risks of computer crashing, public spending, the value of tradition etc etc. At the end the House divided and the proposal was rejected by a substantial majority.

The modern information carrier that was supposed to be introduced was *archival paper*. The Acts of Parliament dating back to 1497 have always been recorded *on vellum* - and, as a result of the outcome of this attempt at modernization, still are. But, as one of the Honourable Members said 'It is sad that we are willfully throwing away a material that works. That is the first thing to be said in praise of *vellum*: it has worked since the Middle Ages. There is no track record of 500 or 1,000 years to let us know whether archival paper will work' ('Record Copies of Acts', 1999).

In defense of the Honourable Members it must be said that in this debate, which is I am afraid at times slightly hilarious, they did make a clear distinction between on the one hand preserving their documents for as long as possible, and on the other providing broad access by the use of modern media like CD-ROM. The latter point, using modern media to facilitate access, was supported by all, which we may take as firm proof that this is by now indeed a totally uncontroversial issue. So if I do not emphasize the role of new technology for access in this paper, it is because the advantages are obvious to literally everyone.

Instead, I will focus on preservation aspects, from the angle of libraries and archives, as an observer of what goes on in this specific area. My subject forces me to be cautious about the

promises of exciting new technology, not because I do not believe in its potential in general, but because I would like to entangle some possible misconceptions about its use for *preservation*, which is a much less exciting and in some ways quite problematic area.

Preservation of library and archive collections has developed substantially over the years. Until a few decades ago, the focus was primarily on conservation of the documentary heritage, which is specialist work aimed at stabilizing objects and requires considerable expertise and skill. Because every item undergoes individual treatment, it is also very time-consuming work.

At the same time, libraries and archives have always been engaged in a constant battle with dust, humidity, and light, which are factors influencing the natural decay of parchment, leather and paper. Librarians fear mould, fires and floods, wars, pillaging, and theft, insects and rodents, all of them threats to the collections. This means that security, adequate storage, creating good environmental conditions, pest control, disaster preparedness etc are also preservation issues that should be part of preservation plans.

In the modern era, information has been produced in enormous quantities on by and large pretty unstable carriers. The problems really started with industrially produced paper from the period 1850-1950, made from wood pulp. This paper is highly acidic and quickly deteriorates, becoming brown and brittle as the cellulose fibers break up under the influence of the acid. The large-scale introduction of inferior paper was only the beginning, for ironically, the more modern the media, the more transient they become. At the end of the nineteenth and in the twentieth century vast amounts of information were stored on carriers much more fragile than paper, such as photographs, films, tapes and disks. Of all of these many different types exist, of varying chemical make-up, mostly intrinsically unstable and all susceptible to the influence of light, fluctuating temperatures and humidity. Whereas the life span of parchment and paper was measured in centuries, that of modern carriers is measured in decades or even years.

The introduction of carriers of ever decreasing stability in combination with the ever-increasing production of information has caused serious problems for libraries and archives that are supposed to keep materials accessible. Individual treatment of all these different materials is simply impossible, nor can the natural process of deterioration be stopped. The best one can do is try to slow down decay of the objects by creating optimal conditions for storage, or alternatively, produce copies to save the information they contain. For paper documents, for instance, the preferred method has for a long time been preservation microfilming. Microfilms produced to standard are expected to last for several hundreds of years and will in many cases outlive the paper on which the information was first circulated.

In other words, the focus is now on preservation rather than conservation, on preventive measures, on extending the life of collections rather than of individual items, and on saving information by creating surrogates rather than saving the original objects.

2. THE CONTEXT OF PRESERVATION

In any discussion of preservation and digitization one needs to consider the size of the collections, for scale does make a difference. A solution for addressing such issues that works for a modest collection is often not feasible for the huge collections kept by major archives and research libraries. To give some indication of scale: the documents held by the National Archives of the Netherlands extend to over 93 linear kilometers. The Bibliothèque nationale de France holds over 11 million books and periodicals, 200,000 of which are rare books. The total number of items held by the British Library is 150 million items, with 3 million new ones added to its collections every year, together taking up 625 kilometers of shelf space. The collections include: books, periodicals, manuscripts, newspapers, prints, photographs, drawings, maps, globes, seals, stamps, coins, sound recordings on all sorts of tapes and disks, sheet music, posters, microforms, and digital materials¹.

