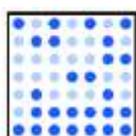


Appendix 3: Action Plan for Digital Preservation



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Introduction

Purpose of this document

The Royal College of Music Museum (RCMM) wishes to extend its digitisation programme to enable it to expand the resources and services it can provide to its various user communities within and outside the Royal College of Music, and to place itself in a position to deliver world-leading services in the future, including extensive redevelopment of the Museum's physical space.

To do this, it is seeking second-round funding from the Heritage Lottery Fund. In this context, the RCMM needs an action plan to cover the next 10 years, which also incorporates a digital preservation plan.

This report sets out a ten-year digital preservation plan for the Museum, supported by a summary of the reason for the need and the benefits of digital preservation.

We also review the Museum's existing digital materials, in particular its current 'digital assets' and their 'digital health', and summarizing short-term and longer-term vulnerabilities. We summarize relevant trends in digital technologies and highlight any actions required in the very near term.

As well as the digital preservation plan itself, this report aims to provide solid, practical, concise foundations for the Museum team to set up a first-class, resilient digital preservation capability and programme which is world-class, applies best practice, and is commensurate with the resources available, without compromising digital preservation success.

Structure of this report

The structure of this report follows that set out in the RCMM's brief. To avoid overloading the main report, more detailed text and coverage of some areas is given in appendices and support papers and materials.

Method and work performed

The DAC gathered information for this report through a combination of desk research, reviewing RCMM and RCM documents and other relevant materials, interviews¹ and site visits. Interviews were held with Museum, some representatives of important departments elsewhere

¹ Listed in Appendix 2.

in the College, with telephone meetings with consultants from Cultural Consulting Network. We would like to record our thanks for the overall support, welcome and time given to us by all, and in particular by Richard Martin.

Appendix 2 lists interviewees and provides fuller detail on method.

Key terms and concepts

We set out below definitions of key terms.

The clear definition, understanding and use of terms are **critically important**. For example, unless there are clear definitions of terms (in particular relating to functions/types of activity), roles and responsibilities risk being wrongly allocated.

This point is particularly relevant to the area of archiving, digital storage, and digital preservation. Digital preservation is not the same as archiving. Indeed, digital preservation actions can be needed for items which are in regular current use.

Analogue: Used here to denote documents and objects which are not in digital forms, such as a painting, a musical instrument such as a trumpet, or a handwritten letter.

Archiving: A curation activity to ensure that data is properly selected, stored, and can be accessed and that its logical and physical integrity is maintained over time, including security and authenticity².

Conservation: In the analogue sphere specific actions to halt or repair the deterioration of some object. This term is used rarely by the digital preservation community, where equivalent processes are termed “preservation actions” or similar.

Curation: The activity of, managing and promoting the use of data from its point of creation to ensure it is fit for contemporary purpose, and available for “discovery” and re-use. For dynamic datasets this may mean continuous enrichment or updating to keep it fit for purpose. Higher levels of curation will also involve maintaining links with annotation and with other published materials.

² The term archiving has widely different professional use. The definition used here is closest to that employed by traditional archivists. However computer scientists often use the term to refer to professionally managed storage without the selection, authenticity, and preservation tasks included here, or simply to back-ups.

Digital: Information either newly created (“born digital”), or obtained by a processes of scanning (or similar) of some object or document, in the form of a binary encoding useable by a computer system.

Digital continuity: The UK’s National Archives defines this as “the ability to use your information in the way you need, for as long as you need”.

Digital preservation: An activity, commonly within archiving (but not exclusively), in which specific items of data are maintained over time so that they can still be accessed and understood through changes in technology.³ Section D4.1 summarizes the problems which mean that digital preservation has to be addressed if digital materials are to remain accessible, readable, understandable, trustworthy over time.

Information management: In the wider context the processes employed to manage information resources whether analogue or digital in form.

Metadata: Information recorded about other information (sometimes referred to as “content”). It can be in digital form (as in Adlib) or in Analogue form (qv) as in a card index.

