Guidance

Technical good practice in ICT

SCOTTISH MUSEUMS COUNCIL

Introduction

SMC published *A national ICT strategy for Scotland's museums* in 2004. This strategy recognises the fact that as more museums develop electronic material, technical standards in ICT become more important.

Consultations carried out during the development of the ICT strategy also highlighted museums' desire to have access to clear and practical introductory guidance on technical issues.

In 2004-2005, SMC commissioned the Centre for Digital Library Research (CDLR) at the University of Strathclyde to produce a report identifying relevant existing technical standards for a range of electronic content types. The CDLR's research formed the basis for this document, which is designed to provide museums with good practice guidance on the technical aspects of ICT.

Who is this guidance aimed at?

This good practice guidance has been written for museums planning to carry out or commission projects involving ICT to produce electronic content. The types of electronic content produced by museums varies, and includes digitised images of objects or photographs, textual information, web sites, and multimedia such as video or audio. This can be used for a range of functions including collections management, interpretation and producing learning materials.

This guidance is designed to be integral to SMC's grants programme. Museums planning grant applications to SMC that involve ICT are expected to refer to this guidance. They must also demonstrate that they are aware of any applicable technical standards, and that they will work to implement them during their projects.

Good practice in ICT projects is not however confined to the technical process. A good ICT project should also have a positive *impact* on its intended audiences. It is essential that end users are taken into account from the outset when planning ICT projects, and robust mechanisms for evaluating user impact are put in place.

Museums should refer to the SMC publication *Museums, Galleries and Digitisation: Current best practice and recommendations on measuring impact*. This provides specific guidance on ensuring that ICT projects have a positive impact on end users,

and that this impact can be measured and demonstrated properly. This can be downloaded from the SMC web site:
http://www.scottishmuseums.org.uk/areas_of_work/ICT/digitisation.asp

How to use this guidance

The guidance is structured around the different types of electronic content commonly produced by museums. While it provides signposting on what museums need to take into account, it is not designed to be definitive and does not provide details on the 'how'.

It does provide museums with a starting point though, and presents an overview of the appropriate technical issues along with signposting to more detailed information that is widely available.

For each general issue or type of electronic content, specific good practice recommendations are given in that area. Signposting is also provided to more detailed technical information.

What are technical standards and why are they important?

Technical standards in ICT can be defined as a set of specifications or guidelines, that are designed to be referred to when carrying out ICT projects. Technical standards are important for a number of reasons:

- **Interoperability**
  By using established and open standards, museums can be confident that the electronic resources that they produce will be compatible alongside those created by other organisations using the same standards. For example, by creating their web site using valid HyperText Markup Language (HTML), a museum can be confident that people will be able to view it properly on a range of different browsers and computer types.

- **Quality**
  Museums can also ensure that the electronic resources they produce are of a certain quality. For example, when scanning a collection of photographs, a minimum image resolution and file type must be specified to ensure that the digitised images are of a good quality.

In ICT, there are two main types of technical standard: open standards and proprietary standards. The main differences between these are summarised in the table below:

Open standards	Proprietary standards
• Developed in open consultation with the technical communities. • Documentation of the standard is freely available. • The standard can be used uninhibited by license or patent issues. • The standard is ratified by a recognised standards body. **E.G:** HyperText Markup Language (HTML), Rich Text Format (RTF)	• Developed and owned by an organisation or group. • The exact specification of the standard is a copyrighted property rather than public knowledge. **E.G:** Portable Document Format (PDF), Microsoft Word Document format (DOC)

Open standards are attractive because they are freely accessible and established within the technical communities, and are usually more widely used. Using open standards means that access to electronic resources is not dependent on users having a specific software application or hardware platform. By adhering to open standards, museums can also be more confident that their data can be preserved and accessed in the long term.

Proprietary standards are formats owned by an organisation or group (such as Microsoft or Apple). Although such formats may be free to use and accepted as de-facto standards, and may even be referred to as standards, they cannot be classed as open since the organisation which owns the standard could choose to change the format or conditions of usage at any time. Where proprietary formats are being used therefore, museums should think about how to move to a suitable open standard instead.

As a general rule, open technical standards should be used wherever possible, rather than proprietary standards.

General issues to take into account

This section relates to general technical issues that museums should take into account when carrying out ICT projects.