The variety of materials and the size of collections are in themselves already preservation problems. All of these materials show different patterns of decay and need to be stored in different ways, which obviously creates considerable problems for preservation. National institutions like the Bibliothèque nationale de France and the British Library have been assigned the task of keeping these materials and making them available to the public. And if things are not used today, then they may be wanted in the future and still have to be kept. Preservation is not exclusively user-driven but also guided by judgments about value of materials that are formal or absolute, or result from ideas about what constitutes cultural heritage. Archives and deposit libraries for instance have legal obligations to keep certain classes of materials irrespective of their use.

At the same time all preservation activities also have to take place in a context of use, for a library or an archive is not a museum and the materials should be accessible to those who need them. This creates something of a paradox, as nothing is more damaging to materials than frequent use, however responsibly readers may behave. In short, what is sound policy in terms of use may not be equally sensible in terms of preservation, and vice versa, and ways have to be found to balance the two.

3. DIGITIZATION AND PRESERVATION

It is often claimed that digitization of library and archive materials is an important step forward as it serves access as well as preservation. After all, what is accessible on line no longer needs to be consulted in the original. Digitization then comes to be presented as a preventive preservation measure. There clearly are situations where this applies; however, for the kind of materials scholars use, digitization and preservation do not go automatically hand in hand, as I will try to explain.

First of all, it has to be recognized that digitization programmes of libraries and archives are primarily driven by use. Arguments to digitize are, for instance: providing access to treasures from a collection, distant access, high frequency of use, possibility to search, to annotate or copy materials for research and educational purposes, or to contextualize materials and integrate them into a larger, distributed context. All of these are of course valid arguments for digitization, but none are *preservation* arguments. Often materials are selected for digitization that are not directly at risk, or that have been microfilmed previously - because they were always frequently used and the originals needed to be kept safe. This means digitization indeed improves access of important

¹ Figures are taken from the websites of these institutions.

or popular materials (for which preservation is usually not an issue as measures were taken before anyway), but does not contribute significantly to preservation of the collection as a whole.

Libraries and archives operate in an environment where there is considerable pressure from politicians and decision makers to open up collections so that more and more people will be able to use them. However, our knowledge of the *kind* of use people make of materials is limited, and use is mostly measured in quantitative terms, with no distinction being made between serious and trivial use. All visitors to a website are counted, whether they end up there quite by accident or because they are in desperate need of an item. The emphasis on numbers favors selection of things that are of some interest to a great many people, over things that are of extreme importance to only a few. When we then consider the size of collections we can safely assume that only a fraction will be digitized in the foreseeable future, and low-use, specialist materials will not be among the first candidates - even if they need to be preserved.

If one approaches the issue from the other end, it would seem logical to assume that if materials need preservation treatment of some kind or another, it would surely be best to digitize them right away, so that one not only preserves the information, but also makes it more easily accessible? Why not make use of the full potential of technology?

The data in figure 1, produced by the Library of Congress (Nicholas and Smith 2001: 101), show that there are in any case economic factors to consider. Compared to other options for preservation, digitization is on average about 9 times as expensive as microfilming and about 4 times as expensive

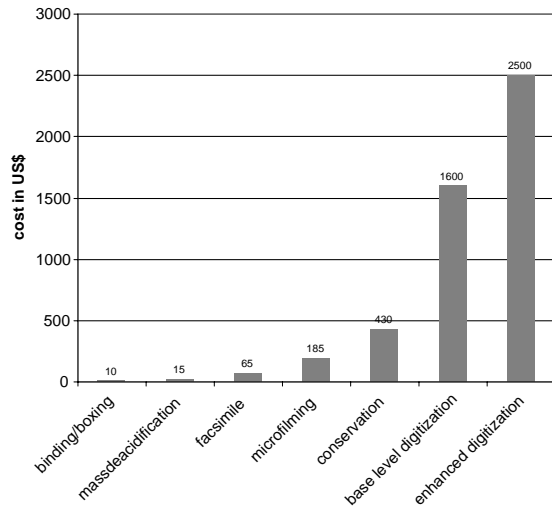


Figure 1. Comparative costs for a 300-page book.
Data Library of Congress

as conservation of the original - and conservation is generally considered a very costly option that should be reserved for unique and valuable materials.