Preservation: An activity within archiving in which specific items of data are maintained over time so that they can still be accessed and understood through changes in technology.

Records management: A specific subset of information management where the information in question is declared as a record - that is, of being the evidence or trace of some (business) transaction. Records management is generally much more tightly controlled than information management.

Abbreviations

The most frequently used abbreviations in the report are in Table 1.1. below. We distinguish very carefully between the Royal College of Music Museum (RCMM) and the Royal College of Music (RCM). Further abbreviations are also included in the technical glossary (section B below).

³ Elaborated by Hedstrom, M., 1998, and quoted in Cedars, 2002a and 2002b, as “the planning, resource allocation, and application of preservation methods and technologies necessary to ensure digital information of continuing value remains accessible and useable”.

Table 1.1 Abbreviations

2D	2-dimensional, as related to images
3D	Three dimensional
HLF	Heritage Lottery Fund
ICT	The RCM organisation delivering ICT (including access to the Janet network) and IT-based services Sometimes (but not here) used to mean “Information, Computing and Telecommunications”.
IT	Information technology – the techniques and materials for processing and transmitting information
OAIS	Open Archival Information System (ISO 14721:2003) – A reference standard “to establish a system for archiving information, both digitalized and physical, with an organizational scheme composed of people who accept the responsibility to preserve information and make it available to a designated community”. See: http://public.ccsds.org/publications/archive/650x0b1.PDF
PREMIS	PREservation Metadata: Implementation Strategies – A data dictionary for core preservation metadata needed to support the long-term preservation of digital materials. From the Library of Congress. See: http://www.loc.gov/standards/premis/
RCM	The Royal College of Music
RCMM	The Royal College of Music Museum



The Domesday Book, 1086 and 1986

To the left above is an image of the Domesday Book, completed 1086, still readable today. To the right is the set of equipment and digital media from the BBC's 1986 project to celebrate 900 years of the Domesday Book: a 12" Laserdisk, Philips Laserdisk player, BBC Acorn PC (which used software written in BPCL) – all obsolete technologies. The 1986 material was inaccessible and unreadable digitally after just a few years. Cost of the project to 'rescue' the material, some £2 million.

Section A – Executive Summary

This report summarises the plan requested by the Royal College of Music Museum to institute digital preservation into its operations; this is particularly important to the museum in relation to the current bid to the HLF for funding in the context of the College's More Music initiative. The plan provides the six sections, A to F, requested by the Museum in its brief to us.

The action plan focuses on actions to be taken over the next 3 years as the Museum undertakes a programme of digitisation, but also looks forwards further to a ten year period as the Museum (and the College) consolidate their digital preservation activities. The plan not only covers technical developments needed but also looks at the wider context of the preservation work – this is vital since digital preservation is an activity which requires the mustering of managerial resources too.

Highlights of this report include the following:

- The digital assets of the Museum (now and projected) are reviewed and assessed for their “digital health”. Overall we found the health of these resources to be sound, the major vulnerability - and therefore risk - being the issue of uncertain staff continuity and lack of written procedures.
- The Museum is doing much that is right to prepare for digital preservation – for example in its indexing methods and choice of file formats.
- A major gap that we have noted is the Museum's (and College's) lack of written and agreed digital preservation policy and strategy, and this gap should be filled with priority.
- We note that some areas of preservation are still the subject of ongoing research and debate, and therefore we have counselled following developments, and where they are critical getting involved. The question of 3D images is of particular note in this context.
- We believe that the cost in the period of the at the HLF project and beyond are modest. The most important of these relate to staffing and the acquisition of necessary skills. We support the idea of hiring, within the HLF project period, a suitably experienced intern to assist the Digitisation & Documentation Officer with this work.

