

## Seeing the whole elephant: an integrated approach to managing preservation

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### **Abstract:**

*Today's hybrid collections demand new ways of thinking about preservation. There is a need for an integrated approach combining the current largely disparate fields of digital and physical preservation, to inform prioritisation of information resources requiring preservation attention, assist in shaping integrated workflows, and enable sharing of strategies across physical and digital formats. This paper explores an integrated approach through the analogy of the traditional Indian story of the six blind men and the elephant. It investigates some preventive and copying strategies as examples of approaches that apply these common principles across digital and physical formats, and concludes with observations on the benefits of seeing the whole preservation elephant.*

**Keywords:** digital preservation; traditional preservation; preservation management; risk management

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## **New ways of thinking about preservation**

There is currently a major divide between traditional (physical) preservation and digital preservation. On the one hand, traditional preservation involves caring for physical materials to ensure they are available for current and future generations. The so-called ‘traditional library materials’ (Adcock 1998, p.8) include paper-based ‘analog’ items such as books, journals and newspapers, manuscripts, and plans, as well as photographs, microforms, audiovisual materials and a range of other artefacts that may be held in these collecting institutions (Adcock 1998, pp.35-52). On the other hand, digital preservation involves caring for digital materials to ensure they are accessible over time. Digital preservation has been defined as ‘the series of managed activities necessary to ensure continued access to digital materials for as long as necessary. Digital preservation...refers to all of the actions required to maintain access to digital media beyond the limits of media failure or technological change’ (Digital Preservation Coalition 2008, *Definitions*).

Reflecting this major divide, over the years, high levels of knowledge, specializations and distinctive professionalism have developed amongst conservators, IT professionals and other specialist staff in preserving traditional and digital materials. While specialist expertise has been invaluable and its development understandable as we have formed ways of thinking about and managing digital preservation, the consequent major divide is no longer sustainable. Today’s hybrid collections demand new ways of thinking about preservation. Preservation, like much else in libraries, has undergone substantial change. Digital materials, both born-digital and the products of digitizing, have been added to the already large number of physical materials that need to be preserved.

Paul Conway (2007) notes some of the changes that are essential in the preservation community’s response to the demands of today’s hybrid collections. He notes in particular the changes in some fundamental preservation concepts, one of them being *integrity*. In traditional practice conservators preserved the physical integrity of an object by avoiding changing it, and maintained its intellectual integrity by documenting the chain of its custody and its conservation treatments. This doesn’t work for digital materials, chiefly because preservation procedures applied to them require that the digital files be changed. It is impossible (or very difficult) to maintain the physical integrity of digital materials, but we can scrupulously document the changes we must make and the chain of custody. As Conway (2007) states: ‘Ultimately, the digital world transforms traditional preservation principles from guaranteeing the physical integrity of the object to specifying the creation of the object whose intellectual integrity is its primary characteristic’.

There is a need for an integrated approach combining the currently disparate fields of digital and physical preservation. Almost all collections in libraries now include both analog and digital media, so knowing how to manage the preservation of digital as well as analog materials is now a professional requirement. Ideally an integrated approach to preservation management, one that combines and rationalises both sets of practices, should be taken. However, we currently lack an understanding of what such an integrated approach looks like. We need to develop new policies and practices, new ways of thinking about preservation that accommodate all kinds of materials. An integrated approach can inform prioritisation of all materials requiring preservation

attention, assist in shaping integrated workflows, and enable sharing of strategies across physical and digital formats.

### **Seeing the whole elephant**

This paper explores an integrated approach through the analogy of the traditional Indian story of the six blind men and the elephant—an evocative symbol of memory and wisdom across many cultures. The story has many versions, but all tell of a group of blind men, each of whom touches an elephant to learn what it is like. Each one feels a different part, but only one part, such as the side, or the trunk, the ear, the tail, or the tusk. The blind men then compare notes and fall into disagreement, as they each understand only an isolated part of the elephant. In the end, it is clear that none of them understands the true integrated nature of the whole elephant. As John Godfrey Saxe’s poem puts it:

And so these men of Indostan  
Disputed loud and long,  
Each in his own opinion  
Exceeding stiff and strong,  
Though each was partly in the right,  
And all were in the wrong! (Saxe 1964).

