Report to ICABS on guidance for digital preservation

Report on a survey of sources

National Library of Australia

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Introduction

Purpose

The purpose of this report is to provide information that will help the IFLA-CDNL Alliance for Bibliographic Standards (ICABS) to understand the availability of useful guidance for those wishing to maintain long term access to digital information resources.

Background

Libraries around the world are faced with a rapidly growing and changing body of information resources that exist in digital form. Often, these exist either in digital form only, or most conveniently for access and storage in digital form.

While this situation offers greatly improved access to information, as well as the opportunity to develop new ways of using information, many people have recognised a high intrinsic risk that access will be ephemeral. Because digital data is relatively easily corrupted in storage, and is typically stored on relatively unstable media, there are inherent risks of data loss. More challenging, however, is the fact that digital data can only be presented for access, understanding and use, through the intermediaries of machines, programs, standards and protocols that are themselves subject to frequent change and obsolescence. It is now widely understood that digital information resources required for long term accessibility must be actively managed to achieve that goal. Such active management includes recognising, capturing, structuring, describing, storing, and securing the information resources themselves, and providing means of re-presenting them for access when needed.

Many organisations are engaged in developing effective ways of carrying out these tasks; there is also much discussion of how these tasks can best be organised and managed.

There is also a growing recognition that the challenges of long-term preservation of access are influenced by the way digital information resources are created in the first place. As a result, those concerned with long-term management often seek to play a role in specifying or guiding standards used by digital content producers.

While many libraries may continue to offer information access services to digital resources without taking a preservation responsibility, many others, including most national libraries and many research and deposit libraries, have a very strong interest in undertaking active digital preservation management. This interest may be associated with any or all of at least three drivers:

- A legal requirement or community expectation to collect, maintain and provide access to information;
- A concern to ensure their users have reliable ongoing access to the information resources they require; and/or

- A strategic business decision to exploit and develop their existing expertise in information management.

ICABS has expressed an interest in understanding the status of guidance available for those organisations and individuals who need to be involved in maintaining access to digital information. The issues and challenges are varied and complex, and many who wish or need to be involved do not have the time or resources to carry out extensive research and development work from scratch. The availability of useful, reliable guidance in setting up and managing effective digital preservation programs is seen as essential if digital preservation is to move beyond the activities of a few relatively well-resourced organisations, to encompass more of the world's growing – and seriously threatened – body of digital information of enduring value.

Approach: Types of guidance sources

While the initial undertaking of the National Library of Australia was to report on the availability of standards, guidelines, and codes of practice relating to the preservation of digital materials, an initial survey indicated that it would be a short report indeed! Very few codified guides to practice, formally endorsed and intended to provide guidance, could be identified.

While of some significance, such a conclusion would inadequately reflect the quite rich guidance which is available, while failing to highlight areas where guidance does seem hard to find even for those willing to make an effort to seek it.

Consequently, this report is based on a broader sweep of potential guidance sources. Many of the reviewed sources appeared to fit into one or another of six main types:

- *Primary sources* - resources written specifically to provide wide guidance (not just describing a specific technique), and with apparent broad community endorsement. Only one standard (for OAIS), a very few guidelines, and some training courses seemed to fit into this category;
- *Secondary sources* - resources written to provide guidance, but considered likely to be dated or without apparent community endorsement;
- *Local sources* - resources written to provide endorsed guidance for specific projects, programs or communities. In many cases, these situation-specific sources may provide useful guidance for a wider audience, but those intending to use them would need to carefully consider their applicability to their own circumstances;
- *Embedded sources* - resources containing some useful preservation guidance within other information, such as reports on projects or articles debating issues, proposing approaches, or critically analysing experience. The great majority of literature on digital preservation, and most relevant conferences and seminars, may be best approached in this light: as sources of some potentially useful guidance requiring critical effort to extract it and decide what is useful.
- *Standards and tools* – resources describing specific approaches or facilities. Except in a very few cases, most resources of this kind appeared to be

marginal as guidance documents. Many relevant standards exist, especially in the area of file formats; there are also many partly developed tools such as format registries and metadata extraction software, which may play a key role in digital preservation. In terms of guidance, however, these resources are of themselves relatively less useful than guides to where, when and how best to use them in the context of managing collections.

- *Current awareness sources* – resources that provide a convenient way of keeping up to date on recent developments and locating leads that may be worth following. A number of subject gateways, discussion lists, project "knowledge bases", and conferences seem to fulfil this kind of role.

Scope

The report focuses on the availability of guidance relating to the preservation of digital materials of greatest interest to libraries. A broad and holistic approach was taken to the scope of both "digital preservation" and the types of materials of interest.

Digital preservation processes –

A key assumption behind this report is that digital preservation refers to the processes required to maintain access. As such, digital preservation should not be seen as a single process, but a cluster of many contributing processes covering the life cycle of information resources and many aspects of their management.

For this reason, the report seeks to evaluate the availability of guidance in the following process areas:

- Taking responsibility for archiving and preservation
- Managing digital preservation programs
- Creating preservable digital content and working with producers
- Deciding what to preserve
- Transferring digital objects to an archive
- Naming, describing and controlling archived digital objects
- Managing legal issues that impact on preservation
- Protecting and storing the data of digital information resources
- Maintaining the means of re-presenting archived objects for access.

Within each of these categories, a number of key issues were proposed as potential focal points for guidance. Against these issues, the criticality of guidance was considered, along with the apparent availability of guidance sources, including areas of particular strength and weakness.

Types of digital materials –

Libraries may be interested in a wide range of digital resources. Some of these are produced, managed, or used by different communities; some also have special needs

or issues that affect their preservation and management. As well as looking at processes, the survey also looked for guidance sources that could be related to a number of broad genres of digital materials:

- General - covering a wide range of materials
- Archival records including email
- Audio-visual materials - audio and moving image materials
- Digital art and e-literature
- Digital games, virtual reality and software
- Digital "manuscripts"
- Images
- Miscellaneous digital materials
- Online information and Web resources
- Physical format digital materials
- Scientific, statistical and research data
- Spatial, geospatial and similar datasets
- Current awareness resources.

It is recognised that these categories are not exhaustive; neither are they definitive nor mutually exclusive. There is much overlap between them, and different people may have approached the categorisation of digital materials in quite different ways. However, the categories were chosen as a potentially useful way of examining the existing literature, and of highlighting sectors or areas of interest that appear to be poorly served by the guidance literature.

Some precautionary comments

Anyone reading this report will be immediately aware that it has no pretensions to either rigour or comprehensiveness. A number of factors and constraints have dictated this:

- The report is based on an extensive survey of digital preservation and related literature (carried out by Ms Jennifer Hodgeman in late 2004, updated and analysed by Colin Webb in mid 2005). The literature of digital preservation is already extensive, making it difficult to identify everything that may be relevant, and impossible to evaluate every resource in depth.
- Most of the resources were identified through the National Library of Australia's PADI subject gateway (PADI: Preserving Access to Digital Information, available at http://www.nla.gov.au/padi/). Although a large number of other search strategies were pursued, and some other resources identified, it is almost certain that other relevant resources were not identified in the survey. This is especially likely to be true for guidance resources in languages other than English, and resources that have not come to the attention of others in the digital preservation community.

- The body of guidance literature is by no means static. Digital preservation is a rapidly evolving field that has attracted the attention of institutions, individuals, funding bodies, research programs, teaching organisations, and many others, in a great many countries. Such growing activity produces a steady stream of reports, papers, discussions and proposals, resulting in a shifting picture of information and guidance. Even during the months between first and second surveys, many new guidance resources appeared.

For these reasons, the report is best viewed as a reasonably well-informed impression of the state of guidance, based on a subjective analysis of a snapshot of available resources taken in mid 2005.

(Some further thoughts on constraints in seeking, guiding and understanding guidance are discussed in the short essay below on *Complications ...*)

Structure of the report

Following the introductory passages, the report is structured as follows:

- A brief summary of key impressions
- Evaluative reports against each of the processes and material types already listed above
- Within each evaluative report, some scoping and evaluation comments are followed by a sample of the guidance resources identified as relevant. Each of the selected resources is listed with a standard citation and, where available, a URL which provided online access in early July 2005. Some brief notes on the source and scope of each resource are also included (generally copied from the PADI database). The resources chosen for inclusion in the report were considered to be either representative of a wider range of relevant resources, or to be the most relevant. The full list of resources identified in the survey will be made available through the National Library of Australia's website.

(Essay: Complications in seeking and providing guidance

It should not be surprising that many guidance-seekers have difficulty finding the guidance they need. Although there are a small number of programs set up specifically to provide training and guidance in this area, and a plethora of conferences, workshops, seminars and papers are available on various aspects of digital preservation, anecdotal evidence suggests that many people remain frustrated in their efforts to "find the answers". There may be a number of explanations for this:

1."Digital preservation" is not a unitary process that can be adequately and comprehensively standardised or described in a single guidance document or standard. It is important to recognise the special requirements of particular kinds of digital materials, as well as the environments in which they are created, captured, managed, used and understood.

2. There is a range of audiences requiring a range of guidance approaches. Different kinds of guidance may be required for different scenarios. Guidance may be required that helps in situations such as:

- Deciding whether to take responsibility for preserving digital materials
- Setting up a digital preservation program
- Creating digital materials that are expected to have ongoing value
- Collecting digital materials and deciding if they should be preserved
- Assessing the preservation effectiveness of existing arrangements for managing a digital collection
- Filling gaps in an existing program
- Developing a collaborative program
- Encouraging and assisting others to set up new preservation programs.

3. To respond to these scenarios, a comprehensive guidance regime would need to range across such diverse areas as:

- Understanding the underlying concepts, issues and principles
- Understanding technical details of current and potential future technologies
- Debating the options
- Recognising local needs
- Identifying good practices even where there where there is limited opportunity to prove their long term effectiveness
- Understanding constraints and risks at technical, organisational, societal and legal levels
- Deciding what is needed and what is achievable
- Finding resources to set up and implement appropriate programs, including skills, equipment, funds
- Understanding how to work with producers, distributors, depositors, users.

4. Providing effective guidance in these and other scenarios is complicated by a number of constraints and difficulties. For example:

- Most importantly, there are only partial answers to some of the most critical long-term challenges. Anyone looking for complete and proven guidance on preserving digital materials will inevitably be disappointed at the present time;
- While there are many commonalities, there are also real differences in the needs of different communities dealing with different kinds of materials, in different cultural and legal contexts, with different levels of knowledge and experience, based on different assumptions, using different learning styles, and encountering language barriers and resource constraints in obtaining or applying any guidance;

- Guidance documents must be kept up to date. In a rapidly evolving field, with such a widespread knowledge gap, an effective guidance regime must include versioning, regular review and re-writing or re-endorsement of guidance. Otherwise, outdated information will quickly render any guidance counter-productive.

In other words, most digital preservation programs – in place or in planning - are still operating in an environment where methods are poorly developed, requirements poorly understood, roles poorly defined, and access to funding is uncertain. It is not surprising that many people still find it difficult to locate guidance that meets their needs.

However, there are some "wellsprings" of guidance that have produced a steady stream of help over the past decade, and to whom it is reasonable to look for further guidance in the future. Typically, these include:

- Projects and programs that investigate existing best practices and standards for their own needs, and then make their findings publicly available (such as literature reviews that occur in the set-up stages of many digital preservation programs);
- Projects and programs that undertake original research for their own needs, and then make their results available (such as a number of research projects that have been funded to explore specific processes);
- Collaborative groups that set standards or benchmarks that all partners agree on (such as standards-setting bodies, collaborative digitisation projects, digital preservation alliances);
- Agencies set up to provide training or guidance to a specific industry or sector (such as bodies that organise training programs, seminars, and reports for the Higher Education sector) ; and
- Agencies with a mission to enable the preservation of digital heritage, wherever it is found (such as UNESCO, IFLA).

Colin Webb
Director of Preservation
National Library of Australia
25 July 2005

Guidance for Digital Preservation - Key Impressions

1. The survey undertaken for ICABS revealed no single best source of guidance covering all or even most relevant topics or levels. However, there is a growing if small body of resources that can be considered as core guidance documents in the digital preservation field.

2. In mid-2005, most of these resources were in the form of guidelines, rather than standards or codes of practice. While the latter two categories exist, they are generally restricted to specific processes or steps, or are relevant to specific communities, and require further layers of guidance documents to create a context in which they can be more widely understood, evaluated and used.

3. Beyond these quite limited formal documents, there exists a very large, growing and complex literature relevant to digital preservation processes. At one level, this literature represents a wealth of guidance; at another level, it is a confusing puzzle requiring connecting the right dots in the right order. To many who look for guidance, encountering the existing literature must be a daunting prospect and a frustrating experience.

4. A number of organisations have recognised this, and set up training programs that aim to provide a framework of basic concepts. Such initiatives may be crucial in helping digital preservation managers and stakeholders orientate themselves, so they can take advantage of the more advanced guidance that is and will be available through the flood of relevant literature.

5. It would be useful for more sectoral peak bodies to recognise the importance of developing basic guidelines for managing different kinds of digital materials. Where this has already happened, such as in the records archiving and audio preservation fields, a platform has been provided for bringing more programs into a common problem space, and a springboard has been created for further, often collaborative, development. While poor guidance is dangerous, incomplete guidance based on "where we are now, and the best we currently know" approaches may be a powerful enabler.

6. There may be a particular need to invest in developing effective guidance to help those struggling to set up programs with inadequate funding, expertise and infrastructure. This presents the serious challenge of reconciling notions of good and sustainable practice with a poorly equipped but keen interest in preserving important digital resources within their own cultural context.

7. Any guidance regime should emphasise the value of personal contact. Indeed, the best guidance regimes would probably involve a mixture of basic concept guidelines, codes of practice for specific communities, standards covering specific steps and techniques, and strong mentoring and support mechanisms.

Evaluative comments – by category

Digital preservation processes: Responsibility

Taking responsibility for archiving and preservation

Core issues on which guidance may be needed include:

- What "digital preservation" or "managing digital resources for ongoing accessibility" mean, and what it means to be responsible for them
- What is required to meet such a responsibility
- Whether there are contributing roles that might support preservation outcomes
- How organisations can decide if they have, or should accept, a level of responsibility
- Understanding theoretical and practical models of preservation responsibility (including repository models) and their advantages and limitations
- How organisations can decide what they need to do to meet their desired level of responsibility
- Understanding costs and devising business models that will support the desired level of preservation responsibility
- Developing policy to articulate and implement the desired preservation responsibility
- Providing an adequate level of accountability
- Identifying arrangements that will provided sustained responsibility and continuity of care across foreseeable contingencies.

Evaluative comments on availability of guidance addressing these issues:

Criticality: There is a rich literature of concern over the potential loss of digital materials, but limited guidance on how to accept responsibility for avoiding loss. Unless someone accepts responsibility for preservation, and can develop the capacity to implement such a responsibility, digital materials will not be preserved. The challenges of responsibility are the source of many requests for guidance. From anecdotal evidence, it appears many organisations still wonder if they have a preservation responsibility and what it might be. It also appears that many people recognise they have a responsibility but need assistance in understanding the implications and in identifying sustainable roles they can take.

Availability of guidance: Approximately 33 resources identified. A small number of sources address most of the broad range of issues listed above, but none address them all in any depth. Most of the sources address specific issues such as repository models or the development of policy. Most of the sources refer to local programs but may offer guidance to others.

Areas of strength: It is relatively easy to find guidance on the nature of digital preservation; there is also much discussion of repository models, but much of this may be considered to be advocacy for specific models rather than guidance.

Areas of weakness: Priority areas of apparent weakness may be guidance on how to decide who has a preservation responsibility; long term business models; accountability; contingency planning; and contributing roles (for less than comprehensive programs).

Some sample guidance resources:

Au Yeung, Tim, 2004, ***Digital Preservation for Museums: Recommendations,***
http://www.chin.gc.ca/English/Digital_Content/Preservation_Recommendations/pdf.html.
This paper suggests key areas that museums should consider in developing a preservation policy, and, where possible, adds concrete actions that museums can implement immediately. A checklist is also provided to offer museums a starting point for developing a preservation policy.

Charles Babbage Institute, ***Documenting Internet2 : a Collaborative Model for Developing Electronic Records Capabilities in the Small Archival Repository***
http://www.cbi.umn.edu/documentinginternet2/index.html
This 18 month project, which began in January 2004 aims to develop feasible methods for selection, description, and long term preservation of historically significant born-digital records in the area of history of information technology.