- Finally we note that the key elements outlined in the plan for assuring that long-term digital sustainability and preservation needs are to.
 - Continual oversight and management of the digital collection
 - Having secure, sustainable storage systems, and sufficient copies of information geographically separated
 - Continued, (unbroken) availability of resources.
 - Preservation strategy, policy and plans in place, and accepted by the wider organisation and regularly maintained. These linked to and consonant with, the wider collections policies of the organisation – digital and analogue.
 - Suitable standards are adopted and adhered to – for file formats, for metadata to guide digital preservation actions, and for archival processes
 - Ensuring outcomes are to expectations and that these expectations are realistic in relation to resources contemporaneously available.
 - Following of technologies and their changes and taking timely actions before obsolescence renders information irretrievable.
 - Engagement in preservation activities vital to the Museum.

Section B - Digital overview

This section provides:

- An overview of the Museum's current digital assets
- A summary of the 'digital health' for the Museum's current-status digital preservation strategy, including potential vulnerabilities.

B.1 The Museum's digital holdings and assets

The RCMM brief asked the DAC to look at the RCMM's digital 'assets' for this section. We define 'digital assets' as digital objects (of any kind) which are of value to the RCMM and its stakeholders – that is, that they are important in the fulfilment or support of the Museum's role; in addition they are likely to be rare or unique (in their master form), and expensive to reproduce.

However, our review also covers digital materials which would not be classed as 'assets' in themselves, but which are needed in the fulfilment or support of the Museum's work. This wider scope is also in line with the HLF's guide, "Using digital technology in heritage projects", which identifies different categories (in the guide, in terms of technologies) which need to be addressed in terms of activities.

This report sets out an overview of the RCMM's current digital 'assets'; it does not attempt to set out a comprehensive or itemized audit of the RCMM's overall digital holdings.

We review the digital holdings as follows:

- The analogue holdings and digital objects derived from them
- The Museum's born-digital assets and important born-digital digital objects
- Other, related holdings in the College

This section B.1 closes with some notes and summary on future evolution of the RCMM's digital holdings and external trends.

B.1.1 Analogue holdings and derived digital objects

The Museum is responsible for (analogue) objects in its collections, for their custody, care, study and display:

- Musical instruments and documentation associated with them (held in "dossiers")

- Paintings and etchings and their associated dossiers
- Sculptures and their associated dossiers
- Prints and photographs (these do not have associated dossiers as far as we are aware)
- A few miscellaneous solid objects (such as medals).

From these materials, digital objects are being derived, and the Museum project proposes an extensive continuation of this activity so that all objects are recorded digitally in one or more ways; some of these will be reused as digital outputs of the RCM and RCMM on the internet and by incorporation in publications, and use in other channels. Leaving aside for the moment the day-to-day administrative information and transactions of the department, these digital objects are:

- 2D scans of documentation – prints, photographs and documents (including manuscripts). It is worth noting that no further derived digital files have been created through Optical Character Recognition software, and there are no current plans for using this technology; with OCR, digital users can search for words; however, given the hand-written nature of most of the documents, OCR would be very time-consuming and expensive. Information re content (in particular, to support discoverability) can be provided in metadata. There are also 2D scans of drawn instrument plans, which are currently available for sale in analogue form.
- 2D images of museum objects – photographs of instruments, paintings, etchings, sculptures, and of miscellaneous objects.
- 3D images (scans) of instruments. There are none of these at the moment, or just a handful, but are included here as they form an important part of the Museum's future programme. These may comprise external views as 3D digital models or (the expected majority) 3D tomographic images; a third possible form is as models, as in computer aided design models and virtual reality models. The formats for these image types are still to be determined. Regarding tomographic data, the Museum is involved with the MUSICES initiative at the Germanisches Nationalmuseum, where standards based on DICOM are being studied. Emerging standards are likely to be aligned with those agreed for the MIMO project.

- Cataloguing information on each object, as listed above and including all those in dossiers. This information constitutes metadata associated with the objects, and is extensive and wide ranging. This is held (and will continue to be so) in Adlib database(s). The Adlib data is essentially held in relational database(s) managed by the system. To our knowledge, given the use of the Adlib database, the database conforms to key standards such as CIDOC CRM. At item level, we understand that the RCMM uses some other standards, databases, and thesauri, such as GeoNames.⁴

The 2D and 3D imaging produces a master file, from which further digital objects are derived for particular uses (such as display on the internet, or as thumbnails for listings).