It is important to realize, when looking at these figures, that digitization includes a lot more than just scanning. In fact, the figure calculated for preparing a facsimile more or less reflects the costs of mere scanning, of converting the text into digital images of average quality in a standard procedure and then preparing a bound library copy on good paper. The figures indicate what it

takes to go from scanned images (\$65) to a fully fledged digital product, which is both sustainable and offers all the functionality users expect, now and in the future (\$1600-\$2500, depending on the added functionality).

Part of the difference can be ascribed to the higher cost of creating images of supreme quality needed to build systems of re-usable materials, rather than images for direct, on-time use. Producing the type of images libraries are looking for requires expert staff, state-of-the-art infrastructure, and lots of storage space; it is time consuming as it involves processing of large files, creation of various levels of derivatives and rigorous quality control. Even so the scanning and image processing itself is a relatively straightforward part of the whole and selection, preparation, organization, creation of metadata etc take up the major part of the budget.

It is difficult to compare these figures as the different types of treatment are in practice used to achieve very different goals. What it comes down to is that it may be worthwhile to invest in digitization of popular materials, but it is an unlikely choice for *preservation* of materials not much in demand, such as primary sources for specialist scholarship. Especially if one considers that the costs of maintaining digital materials over time are substantial, whereas microfilm or facsimiles on good paper only need to be safely stored to last for centuries.

4. USE AND SPECIALIST SCHOLARSHIP

It could be argued that digitization stimulates use of materials, and that therefore the extra investment to digitize materials that have so far been infrequently consulted is well justified as it will pay off by increased use. It is undoubtedly true that what is put on the web is consulted more often than what is not. It is also true that while surfing the web one often comes across unexpected treasures. However, for lack of sophisticated analysis of long-term comparative statistics it is difficult to say anything more definite.

Common sense tells me that if we now see a high use of digital materials, this is partly because the web encourages quick scanning through large amounts of materials (as opposed to thorough reading of a whole book) and partly because users will go for what is easy to get hold of. Especially general users, students etc may be well served by what they happen to find on the web. This would mean that we are not witnessing an increase of use in absolute numbers, but a shift, from resources available in print only, to digital resources, with new groups gaining access to materials they were not aware of before.

Libraries aim to serve certain user groups in the best possible manner and make choices and set priorities accordingly. When it comes to serving the needs of specialist researchers, would these be better off if the whole world had access to a limited number of digitized texts or if a substantial amount of primary sources were preserved in the original or on film? In an ideal world there would not be such choices, but in the real world of dwindling budgets in heritage institutions these choices are made all the time. And because of the pressure of numbers, of an anti-elitist political climate that tends to measure value of cultural heritage by the level of participation or use, and the shriveling budgets thirsty for soft money available for attractive projects, the balance will easily tip in one direction.

What I can imagine is a kind of evolutionary process, in which resources that are used most will be digitized and hence be used even more frequently, with specialist materials that serve very specific needs being left behind, and finally disappearing from sight completely as digital becomes all that is ever used. If such a process is driven by quantitative user-based models, the survival of

the fittest inevitably becomes the survival of the popular. In this vulnerable position the less popular will need the protection of those few who do care. Scholars who depend on the more esoteric materials for their work should be aware that notwithstanding all its obvious and very real advantages, it may be risky to put all one's faith in digitization.

In a report on scholarship and the information environment published in 2001 the authors quote other research that noted:

the growing importance of primary sources in electronic form but also emphasized humanists' frequent use of obscure sources that are unlikely to be digitized, and concluded that this argues for the continuing importance of libraries' maintenance of printed resources (Brockmann *et al.*, 2001: 3).

It is tempting to believe that digitization will solve preservation problems with specialist collections while instead we should be keeping our fingers crossed that in the present climate with all the attention going to digital, the original paper will survive. I cannot help repeating the warning of my Honourable spokesman not to abandon a material that works.

5. PRESERVATION OF DIGITAL MATERIALS

Moreover, digital materials create their own, very serious preservation problems as well. Once something has been digitized, it is not so much a matter of keeping a material that works, but of keeping it working. Digital preservation - which does *not* mean preservation by digitization, but preservation of the digital materials themselves, - is discussed endlessly in the library and archive community because it is such a pressing problem and there are so few certainties. Several large-scale projects have been undertaken by major institutions to address the issue, and there have been initiatives at the highest political level. There is also for instance a private initiative like the Internet Archive with its Wayback Machine, where one can go back to older versions of websites that have been harvested over the years and are stored centrally².