Cornell University Library, 2004, ***Cornell University Library Digital Preservation Policy Framework,***
http://commondepository.library.cornell.edu/cul-dp-framework.pdf
This policy document covers the mandate, objectives, roles and responsibilities, activities and priorities of the Cornell University Library's preservation program.

ERPANET, 2004, ***Business models related to Digital Preservation,***
http://www.erpanet.org/events/2004/amsterdam/Amsterdam_Report.pdf
Covers financial issues related to digital preservation and business models as well as case studies on the practical experiences of specific organisational business models.

ERPANET, 2003, ***Cost Orientation Tool,***
http://www.erpanet.org/www/products/tools/ERPANETCostingTool.pdf
This instrument assists organisations in identifying potential costs and provides a useful table of factors, cost impact and considerations.

ERPANET,2003, ***Digital Preservation Policy Tool,***
http://www.erpanet.org/www/products/tools/ERPANETPolicyTool.pdf
This document provides guidance on what should be covered in a digital preservation policy.

International Standards Organisation, 2003, ***ISO 14721: 2003, Space data and information transfer systems- an Open Archival Information System – Reference Model,***

http://www.iso.org/iso/en/CatalogueDetailPage.CatalogueDetail?CSNUMBER=24683&ICS1=49&ICS2=140&ICS3

ISO 14721:2003 specifies a reference model for an open archival information system (OAIS). The purpose of this standard is to establish a system for archiving information, with an organizational scheme composed of people who accept the responsibility to preserve information and make it available to a designated community. It provides a widely accepted basis for understanding digital preservation responsibility.

Jantz, Ronald, and Giarlo, Michael J., 2005, *Digital Preservation : Architecture and Technology for Trusted Digital Repositories,* Corporation for National Research Initiatives

http://www.dlib.org/dlib/june05/jantz/06jantz.html

This article discusses the importance of establishing and maintaining trust and authenticity throughout the lifecycle of records within academic digital repositories. It gives an overview of technologies for enabling permanence and trust. The digital preservation architecture at Rutgers University Libraries digital repository is used to demonstrate this approach.

Lavoie, Brian F., 2004, *Open Archival Information System Reference Model: Introductory Guide*

http://www.dpconline.org/docs/lavoie_OAIS.pdf

This article (part of the DPC Technology Watch Series) provides an overview of the background, origins, functions and developments of the OAIS (Open Archival Information System) Reference Model. The article also lists the main responsibilities of an OAIS-type archive and provides examples of digital archiving systems that are OAIS-compliant.

Lor, Peter, and Britz, Johannes J., 2004, "Moral Perspective on South-North Web Archiving", *Journal of Information Science,* Vol. 30, no. 6 (December 2004), pp. 540-549, Ebsco Industries

http://ejournals.ebsco.com/Article.asp?ContributionID=6644239

This paper argues that developed countries have a moral obligation to undertake archiving on behalf of developing countries, but to do so in ways that support social justice principles.

Research Libraries Group, 2002, *Trusted Digital Repositories: Attributes and Responsibilities,* http://www.rlg.org/longterm/repositories.pdf.

This joint RLG-OCLC report is the result of a working group created to establish attributes of a digital repository for the long-term preservation of and access to research materials in digital form. It discusses seven attributes of 'trusted digital repositories'.

Testbed Digitale Bewaring, 2005, *From Digital Volatility to Digital Permanence : Costmodel*

http://www.digitaleduurzaamheid.nl/bibliotheek/docs/Kostenmodel_in_Excel_versie_1.0_(final).xls

Developed by the Testbed Digitale Bewaring (Digital Preservation Testbed), this is a cost model in an Excel spreadsheet for a dedicated archive and preservation facility.

Wabel, Gunter, 2003, "Like Russian Dolls : Nesting Standards for Digital Preservation", *RLG DigiNews* Vol. 7, no. 3, June 15, 2003
http://www.rlg.org/legacy/preserv/diginews/diginews7-3.html#feature2
This article discusses three standards for digital preservation, the Open Archival Information System (OAIS), the Metadata Encoding and Transmission Standard (METS) and the NISO Data Dictionary - Technical Metadata for Digital Still Images. The article describes what the standards do and how they can be utilised, noting especially the hierarchical relationship of the three standards, such that the higher level one provides a framework for those below it.

Webb, Colin, National Library of Australia, 2003, *Guidelines for the Preservation of Digital Heritage*, UNESCO Information Society Division,
http://unesdoc.unesco.org/images/0013/001300/130071e.pdf
These Guidelines form a part of a UNESCO campaign to improve access to digital heritage for all the world's peoples, and to ensure that the means of preserving their digital heritage are in the hands of every community. Includes basic guidance on the concepts of digital preservation, and explores contributory roles.

Wheatley, Paul, 2004, *Institutional Repositories Technology Watch Report 04-02*,
http://www.dpconline.org/docs/DPCTWf4word.pdf
Critical review of preservation relevance of various institutional repository software models.

Digital preservation processes: Management

Managing Digital Preservation Programs

Core issues on which guidance may be needed include:

- Recognising the decisions required in establishing a preservation program
- Scoping the program
- Setting objectives, planning and recognising priorities
- Identifying, assessing and managing risks
- Recognising key stakeholders and managing relationships with them
- Recognising and allocating the resources required for the program, including staff, expertise, equipment, systems and other technical infrastructure
- Organising resources into effective organisational structures
- Managing service providers
- Effective collaboration
- Program evaluation.

Evaluative comments on availability of guidance addressing these issues:

Criticality: Digital preservation challenges are complex in themselves, and are often associated with complex organisational issues to do with resources, planning, internal responsibilities, and relationships. Effective programs require good management. While not a substitute for technical knowledge, good approaches to management may help in decision making even in the absence of deep technical expertise.

Availability of guidance: Approximately 23 resources identified. Most of the literature on digital preservation offers some guidance on aspects of managing preservation programs. This means there is a lot of information around and much discussion of issues, but there has been surprisingly little formal guidance which focuses specifically on the key management processes.

Areas of strength: A number of approaches to risk identification have emerged recently, but so far there has been little guidance on their practical application beyond pilot projects. There has also been much discussion of stakeholders, the need for adequate resources, and collaboration, but not much practical guidance.

Areas of weakness: Priority areas of apparent weakness may be guidance on planning; organisational structures; managing service providers; and program evaluation.

Some sample guidance resources:

Cornell University Library, 2003, *Digital Preservation Management Tutorial*

http://www.library.cornell.edu/iris/tutorial/dpm/timeline/index.html
Although this online tutorial is a prerequisite to attending Cornell University's *Digital Preservation Management Workshop Implementing Short-term Strategies for Long-term Problems*, it has been designed as a stand alone tutorial. The tutorial provides a good introduction to the topic of digital preservation as it covers definitions, key concepts, practical advice, exercises and up to date references.

ERPANET, 2003, *Selecting Technologies*
http://www.erpanet.org/guidance/docs/ERPANETSelect_Techno.pdf
This guidance note discusses the selection of technology for digital preservation, preconditions which should be considered before selection and the selection process itself. Also included is a checklist of factors and questions to ask when developing preservation strategies and listing requirements when choosing the technologies

The Cedars Project, 2002, *CEDARS Guide to Digital Collection Management*
http://www.leeds.ac.uk/cedars/guideto/collmanagement/
This report will provide guidance for collection managers on the creation or enhancement of policies to address retention, and preservation of digital materials. For the purposes of this report, collection management is intended to reflect a more demanding concept than simply collection development, to encompass "policies on the housing, preservation, storage, weeding and discard of stock."

ERPANET, 2003, *Risk Communication Tool*
http://www.erpanet.org/guidance/docs/ERPANETRiskTool.pdf.
This brief paper is an introduction to the concepts and principles of risk management within the context of digital preservation. It provides an overview to help identify which digital resources are at risk in an organisation and to identify, categorise and prioritise the associated risks, to enable communication about risk areas and to stimulate risk management strategy development. It includes an example of a matrix for risk evaluation.

Collections Canada, 2003, *Information Management Capacity Check Tool and Methodology*
http://www.collectionscanada.ca/information-management/0603/06030105_e.html.
The IM Capacity Check is a self-assessment tool intended as a diagnostic tool to aid in the assessment of management capacity. The tool can help institutions assess the state of IM practices within each entity against a common standard, bring together all the elements of information management practices, compare against best practices, and provide information to enable management to develop plans for improvements to their own IM practices. This is a limited mention of preservation but the assessment of the status against best practice is highly useful guidance.

Jones, Maggie, and Beagrie, Neil, 2000, *Preservation Management of Digital Materials: A Handbook*
http://www.dpconline.org/graphics/handbook/index.html
A 145 page handbook on the preservation management of digital materials compiled by staff from the JISC Digital Preservation Focus and the Arts and Humanities Data Service. Aimed at a broad audience, it includes sections containing definitions and issues, institutional strategies, organisational activities and media and formats. It gives

examples of good practice and research initiatives from around the world and makes extensive use of decision trees and checklists as a way of assisting the reader to consider the issues.

Kenney, Anne R., and McGovern, Nancy Y., 2002, *Risk Management Resources*
http://irisresearch.library.cornell.edu/VRC/riskresources.html
Part of Cornell University's Virtual Remote Control toolbox, this bibliography includes publications and websites containing information ranging from risk management generally to specific information on risk management for digital projects and resources.

Martin, Julia, and Coleman, David, 2002, "The Archive as an Ecosystem", in *The Journal of Electronic Publishing*, Volume 7, Issue 3 (April 2002), University of Michigan Press
http://www.press.umich.edu/jep/07-03/martin.html
This article introduces a new metaphor for the processes in managing the preservation of digital archives, that of the ecosystem, and likens the survival of data against technological change to the processes of evolutionary adaptation - "an ongoing process of selection -- of media platforms, of preservation structures, of migratory patterns " to avoid "data extinction".

Stanescu, Andreas, 2004, *Assessing the Durability of Formats in a Digital Preservation Environment : the INFORM Methodology*
http://www.dlib.org/dlib/november04/stanescu/11stanescu.html
INFORM (INvestigation of FOrmats based on Risk Management) was developed at the OCLC as a methodology to measure the durability of various digital formats. The methodology includes six classes of risk; specific risk factors are identified in each of these classes. The article describes the methodology of measuring risk, evaluating or comparing formats with respect to risks affecting their preservation.

The National Archives (UK), *Framework of Standards*
http://www.nationalarchives.gov.uk/archives/framework/standards.htm
The Framework comprises a range of standards and best practice guidelines in all aspects of record keeping (both digital and non-digital).

Digital preservation processes: Creating Preservable Digital Materials

Creating preservable digital content and working with producers

Core issues on which guidance may be needed include:

- Understanding how production factors (such as use of standards, file formats, file characteristics, metadata) make it more likely or less likely that digital information resources will be preserved
- Recognising the potential benefits of preservation programs influencing the way digital resources are produced
- Recognising and creating opportunities for influencing
- Choosing effective ways of influencing the production of digital content.

Evaluative comments on availability of guidance addressing these issues:

Criticality: There are potential audiences for guidance amongst those creating digital content, as well as those wishing to preserve digital content as efficiently and effectively as possible. For producers, the degree of criticality may depend on their long-term intentions for their content as well as their existing level of knowledge; for preservation programs the degree of criticality may depend on the kinds of materials to be archived and the opportunities for influencing production. (For example, it may be impossible for preservation programs to exert much influence on external creators of web publications, but they may have opportunities to specify standards for content produced within their own organisation). Criticality may also depend on the nature of any existing relationships between producers and preservers.

Availability of guidance: Approximately 31 resources identified. There is a plethora of guidance available on digital creation, covering the main format categories. While this is not always aimed at achieving preservation outcomes, there is a rich literature on formats and practices that will support ongoing preservation of digital content.

Areas of strength include: guidance on file standards and formats; desirable file characteristics (such as levels of spatial resolution in image files); and discussion of potential benefits in influencing the production of digital materials.

Areas of weakness: Priority areas of apparent weakness may include: guidance on recognising opportunities and building effective relationships between preservation programs and producers. There is also a great need for more preservation guidance for creators of digital art and computer games.

Some sample guidance resources:

Arts and Humanities Data Service, 1999, *Creating A Viable Scholarly Data Resource,*
http://ahds.ac.uk/viable.htm

This information leaflet is intended to inform arts and humanities researchers and teachers about steps they can take to ensure that data resources they create today are accessible in the long term.

Cornell University Library, 2003, ***Moving Theory into Practice : Digital Imaging Tutorial,***
http://www.library.cornell.edu/preservation/tutorial/index.html
Although this tutorial primarily concentrates on the practicalities of digital imaging, there is a comparative table of file formats, a section on digital preservation and a bibliography of additional reading.

Digital Library Federation Benchmark Working Group, 2002, ***Benchmark for Faithful Digital Reproductions of Monographs and Serials,***
http://www.diglib.org/standards/bmarkfin.htm
This document defines a set of minimum characteristics for digital master page images for digitally reformatted monographs and serials, with a view to their quality, long-term access and interoperability across system environments

MINERVA Working Group 6, 2003, ***Good Practice Handbook, Version 1.2***
http://www.minervaeurope.org/structure/workinggroups/goodpract/document/bestpracticehandbook1_2.pdf
A practical handbook on the instigation and management of digitisation projects within the cultural heritage sector.

NISO Framework Advisory Group, 2004, ***Framework of Guidance for Building Good Digital Collections : 2nd Edition,***
http://www.niso.org/framework/Framework2.html
This Framework has two purposes - an overview of the major components and activities involved in the creation of good digital collections; and to provide a framework to identify, organize, and apply existing knowledge in creating and managing digital collections. It is intended for cultural heritage organizations planning projects to create digital collections, and funding organizations that want to encourage the development of good digital collections. The second edition contains new guidance for audio and video materials, several case studies, and updated references to the latest projects.

The Internet2/CNI Performance Archive and Retrieval Working Group, 2003, ***Current Practices in Digital Asset Management, Version 0.9,***
arts.internet2.edu/files/ digital-asset-management(v09).doc
The aim of this report is to give information on the archiving of digital recordings of live performance and performing arts events. This document is written for faculty and other scholars of the arts concerned with how to best archive digital recordings of live performance in research and educational settings.

Digital preservation processes: Appraisal and selection

Deciding what to preserve

Core issues on which guidance may be needed include:

- Recognising or deciding what information resources should be collected and preserved for ongoing access
- Deciding how long the selected information resources need to be kept
- Establishing consistent, informed collection policies and selection criteria
- Recognising the characteristics (or "significant properties") of specific digital resources that need to remain accessible.

Evaluative comments on availability of guidance addressing these issues:

Criticality: For many organisations interested in preserving digital materials, this step has appeared to be a critical stumbling block (reflected in statements like: "We know we should be doing something, but we don't know what should be saved.")

The level of criticality may be decreasing as digital resources become a more familiar aspect of everyday life, allowing a range of stakeholders to feel more comfortable about deciding what is likely to have long term value that would warrant the cost of keeping it. Indeed, many organisations have already established selection policies or disposal schedules for their digital collections.

However, the increasing numbers, types and uses of digital information resources, and changing community expectations about access, may work to ensure there are ongoing challenges in deciding what to collect, even for programs with established collection policies, let alone those approaching selection decisions for the first time.

Availability of guidance: Approximately 11 resources identified, plus many recordkeeping guidelines. There is a reasonably rich literature of discussion about what to select for preservation. Guidance has mainly emerged in the records archiving and some other specialist data management fields. However, there appears to be a growing discussion of selection issues within specific communities, such as some academic disciplines associated with a growing interest in using institutional repositories to manage research outputs.

Areas of strength: As already noted, appraisal guidance is particularly strong in the records management and archiving field, where many recordkeeping guidelines include relevant guidance. This is in line with long accepted practice in records management, and includes concepts of limited retention that have not been part of the working traditions of many research libraries.

Areas of weakness: Priority areas of apparent weakness may include: guidance on recognising "significant properties" that could guide future preservation decisions. Another area of rich potential concerns possible use of risk assessment

methodologies to influence collecting decisions. Such approaches assume other decisions have been made about what is worth collecting and preserving, and focus instead on deciding *when* valued information resources should be collected. While there is a growing literature on the role of risk assessment in digital preservation, there has been little practical guidance on its use in selection decisions.