B.1.2 The Museum's born-digital assets and important born-digital files

At the moment there is little in the collections themselves which is "born digital", but this category is likely to grow in the future, possibly quite strongly (we discuss this in B2.2 below).

We note the following:

- There are some audio/video files of performances in the Museum using the instruments in the collection (we believe in some cases their digital location, possibly also 'custody', is outside the Museum)
- There are digital photographs of objects
- There is a little legacy (i.e. some years old) documentation and imagery in digital format (such as some floppy diskettes, yet to be decoded)
- Cataloguing information (metadata) on these objects – in Adlib, as above.

Outside the collections themselves, the Museum generates, receives and uses a range of materials which are born-digital - documents (including emails, 'PowerPoint' presentations), spreadsheets. A proportion of these will need to be kept for over seven years at the least. Archival responsibility for the administrative records, we understand, lies outside the Museum in the RCM Library.

⁴ There are issues of semantic interoperability with GeoNames; we recommend adding geospatial resources to the technology and standards watch at a later date.

B.1.3 Other, related, holdings in the College

There are other collections or groups of information or records which will need future preservation but which are currently under the control of other departments in the organisation.

We mention them here because:

- a. They will require the same, or very closely related, preservation techniques applied to them as the Museum's materials
- b. Some are sometimes related to the work of the Museum – particularly for presentational purposes - and thereby may come under the Museum's preservation remit.

We have not explored these in great detail since they were out of our remit, but are worth noting for the synergies which are possible later concerning digital preservation. In brief:

- In the RCM Library, there are scans of all or some of the following:
 - Concert programmes – a large collection of some 600,000 items
 - Archival holdings of collections from musicians, companies and institutions
 - Books and manuscripts (some of great age)
 - Archival holdings of the RCM as a corporate entity and as a teaching institution – there is now a small quantity of born digital-materials.
- The Studio and Marketing departments:
 - Audio-visual as well as printed promotional and display materials
 - Audio-visual recordings of performances
 - Old web pages, in HTML (possibly with the IT department). Note that these may be heterogeneous in information types, not only HTML but embedded images, Java scripts, audio-visual materials, etc.
- The Research Department, Centre for Performance Studies:
 - Research reports, studies, including some 'compound' materials (PDFs, audio-visual), some carried out with other institutions
- HR department, Finance:
 - Training records; financial records (where not archived with the Library).

- IT department:
 - The IT department hosts Canvas, the ‘VLE’ (Virtual Learning Environment) for staff and students (teaching materials, students’ work etc.)

B.1.4 Museum holdings on the Internet

Currently some of the Museum’s holdings, documentation about the holdings, and other materials about the Museum, events, and some ‘interpretive’ information (as in HLF terminology) are made available digitally, in particular on the Internet via the RCM website, and in particular using third parties. The information is generally provided in LIDO and MIMO format, and, for Europeana, using the Europeana Data Model.

The Museum’s extensive and impressive digital catalogue will supersede the Museum’s previous catalogues (which go back some 130 years). The printed catalogues provide information about each catalogue issue, its preparation and contributors, generally in line with the editorial practice at time of publication. In the 2007 edition (and likely in earlier editions), there is information about the provenance of the detail of the records within the catalogue, in the form of authors and the names of external experts. The 2007 edition (produced in several books, by class of instrument) is available for purchase in printed form but has also been scanned and is available to read on the Issuu web site (albeit with very limited ‘discoverability’, in particular in terms of text-based searches).