At the moment we cannot know the validity of the solutions proposed until sufficient time has passed to test them. And there are many factors to take into account. The problems start with the medium on which material is stored. Contrary to what many innocent consumers believe, CDs for instance are notoriously unstable. A recent test in the The Netherlands found that new, unused CDs after 14 months of storage under average conditions had become completely illegible (*PC Active*, September 2003). These were very cheap CDs for the consumer market, but the tests go to show that CDs are not stable by definition and may well be affected by 'CD rot'. The precise components that make up a CD vary between brands and between batches, as does the exact production process. The industry works primarily for the short-term consumer market where price is the first issue and durability does not figure high in the list of requirements. Some types and brands claim to be durable, but there are no guarantees, as it has proved impossible to agree on an official standard

² The Wayback Machine is at <http://webdev.archive.org/index.php> In October 2003 the General Meeting of UNESCO accepted a Charter on the Preservation of the Digital Heritage (<http://portal.unesco.org/>). For a brief overview of issues concerning digital preservation see for example my paper at <http://www.knaw.nl/ecpa/PUBL/unesco.html>. The best gateway to information on digital preservation is hosted by the National Library of Australia (<http://www.nla.gov.au/padi>)

that CDs should meet. Moreover, durability also depends on the CD-writer one uses and the speed used for writing. Tests have shown that the interaction between CD and writer produces different, sometimes highly unexpected results in terms of stability for every combination of a specific writer and a specific type of CD (Fontaine, 2003). All the individual user can do is buy respectable brands and hope they will indeed last. Some major institutions test batches of CDs before they use them, but by smaller institutions and for individual projects this is not done very often. In short, however stable a CD may appear, it is in general a highly unreliable medium in the context of an archive or library that aims to keep materials accessible for decades.

Even if a CD, or a DVD, happens to be stable, however, the information stored on it will become inaccessible anyway because the medium itself will be forced out of use very rapidly. Thirty years ago we did not have CDs or CD players, and thirty years from now we will almost certainly not have them either. That media are transient is not a new phenomenon: the moment we became dependent on an intermediary, a machine, to see or hear the information stored on a medium, obsolescence of carriers became a risk for its survival. Let us consider for instance sound recordings where we have seen a succession of gramophone records and audiotapes; some of these may have survived but without working equipment the information is locked away inside. The same happened within years to the first generations of (floppy) disks and will no doubt happen to all carriers now in use.

When media become outdated, the information can be transferred to a new, current medium, and because of media-dependency institutions are forced nowadays to have a programme in place for periodically refreshing data. On top of this we also have to deal with the accompanying dependency on software; after all, if we transfer the bit stream from a CD to a new type of carrier, this does not mean that the information can actually be read and interpreted in the long run. As generations of file formats, software, and platforms succeed each other rapidly, the moment that we cannot read it any longer is always just around the corner.

6. STRATEGIES FOR DIGITAL PRESERVATION

The two main strategies for preserving digital information at the moment are basically (a) to keep the programmes that can read the original files and somehow keep them running on new platforms, by emulation of the old environment, or (b) rely on migration, to convert the original files to a new format that can be interpreted by new generations of platforms and programmes. As the digital world moves on all the time, this is a continuous process. In many cases, sooner or later (and in the digital world this usually means sooner), we can expect information, functionality and/or appearance to be lost, especially with complex, multimedia materials that combine a variety of file formats and applications.

This poses risks for the integrity of digital materials: how can it be ensured that the digital object, moving from one environment to the next, remains complete and undamaged? A different but related issue is authenticity, which relates to the trustworthiness of materials, that the file is indeed what it purports to be. Both these issues particularly worry archivists for whom fixity of records is essential and who are now struggling with the problem of how to preserve digital records if they keep changing with changing environments.

However, for research material this is equally important and only beginning to be recognized. References to web sources are often of doubtful value as a result of 'link rot', several versions of a source may exist in different places, without clear explanation of which is the only true one, and

versions may succeed each other silently, so that a link refers to a source that has meanwhile changed considerably. These threats to integrity and authenticity result from careless management of web resources; but one should be aware that procedures to safeguard digital information for a future generation through conversion and migration may have unexpected side effects as well, of corrupting data and damaging files.