Some sample guidance resources:

Cornell University Library, (undated), *Virtual Remote Control,*
http://irisresearch.library.cornell.edu/VRC/index.html
Website for Cornell University Library's Virtual Remote Control (VRC) methodology and toolbox for monitoring and identifying potential risks of loss of Web-based information.

Deken, Jean Marie, 2004, "Preserving Digital Libraries : Determining 'What' Before Deciding 'How'", *Science & Technology Libraries,* Vol 25, no.1-2, Dec 2004
http://www.haworthpress.com/store/Toc_views.asp?sid=87VE2H85QQN48GT93H3M8GE63VLQ6G6C&TOCName=J122v25n01%5FTOC&desc=Volume%3A%2025%20Issue%3A%201%2F2
"Current research projects into the preservation of digital entities have concluded that a necessary first step is the appraisal of the 'significant properties' of digital objects."

Eastwood, Terry, 2004, "Appraising Digital Records for Long-Term Preservation", *Data Science Journal,* Vol. 3, 2004, pp. 202-208, CODATA (Committee on Data for Science and Technology)
http://journals.cecs.qub.ac.uk/codata/Journal/contents/3_04/3_04pdfs/DS387.pdf
This article discusses electronic record appraisal from an archival viewpoint but draws inferences that may be helpful in the preservation of other types of data, such as scientific data. The article discusses the various stages and processes of appraisal as a first step in digital preservation. The Appraisal Task Force of the InterPARES project is also outlined.

Gutmann, M.; Schurer, K., Donakowski, D.; and Beedham, Hilary, 2004, "Selection, Appraisal and Retention of Digital Social Science Data", *Data Science Journal*, Vol. 3, December 2004, pp 209-221, CODATA
http://journals.cecs.qub.ac.uk/codata/Journal/contents/3_04/3_04pdfs/DS386.pdf
The volume of social science data means that not everything can be preserved. The stages of the preservation process including selection criteria, appraisal processes and issues in the long term accessibility of data are illustrated using the situation at two data archives in the US and the UK.

International Association of Sound and Audiovisual Archives (IASA), *Task Force to Establish Selection Criteria of Analogue and Digital Audio Contents for Transfer to Data Formats for Preservation Purposes,*
http://www.iasa-web.org/taskforce.pdf
The aim of this publication by the IASA Task Force to establish principles and guidelines that can be used at an institutional level to plan and set priorities for the transfer of audiovisual resources to data formats for preservation purposes. The

guidelines cover issues such as fragility of existing analogue carriers and the technological obsolescence of the platforms required to play them, the significance of the contents and the responsibilities of the archival institution.

Marcum, Deanna B., 2001, "Scholars as partners in digital preservation", in *CLIR Issues, no 20,* Council on Library and Information Resources,
http://www.clir.org/pubs/issues/issues20.html#scholars
Presents case for involving scholars in decisions about what born digital resources should be selected for preservation.

National Library of Australia, 2003, *Guidelines for the Selection of Online Australian Publications Intended for Preservation by the National Library,*
http://pandora.nla.gov.au/selectionguidelines.html
These guidelines were developed to select online publications to which long-term access should ideally be ensured. They form a part of the National Library's program to manage long-term access to online Australian publications

UNESCO, 2003, *Charter on the Preservation of the Digital Heritage,*
http://portal.unesco.org/ci/en/ev.php-URL_ID=13367&URL_DO=DO_TOPIC&URL_SECTION=201.html
The Charter, adopted by the General Conference of UNESCO in October 2003, makes recommendations on a wide range of digital preservation issues including responsibility and selection.

Digital preservation processes: Collecting

Transferring digital objects to an archive

Core issues on which guidance may be needed include:

- Understanding the available options for collecting digital resources
- Choosing appropriate collecting and transfer methods for bringing selected resources into the care of an archive or preservation program
- Developing ways of streamlining collecting processes (including deposit models)
- Deciding what file formats will be accepted for transfer into the archive, and deciding on the appropriate stage to impose any format restrictions or normalisation.

Evaluative comments on availability of guidance addressing these issues:

Criticality: Assuming that digital resources are best protected and managed for long term access by some kind of archiving arrangement, it is critical that those who accept responsibility choose effective and sustainable methods of transferring materials to a "safe place". Amongst various models for voluntary or mandated deposit, archive-, producer-, or other party-invoked gathering, and other approaches, some may be more appropriate for different kinds of resources and circumstances than for others. This situation calls for informed choices of method, based on sufficient knowledge to think through the implications of any decision.

Choice of file formats may also have a profound impact on the ability of preservation programs to provide later access, either because the cost of managing a great number of formats is unsustainable, or because significant properties are lost in standardising formats.

Availability of guidance: Approximately 12 resources identified. Overall, the level of guidance on these issues is quite strong. For many programs, the processes of collecting and "archiving" (bringing material into the archive) have been the key focus of their preservation activities (based on a recognition that bringing resources into a safe place is the first requirement for preservation).

Areas of strength: There have been many studies of methods for collecting web-based materials, producing a rich literature discussing different harvesting approaches. It is also relatively easy to find guidance on transfer methods and desirable file formats in some sectors where there is a reasonably close link between archiving bodies and producer and user communities.

Areas of weakness: Priority areas of apparent weakness may include guidance that goes beyond case studies or local codes of practice. Possibly due to the still restricted experience with legal deposit for digital materials, there is little guidance available that might encourage governments and publisher communities to support the extension of mandated collecting and preservation. There is also

little guidance on ways of increasing productivity so that large scale collecting can become sustainable.

Some sample guidance resources:

Day, Michael, 2003, ***Collecting and Preserving the World Wide Web : a Feasibility Study Undertaken for the JISC and Wellcome Trust,***
http://www.jisc.ac.uk/uploaded_documents/archiving_feasibility.pdf
The study is an analysis of the task of archiving the web, and includes a review of current web archiving activities and approaches.

Economic and Social Data Service, 2004, ***Data formats and software,***
http://www.esds.ac.uk/aandp/create/data.asp
A list of preferred and acceptable formats for data and documentation for acceptance into the UK data archive. The ESDS has preferred, acceptable and problematic formats for depositing data.

Koninklijke Bibliotheek, ***e-Depot and Digital Preservation***
http://www.kb.nl/dnp/e-depot/e-depot-en.html
This web page is an introduction to and the entry point for the e-Depot at the Koninklijke Bibliotheek (KB), the National Library of the Netherlands, via which the KB aims to preserve and provide long-term access to Dutch electronic publications. There are also links to the broader topic of digital preservation.

Marill, J., Boyko, A., and Ashenfelder, M., 2004, ***Web Harvesting Survey,***
http://netpreserve.org/publications/iipc-r-001.pdf
This survey rates the harvestability of various types of web documents and websites within both the surface and deep web. The results are presented in tabular form and include types of documents, examples, formats, and difficulty ratings for harvest in terms of acquisition, parsing and presentation. More detail on problems in harvesting may be found in the complementary document, Test Bed Taxonomy for Crawler.

Netpreserve.org : ***International Internet Preservation Consortium,***
http://netpreserve.org/about/index.php
Coordinated by the Bibliotheque nationale de France, the International Internet Preservation Consortium (IIPC) also comprises the National libraries of Australia, Canada, Denmark, Finland, Iceland, Italy, Norway, Sweden, United Kingdom ,The Library of Congress (USA) and the Internet Archive. The Consortium will concentrate on advocacy for internet archiving initiatives, developing standards and internet archiving tools, and raising international awareness of internet preservation issues.

Phillips, Margaret E., 2005, "Selective Archiving of Web Resources : A Study of Acquisition Costs at the National Library of Australia", ***RLG DigiNews,***
Vol. 9, No. 3 (June 2005)
http://www.rlg.org/en/page.php?Page_ID=20666#article0
This article examines the costs of maintaining PANDORA : Australia's web archive at the National Library of Australia. In outlining the costs, the article also describes the purpose, history, activities and staffing of PANDORA. It finds that acquiring Web

publications is considerably more expensive than printed publications and describes ways in which the costs could be reduced.

V2_ Organisation, 2003, *Capturing Unstable Media*,
http://www.v2.nl/Projects/capturing/recomm.html
"As a summary of the research on *Capturing Unstable Media*, the following general recommendations can be formulated. These recommendations are deliberately kept general, in order to make them applicable to the individual situation of a wide range of organizations."

Digital preservation processes: Describing

Naming, describing and controlling digital resources

Core issues on which guidance may be needed include:

- Understanding the importance of file naming, metadata and control for preservation
- Choosing appropriate and sustainable file naming schemes for persistent citation and access
- Managing online digital resources so they remain findable
- Describing digital resources so they can be found, understood, managed and re-presented
- Ensuring digital resources and their metadata remain linked
- Deciding what file formats will be stored (if not already decided at an earlier stage), and how they will be documented.

Evaluative comments on availability of guidance addressing these issues:

Criticality: Numerous studies have concluded that the management and re-presentation of digital objects is simply not feasible without adequate naming and metadata. This understanding is grounded in knowledge of contemporary use of computer files: they cannot be accessed if they cannot be identified and retrieved, and if software used to provide access does not recognise what they are and what to do with them. Guidance in this area is particularly critical because the stakes are high, and because there are multiple file naming and metadata schemes that may provide only partial long term solutions.

Availability of guidance: Approximately 43 resources identified. This is one of the best served areas for guidance, reflecting concerted international and local efforts to develop agreed standards and methods. Because needs vary, it is unlikely that a single standard will emerge in either file naming or preservation metadata, but there does seem to be a growing consensus on the objectives of persistent identification and use of metadata that will enable ongoing management of access over time. Metadata approaches to long-term management seem to be well understood and widely discussed in most sectors including libraries and records archives; they have been particularly important crystallisation points for progress in the spatial data field, and even amongst producers and curators of digital art.

Areas of strength: There is a rich literature of advocacy and explanation for various proposed naming and metadata schemes. In the area of preservation metadata, the PREMIS international working group has provided authoritative guidance. Additionally, there is growing strength in the availability of documentation for file formats, seen by many people as a key element of preservation metadata and a key enabler of future preservation activity.

Areas of weakness: There appears to be little guidance on the management of metadata resources themselves.

Some sample guidance resources:

Preservation metadata -

Berkeley Art Museum and Pacific Film Archive, 2001, *Archiving the Avant Garde: Documenting and Preserving Variable Media Art*
http://www.bampfa.berkeley.edu/about_bampfa/avantgarde.html
Archiving the Avant Garde is a collaborative project to develop, document, and disseminate strategies for describing and preserving non-traditional, intermedia, and variable media art forms, such as performance, installation, conceptual, and digital art. The project includes a System of Formal Notation for Scoring Works of Digital and Variable Media Art

Day, Michael, 2004, "Preservation Metadata Initiatives : Practicality, Sustainability and Interoperability", in Frank M. Bischoff, Hans Hofman and Seamus Ross, *Metadata in preservation: selected papers from an ERPANET Seminar at the Archives School Marburg, 3-5 September 2003*
http://www.ukoln.ac.uk/preservation/publications/erpanet-marburg/day-paper.pdf
This article discusses various specific and generic preservation metadata initiatives. Also discussed are sustainability and interoperability issues that arise from their development and use, including file format registries and metadata registries.

Day, Michael, 2003, *Integrating Metadata Schema Registries With Digital Preservation Systems To Support Interoperability: A Proposal*
http://www.siderean.com/dc2003/101_paper38.pdf
A paper presented by Michael Day at the 2003 Dublin Core Conference in Seattle argued that metadata registries may assist in managing metadata in repositories and may also support the re-use and exchange of metadata and/or information packages. The paper describes the development of metadata schemas by national libraries, research initiatives, recordkeeping institutions and digitisation programs and notes that interoperability between these schemas is desirable. Day suggests that metadata registries may be a useful tool that provide authoritative information on schema and element specifications and inter-scheme mappings. They could possibly also support the re-use of metadata and the exchange of information packages between trusted repositories.

Information Management Branch, Information Management, Access and Privacy, Alberta Government Services, 2003, *Metadata Resources Guide*
http://www.im.gov.ab.ca/publications/pdf/MetadataResGuide.pdf
This Guide was developed to assist in the development of metadata standards for the Government of Alberta. The Guide covers major metadata resources and is organised by subject, including international initiatives, background information, preservation metadata, current awareness resources, standards, major metadata schemas and listservs.

International Standards Organisation, 2003, *ISO 14721: 2003, Space data and information transfer systems- an Open Archival Information System – Reference Model,*
http://www.iso.org/iso/en/CatalogueDetailPage.CatalogueDetail?CSNUMBER=24683&ICS1=49&ICS2=140&ICS3
ISO 14721:2003 specifies a reference model for an open archival information system (OAIS). The purpose of this standard is to establish a system for archiving information, with an organizational scheme composed of people who accept the responsibility to preserve information and make it available to a designated community. It provides a widely accepted basis for understanding digital preservation responsibility, and preservation metadata requirements.

National Information Standards Organisation (NISO), 2002, *NISO Data Dictionary - Technical Metadata for Digital Still Images*
http://www.niso.org/standards/resources/Z39_87_trial_use.pdf
Released as a Draft for Trial Use over the period 1 June 2002 to 31 December 2003, this NISO document (NISO Z39.87-2002, AIIM 20-2002) has been produced "to facilitate the development of applications to validate, manage, migrate and otherwise process images of enduring value" and "to facilitate interoperability between systems, services and software, as well as to support the long-term management of and continuing access to digital image collections". A corresponding XML schema to assist in implementation is available at: http://www.loc.gov/standards/mix

PREMIS (PREservation Metadata: Implementation Strategies) Working Group
http://www.oclc.org/research/projects/pmwg/
The focus of the PREMIS group was on the practical aspects of implementing preservation metadata in digital preservation systems. It used the metadata framework produced in 2002 by the first OCLC/RLG Preservation Metadata Working Group as a conceptual foundation and starting point for its work. The working group released a number of key guidance papers on preservation metadata, available through this website, including a Final Report (containing a data dictionary and examples), a set of XML schemas containing all the semantic units defined in the PREMIS Data Dictionary, and a report on current activities and emerging trends in preservation metadata use amongst preservation repositories. Maintenance activity on the data dictionary and XML schema is documented through the Library of Congress at http://www.loc.gov/standards/premis/.

Research Libraries Group (http://www.rlg.org), [supported by the Consortium for Interchange of Museum Information (CIMI), the Digital Library Federation (DLF) and the Museum Computer Network (MCN)], 2004, *Automatic Exposure: Capturing Technical Metadata for Digital Still Images*
http://www.rlg.org/longterm/ae_whitepaper_2003.pdf
This paper explores a Research Libraries Group (RLG) initiative that seeks to enable cultural heritage institutions to capture the data elements proposed by the draft standard, NISO Z39.87 Technical Metadata for Digital Still Images. This standard provides a set of data elements, essential to an institution's ability to manage and preserve its digital images. Included in the article are ways cultural heritage institutions are dealing with the capture of technical metadata and gives examples of harvesting tools that have been employed by cultural heritage institutions world-wide. The initiative is further described in an ***RLG DigiNews*** [Vol. 8, no. 5 (Oct. 15, 2004)]

article by **Robin Dale and Günter Waibel** at
http://www.rlg.org/en/page.php?Page_ID=20462#article1.

Choosing and documenting file formats -

Arms, Caroline R., and Fleischhauer, Carl, 2004, *Digital Formats for Library of Congress Collections*
http://www.digitalpreservation.gov/formats/index.shtml
This website provides information on the suitability of various formats for preserving the Library of Congress's digital collections. Formats are examined for still images, sound recordings, textual content, and moving images, although it is planned to examine more complex digital works such as web sites. Formats are examined using several factors including transparency, technical protection, patents, self-documentation and external dependencies.

Aschenbrenner, Andreas, 2004, "Bits and Bites of Data Formats : Stainless Design for Digital Endurance", *RLG DigiNews* Vol. 8, no. 1, February 2004
http://www.rlg.org/en/page.php?Page_ID=13201&Printable=1&Article_ID=701
This paper analyses the use of XML as a preservation format, particularly in those areas which may be problematic. The article discusses the ideal design criteria for the development data types and then concentrates on the shortcomings or concerns of XML in preserving data formats.