The story provides an appropriate metaphor for the need to develop new ways of thinking about the preservation of today’s complex, hybrid collections. Through seeing and understanding the nature of the ‘whole preservation elephant’ and how all the parts are interconnected, we can gain a new holistic perspective that will enable us to manage preservation more effectively in the 21st century. Such a perspective has been described by Michèle Cloonan (2002, p.232) as ‘a way of seeing’, as opposed to viewing preservation as merely a series of disparate actions.

The following two sections explore the understanding and management of the ‘whole preservation elephant’. Stage one considers how an integrated perspective based on common principles can be developed. Stage two examines how these principles can be practically applied in the form of strategies to manage the preservation of physical and digital collections in 21st century libraries.

#### **Stage one: developing an integrated perspective**

One way to begin developing an integrated perspective is to determine key common principles and strategies that are helpful in managing the preservation of both digital and physical materials.

In this paper the term *principles* refers to higher-level fundamental norms, such as quality assurance and integrity, which underpin strategies and actions. *Strategies* refers to major directions and groups of actions, such as copying, preservation metadata, and disaster preparedness and response, linked to achieving the overall objectives and direction. *Actions* refers to the carrying out of the specific activities that are parts of strategies, such as preparing a salvage priority list as a part of a disaster preparedness strategy. It is actions that are likely to be the points of difference between the digital and physical preservation.

## Common principles

The literature reveals a number of key principles that are common to managing the ‘whole elephant’ of preservation. For example, Webb (2004) identifies common principles that apply to both physical and digital formats, such as minimal intervention, high quality, maintaining a long-term perspective and the importance of capturing preservation documentation. Similarly, the principle of stewardship that has long been applied to the preservation of traditional physical materials can be applied to preserving new digital technologies (Bastian, Cloonan & Harvey 2011, pp.610-11; Harvey 2010a; Conway 2010). Closely related are Conway’s common principles of longevity, choice, quality, integrity and access (2007) and the suite of principles in areas ranging from scalability to the structure of digital materials proposed by Harvey and Mahard (2013).

One principle that connects the management of traditional and digital preservation is risk management. Risk management has become an established tool in systematically mitigating risks and shaping the priorities and directions of traditional physical preservation programs to reduce current and future losses (Ashley-Smith 1999 and 2001; ICCROM & CCI 2012). The risk framework is also well established in digital preservation, especially in the context of preservation planning (Kenney et al. 2002; Harvey 2010b, pp.83-4,135-6). It underpins key preservation management frameworks, such as the Open Archival Information System Reference Model (OAIS)<sup>1</sup> (CCSDS 2012) and the Digital Curation Centre Curation Lifecycle Model (DCC 2008). It is also integral to key auditing systems such as the International Organization for Standardization (ISO) Audit and Certification of Trustworthy Digital Repositories (ISO 2011). A preliminary list of common principles is provided in Figure 1.

<b>Principle</b>	<b>In traditional preservation</b>	<b>In digital preservation</b>
Longevity	extending the life expectancy of the original object, or a copy of the original	extending the life expectancy of the digital object, or a copy
Minimal intervention	minimum interference with the original object	minimum interference with the digital object or file
Choice	selecting or appraising materials for preservation which involves defining value	selecting or appraising digital objects for preservation which involves defining value
Quality	maintaining quality by applying standards for treatment options, copying processes and preventive measures	maintaining quality by applying standards during preservation actions to digital objects, for example during ingesting or migrating files
Integrity	ensuring integrity of objects in preservation actions, for example by protecting historical evidence, intellectually documenting provenance and conservation treatment	ensuring integrity of objects in preservation actions, for example by intellectually documenting changes and other verification mechanisms of file and data integrity

<sup>1</sup> It is noteworthy that the high-level OAIS model has the potential to traverse both digital and non-digital worlds as it ‘accommodates information that is inherently non-digital (e.g. a physical sample), but the modeling and preservation of this is not addressed in detail’ (CCDS 2012, 1-1).