Preservation of digital materials cannot be understood in terms of fixed objects that should be stored safely and kept in their present form. Digital objects are manifestations on a screen of underlying code, they look differently on different computer screens, they may also behave differently on different platforms, and if they are preserved over time, the odds are that they will change their looks or their behavior in the process. As digital objects inevitably have different manifestations and behaviors, we need to establish which are the essential characteristics that define the object and which are secondary or even more or less accidental. We need to establish which content and properties need to be represented in future systems. To take an easy example, if we think of text, it may not be important which typeface or colors or line spacing are used to represent the information, but it will be important that text now in normal type is somehow distinguished from italics and capitals. This is a very trivial example compared to what we have to deal with in databases, websites and multimedia applications. That is why the whole issue of metadata, which document the information so that at a later date we can understand how it is meant to be represented, is at the moment such a hot issue.

In short, with digital preservation, the problem is not how to preserve a carrier containing information, as it is with books and journals we can read with our own eyes, but to preserve ways of accessing and representing the information.

There is a wonderful paradoxical concept in preservation: ‘benign neglect’, which refers to the phenomenon that books and papers that are forgotten and left on the shelves may survive precisely because they are not used. ‘Benign neglect’, enhancing chances of survival by leaving things alone, does not exist in the digital world. Any neglect of digital materials cannot be benign, they have to be looked after constantly, they have to be used, migrated, converted and recreated in order to survive. If we neglect them, they will certainly die.

Those building digital resources should be aware that preservation is no longer an activity that is undertaken long after creation, when the material starts to show signs of decay, as with books. Preservation has to be built into the digital resource, by adhering to standards, by using open source software of which the code is in the public domain, as opposed to proprietary software. As everyone knows, compatibility of proprietary software is a joke: it works between one generation of software and the next, but even with simple text files problems occur after several steps - problems that may seem negligible at first, but that add up. And as proprietary software is in many ways a black box, there is no way of finding out what can be done about it.

The use of standards and non-proprietary, open software is one factor that contributes to long-term access. In addition, applications have to be documented, so that others can understand what they are meant to do and how, can check that everything is still working properly, or take steps to correct problems. Appropriate metadata have to be added to files, and several copies should be kept. All this helps to transfer materials to new environments and to keep them working.

The fact that so much vital information, for instance in banking or the defense industry, is only available in digital format will no doubt lead to the development of systems that can keep it alive. The technological problems are daunting, but there is so much at stake that they are bound to be solved. For the heritage sector, it is more important at the moment to address organizational issues

than the technological ones. As things stand now, it is not yet clear how far the responsibility of national institutions in maintaining digital resources will extend. Should we create digital archives that actively collect and maintain digital materials? What exactly should we keep - data, tools, software, websites, e-mail? And who will pay for all this?

The heritage sector will need to solve the very complex issue of selection if only because of the cost factor. We are used to the capacity of computer systems increasing very rapidly and costs going down all the time. Storage is sold by the gigabyte at prices that were paid for megabytes only a couple of years ago. However, the volume of the material to be stored has also increased exponentially - those involved in satellite surveillance or meteorological observations think in terabytes. The financial burden of storing immense amounts of digital information is already weighing quite heavily on heritage institutions. Chapman (2003) did some work on comparative costs of storage of different media. Storing information as 1-bit (bitonal) 600 dpi images is at the present rates at least twice as expensive as storing books or microfilm; for images of higher quality (grayscale or color) the costs rise very quickly and may be over 100 times the cost of storing books or microfilm. The costs simply follow from file size, i.e. quality and compression ratio, as one pays for storage by the gigabyte. Moreover, this does not include the cost of migration or conversion.

7. CONCLUSION

I have focused on the role of digitization for preservation of originals because I consider the original documents the basis of scholarly research. I have emphasized the risks involved in keeping digital materials available because it is important that what is created today will not be lost tomorrow. But I do not want to appear here as a prophet of doom or deny the enormous potential of digitization for preservation of a textual and scholarly tradition by disseminating materials widely and making them available for further research. That dissemination is another level of preservation, of texts being known and studied and quoted. The one cannot exist without the other, for preserving materials by locking them up safely in libraries and archives so that no one knows of their existence does indeed extend their lifespan but serves no purpose.