Folk, Mike, and Barkstrom, Bruce R., 2002, *Attributes of File Formats for Long Term Preservation of Scientific and Engineering Data in Digital Libraries*
http://www.ncsa.uiuc.edu/NARA/Sci_Formats_and_Archiving.doc
This paper was produced as part of the Investigating Scientific Data Management Applications with Electronic Records Project sponsored by NARA (National Archives and Records Administration). The paper discusses the characteristics of file formats that can be advantageous in the preservation and storage of scientific and engineering data. File formats are discussed in the context of archival storage and access, usability, data integrity and maintainability and durability.

van Nispen, Annelies; Kramer, Rutger; and van Horik, René, 2005, EXtensible Past : The Relevance of the XML Data Format for Access to Historical Datasets and a Strategy for Digital Preservation, *D-Lib magazine, Vol. 11, no. 2, February 2005*
http://www.dlib.org/dlib/february05/vannispen/02vannispen.html
This article describes the 'X past' project undertaken by the Netherlands Historical Data Archive (NHDA) which was developed to investigate how OAI PMH (Open Archives Initiative Protocol for Metadata Harvesting) can be used for long term access to historical datasets. The development of a prototype to investigate the practical considerations of whether XML can be used for long term preservation of datasets is also discussed.

Ockerbloom, John Mark, 2004, *Building a Robust Knowledge Base for Digital Formats*
http://www.diglib.org/forums/Spring2004/ockerbloom0404_files/frame.htm

FRED (Format REgistry Demonstrator) is a proof-of-concept prototype format registry which is part of the Mellon-funded TOM (Typed Object Model) project. This is a brief overview of FRED and includes characteristics of the registry, how formats are described and future challenges.

Persistent identification -

CENDI Persistent Identification Task Group, 2004, *Persistent Identification : a Key Component of an E-Government Infrastructure*
http://cendi.dtic.mil/publications/04-2persist_id.html
This report begins by discussing the various approaches to persistent identification (PI) and how they are being used. It then discusses how this technology fits in with the Federal Enterprise Architecture model of e-government currently being developed by the United States government. The report raises several issues for future study including a centralised versus distributed implementation and the proposed framework for a government wide PI scheme.

Dack, Diana, 2001, *Persistent Identification Systems : Report on a Consultancy for the National Library of Australia*
http://www.nla.gov.au/initiatives/persistence/PIcontents.html
This report considers the role of persistent identifiers in the provision of long-term access to Internet resources. Existing identification schemes are examined and factors important in the establishment of new naming schemes are discussed. The report concludes by identifying the short-term options for the NLA, and by providing a list of recommendations for ensuring persistent access to resources.

National Library of Australia, 2002, *Managing Web Resources for Persistent Access*
http://www.nla.gov.au/guidelines/persistence.html
A set of guidelines formulated by the National Library of Australia to assist in the management of links to web resources. The document examines the reasons for link failure, and suggests strategies for maintaining active links.

Digital preservation processes: Managing rights

Managing legal issues that impact on preservation

Core issues on which guidance may be needed include:

- Recognising the rights that may be attached to digital resources chosen for archiving and preservation, and their potential impact on the preservation program
- Understanding the options for obtaining permissions required to allow preservation and ongoing accessibility
- Protecting the ongoing sustainability of the program by managing legal risks, including providing adequate protection of rights
- Understanding rights regimes that may foster preservation action.

Evaluative comments on availability of guidance addressing these issues:

Criticality: Many digital preservation processes involve copying, which raises potential conflict with the owners of rights attached to digital materials including intellectual property rights. While some preservation programs operate with a mandated role that simplifies rights issues, most digital preservation managers have a critical need to understand the legal environment in which they work. They also must ensure their actions do not jeopardise either the rights of others, or the sustainability of their own program by exposing it to unacceptable risks of legal or financial penalties. This situation demands guidance on recognising and negotiating rights that will allow preservation, but also on managing rights that may still attach to resources within the archive.

Availability of guidance: Approximately 15 resources identified. There is a good deal of guidance available on legal risks associated with collecting and providing access to digital resources. However, rights management is a difficult area for guidance providers and guidance seekers, for a number of reasons. There may be significant differences in rights between jurisdictions, so accurate advice in one place may be a poor guide to safe practices in another; the interplay of local and international law may create a complex mix of rights and obligations; this mix may be further complicated by contractual licensing arrangements; and the attitudes of different rights owners regarding the enforcement of their rights may vary widely. In addition, the legal risks associated with providing potentially inaccurate or out of date information may act as a strong disincentive, or may ensure that any publicly offered guidance tends to focus on what can go wrong rather than realistic options for managing the risks.

Areas of strength: The main area of strong guidance is in raising awareness of legal risks associated with collecting and providing access.

Areas of weakness: There is much less guidance publicly available on the legal risks associated with other preservation processes such as copying resources in storage and migrating resources to new formats to maintain accessibility. There is a great

need for guidance that is tailored to the local laws and conditions in which preservation programs operate. There may also be room for increased guidance on defining realistic levels of risk that may be acceptable in some circumstances. Presumably all of these needs can be addressed by programs seeking specialist legal advice, which is often expensive.

Some sample guidance resources:

Ayre, Catherine, and Muir, Adrienne, 2004, "Right to Preserve: The Rights Issues of Digital Preservation", *D-Lib magazine*, Volume 10 Number 3, March 2004
http://www.dlib.org/dlib/march04/ayre/03ayre.html
This article provides an overview of the Copyright and Licensing for Digital Preservation (CLDP) project, undertaken between September 2002 and March 2004 and funded by the Arts and Humanities Research Board (UK). Based on questionnaire surveys, face-to-face interviews and a seminar, the project's aim was to examine whether copyright legislation and licensed access to digital content affects the roles of libraries in providing long-term access. Areas outlined in the article include rights implications of digital preservation methods; provision for preservation copying in existing laws and licences; solutions to the rights issues, incorporating areas such as digital preservation responsibility and legal deposit; and rights issues specific to licensed digital content.

Charlesworth, Andrew, 2003, *Legal Issues Relating to the Archiving of Internet Resources in the UK, EU, USA and Australia : a Study Undertaken for the JISC and Wellcome Trust*
http://www.jisc.ac.uk/uploaded_documents/archiving_legal.pdf
Key legal issues such as copyright, data protection and defamation are discussed with emphasis on their application to the United Kingdom legal framework. The article also examines other approaches to web archiving, including several EU countries, the US and Australia. EU experience suggests that establishing legal deposit is highly desirable, US experience reveals that pragmatic approach is successful, but potentially full of legal controversies and Australian licensing approach although limited in its ability to deal with general harvesting of the web provides an acceptable degree of legal risk and allows selective archiving of both 'shallow' and 'deep' web resources. Also included is a series of recommendations for the JISC and Wellcome Trust regarding the archiving of UK materials.

International Federation of Library Associations and Institutions, 2004, *Information Policy : Copyright and Intellectual Property*
http://www.ifla.org/II/cpyright.htm
This IFLA resource page has links to a wide range of reports and sites about intellectual property rights and digital information.

Kavcic-Colic, Alenka, 2002, *Archiving the Web - Some Legal Aspects*
http://www.ifla.org/IV/ifla68/papers/116-163e.pdf
A paper presented at the 68th IFLA General Conference and Council held in Glasgow, 18-24 August, 2002, discussing some legal aspects of archiving publications from the web. Copyright and legal deposit legislation are discussed with regard to rights implications for harvesting, public access and long-term preservation.

Kilbride, William, 2004, *Copyright and Intellectual Property Rights : a Case Study from the Web Face*
http://ahds.ac.uk/creating/case-studies/protecting-rights/
This paper reports on the issues of copyright and IPR (Intellectural Property Rights) within the context of an online archive such as the ADS (Archaeology Data Service).

The Cedars Project, 2002, *Cedars guide to intellectual property rights*
http://www.leeds.ac.uk/cedars/guideto/ipr/guidetoipr.pdf
One of a series of guides produced by the Cedars project, this publication introduces intellectual property rights issues as they relate to digital preservation. In particular, it provides a discussion of copyright law in the UK and the European Union and some recommendations to institutions acquiring digital materials and those preserving them.

Digital preservation processes: Bit-level preservation

Storing and protecting the data of digital information resources

Core issues on which guidance may be needed include:

- Understanding risks to the safe storage of both data and metadata
- Recognising or deciding how much evidence of authenticity is needed
- Maintaining data integrity and data identity
- Providing appropriate technical infrastructure to manage data and metadata
- Providing appropriate data carriers, monitoring their performance, providing appropriate storage and handling conditions, and refreshing data by copying from carrier to carrier
- Choosing and maintaining adequate data backup and recovery arrangements
- Disaster preparedness
- Managing contracted data storage service providers.

Evaluative comments on availability of guidance addressing these issues:

Criticality: Maintaining data streams is a core dependency of digital preservation: without the data streams it is impossible to provide access to content. While data storage and protection are long-established global industries with their own standards and protocols, there is often a gap between the knowledge and assumptions current in those industries, and the assumptions and expectations of digital preservation managers. This may make it difficult for preservation managers to provide adequate specifications, or to adequately monitor compliance until something goes wrong.

It is at least arguable that reliable large scale preservation repositories cannot operate without extensive IT expertise. However, in some circumstances small organisations may have a preservation role to play, and non-IT specialists may well require considerable guidance on the practicalities of managing and protecting data, well beyond the basics of caring for floppy discs and CDs.

Availability of guidance: Approximately 20 resources identified. As well as information on data carriers, there is a growing body of case studies for the procurement of technical infrastructure to manage large data collections. There is also a long-standing but growing body of information about "peer-to-peer" preservation systems that rely on arrangements to manage connected distributed stores, spreading the risk of data loss while detecting and correcting data failures.

Areas of strength include:

- the deterioration characteristics of removable magnetic and optical media
- redefinition and management of the concept of authenticity in relation to digital records

- presumably, there is also strong guidance in data management practices available for IT professionals, although it was not found in the scope of the current survey

Areas of weakness: Priority areas of apparent weakness may include:

- detailed but accessible guidance on data management requirements that would help preservation managers to audit current practices and to specify requirements
- guidance for managers of small scale programs, including small scale infrastructure to store and manage data
- guidance on required levels of authenticity outside the digital records field.

Some sample guidance resources:

Brown, Adrian, 2003, *Digital Preservation Guidance Note 2: Selecting Storage Media for Long-Term Preservation*
http://www.nationalarchives.gov.uk/preservation/advice/pdf/selecting_storage_media.pdf
Produced by the Digital Preservation Department of the National Archives (UK) as part of its series of guidance notes on the preservation of electronic records, this document concentrates on selecting storage media for long-term preservation. Focusing on removable storage media, the document lists various criteria that need to be considered. Also included in the document is a media selection scorecard which compares different types of media and evaluates them against the selection criteria.

Brown, Adrian, 2003, *Digital Preservation Guidance Note 3: Care, Handling and Storage of Removable Media*
http://www.nationalarchives.gov.uk/preservation/advice/pdf/media_care.pdf
Produced by the Digital Preservation Department of the National Archives (UK) as part of its series of guidance notes on the preservation of electronic records, this document concentrates on the care, handling and storage of removable media as a means of ensuring their longevity. Focusing on the knowledge of the correct handling and storage conditions for different types of media, the guide gives an overview of the main types available and provides information as to the most appropriate care, handling, storage and environmental conditions.

Bungale, Prashanth P.; Goodell, Geoffrey; and Roussopoulos, Mema, (2005), "Conservation vs. consensus in peer-to-peer preservation systems", *4th International Workshop on Peer-to-Peer Systems (IPTPS '05), Ithaca, N.Y., USA, February 24-25, 2005.*
http://iptps05.cs.cornell.edu/PDFs/CameraReady_214.pdf
or
http://www.eecs.harvard.edu/~mema/publications/iptps2005-Conservation.pdf
The problem of digital preservation is widely acknowledged, but the underlying assumptions implicit to the design of systems that address this problem have not been analyzed explicitly. The paper identifies two basic approaches to address the problem of digital preservation using peer-to-peer systems (such as LOCKSS and Sierra): *conservation* and *consensus*. The authors highlight the design tradeoffs involved in using the two general approaches, and provide a framework for analyzing the characteristics of peer-to-peer preservation systems in general. In addition, the paper proposes a novel conservation-based protocol for achieving preservation and analyzes its effectiveness.

Byers, Fred R., 2003, *Care and Handling CDs and DVDs : a Guide for Librarians and Archivists*
http://www.itl.nist.gov/div895/carefordisc/index.html
This NIST special publication no. 500-252 provides care and handling guidelines for those responsible for the long-term preservation of optical discs. The guide examines issues such as cleaning, storage conditions, disc structure and other issues influencing media stability. The guide also includes a glossary.

Moore, Reagan W.; JaJa, Joseph F.; and Chadduck, Robert, 2005, *Mitigating Risk of Data Loss in Preservation Environments*
http://www.storageconference.org/2005/papers/04_moorer_risk.pdf
This paper describes approaches to minimise the risk of data loss and to preserve authenticity and integrity within a preservation environment. It describes Grid Bricks and Data Grids and uses the National Archives and Records Administration (NARA) research prototype persistent archive as an example of how they are used.

Entlich, Richard, 2005, "A Little Bit'll Do You (In) : Checksums to the Rescue", *RLG DigiNews* Vol. 9, No. 3 (June 2005)
http://www.rlg.org/en/page.php?Page_ID=20666#article3
This article discusses the use and applicability of checksums as a means to track the authenticity and fixity of digital objects. It provides an overview on what are checksums and the different types of checksum algorithms that are currently used for fixity determination.

ERPANET, 2003, *Selecting Technologies*
http://www.erpanet.org/guidance/docs/ERPANETSelect_Techno.pdf
This ERPANET (Electronic Resource Preservation and Access Network) guidance note discusses the selection of technology for digital preservation, preconditions which should be considered before selection and the selection process itself. Also included is a checklist of factors and questions to ask when developing preservation strategies and listing requirements when choosing the technologies.

InterPARES Project, *Long-Term Preservation of Authentic Electronic Records: Findings of the InterPARES Project*
http://www.interpares.org/book/index.cfm
This page provides links to the findings of the first stage of the InterPARES project (International Research on Permanent Authentic Records in Electronic Systems) which ran from 1999 to 2001. As well as a description of the project, there are reports from the Task Forces investigating authenticity, selection, long-term preservation and policies, strategies and standards. Additional resources include a glossary, diagrams of the selection and preservation functions and a template for record analysis..

Linden, Jim ; Martin, Sean ; Masters, Richard ; and Parker, Roderic, 2005, *Large Scale Archival Storage of Digital Objects*
http://www.dpconline.org/docs/dpctw04-03.pdf
This Digital Preservation Coalition Technology Watch series report on mass archival storage was based on practical experience in developing the Digital Object Management system for the British Library. The report includes an overview of general issues related to building a large secure data storage system, including storage

management, emerging technologies and software. Although based on the British Library's experience, many of the issues discussed are applicable to any institution planning or engaged in secure long-term storage of large volumes of digital materials.

Sadashige, Koichi, 2003, *Data Storage Technology Assessment 2002 : Projections Through 2010*
http://www.imation.com/government/nml/pdfs/AP_NMLdoc_DSTAssessment.pdf
This report is a follow-up to the "Data Storage Technology Assessment" published in August 2000 and is divided into two main parts. The first part of the report explores the impact the market has on the progress of technology, and lists most important technological events between 2000-2002, such as development of the DVD, optical disc, magnetic tape, hard disc drive and Flash memory. The second part of the report provides an overview of data storage equipment, with emphasis on storage equipment in network environment. Magnetic tape and optical disc technologies are discussed in detail, including various available products. Future trends in the area are outlined for this decade.

Digital preservation processes: Preserving accessibility

Maintaining the means of re-presenting archived objects for access

Core issues on which guidance may be needed include:

- Understanding the risks to ongoing accessibility over time
- Understanding the options for maintaining accessibility
- Deciding what level of loss will be acceptable
- Deciding on appropriate re-presentation pathways to maintain the required accessibility
- Understanding and providing what is required to make the chosen re-presentation pathways work when they are needed
- Contingency planning for circumstances in which the preferred re-presentation pathways are not available or not successful.

Evaluative comments on availability of guidance addressing these issues:

Criticality: Maintaining the ability to provide access is at the heart of digital preservation: technology obsolescence can be expected to have a profound impact on access. The availability of good advice is critical for a number of reasons: the stakes are very high; there are many complexities including unpredictable risks that will have to be dealt with in an unknown future operating environment. Many preservation programs cannot afford the expense of research on which to base decisions about effective, and cost-effective, solutions. They may also have only a limited window of opportunity to make such decisions before their collections become effectively inaccessible.