1. Backup and recovery planning
By its nature, electronic data is vulnerable to loss or damage resulting from hardware or software faults. Museums can generate large amounts of electronic data that has taken a long time to produce, such as object documentation records or collections of digitised images. By backing up data properly and regularly, museums can be confident that if important electronic information is lost there will be an up to date copy available.

Furthermore, backing up accession records, either electronically or in hard copy, is a requirement of the museum Accreditation scheme.

Recommendations: Backup and recovery planning

- ✓ A backup copy of electronic data should be saved onto an appropriate storage media like digital tape, CD-ROM or DVD. A backup routine should be followed, so that updated backups are created on a regular basis.

- ✓ Data backup and recovery procedures should be fully documented so new staff can follow them easily.

- ✓ Recovery procedures should be tested on a regular basis to ensure that data can be successfully restored, and that the backups remain compatible with changing technology.

- ✓ Backups should be stored off site if possible, as a precaution against natural or other disasters.

How to find out more: Backup and recovery planning

- ➔ MDA fact sheet: Protecting your records: http://www.mda.org.uk/protect.htm

- ➔ Jones, Maggie & Baigrie, Neil (2001, page 97). Preservation Management of Digital Materials: A Handbook. British Library: http://www.dpconline.org/graphics/handbook/

2. Storage media and environment

Electronic storage media can take several forms, including computer hard disks, digital tape, CD-ROM or DVD. This media does deteriorate with time, and there is a risk that valuable information contained on it may become corrupted if care is not taken when storing and maintaining it.

Recommendations: Storage media and environment

- ✓ Storage media, and the hardware used to access it should be of high quality and be well maintained over time, even after digitisation projects have ended.

- ✓ As with paper archives, electronic archival media should be handled or used as infrequently as possible.

- ✓ Electronic archives should be transferred to new media periodically, to avoid degradation of the physical disks or tape. As a general rule, this should be done once a year.

- ✓ Storage media and the hardware to access it should be stored and operated in suitable environmental conditions. Manufacturers will usually provide information on appropriate operating environments for their products.

How to find out more: Storage media and environment

- ➔ Jones, Maggie & Baigrie, Neil (2001, page 96-97). Preservation Management of Digital Materials: A Handbook. British Library: http://www.dpconline.org/graphics/handbook/

➔ Benchmarks in Collection Care for Museums, Archives and Libraries. MLA: http://www.mla.gov.uk

3. File naming systems

The issue of how to name computer files should be considered at the very outset of a project. These may include digitisation or documentation projects, that can result in the creation of thousands of individual files. Consistent file naming helps to avoid confusion or duplication.

Recommendations: File naming systems

✓ A well structured and consistent naming system should be devised and implemented from the beginning of a digitisation or other ICT project.

How to find out more: File naming systems

➔ TASI (2002). Creating Digital Images: File Naming. ILRT, University of Bristol: http://www.tasi.ac.uk/advice/creating/filenaming.html

4. Metadata

Metadata is simply information *about* information. It is used to record information about documents, museum object records, digitised images or other electronic material produced by museums. This metadata can then be used by software such as web search engines, databases or content management systems to help people find or categorise records and other electronic resources.

Information commonly stored as metadata includes authorship, publication date, modification date, copyright information, and subject keywords.

For example, this digitised photograph which has been stored in a computer database might have some of the following information associated with it as metadata:

Title:	Balvaird Castle
Creator:	A. Photographer
Creation date:	2006
Subject keywords:	Balvaird, Castle, Fife, Scotland

In this instance, if someone were to search the database of digitised images using the keyword 'Castle', this image would appear in the search results because the keyword 'Castle' has been recorded as metadata for the photograph. Without the associated metadata, the computer would have no way of knowing that the image depicts a castle.

A standardised approach to metadata is very important to ensure interoperability, because it means that information about electronic resources is recorded in a consistent way.

A wide range of metadata standards and specifications are in use within the museums, libraries and archives domains, and within the cultural and educational sectors generally. The most commonly used is Dublin Core (DC), but museums working closely with libraries may chose to use MARC. Others may find METS or IEEE LOM more appropriate. Mappings exist between the most widely used standards to aid interoperability.

Ultimately, the choice of metadata standard depends on the nature of the materials being described, the use to which the metadata will be put and the choices made by partner organisations.