Digitization is necessary to keep the scholarly tradition of transmission of texts alive. In many ways it is therefore closer to what we know from publishing texts than to collection management in libraries and archives. The report by Brockman *et al.* (2001) recommends that libraries work together with scholars to create digital collections of the kind specialists need, and to me that seems the best way to go forward. After all, only scholars know what functionality is required and it is because they need certain materials rather than others that libraries should be encouraged to make them available as a basis for further scholarly work. Libraries on the other hand can provide a stable infrastructure for continued access, which is not ensured if scholars build up their own collections of material independently.

I have tried to argue that this work, which is essential for the preservation of a textual tradition, has to be distinguished from making available texts for general use, now undertaken by many institutions in the framework of encouraging participation in culture and use of heritage materials which is widely promoted. Such initiatives, however necessary and exciting they may be in themselves, have as little to do with scholarship or preservation as my \$1.95 edition of *Moby Dick* and it will not do to pretend otherwise and confuse the issue.

While we are building up digital collections for research that meet the requirements of researchers, we should take care both of the old things we still have and of the new ones we are creating. Our responsibility extends towards the past and towards the future. We may not manage to keep everything, but we should at least beware of willfully throwing away things that work.

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Yola DE LUSENET
European Commission on Preservation and Access
C/o KNAW
Kloveniersburgwal 29
1011 JV Amsterdam
The Netherlands
yola.de.lusenet@bureau.knaw.nl

tmp.1498144961.pdf.iktot. 2. Literature Review Implications for preserving Audio Visual collections Preservation strategies are usually undertaken to determine the preservation requirements required for the AV collection and to evaluate the strengths and weaknesses of the building, policies and guidelines, storage environment, and disaster management issues (Mnjama, 2010). Depending on the state of the document, AV materials feature in three main forms, namely: Conservation, Restoration and Digitization (Oomen et al. Digitization is a vital aspect of collection care in audio visual archives (DeGracia, 2009; Edmondson, 2004). preservation measure and preservation of digital resources, and the concerns that they have arisen in the Library and Information Science (LIS) field. Articles alight on such topics as ethics, preservation, and collaboration as they relate to the constantly changing technology in the LIS field. A few articles discuss the general ideology of ethics in the LIS field, in order to convey the basis of how LIS professionals view their ethical responsibilities. Description Digitization as a preservation measure refers to creating digital surrogates of paper-based. sources, such as books, while preservation of digital resources aims to archive born-digital sources. Although related, they also have distinct issues specific to each (Berger, 2009, p. 62). " Keep a clean working space, ideally one that is dedicated to scanning collections. It should also be large enough to fit documents and have extra space to move collections around. This will prevent damage happening to the collection materials. Presentation on theme: "Preservation of Paper Materials During Digitization Best Practices." Presentation transcript 2 Important Aspects to Remember Concerning Digitization Sympathetic process Access to original will be required again Damage can be caused by equipment, high volume handling, and time pressures It's better to be careful than quick! For a collection where preservation of the documents is of paramount importance, original material should be preserved as far as possible. Digital preservation needs to be ongoing with activities integrated into all phases of creating, managing, and storing information. Cloonan (2015) emphasizes the dynamic nature of the digital preservation cycle "that it is not linear and requires multiple actions. Technical aspects have received a considerable amount of attention in the preservation community because of the immediate need of keeping intact files and protecting them from storage media failure and obsolescence. Increasingly, the researchers in the digital library field recognize that contextual information needs to be preserved along with the bitstream to render the bits as useful and meaningful objects (Beaudoin, 2012a; Chowdhury, 2010; Ross, 2012). Guidelines for Electronic Preservation of Visual Materials. Aspects of Collection Analysis for Preservation Digitization. Material Form - Content - Electronic Form - Use. To clearly discuss the issues in digital imaging for preservation of visual materials, it is important to begin by developing a set of terms. MATERIAL FORM. The material form of an item encompasses those aspects of an item which may affect the manner in which it is captured digitally, but which are not intrinsic to its primary use as a conveyor of information. In essence, the item's material form is an historical accident