Availability of guidance: Many possible approaches to maintaining the means of providing access have been proposed, and many of these have undergone at least theoretical or preliminary prototyping. Consequently there is a very large and constantly growing literature proposing, analysing, critiquing and discussing approaches including format migration, pre-emptive migration, migration on demand, hardware and software emulation, software archiving, and others. Very little of the existing literature on these possible approaches could be called guidance. In most cases, practices remain experimental and are yet to be standardised. It will be difficult for reliable, comprehensive and comparative guidance to appear until at least a small number of obsolescence cycles have tested current proposed strategies across a range of types of materials. However, preservation managers have an increasingly critical need to decide on some "most likely to succeed" hypotheses, so they can plan for the steps they will need to take.

Areas of strength include guidance on:

- The risks to ongoing accessibility of technological change;
- Conceptual options for addressing the risks.

Areas of apparent weakness include guidance on:

- Deciding which options will be best for what circumstances;
- Deciding on acceptable levels of risk or loss;
- Making multiple approaches work together;
- Ways of automating the processes; and
- Contingency planning.

Some sample guidance resources:

CAMiLEON Project (Creative Archiving at Michigan and Leeds: Emulating the Old on the New), 2002, *CAMiLEON : Migration on Request*
http://www.si.umich.edu/CAMILEON/reports/mor/index.html
This resource notes the concepts behind "Migration on Request", an alternative to conventional migration, and describes the design and development of a Migration on Request tool, in this case a tool for transforming vector graphics files for rendering by contemporary software. Executable files, source code and developer documentation are available for the tool exemplar.

CEDARS Project Team, 2001, *CEDARS Project Report: April 1998 - March 2001*
http://www.leeds.ac.uk/cedars/OurPublications/cedarsrepmar01exec.html
The report of the first three years of the CEDARS project, a focussed investigation into digital preservation issues. The report comprises an overview of the CEDARS demonstrator archive established across the CEDARS partners, the universities of Oxford, Cambridge and Leeds, and contains case studies for a variety of deposited digital materials and basic recommendations for use of migration and emulation as preservation strategies. The report also provides guidance and recommendations on organisational and management issues. The full report is available for download.

Clausen, Lars. R., 2004, *Handling File Formats*
http://www.netarchive.dk/website/publications/FileFormats-2004.pdf
This report describes a part of "Internetbevaringsprojektet" (the Internet preservation project), which is a joint project between Statsbiblioteket (The State Library) and Det Kongelige Bibliotek (The Royal Library) in Denmark. The aim of the project is to archive the Danish part of the Internet. As part of this project, this report specifically deals with strategies in handling file formats to ensure long term preservation and accessibility. Some of the main ways to preserve access to information stored as digital objects are discussed, including capture, sequential conversion to new formats, conversion on demand, emulation and hardware preservation. The report concludes with a suggested strategy for dealing with file formats in an archival system, file preservation workflows and general recommendations for handling file formats.

Digital Preservation Testbed Project, 2003, *Digital Preservation Testbed White Paper: Emulation : Context and Current Status*,
http://www.digitaleduurzaamheid.nl/bibliotheek/docs/White_paper_emulation_UK.pdf
This paper provides a detailed analysis of emulation as a means of digital preservation. It includes information about the background, context and use of emulation in digital preservation as well as a summary of current knowledge and research. The analysis concludes that "emulation is the only solution to digital preservation proposed so far that offers a way of preserving a digital record in its

original form". While recognising the need to resolve some significant issues, the analysis identifies the potential low cost of emulation, its universality and ability to preserve the inherent aspects of digital originals as factors recommending the pursuit of emulation as a preservation strategy.

Granger, Stewart, 2001, *Digital Preservation & Emulation: From Theory to Practice*,
http://www.leeds.ac.uk/cedars/pubconf/papers/ichim01SG.html
Presented at the September 2001 ICHIM Conference, this paper examines emulation as a digital preservation strategy. As well as drawing on mathematical theory, the author analyses the practical role of emulation in the preservation of digital materials.

Hedstrom, Margaret, and Lampe, Clifford, 2001, "Emulation vs. Migration: Do Users Care?", in *RLG DigiNews*, Vol 5, No. 6, Dec 2001
http://www.rlg.org/legacy/preserv/diginews/diginews5-6.html#feature1
This article describes the findings of a user needs analysis investigating emulation and migration as digital preservation strategies. Performed as part of the CAMiLEON project, users were asked to evaluate a game running on its original platform, in emulation and as a migrated version rewritten for a later platform. The findings suggest little difference between the approaches from a user perspective, but draw attention to user sensitivity and the usefulness of user needs analysis.

Hunter, Jane, and Choudhury, Sharmin, 2003, *Implementing Preservation Strategies for Complex Multimedia Objects*
http://metadata.net/newmedia/Papers/ECDL2003_paper.pdf
This article focuses on appropriate preservation strategies for mixed-media digital objects. While the authors provide background information on different digital preservation strategies (such as emulation, migration and preservation metadata), the article is primarily based on case studies using three different examples of new media artworks. For each case study, the authors describe the artwork, highlight problems in preserving the particular objects and determine appropriate preservation strategies. Also included, is a description of the software tools which have been developed as a means of implementing such strategies

International Research on Permanent Authentic Records in Electronic Systems (InterPARES), 2001, *Long-Term Preservation of Authentic Electronic Records: Findings of the InterPARES Project*
http://www.interpares.org/book/index.cfm
This page provides links to the findings of the first stage of the InterPARES project (International Research on Permanent Authentic Records in Electronic Systems) which ran from 1999 to 2001. As well as a description of the project, there are reports from the Task Forces investigating authenticity, selection, long-term preservation and policies, strategies and standards. Additional resources include a glossary, diagrams of the selection and preservation functions and a template for record analysis.

Mellor, Phil; Wheatley, Paul; and Sergeant, Derek, 2002, *Migration On Request : A Practical Technique for Preservation*
http://www.si.umich.edu/CAMILEON/reports/migreq.pdf
This paper proposes "Migration On Request" as an alternative to the traditional view of format migration. The concept shifts the burden of preservation to a single tool,

which must be preserved over time. The paper discusses the design, construction and testing of a software tool for On-Request migration of a digital drawing format.

Moore, Reagan; Baru, Chaitan; Rajasekar, Arcot; Ludaescher, Bertram; Marciano, Richard; Wan, Michael; Schroeder, Wayne; and Gupta, Amarnath, 2000, "Collection-Based Persistent Digital Archives - Part 1", in *D-Lib magazine*, Vol 6, No. 3, March 2000
http://www.dlib.org/dlib/march00/moore/03moore-pt1.html
This article, from the San Diego Supercomputer Center, "defines an approach for maintaining digital data for hundreds of years through development of an environment that supports migration of collections onto new software systems." "The ultimate goal is to preserve not only the bits associated with the original data, but also the context that permits the data to be interpreted."

Moore, Reagan; Baru, Chaitan; Rajasekar, Arcot; Ludaescher, Bertram; Marciano, Richard; Wan, Michael; Schroeder, Wayne; and Gupta, Amarnath, 2000, "Collection-Based Persistent Digital Archives - Part 2", in *D-Lib magazine*, Vol 6, No. 4, April 2000
http://www.dlib.org/dlib/april00/moore/04moore-pt2.html
This article, from the San Diego Supercomputer Center, describes a project to create a one million message persistent email collection. Following on from Part 1, this article discusses the four parts of a persistent archive system: "support for ingestion, archival storage, information discovery, and presentation of the collection."

Ockerbloom, John Mark, 2001, "Archiving and Preserving PDF Files", in *RLG DigiNews* , Vol 5, No. 1, 15 February 2001
http://www.rlg.org/legacy/preserv/diginews/diginews5-1.html#feature2
This article examines the long-term preservation of Adobe Portable Document Format (PDF) files. Possible migration strategies for PDF documents are outlined and appropriate techniques for archiving are discussed.

Slats, Jacqueline, and Verdegem, Remco, 2004, *Practical Experiences of the Dutch Digital Preservation Test-Bed*
http://dandini.emeraldinsight.com/vl=797097/cl=19/nw=1/fm=html/rpsv/cw/mcb/03055728/v34n2/s2/p56
[Also available in pdf version and in *VINE . Digital Preservation and Libraries*, Part Two, Vol. 34, no. 2, 2004, pp. 56-65.]
The Testbed is an experimental research project undertaken by Dutch government to ensure long-term preservation of archival records. In this article the Testbed's focus on four document types (text documents, emails, spreadsheets and databases) using three preservation approaches (migration, emulation and XML) is described. The research methodology is discussed and results are examined for the four record types.

van der Hoeven, Jeffrey, 2004, *Permanent Access Technology for the Virtual Heritage : the Endeavour for Continuous Rendering*
http://jeffrey.famvdhoeven.nl/dd/Researchtask%20IBM%20TU%20Delft%20-%20J.R.%20van%20der%20Hoeven.pdf
This research report focuses on the preservation of static digital objects on a primarily technical level. It does not include internet content or software applications. Within this context, the report discusses digital preservation strategies and issues such as

encapsulation, migration, the Universal Virtual Computer (UVC) and XML. International digital preservation initiatives such as PREMIS, Cedars, InterPARES and DARE are also discussed.

van Wijngaarden, Hilde, and Oltmans, Erik, 2004, *Digital Preservation and Permanent Access : the UVC for Images*
http://www.kb.nl/hrd/dd/dd_links_en_publicaties/publicaties/uvc-ist.pdf
This paper describes the extension of the e-Depot at the Koninklijke Bibliotheek, the National Library of the Netherlands. Two components of the preservation subsystem, the Preservation Manager and the Universal Virtual Computer (UVC) for images are covered in detail. The Preservation Manager monitors the technical environment required to render stored digital objects. The UVC offers a method for permanent access to images, with the future aim being to support PDF for the long term.

Guidance linked to specific types of digital resources or types of communities

It was considered potentially useful to also look at the availability of guidance for managing the preservation of different kinds of digital resources, to highlight sectors or communities that may require additional attention. There is considerable overlap with the Process categories already discussed.

Genres, materials and communities: General
[guidance sources that refer generally to a wide range of materials and processes.]

[approximately 10 resources identified]

The survey revealed no single best source of guidance on all or even most topics or levels. A small number of sources were considered to have broad enough relevance and use to be included as General sources of guidance. As such, they are likely to have something useful to say about most or all processes of digital preservation, and most formats of digital resources. Probably none of them should be seen as a wholly adequate sources of guidance for all needs.

The most significant single guidance instrument is probably still the OAIS standard and explanatory material associated with it. The NDIIPP hosted by the Library of Congress is expected to become a very significant source of guidance, although much of what it has produced is still at the "issues" level. The UNESCO Guidelines were written to address a wide range of needs but do not include much technical detail.

Recommendation: There is probably an adequate base for using existing guidance materials to develop basic training programs in the underlying principles of digital preservation, especially if trainees can be encouraged and enabled to discuss how these principles may apply to their situation and the digital materials for which they are responsible. It would not be possible to develop a training program for full scale implementation of digital preservation based on these guidance materials alone.

Some sample guidance resources:

Jones, Maggie, and Beagrie, Neil, 2000, *Preservation Management of Digital Materials: A Handbook*
http://www.dpconline.org/graphics/handbook/index.html
A 145 page handbook on the preservation management of digital materials compiled by staff from the JISC Digital Preservation Focus and the Arts and Humanities Data Service. Aimed at a broad audience, it includes sections containing definitions and issues, institutional strategies, organisational activities and media and formats. It gives examples of good practice and research initiatives from around the world and makes extensive use of decision trees and checklists as a way of assisting the reader to consider the issues.

Beagrie, Neil, 2005, *Digital Preservation : Best Practice and its Dissemination*
http://www.ariadne.ac.uk/issue43/beagrie/

This article discusses a number of digital preservation guidance initiatives in the United Kingdom, and introduces the Digital Preservation Training Programme (DPTP), a JISC-funded project which aims to provide practical training and support for all staff in managing digital information in a range of institutional settings. The DPTP is a collaboration of University of London Computer Centre, Cornell University, the Digital Preservation Coalition, the Archaeology Data Service, and the King's College Digital Consultancy Service.

Cornell University Library, 2003, *Digital Preservation Management Tutorial,*
http://www.library.cornell.edu/iris/tutorial/dpm/timeline/index.html
Although this online tutorial is a prerequisite to attending Cornell University's *Digital Preservation Management Workshop Implementing Short-term Strategies for Long-term Problems*, it has been designed as a stand alone tutorial. The tutorial provides a good introduction to the topic of digital preservation as it covers definitions, key concepts, practical advice, exercises and up to date references.

Hodge, Gail and Frangakis, Evelyn,, 2005, *Digital Preservation and Permanent Access to Scientific Information : The State of the Practice*
http://www.dtic.mil/cendi/publications/04-3dig_preserv.html
This report is an update to "Digital Electronic Archiving : the State of the Art and Practice" report, also jointly sponsored by the International Council for Scientific and Technical Information (ICSTI) and CENDI. It focuses on operational digital preservation systems used specifically in science and technology, while considering the wide range of digital objects as well as different format types, including text, data, audio, video, etc. The report identified 50 projects and systems used by various international organizations to preserve digital science data, of which 21 were selected to highlight because of the operational nature of their systems as well as the potential wider interest to the scientific community

Howell, Alan, 2004, *Preserving Digital Information : Challenges and Solutions : Workbook*
http://www.alanhowell.com.au/papers/pdi_wkb.pdf
Since 2001, Alan Howell, Manager, Preservation and Storage at the State Library of Victoria has been presenting digital preservation workshops for CAVAL (Cooperation Action for Victorian Academic Libraries). The one day workshop for which the workbook is designed focuses on digital preservation in archives, libraries and museums. It provides an introduction to challenges and practical solutions, preservation planning and resources on digital preservation. It mainly deals with digital preservation from a management perspective, although technical aspects are briefly covered. The workbook is also intended as a reference book for planning and implementing digital preservation programs.

International Standards Organisation, 2003, *ISO 14721: 2003, Space data and information transfer systems- an Open Archival Information System – Reference Model,*
http://www.iso.org/iso/en/CatalogueDetailPage.CatalogueDetail?CSNUMBER=24683&ICS1=49&ICS2=140&ICS3

ISO 14721:2003 specifies a reference model for an open archival information system (OAIS). The purpose of this ISO 14721:2003 is to establish a system for archiving information, both digitized and physical, with an organizational scheme composed of

people who accept the responsibility to preserve information and make it available to a designated community.

Library of Congress, *NDIIPP reports and papers : Draft Technical Working Documents*
http://www.digitalpreservation.gov/index.php?nav=3&subnav=13
The Digital Formats Web site provides information about digital content formats, including *files, underlying bitstreams and encodings*, and *"wrappers"*. The site provides information about media-independent ("intangible") formats but not about media-dependent ("tangible") formats. This resource is intended to support both strategic planning and individual selection decisions regarding digital content and its preservation at the Library of Congress. As time passes, the site will offer an ever-increasing inventory of information about current and emerging formats that are promising (or not promising) for long-term sustainability.

National Library of Australia, 2004, *Recommended Practices for Digital Preservation*
http://www.nla.gov.au/preserve/digipres/digirespractices.html
Provides advice on the principles and procedures that should be considered and applied to long term responsibility for digital materials.

UNESCO, 2003, *Charter on the Preservation of the Digital Heritage,*
http://portal.unesco.org/ci/en/ev.php-URL_ID=13367&URL_DO=DO_TOPIC&URL_SECTION=201.html
The Charter, adopted by the General Conference of UNESCO in October 2003, makes recommendations on a wide range of digital preservation issues including responsibility and selection.

Webb, Colin, National Library of Australia, 2003, *Guidelines for the Preservation of Digital Heritage*
http://unesdoc.unesco.org/images/0013/001300/130071e.pdf
These Guidelines form a part of a UNESCO campaign to improve access to digital heritage for all the world's peoples, and to ensure that the means of preserving their digital heritage are in the hands of every community. The Guidelines have been prepared to offer realistic and useful guidance for those responsible for preserving digital heritage, including those having only very limited resources.

Genres, materials and communities: Archival records including Email

[approximately 35 resources identified]

Guidance in this field appears to be highly developed, and includes many jurisdiction-specific guidance resources that may serve as good models for others.

Guidance in preservation of digital records covers all processes, although understandably there is a predominance of guidance covering record creation, metadata, appraisal, and record keeping standards. However, there is also considerable discussion and guidance available on approaches to maintaining long term accessibility.