How to find out more: Metadata

➔ UKOLN Interoperability Focus:
http://www.ukoln.ac.uk/interop-focus/

➔ UKOLN Interoperability Focus metadata pages:
http://www.ukoln.ac.uk/metadata/

➔ CMS Metadata Interoperability Project guidelines on metadata:
http://cms.cdlr.strath.ac.uk/

Types of electronic content and relevant standards

This section discusses the various types of electronic content commonly produced by museums, and provides good practice guidelines on each.

1. Digital images

Digitisation is a technique that enables museums to share information about their collections electronically. Within museums, digitisation can be defined as *"the process of converting objects and documents into digital form, for example through digital photography or scanning."*

- **File formats**
  There are a number of different file formats that can be used to save and display digital images on computers, and each have attributes that make them suitable in different circumstances. These are summarised in the table below:

Recommendations: Digital images, file formats

Use	File format	Image quality	Notes
Archiving original digitised images.	TIFF (Tagged Image Format).	TIFF files tend not to be compressed, so the digital image is stored at its highest possible quality for archiving.	TIFF files tend to be large in size, which makes them unsuitable for use on web sites. More expensive digital cameras may also produce uncompressed RAW image files. These are proprietary formats, and should be saved as TIFF files once they have been downloaded from the camera.
Displaying digital photographs on web sites.	JPEG (Joint Photographic Experts Group, also referred to as JPG).	Saving an image as a JPEG file means that it can be compressed to reduce its file size for quicker download times. Greater compression means smaller file sizes and faster download times, but more loss of image quality.	JPEG format may also be suitable for image capture and archival storage in some cases. For example, cheaper digital cameras may only produce JPEG files. These will be of a lower quality than TIFF images, and should not be used for large scale digitisation projects.

- **Image resolution**
  Image resolution refers to the number of individual pixels of colour or greyscale information stored in a digital image. The higher the resolution, the more pixels the image contains, generally (but not always) resulting in a higher quality image.

  When photographing or scanning in photographs or other documents, the resolution at which this is done will usually effect the quality of the digitised image. The maximum resolution will depend on the scanning or photographic hardware that is used. Higher resolutions will result in larger file sizes, but as a general rule images should be captured at the highest practical resolution possible. This will result in high quality archival images that can be copied and compressed for day to day use.

Recommendations: Digital images, resolution

✓ When scanning photographic prints, a resolution of 600 dpi and a bit depth of 24-bit colour or 8-bit greyscale should be considered.

✓ 2400 dpi should be used for 35mm slides in order to capture their high level of detail.

How to find out more: Digital images

➔ TASI (Technical Advisory Service for Images):
http://www.tasi.ac.uk

➔ MDA Fact Sheet: Computer Graphics:
http://www.mda.org.uk/graphics.htm

➔ MDA Fact Sheet: Digitisation:
http://www.mda.org.uk/digitise.htm

2. Web pages

As more museums get online with their own web site to share information about their collections and services, technical standards in this area become increasingly important.

Due to the universality of the web, there is no way of knowing what kind of computer hardware, web browser or other software someone trying to access a museum's web site will be using.

For example, a web site displayed using the Netscape web browser on an Apple computer will appear slightly differently when it is displayed on a Windows computer using Internet Explorer. This discrepancy will be further emphasised if someone is accessing the web site using a handheld computer, mobile phone, or digital TV. In a worst case scenario, it may not work at all and people will be unable to access the content of the web site if they are using certain software and hardware configurations.

By adhering properly to open technical standards for the web, museums can help to ensure that their web sites will work with the widest possible range of hardware and software configurations, and therefore reach the widest possible audience.

- **HyperText Markup Language (HTML)**
  HTML is one of the core technologies that make up the World Wide Web. It is the computer code that is used to create web pages so they can be viewed using a web browser like Internet Explorer. To view the HTML code that makes up a web page, simply select 'Source' from the 'View' menu in Internet Explorer.

  The HTML standard is maintained by the World Wide Web Consortium (W3C for short). The W3C is an international consortium that works to develop open web standards.

  Various proprietary incarnations of the original HTML standard have been developed, that add different types of functionality. However, these do not often enjoy the widespread support and open access of the original standard. Consequently, the only way to be confident that a web page will be fully accessible and standards compliant is to use valid HTML.