Access	addressing user needs by providing ongoing access as an outcome of preservation, for example through stabilising the original, or making a copy	addressing user needs by providing ongoing access as an outcome of preservation, for example through the access entity of the OAIS model (CCSDS 2012)
Long-term stewardship	maintaining active, ongoing vigilance	maintaining active, ongoing vigilance
Scalability	preferring preservation actions that address large quantities of material over actions that focus on individual objects	preferring preservation actions that address large quantities of material over actions that focus on individual digital objects
Risk management	applying a coordinated set of strategies that are used to direct and control risks, for example in disaster preparedness and optimising environmental parameters	applying a coordinated set of strategies that are used to direct and control risks, for example in preservation planning and auditing of trusted digital repositories
Focus at creation stage	directing effort into encouraging the creation of long-lasting materials to reduce the need for preservation attention in the future	directing effort into encouraging the creation of long-lasting digital objects to reduce the need for preservation attention in the future
Understanding structures	the key to understanding what preservation strategies and actions to follow, as materials contain the seeds of their own destruction	the key to understanding what preservation strategies and actions to follow, as digital objects contain the seeds of their own destruction
Artefact vs. content	distinguishing between the artefact/object and the content contained within the artefact/object	distinguishing between the digital object and the content contained within the digital object
Documentation	keeping a record of preservation actions, for example conservation treatment records	keeping a record of preservation actions, for example metadata describing actions that have been applied to digital objects

*Figure 1: Common principles in the preservation management of both digital and traditional (physical) materials*

These principles provide a commonality to preservation management in the 21st century. They can intersect and interconnect all the parts of the preservation elephant, much like the elephant’s skeletal system, incorporating all material formats—digital and non-digital. An understanding of the interconnectedness of these common principles reduces the risk of developing a preservation program that is only ‘partly in the right’ through preserving only the equivalent of the elephant’s trunk, in isolation from all the other parts and material formats.

## **Stage two: applying the common principles as strategies**

The next stage of an integrated approach to preservation management occurs when the principles noted above are applied in practice at the strategy level, across digital and traditional (physical) formats. The potential for interconnections at the strategy level is explored next in the context of the two broad areas of *preventive preservation* and *copying*.

### **Preventive strategies**

Preventive preservation strategies are concerned with directions and/or groups of actions that are taken to prevent or delay material becoming damaged, and they are applied to digital and to physical materials. The following section discusses how four interrelated preventive strategies (disaster preparedness and response, environmental monitoring and control, preservation needs assessments, and protection from threats and vulnerabilities) can be applied across digital and traditional (physical) formats, thereby providing an opportunity to align their preservation management more closely.

#### *Disaster preparedness and response*

A disaster preparedness and response strategy is a key preventive strategy that focuses on reducing the risk of damage to collection materials in the event of a disaster. Disaster preparedness and response strategies for both physical and digital materials are underpinned by a risk management framework.

Whether a disaster strategy is for physical or digital materials, typically its various components involve *prevention*, *preparation*, *response* and *recovery*. ISO/DIS 16363, for example, requires ‘documentation of what is being backed up and how often; audit log/inventory of backups; validation of completed backups; disaster recovery plan, policy and documentation; fire drills; testing of backups; support contracts for hardware and software for backup mechanisms’ (ISO 2011, Section 5.1.1.2). A disaster strategy that focuses only on the digital or traditional physical materials is like seeing just the elephant’s ear or tail. For example, the ‘disaster recovery plan, policy and documentation, fire drills and testing of back ups’ referred to in ISO/DIS 16363 could equally apply to physical materials. Moreover, a strategy that integrates and aligns the disaster risk management of both physical and digital collection materials allows preservation managers to make better informed and coordinated decisions and to prioritise actions. As one specific example, disaster response decisions about digital collections that are also backed up offsite can be effectively and consistently aligned with decisions about analog collections that have additional copies stored offsite.