The richness of resources in this sector presumably reflects the fact that many organisational archives, and especially government archives, are required to accept responsibility for digital records, and most have long been mandated to specify record keeping standards to be used within their jurisdiction. In addition, a number of national archiving authorities and international peak bodies, have actively collaborated to establish a high degree of consensus on how digital records should be managed, and how concepts such as "authenticity" should be adapted to the digital environment.

Some sample guidance resources:

Boudrez, F. 2001, ***Report 3:, DAVID: The digital recordkeeping system: inventory, information layers, and decision-making model as a point of departure***
http://www.antwerpen.be/david/website/teksten/Rapporten/Report3.pdf
This report is an outcome of the DAVID project and describes a methodology for the preservation of archival information using a decision matrix of recordkeeping requirements based on the strategies of migration, technology preservation using emulation, and reformatting to hard copy.

Interpares Project, 1999- , ***InterPARES Project: International Research on Permanent Authentic Records in Electronic Systems,***
http://www.interpares.org/
The goal of the InterPARES Project is to use the tools of archival science and diplomatics to develop the theoretical and methodological knowledge essential to the permanent preservation of electronically generated records. On the basis of this knowledge it formulates model strategies, policies and standards capable of ensuring their preservation.

LOTAR, 2002, ***White Paper for Long Term Archiving and Retrieval of Product Data within the Aerospace Industry (LOTAR). Technical Aspects of an approach for application,***
http://www.prostep.org/file/14037.wp_v10
This White Paper (Version 1.0) is a release of the LOTAR Working Group of the ProSTEP iViP society, an international association of aerospace industry companies, IT companies, universities and industry associations. The paper describes the approach, initial phase and main parameters of the architecture for a long term

archiving environment in the aerospace industry. The White Paper contains use case methods, information on processes, data, system architecture, and scenarios, as well as proposing the main requirements for preservation and describing a general methodology for long-term archiving.

National Archives of Australia, 2004, *Digital Recordkeeping: Guidelines for Creating, Managing and Preserving Digital Records*,
http://www.naa.gov.au/recordkeeping/er/guidelines.html
The Digital Recordkeeping Guidelines provide comprehensive help to Australian Government agencies in creating, managing and preserving their digital records. It will assist staff responsible for digital records and information to manage digital records for as long as they are required. There is a specific chapter on the preservation of records that includes a range of strategies related to documentation, obsolescence issues and migration, encapsulation and emulation.

National Archives of Australia, 2004, *Digital Recordkeeping Self-Assessment Checklist,*
http://www.naa.gov.au/recordkeeping/er/checklist.html.
The checklist in this document is a self-assessment tool to help Australian Government agencies manage their digital records effectively. It enables agencies to determine whether they have appropriate recordkeeping strategies, practices and systems for managing digital records, and to identify areas needing improvement. The checklist should be read and used in conjunction with the National Archives publication *Digital Recordkeeping: Guidelines for Creating, Managing and Preserving Digital Records.*

Public Record Office Victoria, 2003, *Victorian Electronic Records Strategy (VERS): Version 2*
http://www.prov.vic.gov.au/vers/standards/Version%202%20release/StandardVersion2.htm
This web site has links to the standard "Management of Electronic Records", its supporting specifications and the explanatory advices, which were revised in July 2003. The five supporting specifications include system requirements for preserving electronic records, metadata, standard electronic record format, long term preservation formats and export of electronic records to PROV (Public Record Office Victoria). (The VERS approach is based on converting all records to xml and pdf, encapsulated with metadata and verified with a digital signature, and proposes use of custom viewers over time to view the normalised original record.)

State Archives Department, Minnesota Historical Society, 2004, *Electronic Records Management Guidelines Version 4*,
http://www.mnhs.org/preserve/records/electronicrecords/erguidelinestoc.html
The Electronic Records Management Guidelines provide information on a variety of topics, such as file formats and file naming, electronic records management strategies, electronic document management systems, digital media, storage facilities and procedures, e-mail and web content management, and electronic and digital signatures.

State Records New South Wales, 2002, *Future Proof : Ensuring the Accessibility of Equipment Technology Dependent Records*,
http://www.records.nsw.gov.au/publicsector/rk/guidelines/techdependent/techdependentbody13.htm
The purpose of this State Records New South Wales Guideline is to offer advice to public offices who are seeking to ensure that their technology dependent records remain accessible over time. The guidelines contain 10 strategies covering metadata, data conversion/migration, monitoring and auditing accessibility and storing and preserving media.

Testbed Digitale Bewaring, 2003, *From Digital Volatility to Digital Permanence : Preserving Email*,
http://www.digitaleduurzaamheid.nl/bibliotheek/docs/volatility-permanence-email-en.pdf
This report presents the final recommendations of the Testbed Digitale Bewaring Project on the long term preservation of email. The publication covers cultural, legal, technical and practical issues. It also has sections targeted towards specific groups such as managers, record keepers and end users. There is a comparison of migration, emulation and XML as migration strategies, and the appendices include an XML schema for archiving Outlook emails.

Genres, materials and communities: Audio-Visual Materials

[approximately 10 resources identified]

There appears to be quite good guidance available for creators and curators of digital audio materials. Strong international associations such as IASA have taken a leading role in developing practices and producing guidance documents. This is especially so in the audio arena, where managers of collections were leaders in recognising that ongoing access could only be achieved by transferring data from either unstable or obsolete media. While removable media such as CD and DVD still play a role as transition carriers, sound archives are increasingly being transferred to digital mass storage systems that can be managed much like other digital data. Procedures for doing this, and preservation grade file formats, are widely understood and used. However, these processes remain beyond the resources of many organisations seeking to preserve important audio collections, so there may be an ongoing need for guidance in devising and using alternative, lower cost strategies that can at least buy time for preservation action to be taken.

Guidance in the preservation of digital video does not appear to be well addressed. Digital video requires high storage capacities, presenting problems for mass storage systems. While small collections continue to use removable carriers such as DVD, they may find useful guidance is available relating to storage and handling of optical discs.

Some sample guidance resources:

Arts and Humanities Data Service (AHDS). ***Guide to Good Practice Creating Digital Audio Resources,***
http://ahds.ac.uk/creating/guides/audio-resources/GGP_Audio_Contents.htm
This guide is intended as a basic 'how to' for those wishing to use audio materials in the creation of digital resources. It deals with such issues as copyright, choosing equipment, playing audio media, delivery of audio to users, data management and preservation.

European Broadcasting Union, ***EBU Broadcast Wave Format,***
http://www.sr.se/utveckling/tu/bwf/
Site of the Broadcast wave format which is considered an acceptable preservation audio format.

International Association of Sound and Audiovisual Archives (IASA), 2004, ***Guidelines on the Production and Preservation of Digital Audio Objects, Publication TC04***
Currently only available in hardcopy. Order from: http://www.iasa-web.org/iasa0022.htm.
These guidelines discuss key principles and standards, metadata, signal extraction from originals and target formats in the production and preservation of digital audio objects. It includes information on the reproduction of optical disk media such as CD and DVD and digital magnetic carriers. Target formats and systems include Digital Mass Storage Systems (DMSS), optical disks and magneto-optical (MO) disks.

Presto Space Consortium, 2003, *PrestoSpace*,
http://prestospace.ina.fr/
This project, funded by the EU and building upon earlier projects such as Presto, seeks to establish a framework for the digital preservation of audio-visual materials. The aim of the Project is to build 'preservation factories' which would provide an affordable infrastructure for institutions such as libraries and museums in order to manage, reduce costs, standardise processes and to provide access to their digital audio visual assets.

The Internet2/CNI Performance Archive and Retrieval Working Group, 2003, *Current Practices in Digital Asset Management, Version 0.9*,
arts.internet2.edu/files/ digital-asset-management(v09).pdf
The aim of this report is to give information on tbe archiving of digital recordings of live performance and performing arts events.

Genres, materials and communities: Digital Art and e-Literature

[approximately 15 resources identified]

Guidance in this area appears to be poorly developed, which may reflect a slow acceptance of responsibility for preservation, as well as the difficulties presented by the use of ephemeral formats. Other factors may include the importance placed on retaining "look and feel" as a significant property, and a high level of dependency on specific software and hardware to achieve it.

Understandably, most of the guidance that exists seems to relate to local projects which have emphasised the development of metadata to document the techniques and intentions of artists, as a way of informing later preservation action.

This area appears to warrant investment in developing guidance for both creators and custodians, if long term accessibility is to be achieved. The availability of good guidance may encourage more organisations to accept responsibility for preserving digital art.

Some sample guidance resources:

Besser, Howard, 2001, *Longevity of Electronic Art*
http://www.gseis.ucla.edu/~howard/Papers/elect-art-longevity.html
This paper, submitted to the International Cultural Heritage Informatics Meeting, 2001, highlights the problems in preserving electronic art. It describes the approaches to preserving electronic resources in general, notes the special characteristics of electronic artworks that pose challenges for preservation and proposes practical strategies for preserving electronic art.

Depocas, Alain, 2004, "Variable and Unstable : Preserving and Documenting Our Digital Art Heritage", *HorizonZero Digital Art + Culture in Canada*, Issue 18, Nov/Dec 2004
http://www.horizonzero.ca/textsite/ghost.php?is=18&file=7&tlang=0
This article describes various initiatives in developing new methodologies, standards and documentation in variable or new media art. These initiatives include the Centre for Research and Documentation at the Daniel Langlois Foundation, and the Variable Media Network.

Humboldt University, *Database of Virtual Art : Internationale Datenbank für Virtuelle Kunst*,
http://virtualart.hu-berlin.de/common/info.do
This database, supported by the German Research Foundation (DFG) and the Federal Ministry of Education and Science (BMBF), has been developed to document and provide access to digital installation art. Its documentation system focuses on information about technical requirements, installation settings, software and hardware configurations. The web interface also allows artists to input this information themselves. This database represents an important development in ensuring continuing access to this art.

Hunter, Jane, and Choudhury, Sharmin, 2003, *Implementing Preservation Strategies for Complex Multimedia Objects*
http://metadata.net/newmedia/Papers/ECDL2003_paper.pdf
This article focuses on appropriate preservation strategies for mixed-media digital objects. While the authors provide background information on different digital preservation strategies (such as emulation, migration and preservation metadata), the article is primarily based on case studies using three different examples of new media artworks. For each case study, the authors describe the artwork, highlight problems in preserving the particular objects and determine appropriate preservation strategies. Also included, is a description of the software tools which have been developed as a means of implementing such strategies

***IMAP (Independent Media Arts Preservation Inc.)*, 2004**
http://www.imappreserve.org/
Independent Media Arts Preservation, Inc. (IMAP) is a United States based non-profit service, education, and advocacy organisation that focuses on preservation of non-commercial electronic media that is stored outside of large archiving institutions. Although mostly concerned with electronic material, IMAP also assists groups dealing with the preservation of film, performance, interdisciplinary, and multimedia work. IMAP provides various services to facilitate digital preservation and access to collections, including preservation education, cataloguing and training. (The site includes a "Preservation 101" introduction to the issues and approaches.)

Preservation, Archiving, and Dissemination (PAD)
http://www.eliterature.org/pad/
The Preservation, Archiving, and Dissemination (PAD) project seeks to identify threatened and endangered electronic literature and to maintain accessibility, encourage stability, and ensure availability of electronic works for readers, institutions, and scholars.

Rhizome.org, 2002, *Rhizome Art base management policy*
http://rhizome.org/artbase/policy.htm
"The Rhizome ArtBase is an artist-driven, web-based archive of new media art assembled and maintained by Rhizome.org, a non-profit organization based in New York City. The goals of the Rhizome ArtBase are to provide public access and exposure to a comprehensive collection of new media art, to provide an online platform for new media artists to present their work within a context of relevant critical discourse and online discussions, and to preserve their work for the future." This policy describes the archiving model including the principles of cloning or linking to an object in an archive and gives lists of metadata and possible descriptors. (The site also contains papers discussing possible preservation approaches.)

Rinehart, Richard, *A system of formal notation for the scoring of works of digital and variable art*
http://www.bampfa.berkeley.edu/about_bampfa/formalnotation.pdf
A paper giving an overview of current research activity and proposing a system of describing and exhibiting or performing art works based on a modification of the principles of musical notation.

Genres, materials and communities: Digital Games, Virtual Reality and Software

[approximately 7 resources identified]

Guidance in this area appears to be very poorly developed, even though the digital gaming industry is large and growing, and computer games are ubiquitous and genuinely popular artefacts of late Twentieth and early Twenty First Century global culture.

Most preservation action in the games area appears to have been taken by enthusiasts dedicated to maintaining access to specific games or families of products. Like much digital art, most computer games are very closely tied to, or even consist of, software designed to present an experience for the user rather than just providing information. This implies that preservation guidance would need to address very complex multi-media where preservation results have to reproduce specific sets of experiences (such as speed of play).

At a minimum, good guidance might increase the readiness of archiving organisations to accept preservation responsibility for this kind of digital material.

Virtual reality products have been included in this group because they share many features with digital games (indeed many computer games use VR software), however they are also frequently found in other kinds of collections or application contexts, in which they may be better served by preservation guidance.

Some sample guidance resources:

Classic Amiga Preservation Society, *Welcome to C.A.P.S.*
http://www.caps-project.org/
C.A.P.S., the Classic Amiga Preservation Society, as the name implies, dedicates itself to the preservation of classic software for the future, currently classic Amiga games. In 2004, CAPS joined with the Internet Archive to form the CLASP (Classic Software Preservation) project, to permanently archive classic, obsolete retail software from the late 1970s to the early 1990s. The Internet Archive describes the project and expects to release technical details of the project, at http://www.archive.org/details/clasp.

Fernie, Kate, and Richards, Julian D., (editors), 2002, *Creating and Using Virtual Reality : a Guide for the Arts and Humanities*
http://vads.ahds.ac.uk/guides/vr_guide/
This AHDS guide to good practice includes sections on archiving virtual reality projects and resources discovery. It includes information on metadata, formats, access and documentation of Virtual Reality projects. The Guide concentrates on accessible desk-top virtual reality which may be distributed and viewed on-line via the World Wide Web. It is concerned with the variety of virtual reality models that may be produced and how to ensure that these can be delivered successfully to users and preserved for future reuse.

Huth, Karsten, 2004, *Problems and solutions of software preservation using video games for the Atari 2600 and the C64 as an example*
http://www.digitalgamearchive.org/home.php
One of the first major works on the preservation of computer games from inside the librarian sector. Berlin-based librarian Karsten Huth offers a strategy (including a complete metadata scheme) of how this task could be handled. This (German) thesis can be downloaded from the site of the Digital Games Archive (DiGA).

Lowood, Henry, 2004, *Playing History with Games : Steps Towards Historical Archives of Computer Gaming*, Presented at the Electronic Media Group, American Institute for Conservation of Historic and Artistic Works, AIC Annual Meeting 2004, Portland, Oregon, 14 June 2004.
http://aic.stanford.edu/sg/emg/pdfs/Lowood-EMG2004.pdf
The unique problems of preserving computer games arise because they are both dynamic and interactive and function on a variety of platforms, including hand held devices, mobile phones, cartridges and desk top computers. This article describes the development of the Machinima Archives and some of the challenges in long term preservation of computer games. The article describes the nature of computer games, in terms of technology and as performance, the challenges for preservation and some curatorial models. It also notes several projects, such as CLASP (Classic Software Preservation Project) at the Internet Archive, working on emulation, game software reformatting or conservation of games artifacts.

Zabolitzky, John G, 2002, "Preserving Software: Why and How", *Iterations: An Interdisciplinary Journal of Software History*, 1, 13 September 2002, pp. 1-8
http://www.cbi.umn.edu/iterations/zabolitzky.html
In this article the author highlights the importance of preserving both hardware and software developments so that future generations have a greater knowledge and understanding of computer history. As well as providing an overview of why it is necessary to preserve software and how such preservation can be achieved, the author stresses that the preservation of source code format software should be an immediate goal of organizations and suggests ways for this to be achieved such as the creation of a list of national heritage software.

Genres, materials and communities: Digital Manuscripts

[approximately 3 resources identified]

While most digital preservation attention has been directed towards more formally published, distributed or recorded information resources, there is likely to be a growing body of digital material not produced for public use but finding its way into collections and of ongoing interest to researchers, in much the same way as personal letters, notes and drafts of other works by notable individuals have found their way into paper-based manuscript collections. Such "digital manuscripts" collections are likely to include collections of email messages. (Email is also appropriately considered under the category Archival Records, but there may be subtle differences in the way these are treated as personal or official records.)