Recommendations: Web pages, HTML

✓ Web pages should be created with valid HTML or XHTML using the latest version of each recommended by the W3C. Currently these are HTML version 4.01 and XHTML version 1.0.

How to find out more: Web pages, HTML

➔ World Wide Web Consortium HTML home page:
http://www.w3.org/MarkUp/

➔ HTML validator (use to test a web site against the relevant standards):
http://validator.w3.org/

- **Cascading Style Sheets (CSS)**
  CSS is a language that can be used in conjunction with HTML to control the appearance of web pages. One CSS file can be used to define the colours, fonts, and general look and feel of an entire web site that might consist of dozens of pages. This makes it easy to change the appearance of many different web pages, simply by altering a single CSS file rather than manually changing the design of every individual page that makes up a site.

  Furthermore, people can override CSS settings on web sites to use their own personal CSS files. This is especially relevant to people with visual impairments, who may prefer to view web sites with larger text or particularly high contrast colour combinations. By using valid CSS, museums can increase the accessibility of a web site and enable more people to view the content.

Recommendations: Web pages, CSS

✓ CSS should be used to control the appearance of HTML pages, and should be validated to ensure that it complies with the appropriate CSS standard.

How to find out more: Web pages, CSS

➔ World Wide Web Consortium CSS home page:
http://www.w3.org/Style/CSS/

➔ CSS validator (use to test CSS code against the relevant standards):
http://jigsaw.w3.org/css-validator/

- **Accessibility**
  Web accessibility means making sure that information on the web is accessible to everyone, regardless of their access needs. For museums, this means creating web pages that people with diverse access needs can view, navigate, and interact with effectively.

  Since October 1999, the Disability Discrimination Act has stated that service providers must make “reasonable adjustments” to the way they deliver their services so that people with disabilities can use them. This includes web sites.

The accepted standards for web accessibility are the Web Content Accessibility Guidelines. These recommendations have been drawn up by the Web Accessibility Initiative at the W3C. They specify technical checkpoints for web developers to follow, and are categorised into three priority levels that directly impact on the accessibility of a web site.

Recommendations: Web pages, accessibility

✓ Web sites should conform to the Web Content Accessibility Guidelines as closely as possible, with Level A conformance being considered a minimum requirement.

How to find out more: Web pages, accessibility

➔ The Web Accessibility Initiative:
http://www.w3.org/WAI

➔ The Web Content Accessibility Guidelines in full:
http://www.w3.org/TR/1999/WAI-WEBCONTENT-19990505

➔ The Web Content Accessibility Guidelines checklist:
http://www.w3.org/TR/1999/WAI-WEBCONTENT-19990505/full-checklist.html

➔ MDA fact sheet: Web Accessibility for Museums:
http://www.mda.org.uk/webacs.htm

3. Digital audio

Many museums are using computers and digital recording equipment to produce audio files, such as oral histories or interpretation, that can then be made available to download from a web site or through audio tours at the museum. As with other types of electronic content, there are appropriate standards that museums should consider when making digital audio recordings.

Digital audio should be created and stored as either MP3 files (MPEG-1 Audio Layer 3), WAV files (Wave file) or the proprietary RA (Real Audio) or Microsoft Windows Audio file formats.

The following table is based on the EMII Distributed Content Framework, and provides a guide to choosing a suitable file format based on different requirements and uses:

Recommendations: Digital audio

Use	File format	Sound quality	Notes
Storage of the original digitised audio for an archive	WAV	Minimum 44100 samples per second	As with digitised images, the idea behind keeping an archive copy of the audio file is that other versions of the recording can be produced from this, preventing the need for

copy.		Stereo 16 bit samples	more digitisation in the future. Store the original data as obtained from the recording device without any sound processing (such as noise reduction or compression) since most of these operations are not reversible. The sound quality corresponds to the standard CD quality.
Playback on the web, or using a portable device like an iPod.	MP3 or WMA	256 kBit/s for near CD quality 160 kBit/s for good quality Bit rates lower than 128 kBit/s give noticeable distortion of the sound	When publishing audio on the web, audio files usually need to be compressed to allow for quicker download and playback times. These file formats allow audio files to be compressed for playback. Change any proprietary formats to MP3 unless there is a good reason not to do so. There must be open access to any of these formats (e.g. free plug-ins). WMA is Microsoft's alternative for MP3, which might be offered to the web user as an alternative to MP3.