However, when the principles and strategies are applied at the next granular level of specific actions, clear distinctions emerge between the physical and digital. Again, the challenge is to see the whole interconnected elephant—the combination of its distinctive parts. Just as there are very specific disaster response actions for damaged paper-based materials or films, so too there are different technological actions required for the recovery of the media on which the digital objects are stored. Such specialized and distinctive preservation actions are absolutely critical—yet the effective preservation management of hybrid collections in the 21st century also requires an

understanding of the common higher-level principles, as well as an ability to maximize the opportunities to align and leverage the application of common disaster strategies.

### *Environmental monitoring and control*

For physical materials in collections the strategy of environmental monitoring and control ensures that the environmental conditions they are stored in are checked and kept at levels that help to contain or slow down the rate of deterioration. Extremes and rapid fluctuations of temperature and relative humidity can lead to a range of problems in collections of physical materials, such as warping and cracking, mould, and increased rate of chemical deterioration, while high UV and lux levels can lead to irreversible fading in light-sensitive materials. Dust and pollutants can further accelerate physical and chemical damage. Monitoring and controlling the physical collection environment helps preservation managers determine and control conditions and, therefore, influence the nature and rate of deterioration that could be expected in collection materials. In parallel, environmental monitoring and control is a key preservation strategy for the areas in which digital information storage media are housed. Key environmental parameters are identified as integral to the 'physical environment' and computer storage centres of trusted digital repositories (OCLC & RLG 2002, p.13).

Again, there are some clear similarities in the strategy of monitoring and controlling the environment for physical and digital materials. The measuring and monitoring tools and frameworks are similar, especially those for measuring and monitoring temperature, relative humidity and air quality.

It follows that the major points of difference are found at more specific levels of application. For example, there are different optimum levels of temperature, relative humidity, lux and UV, and air quality that should be applied to various types of physical collection materials (BSI, 2012; National Standards Taskforce 2011; IPI 2013). Likewise, in the digital arena, there are specific recommended computer room conditions for temperature, relative humidity, airflow and air quality (ASHRAE 2008; ISO 1999, Class 8). These specializations are vital, yet they should not mask the commonalities in the overall strategy. The potential is ripe for more closely coordinating environmental monitoring and control across our physical and digital library collections and hence further interconnecting the preservation management of the 'whole elephant'.

### *Preservation needs assessments*

Preservation surveys or needs assessments are a well established strategy in systematically identifying and prioritising a number of critical factors including areas of risk and vulnerabilities and existing damage in traditional collections (AICCM 2008). As the authors of the British Library Preservation Advisory Centre survey comment: 'Collectively the [survey] results...provide a strong body of evidence from which to appraise practice and make recommendations for the changes that are necessary to improve standards of care' (Peach & Foster 2013, p.3). This systematic surveying, or 'taking the pulse' of traditional collections has its parallel in the digital environment with the 'preservation planning' function in the OAIS

framework (CCSDS 2012, p.4-1). It is also embedded in risk management principles and which includes monitoring and ‘providing periodic risk analysis reports’.

While, in each case, at the granular level the actions are distinctive and specialised, the overall strategy of monitoring and surveying can be applied across the whole elephant.

### *Protection from threats and vulnerabilities*

Apart from disaster preparedness and environmental monitoring and control, for traditional collections this key strategy includes integrated pest management (IPM). IPM is a coordinated approach that focuses on making the physical collection environment unattractive to insects and other pests through physical exclusion, good housekeeping and early detection. It relies on knowledge of the pests’ biology and life cycles, as well as management and blocking sources of likely infestation, and monitoring of the collection environment (Adcock 1998, p. 32). In the digital arena the strategic equivalent is the systematic protection of digital repositories from threats such as unauthorised access, viruses and alteration or destruction of data (CCSDS 2012, p.4-4).