Specific guidance on managing these materials appears to be extremely poor. Preservation is likely to be challenging, involving recognition of obscure formats, reconstruction of often poorly documented provenance, and in many instances recovery of access and meaning from obsolete formats or carriers. While there are very reasonable objections to relying on data rescue approaches in place of proactive preservation management, there is also a need to develop and promulgate good practices in dealing with such collections, both proactively and reactively if necessary.

Some sample guidance resources:

National Library of Australia, 2004, *Recovering and Converting Data from Manuscripts Collection Discs*
http://www.nla.gov.au/preserve/digipres/recovering.html
Covers the work flow processes used by the National Library of Australia in attempting to recover data from obsolete discs.

Genres, materials and communities: Images

[approximately 12 resources identified]

Digital images include born digital images and images copied from non-digital originals such as photographs, printed texts, manuscripts, maps, microform and other documentary materials. Almost every cultural collecting institution, documentary heritage body and information management archive will be responsible for some digital image files.

Given this situation, it is not surprising that there is much guidance available, especially in the area of creating good quality digital images. There appears to be surprisingly little guidance available specifically on the long-term maintenance of access, perhaps reflecting a rush to use digital technology to enhance current access, with less immediate consideration of long-term access. (While most digitisation programs are put in place to improve access, it seems likely that most institutions will eventually seek to preserve the resulting digital images, even if only to avoid the cost of repeated copying of the same analogue originals.)

However, an emphasis on high fidelity information capture to suitable well-standardised file formats, accompanied by good technical metadata, all of which appears in most current guidance, should simplify the process of preserving access to these image collections, even though the numbers of images to be preserved is very great.

Guidance on reliable, long term management of such materials would probably increase the readiness of some collecting institutions to accept high quality digital copies as suitable preservation copies in place of microform or other analogue photography.

Some sample guidance resources:

Brown, Adrian, 2003, *Digital Preservation Guidance Note 4: Graphics File Formats Preservation,*
http://www.nationalarchives.gov.uk/preservation/advice/pdf/graphic_file_formats.pdf
Produced by the Digital Preservation Department of the National Archives (UK) as part of its series of guidance notes on the preservation of electronic records, this document focuses on selecting file formats for use with images. It provides summary information about the most common graphics file formats in current use to help users to make informed decisions regarding the selection of most suitable files. The guidelines provided are limited to static images.

Cornell University Library, 2001, *Report of the Digital Preservation Policy Working Group on Establishing a Central Depository for Preserving Digital Image Collections, Part 1: Responsibilities of Transferee*
http://www.library.cornell.edu/imls/image%20deposit%20guidelines.pdf
The Digital Preservation Policy Working Group of Cornell University Library's plan for establishing a central depository as part of a digital preservation solution for Cornell's digital image collections is based on two recommendations: the formation of

such a centralised depository for ensuring continuing access to the collections, and collaboration with transferees to provide both access and security to deposited files. This report, in PDF format, represents the first part of that plan and defines requirements for transfer of materials to the central depository and indicates the depository's possible roles and responsibilities

Cornell University Library, 2003, ***Moving Theory into Practice : Digital Imaging Tutorial,***
http://www.library.cornell.edu/preservation/tutorial/index.html
Although this tutorial primarily concentrates on the practicalities of digital imaging, there is a comparative table of file formats, a section on digital preservation and a bibliography of additional reading.

Digital Library Federation Benchmark Working Group, 2002, ***Benchmark for Faithful Digital Reproductions of Monographs and Serials,***
http://www.diglib.org/standards/bmarkfin.htm
This document defines a set of minimum characteristics for digital master page images for digitally reformatted monographs and serials, with a view to their quality, long-term access and interoperability across system environments

MINERVA Working Group 6, 2003, ***Good Practice Handbook, Version 1.2***
http://www.minervaeurope.org/structure/workinggroups/goodpract/document/bestpracticehandbook1_2.pdf
A practical handbook on the instigation and management of digitisation projects within the cultural heritage sector.

NARA, 2004, ***Technical Guidelines for Digitizing Archival Materials for Electronic Access: Creation of Production Master Files - Raster Images,***
http://www.archives.gov/research_room/arc/arc_info/guidelines_for_digitizing_archival_materials.html
These Guidelines define approaches for creating digital surrogates for facilitating access and reproduction; they are not considered appropriate for preservation reformatting to create digital surrogates that will replace original records. These *Technical Guidelines* provide technical benchmarks for the creation of "production master" raster image (pixel-based) files.

National Institute for a Networked Cultural Heritage (NINCH), 2002, ***The NINCH Guide to Good Practice in the Digital Representation and Management of Cultural Heritage Materials.*** **Version 1.0,**
http://www.nyu.edu/its/humanities/ninchguide/index.html
A guide developed by an expert working group on current best practice on the capture, preservation and management of digitised and networked digital resources. The guide provides a useful chapter on digital preservation.

Northeast Document Conservation Center, Sitts, Maxine K (Editor), 2000, ***Handbook for Digital Projects : A Management Tool for Preservation and Access,***
http://www.nedcc.org/digital/dighome.htm
A web resource providing information on the issues surrounding the digital conversion of collection materials. With contributions from many of the School for Scanning series presenters, it provides information on project selection and

management, technical and copyright considerations, digital longevity and includes commentary on the transformation in scholarly access and preservation tenets required to fully utilize and maintain digital images

Genres, materials and communities: Miscellaneous Digital Materials

[approximately 4 resources identified]

Although it was expected that there would be many kinds of specialised materials that might fit into this category, only a very few guidance documents were identified, concerning e-learning materials and personal collections.

As interest in maintaining access to digital information resources continues to grow beyond current collecting institutions, and as the uses of digital information moves into more and more areas of life, the need for guidance that addresses new communities of users can be expected to increase.

Some sample guidance resources:

Baker, Ed; James, Hamish; Knight, Gareth; Milligan, Colin; Polfeman, Malcolm; and Rist, Roger, 2004, *Long-Term Retention and Reuse of E-Learning Objects and Materials, Version 1.4*,
http://www.jisc.ac.uk/uploaded_documents/LTR_study_v1-4.doc
This study has been commissioned to examine the factors that may affect the long-term retention and reuse of learning object and materials, and to make recommendations on how best to address these challenges.

Beagrie, Neil, (2005), "Plenty of Room at the Bottom? Personal Digital Libraries and Collections", in *Dlib magazine* June 2005
http://www.dlib.org/dlib/june05/beagrie/06beagrie.html
This article comments on the growth in the amount of digital content produced and stored by individuals and discusses the implications of this for collecting institutions. It surveys recent research and current services for storage and management provided by commercial organisations.

JISC, 2005, *Paradigm : Personal Archives Accessible in Digital Media*
http://www.paradigm.ac.uk/
This is a two-year exemplar project, from January 2005 to December 2006, to explore the issues involved in the long-term preservation of digital private papers. Using the digital papers of contemporary United Kingdom politicians, the project will test digital preservation tools and digital repositories, and produce an online Workbook on Digital Private Papers which includes template policies and procedures.
Collaboration of University of Oxford Bodleian Library and the University of Manchester John Rylands University Library.

Ourmedia, 2005, *Ourmedia : the Global Home for Grassroots Media*
http://ourmedia.org/
Ourmedia is an open source personal digital archive project that hosts audio, video, text and images. The alpha version was released in 2005. Its partners include the Internet Archive, Bryght, Creative Commons and Wikipedia. Ourmedia is a free service, the only proviso in using this facility is that contributed works are made available globally. Ourmedia resources will be archived and stored on the Internet Archive so they will be guaranteed permanence and future access.

Genres, materials and communities: Online Information and Web Resources

[approximately 24 resources identified]

> There is a great deal of activity at national and international levels, producing a rich literature on "web archiving". So far, this has not gone very far in providing guidelines on long term management of web archives. However, some important international collaborations such as IIPC are developing workflows and tools which will tend to standardise practices in the short- to medium terms, and can be expected to become a rich source of guidance.

Some sample guidance resources:

Marill, J.; Boyko, A.; and Ashenfelder, M., 2004, ***Web Harvesting Survey*****,**
http://netpreserve.org/publications/iipc-r-001.pdf
This survey rates the harvestability of various types of web documents and websites within both the surface and deep web. The results are presented in tabular form and include types of documents, examples, formats, and difficulty ratings for harvest in terms of acquisition, parsing and presentation. More detail on problems in harvesting may be found in the complementary document, Test Bed Taxonomy for Crawler.

Brugger, Niels, 2005, ***Archiving Websites : General Considerations and Strategies,*** **Centre for Internet Research**
http://cfi.imv.au.dk/eng/pub/webarc
The topic of this monograph is the micro archiving of websites. Micro archiving is defined as small scale archiving by individuals who have limited space, such as a desk top computer, and require the archiving for study or research. Other topics covered include the testing of currently available archiving software and the development of micro archiving strategies. The website associated with the electronic version of this monograph has additional information including detailed test descriptions and results, recommendations for using individual programmes and links to resources.

Day, Michael, 2003, ***Collecting and Preserving the World Wide Web : a Feasibility Study Undertaken for the JISC and Wellcome Trust*****,**
http://www.jisc.ac.uk/uploaded_documents/archiving_feasibility.pdf
The study is an analysis of the task of archiving the web, and includes a review of current web archiving activities and approaches.

ERPANET, 2003, ***Preserving the Web*****,**
http://www.erpanet.org/events/2003/kerkira/index.php
ERPANET workshop on web archiving with seminar presentations and briefing papers

JISC, 2003, ***Web Standards and Guidelines,***
http://www.jisc.ac.uk/index.cfm?name=topic_standards
A topic from an Advice and Guidance Series giving brief guidance on recommended practice for the creation and maintenance of stable and usable web content.

National Archives of Australia, 2001, ***Archiving Web Resources: Guidelines for keeping records of web-based activity in the Commonwealth Government*****,**

http://www.naa.gov.au/recordkeeping/er/web_records/guide_contents.html
This document offers specific strategic and technical advice to help Australian Commonwealth government agencies establish good record-keeping strategies for web-based activities.

National Library of Australia, 2002, *Safeguarding Australia's web resources: guidelines for creators and publishers*,
http://www.nla.gov.au/guidelines/webresources.html
The guidelines provide advice on creating, describing, naming and managing web resources to facilitate their ongoing use. The practices that are recommended will make it easier to carry out future preservation actions, which may be necessary in the longer term to maintain continued access to important resources.

Netpreserve.org : *International Internet Preservation Consortium*,
http://netpreserve.org/about/index.php
Coordinated by the Bibliotheque nationale de France, the International Internet Preservation Consortium (IIPC) also comprises the National libraries of Australia, Canada, Denmark, Finland, Iceland, Italy, Norway, Sweden, United Kingdom ,The Library of Congress (USA) and the Internet Archive. The Consortium concentrates on advocacy for internet archiving initiatives, developing standards and internet archiving tools, and raising international awareness of internet preservation issues.

Genres, materials and communities: Physical format digital materials

[approximately 13 resources identified]

While there is a considerable body of guidance on the basic care of physical format carriers used for this category of materials, there is little discussion of the need for good documentation, transfer to more stable media or stable archiving systems, methods of dealing with software dependencies, and the challenges of preserving materials that incorporate copy protection devices.

Although digital publication is increasingly moving online, many organisations have urgent needs for guidance in managing large legacy collections of complex physical format digital publications, many of which are already approaching the end of the useful life of their carrier and/or underlying software dependencies.

Some sample guidance resources:

Bennett, H., 2004, *Understanding Recordable & Rewritable DVD*
http://www.osta.org/technology/pdf/dvdqa.pdf
This paper, in question/answer format, features information on specifications, construction, handling, care and storage, labelling and longevity of recordable and rewritable DVDs. Also featured is a bibliography of resources

Berkmeyer, J., 1999, *Mapping Functionality of Off-Line Archiving and Preservation Systems to OAIS*
http://www.kb.nl/coop/nedlib/meetings/frankfurt/GEN-232.doc
This paper discusses the preservation of physical format digital materials by national libraries and then considers it in the context of the OAIS model as specified in the *Reference Model for an Open Archival Information System (OAIS) (version 4.0)* by the Consultative Committee on Space Data Systems. It concludes that the OAIS model is indeed relevant to the preservation of physical format digital materials.

National Library of Australia, 1999, *First steps in preserving digital publications*
http://www.nla.gov.au/pres/epupam.html
This online version of a pamphlet produced by the National Library of Australia gives practical advice on steps that can be taken to start the process of preserving your physical format digital collection.

National Library of Australia, 2004, *Preservation Processing of Physical Format Digital Publications (PFDPs)*
http://www.nla.gov.au/preserve/digipres/pfdp.html
Describes the work flow procedures used by the National Library of Australia in processing media based publications, covering assessment, documentation and preservation copying.

NIST (National Institute of Standards and Technology), 2004, *Digital Data Preservation Program : CD and DVD Archiving : Quick Reference Guide for Care and Handling*
http://www.itl.nist.gov/div895/carefordisc/disccare.html

A brief list of recommendations made by computer scientists at NIST in order to maximize longevity for CDs and DVDs, including general recommendations for long-term storage conditions.

Genres, materials and communities: Scientific, Statistical and Research Data

[approximately 19 resources identified]

A wide range of guidance is available for managing these materials, including resources from national and international peak organisations. The growth in the use of grid technologies as alternatives to discrete closed repositories has introduced new challenges, but the business imperative of protecting data for research validation and possible re-use has driven the development of widely accepted practices.

Some sample guidance resources:

Ashley, Kevin, 2004, "Preservation of Databases", in *VINE, Digital Preservation and Libraries*, Part Two Vol. 34, no. 2, 2004, pp. 66-70
http://ninetta.emeraldinsight.com/vl=6678856/cl=20/nw=1/fm=html/rpsv/cw/mcb/03055728/v34n2/s3/p66
This article provides an overview of the underlying concepts as well as issues facing institutions undertaking long term preservation of databases. Specifics of various types of databases such as dynamic and static systems are briefly discussed. Unique issues pertaining to proprietary GIS systems such as the lack of standards in storing data are also canvassed. Two technical approaches to preservation are discussed, XML and emulation.

CODATA/ICSU, 2004, *Task Group on Preservation and Archiving of Scientific and Technical Data in Developing Countries*, International Council for Science, Committee on Data for Science and Technology
http://www.tgdc-codata.org.cn/
Established in 2002, the objectives of the Task Group include the "promotion and understanding of the particular conditions in developing countries with regard to long-term preservation, archiving, and access to scientific and technical (S&T) data; the advancement of improved archiving procedures, technologies, standards, and policies; the provision of an interdisciplinary forum and mechanisms for exchanging information about S&T data archiving requirements and activities, with particular focus on the concerns of developing countries; and the dissemination of the results of these efforts." The Task Group regularly convenes conferences and workshops.

Economic and Social Data Service, 2004, *Data Formats and Software*,
http://www.esds.ac.uk/aandp/create/data.asp
A list of preferred and acceptable formats for data and documentation for acceptance into the UK Data Archive. The ESDS has preferred, acceptable and problematic formats for depositing data. The ESDS provides advice on best practice in format conversion.

Economic and Social Data Service, 2004, *ESDS Access and Preservation, Create and Deposit,*
http://www.esds.ac.uk/aandp/create/create.asp
A guidance document on the required procedures and documentation and other considerations that assist in creating best practice data for inclusion into the UK data service.

ERPANET, 2003, *The Long Term Preservation of Databases*
http://www.erpanet.org/events/2003/bern/Bern_Report_final.pdf
Report of the workshop held at the Swiss Federal Archives, Bern, April 9-11, 2003.

Hodge, G, and Frangakis, E, 2004, *Digital Preservation and Permanent Access to Scientific Information : The State of the Practice*,
http://cendi.dtic.mil/publications/04-3dig_preserv.html
This report is an update to "Digital Electronic Archiving: the State of the Art and Practice" report, also jointly sponsored by the International Council for Scientific and Technical Information (ICSTI) and CENDI. It focuses on operational digital preservation systems used specifically in science and technology, while considering the wide range of digital objects as well as different format types, including text, data, audio, video, etc. The report identified 50 projects and systems used by various international organizations to preserve digital science data, of which 21 were selected to highlight because of the operational nature of their systems as well as the potential wider interest to the scientific community

Inter-university Consortium for Political and Social Research (ICPSR), 2005, *Guide to Social Science Data Preparation and Archiving*: *Best Practice Throughout the Data Life Cycle* (3rd edition)
http://www.icpsr.umich.edu/ACCESS/dpm.html
This is ICPSR's guide to the task of preparing data for deposit in a public archive. It is mostly focused on quantitative data generated by statistical software like SPSS or SAS.