How to find out more: Digital audio

➔ UKOLN, 2003. Technical Guidelines for Digital Cultural Content Creation Programmes. UKOLN, University of Bath: http://www.minervaeurope.org/structure/workinggroups/servprov/documents/techguid005draft.pdf

4. Digital video

It is becoming easier and cheaper for museums to use digital recording and editing equipment to produce video files. These are often made available on web sites, DVD or CD-ROM, or as interpretive material on computers in the museum.

- **File formats**

  The choice of format for the creation and storage of digital video content will depend on a number of factors, including:

  - The intended means of distribution (e.g. Internet, CD-ROM)
  - Whether the video will require editing at a later date
  - The intended audience

  There are two main types of format for digital video: progressive and streaming.

  Progressive formats require users to download the entire video before they can view it. This can result in long download times if the video is made available online. Therefore, progressive formats are generally more suited for archival

purposes or for delivery on CD-ROM and DVD, where download time is less of an issue.

Streaming formats allow users to view the beginning of the video after a few seconds, while later portions of the video are still being downloaded in the background. The quality of streaming video tends to be much lower than progressive formats due to the compression methods used. Streaming formats are better suited to delivery over the internet because of the quicker download times.

Some file formats provide both progressive *and* streaming options. A number of different progressive and streaming digital video file formats are available. The following table summarises these:

File format	**Streaming**	**Progressive**
ASF (Advanced Streaming Format)	Yes	No
AVI (Audio Video Interleave)	No	Yes
MPEG-1 (Moving Picture Experts Group)	No	Yes
MPEG-2 (Moving Picture Experts Group)	No	Yes
QT (Apple QuickTime)	Yes	Yes
RM (RealMedia)	Yes	Yes
WMV (Windows Media Video)	Yes	Yes

Adapted from: JISC QA Focus, “Choosing A Suitable Digital Video Format”. http://www.ukoln.ac.uk/qa-focus/documents/briefings/briefing-25/briefing-25-A4.doc

The prospective audience for the video content must be considered when choosing a format. If the video is intended mainly for users of computers using Windows, then a Microsoft streaming format such as ASF or WMV may be the preferred format. If a more general audience (like that encountered over the internet) is anticipated however, then formats such as RealMedia or QuickTime may be preferable.

Recommendations: Digital video, file formats

- ✓ Digital video content should be created and stored using one of the open MPEG formats, or proprietary but widely used formats such as Microsoft AVI or Apple QuickTime.

✓ Where content is to be distributed via the internet, an appropriate streaming format should be employed for quicker download times.

- **Video quality**
  The final image quality of a digital video depends on a number of different factors. These include resolution (the dimensions of the video image in pixels), colour depth (the number of colours in the video, often expressed in *bits*), and frame rate (the number of individual frames of video per second).

  It may not be possible to provide high quality video to end users: there are limitations to the storage capacity of CD-ROMs and DVDs for example, and streaming content may be restricted because of the compression methods used. The computer resource implications must also be considered (processing time, hard disk storage etc) and a minimum level of quality defined accordingly.

  The following table provides an indication of how resolution, colour depth and frame rates relate to video quality, and suggests which quality is most suited to different delivery methods:

Video quality	Resolution (in pixels)	Colour depth (in bits)	Frames per second	Delivery method
High	640 x 480	24	30	DVD
	320 x 240	16	25	CD-ROM
	320 x 240	8	15	CD-ROM
	160 x 120	8	10	Broadband internet
Low	160 x 120	8	5	Dial-up internet

Adapted from: JISC QA Focus, "Choosing A Suitable Digital Video Format".
http://www.ukoln.ac.uk/qa-focus/documents/briefings/briefing-25/briefing-25-A4.doc

Recommendations: Digital video, quality

✓ Video content should be created and archived at the highest resolution, colour depth and frame rate that are practical and affordable.

✓ Video quality should be reduced accordingly for delivery over the internet to enable quicker download times.

How to find out more: Digital video

➔ JISC QA Focus, "Choosing A Suitable Digital Video Format":
http://www.ukoln.ac.uk/qa-focus/documents/briefings/briefing-25/briefing-25-A4.doc

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