Once more, the specific actions are different—physical detection and blocking on one hand, and digital authentication, security capabilities, virus screening and data integrity services on the other. Yet, at a higher strategic level, the purpose and approach are similar.

### **Copying**

Copying or reformatting strategies are concerned with creating copies of the content of information resources in a more stable medium or format. For preservation of traditional materials, copying involves techniques such as digitizing or, in some cases, microfilming, to preserve the content (as opposed to preserving the original artefact—the information carrier). A copy that is the digitized version of an analog original then joins born-digital objects in the digital world as a turned-digital object.

The next section discusses how two interrelated copying strategies (quality assurance, and managing the relationship between the copy and the original) can be applied in similar ways across digital and traditional formats. These two strategies are also underpinned by the principles of risk management and integrity.

### *Quality assurance*

Conway’s principle of quality is applied through the strategy of quality assurance. In microfilming or digitizing analog materials this is achieved through adherence to standards and guidelines throughout all stages of the copying process from preparation of originals, to image capture, format mode, resolution size and inspection (Brown 2003, Learning Guide p.15; FADGI Still Image Working Group 2009).

Similarly, within a digital repository, copying may be used as a strategy at a number of stages in the management of digital materials. These may include *refreshment* (replacing with a copy that is sufficiently exact that all hardware and software continues to run as before), *replication* (where there is no change in the copy to the digital object) and *migration* when holdings are transferred to different media and/or to a different hardware or software environment to keep them accessible (ISO 2011, p1-14). Various technological mechanisms and verifications are applied to ensure the quality and data integrity of the copies (ISO 2011, p. 5.1, 5.10). In the auditing process the Audit and Certification of Trusted Digital Repositories highlights the need for quality control (CCSDS 2012, 3.3.2.1 p.3-7).

While the actions are specialised in each case, the overall aim of quality assurance is to ensure the integrity and trustworthiness of the copy, and the strategy should be applied irrespective of where it is located within the whole preservation elephant.

#### *Managing the relationship between the copy and the 'original'*

Managing the relationship between original objects and their copies is a critical part of traditional and digital preservation management. In traditional preservation practice, preservation of the original is every bit as important as making the copy. Preservation of the original in digital preservation practice is whatever is required to keep the original bit stream and it is managed as an integral part of the framework of the digital preservation program.

In traditional preservation, effective preservation management of the relationship between the original and the copy involves identifying, interlinking and applying relevant strategies in efficient workflows that link the various parts of the preservation elephant. For example, this could mean that conservation treatments of originals are sequenced prior to copying, after which protective storage enclosures are added and the original is returned to appropriate environmental conditions (Brown 2011, p.193); or it could mean long-term storage of the microfilm master from which the digital copy has been created

However, all too often in traditional preservation practice, at the point that a digital copy is created, the preservation of the digital copy is not automatically considered as an integral strategy in the preservation program. This is like seeing only the elephant's tusk. In digital preservation practice, however, the ongoing management of the digital copies is an integrated part of the whole framework.

This is another example of the potential benefits to digital and traditional preservation practice in learning from one another and developing a truly integrated framework that encompasses the preservation of original traditional materials together with the long-term preservation of digital copies.

#### **An interconnected framework**

We suggest that now there is an opportunity to develop a truly interconnected framework for preserving today's hybrid collections. An integrated framework, based on a common understanding of shared principles such as longevity, choice and integrity and on the extended list of principles in Table 1, provides the opportunity to manage more astutely the preservation

of hybrid collections. It achieves this by providing a structure to systematically apply and align common strategies across digital and physical collections. Such a framework provides the opportunity to leverage and maximise potential benefits such as better informed decisions and prioritising of resources to address risks, and sharing of common strategies applied across digital and physical materials.

However, this will only be possible when we expand our perspective beyond the elephant's trunk and tail, to a view of the whole preservation elephant.

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