Robinson, Damian, and Richards, Julian (editors), 2000, *Digital Archives from Excavation and Fieldwork : Guide to Good Practice: 2nd Edition,* Arts and Humanities Data Service
http://ads.ahds.ac.uk/project/goodguides/excavation/
This guide discusses best practice in the creation, management, preservation and re-use of digital records produced during the various phases of archaeological projects.

Royal Statistical Society; UK Data Archive, 2002, *Preserving and Sharing Statistical Material*,
http://www.data-archive.ac.uk/home/PreservingSharing.pdf
This booklet is aimed at promoting the preservation and sharing of electronic data. It also discusses what should be preserved and includes the RSS Code of Best Practice on the Preservation and Sharing of Statistical Material.

Testbed Digitale Bewaring, 2003, *From Digital Volatility to Digital Permanence : Preserving Databases*
http://www.digitaleduurzaamheid.nl/bibliotheek/docs/volatility-permanence-databases-en.pdf
The final recommendations of the Testbed Digitale Bewaring on the long term preservation strategy for databases. This publication discusses characteristics of databases, requirements for retaining authenticity plus a comparison of preservation strategies including migration encoding and emulation. It concludes that the conversion of databases to XML is the most suitable preservation strategy. This contains sections targeted towards specific groups such as managers, IT specialists

and end users for implementation of preservation strategies. A decision model, cost model and functional requirements are also included.

Genres, materials and communities: Spatial, Geospatial and Similar Datasets

[approximately 12 resources identified + many uncited sources on metadata standards]

While materials in this category include many complex mapping products, there is a strong business need to maintain both data integrity and accessibility, so a number of agencies have produced guidance documents. There has also been widespread standardisation of metadata. There is a growing pattern of collaboration between agencies, and action by peak bodies in negotiating and promulgating data standards and guidance.

Some sample guidance resources:

Bewley, Robert; Donoghue, Danny; Gaffney, Vince; Wise, Alicia; and van Leusen, Martijn, 1998, *Archiving Aerial Photography and Remote Sensing Data: a Guide to Good Practice*, Arts & Humanities Data Service
http://ads.ahds.ac.uk/project/goodguides/apandrs/
This guide discusses best practice in the creation, management, preservation, and re-use of remotely collected data including aerial photography such as optical and infrared imagery, and satellite and airborne remote sensing.

Bleakly, Denise R., 2002, *Long Term Spatial Data Preservation and Archiving : What are the Issues?* Sandia National Laboratories
http://www.prod.sandia.gov/cgi-bin/techlib/access-control.pl/2002/020107.pdf
This report discusses the activities of several United States government agencies relating to data management and preservation of geospatial data. It includes a general overview of the various digital preservation strategies and describes how geospatial data is unique and what makes it more difficult to archive compared to other types of data.

Folk, Mike, and Choi, Vailin, 2004, *Scientific Formats for Geospatial Data Preservation : a Study of Suitability and Performance,* National Center for Supercomputing Applications (NCSA)
http://www.ncsa.uiuc.edu/NARA/Sci_fmts_and_geodata_HDF.pdf
This report discusses the preservation of federal geospatial data at the NARA (National Archives and Records Administration). Geospatial data is characterised by its large volume and variable formats. This report describes the various types of geospatial data, storage and access requirements of this data, and the suitability of HDF5 as a preservation format.

CIESIN (Center for International Earth Science Information Network, Columbia University) (ciesin.info@ciesin.columbia.edu), 2004, *Geospatial Electronic Records*
http://www.ciesin.columbia.edu/ger/
This website, developed through the Managing and Preserving Geospatial Electronic Records project and funded by NARA (United States National Archives and Records Administration), aims to identify and disseminate practical policies, techniques, standards, and procedures to manage, preserve, and provide access to electronic

records that have significant geospatial components, especially those generated by a Geographic Information System (GIS).

National Archives and Records Administration (NARA), *Expanding Acceptable Transfer Requirements: Transfer Instructions for Permanent Electronic Records, Digital Geospatial Data Records*
http://www.archives.gov/records_management/initiatives/digital_geospatial_data_records.html
A guidance document on the preferred and accepted standards for the transfer of GIS data to NARA.

Robinson, Damien; Eiteljorg, Harrison II; Huggett, Jeremy; and Fernie, Kate, 2002, *CAD: A Guide to Good Practice*, Archaeology Data Service
http://ads.ahds.ac.uk/project/goodguides/cad/
The Guide is based on the premise that many organisations create and use computer aided design (CAD) software for archaeological and architectural projects. Increasingly CAD files comprise a component of project archives which are born digital, used digitally and which may not fully be re-produced on paper. The CAD guide is aimed at those who create CAD files, at project managers and at those considering the management of CAD archives. The guide offers a description of CAD software with a discussion of its use in a variety of situations, methods of data capture and good practices in the preparation of CAD models including consideration of layer naming schemes, drawing conventions and file formats. The guide provides an invaluable source of information about the management of digital data both during the project life-cycle and for its long-term preservation, archiving and effective data re-use. As a result it emphasises the importance of adhering to standards and of documentation essential information to support the re-use of the resource. The CAD Guide to Good Practice is of use to academic researchers, staff in national heritage agencies and local authorities, project field-workers, illustrators and others who are using CAD files as the foundation on which to build mapping applications and virtual reality models.

Schmidt, Armin, 2002, *Geophysical Data in Archaeology: a guide to good practice*
http://ads.ahds.ac.uk/project/goodguides/geophys/
The Guide to Good Practice offers an introduction to archaeological geophysics and the variety of data that are produced including raw measurement data, processed data and interpretative drawings. The guide emphasises the importance of ensuring that effective documentation is available for effective re-processing and re-interpretation of geophysical data. It also provides an introduction to storage and archiving of geophysical datasets in the UK.

Zaslavsky, Ilya, 2001, *Archiving Spatial Data: Research Issues*, San Diego Supercomputer Center Technical Report
http://www.sdsc.edu/TR/TR-2001-06.doc.pdf
A report discussing the issues around creating preservable spatial data.

Current awareness resources

There are many current awareness services available for maintaining an understanding of issues and developments. These include sources of access to current literature, opportunities to ask questions, training programs, and reports from practitioners.

Personal contact with practitioners in major libraries and archives is a key source of up to date guidance. However, practitioners are usually constrained in their capacity to provide personal advice. In most cases, what they have to offer is available through reports and discussion papers that can be found via the other current awareness mechanisms mentioned below.

Although discussion lists are potentially useful avenues for discussion, most of the traffic on many of the lists mentioned below tends to be announcements of events and publications.

Some sample current awareness resources:

Subject gateways and indexes

Berkeley Digital Library SunSITE
http://sunsite.berkeley.edu/
This site, maintained by University of California Berkeley Library and Sun Microsystems Inc., builds digital collections and services, as well as providing information and support to digital library developers worldwide. It includes links to information on topics such as copyright, metadata, preservation and standards; digital library projects; tools for building digital libraries.

CoOL Conservation OnLine : Resources for Conservation Professionals
http://palimpsest.stanford.edu/
CoOL, a project of the Preservation Department of Stanford University Libraries, is a full text library of conservation information, covering a wide spectrum of topics of interest to those involved with the conservation of library, archives and museum materials. It includes sections on electronic media and records.

Creating and Managing Digital Content
http://www.chin.gc.ca/English/Digital_Content/index.html
This web site, maintained by the Canadian Heritage Information Network (CHIN), provides guidance on creating and managing digital resources for heritage projects, including an overview of issues and resources in preservation of digital materials.

DigitCULT Consortium, *DigiCULT Resources*
http://www.digicult.info/pages/resources.php
An aggregated resource with many links to various digital preservation related issues. The resource is broken down into themes, forums and topics.

PADI: Preserving Access to Digital Information
http://www.nla.gov.au/padi/

The PADI web site is a subject gateway to international digital preservation resources. Maintained by the National Library of Australia, with input from international contacts, citations listed on PADI are held in a database for easy searching. As well as a very wide range of linked resources, the website includes structured "trails" that identify key resources on certain subjects (including a Beginners Trail), and a Quarterly Digest of the most significant developments in digital preservation.

Discussion lists

DIGITAL-PRESERVATION
http://www.jiscmail.ac.uk/lists/digital-preservation.html
The DIGITAL-PRESERVATION discussion list has been established to carry announcements and information on activities relevant to the preservation and management of digital materials in the UK. It will be used to disseminate information on the work of JISC Digital Preservation Focus, the Digital Preservation Coalition and related initiatives.

DIGLIB
http://www.ifla.org/II/lists/diglib.htm
A moderated discussion list sponsored by the International Federation of Library Associations (IFLA) for librarians, information scientists, and other information professionals to discuss issues relating to the creation of digital libraries.

EPIC-LST
http://www.knaw.nl/ecpa/discussion.html
A discussion list hosted by the European Commission on Preservation and Access (ECPA) for all those concerned with preservation of intellectual heritage, including librarians, archivists, researchers and policy makers. It includes discussion of digital preservation issues.

ERECS-L
http://listserv.albany.edu:8080/archives/erecs-l.html
A moderated list for archivists and other information professionals which provides a forum for discussion of ideas, techniques, and issues associated with the management and preservation of electronic records. It also provides a vehicle for the electronic distribution of publications, newsletters, and grey literature associated with managing electronic records.

Mattison, David, *Ten Thousand Year Blog*
http://www.davidmattison.ca/wordpress/
This blog (web log) was created in June 2003 and is owned and maintained by an archivist, David Mattison. The blog includes comments and links to news and resources on digital preservation, digital libraries, digital records, intellectual property rights and e learning. The site also provides commentary on current trends in online information preservation and management..

OAIS Implementers Discussion List (oais-implementers@lists2.rlg.org)
http://www.rlg.org/longterm/oais.html

A discussion list hosted by the Research Libraries Group (RLG) intended for individuals and institutions actively working with the Open Archival Information Systems (OAIS) Reference Model in an effort to model, build and manage digital archives or repositories.

padiforum-l
http://www.nla.gov.au/padi/forum/
padiforum-l is a moderated discussion list for the exchange of news and ideas about digital preservation issues.

Preservation Administration Discussion Group (PADG-L)
http://palimpsest.stanford.edu/byform/mailing-lists/padg/
This list covers preservation of both digital and (predominantly) traditional materials.

WEB-ARCHIVE
http://listes.cru.fr/wws/info/web-archive
"This list is focused on on-line content archiving, from the technical, legal and organisational point of view... It is intended to facilitate exchanges between people involved in Web archiving projects around the world, whether they are governmental or private initiatives."

Training providers, seminar organisers and publishers

Cornell University Library, Department of Preservation and Collection Maintenance, *Education and Training,*
http://www.library.cornell.edu/preservation/index.html
Cornell University Library organises and provides a range of digital preservation related training programs including tutorials and workshops.

Council on Library and Information Resources, *CLIR issues*
http://www.clir.org/pubs/issues/issues.html
Published by the Council on Library and Information Resources, the bimonthly *CLIR Issues* covers information resources and services, from traditional library and archival materials to digital formats, and provides news and information relevant to digital preservation issues. CLIR also publishes occasional *Reports*, some of which focus on digital preservation issues. CLIR is also an active organiser of seminars and conferences relevant to digital preservation.

Digital Preservation Coalition
http://www.dpconline.org/
Established in 2001, the Digital Preservation Coalition is supported by a wide range of UK institutions. The Coalition's aim is to develop and pursue a UK digital preservation agenda within an international context. As well as advocacy activities, the DPC plays a leading role in organizing training and information exchange opportunities.

ERPANET: Electronic Resource Preservation and Access NETwork
http://www.erpanet.org/

ERPANET, funded by the European Commission, aims to establish a European Consortium to provide a virtual clearinghouse and knowledge-base on state-of-the-art developments in digital preservation. Focusing on the areas of cultural heritage and scientific objects, it will facilitate the transfer of expertise, information, best practice and skills development among individuals and institutions, bringing together industry, academic and memory institutions, entertainment and government organisations.

European Commission on Preservation and Access (ECPA)
http://www.knaw.nl/ecpa/about.html
The European Commission on Preservation and Access (ECPA) "acts as a European platform for discussion and cooperation of heritage organisations in areas of preservation and access". Its website contains news and information about projects, activities, publications and other resources related to the preservation of documentary heritage (including digital material) in Europe.

Nestor : Kompetenznetzwerk Langzeitarchivierung : Network of Expertise in Digital Preservation
http://www.langzeitarchivierung.de/index.php?newlang=eng
Nestor, the German Network of Expertise in long term storage of digital information, began in June 2003 as a cooperative effort between six partners lead-managed by the German National Library (Die Deutsche Bibliothek). The goal is a permanent distributed infrastructure primarily for long term accessibility of digital resources and less so for pure preservation aspects, comparable to the Digital Preservation Coalition in the United Kingdom. Nestor will provide a broad communication platform for all interested institutions as well as various guidelines for standardised digital preservation policies and coordinated activities to be utilised mostly within Germany and possibly to be extended via international cooperation.

Research Libraries Group, *RLG DigiNews*
http://www.rlg.org/en/page.php?Page_ID=12081
RLG DigiNews is a bi-monthly online newsletter which provides information on digital imaging and digital preservation.

Sectoral guidance bodies

Arts and Humanities Data Service
http://ahds.ac.uk/
AHDS is a national UK service to collect, describe and preserve the electronic resources which result from research and teaching in the humanities. One of its aims is to develop strategies for preserving digital cultural heritage.

Australian Partnership for Sustainable Repositories (APSR)
http://www.apsr.edu.au/index.html
This project, funded by the Australian Dept. of Education, Science and Training, has five partners - the Australian National University, National Library of Australia, University of Queensland, University of Sydney and the Australian Partnership for Advanced Computing. The aim of the project is to act as a centre of excellence for the management of scholarly assets in digital format. The project consists of four

interlinked programs - digital continuity and sustainability; international linkages; national services; and practices and testbeds.

CENDI Digital Preservation Task Group
http://cendi.dtic.mil/proj_dig_elec_arch_new.html
CENDI is an interagency working group of senior Scientific and Technical Information Managers from 12 U.S. federal agencies. CENDI's mission is to help improve the productivity of federal science- and technology-based programs through effective scientific, technical, and related information-support systems. CENDI's Digital Preservation Task Group reviews digital archiving practices and guidelines developed by publishers, library organizations and other stakeholder groups to see if these practices and guidelines can be used in the federal information environment. The Task Group organises workshops and conferences on its activities and on digital preservation issues.

CIESIN (Center for International Earth Science Information Network, Columbia University) (ciesin.info@ciesin.columbia.edu), 2004, *Geospatial Electronic Records*
http://www.ciesin.columbia.edu/ger/
This website, developed through the Managing and Preserving Geospatial Electronic Records project and funded by NARA (United States National Archives and Records Administration), aims to identify and disseminate practical policies, techniques, standards, and procedures to manage, preserve, and provide access to electronic records that have significant geospatial components, especially those generated by a Geographic Information System (GIS).

CODATA/ICSTI Prototype Portal on Permanent Access to Scientific Data and Information
http://stills.nap.edu/shelves/codata/index.html
[CODATA is the Committee on Data for Science and Technology, which is part of the International Council of Science (ICSU). ICSTI is the International Council on Scientific and Technical Information.] This website is a portal to resources on managing and preserving geospatial data and related electronic records. It contains links to a Guide to Managing Geospatial Electronic Records; a Data Model for Managing and Preserving Geospatial Electronic Records; categorized references to related resources; project presentations; and materials from *Extending the Boundaries: A workshop on Managing and Preserving Geospatial Electronic Records.*

DCC: Digital Curation Centre
http://www.dcc.ac.uk
Consisting of four partner institutions - the University of Edinburgh, University of Glasgow, UKOLN at the University of Bath, and the Council for the Central Laboratory of the Research Councils - the Digital Curation Centre (DCC) aims to support UK Higher Education and research institutions to store, manage and preserve digital data for long-term access. The website includes links to information about the Digital Curation Centre, a definition of digital curation, DCC aims and objectives, and an overview of the DCC research agenda.