B.1.5 Evolution of digital holdings, future directions for digital holdings

Development of the department’s role and changing technologies will/may introduce and/or substantially increase the following:

- **“Office”, transactional documents** created wholly digitally; facilities management, physical exhibition design materials⁵
- Materials generated in the management of the More Music initiative, and the **HLF funded project documentation**
- **Learning and engagement** materials created digitally

⁵ The UK government has been working on a ‘Building Imaging Modelling’ initiative, which will require all construction projects to use building imaging modelling by 2016. Benefits include reduced capital cost. <http://www.bimtaskgroup.org/> Of course, this means that challenging 3D digital files will need to be archived digitally and preserved over very long periods of time.

- **Environmental records**, output digitally from sensors, equipment; this will help ensure rigorous capture and review of this important information, and will also be available for use in other contexts, eg research (depending on Museum/College policy, of course)
- In the near future there will be a need to capture and keep **internet-based materials**: emails, web pages, social media feeds and contributions from third parties. These may be related to exhibitions, either in the new exhibition space in Kensington and/or to virtual exhibitions delivered on-line.
- There are likely to be **'virtual' exhibitions**, provided online, of increasing sophistication, allowing online visitors to move around the online exhibition as though in reality; currently, video-game software is usually used to achieve this
- **Digital donations/acquisitions**: In the future it is likely that significant musicians (or their executors or heirs) – performers, composers, music companies, instrument makers – may wish to donate materials; these will certainly include a large proportion of digitally generated material
- At the time of writing, to our knowledge, there are no holdings in the Museum which could be described as **"digital instruments"**. However, such objects are not inconceivable, and may be very likely acquired in the future. (They may be computer programmes, for example, which produce music, either in a stand-alone environment or by creating music delivered over the internet).
- It is possible that **further 3D formats** will be introduced for instrument visualisation over those discussed above (such as Computer-Aided Design files of instrument drawings, 3D scan files for external 3-visualisation, and files used to drive 3D print devices.)

B.1.5.1 Quantity, complexity

Under the More Music project in particular, the RCMM aims to digitize all of its holdings. The Museum will be increasing its activities – more exhibitions, more concerts/performances using some of its holdings (or similar), more web-based materials and activities, more research.

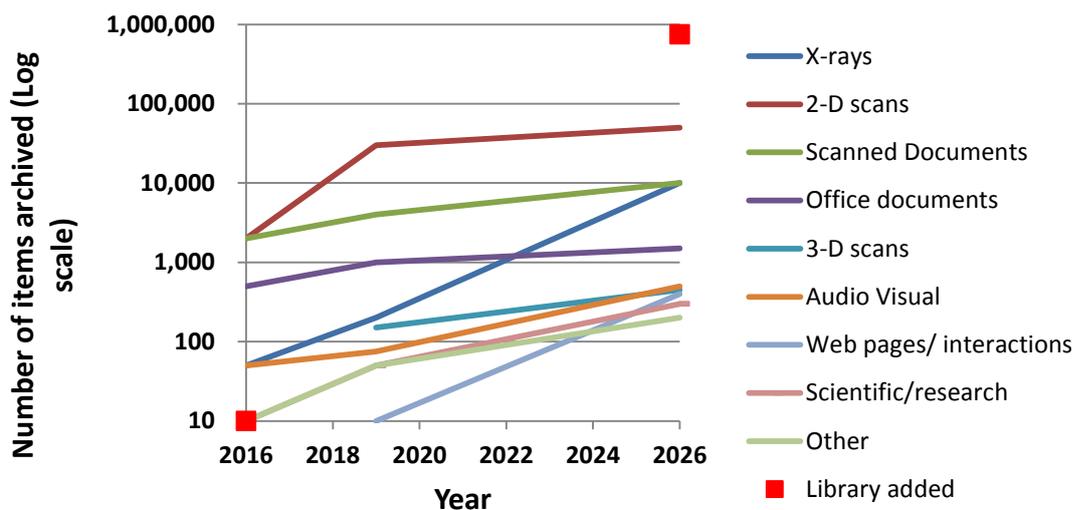


Figure 1: Notional increases in digital items, by type, 2016 to 2026
(logarithmic scale)

The quantity of digital materials will increase, therefore. Though at this point precise figures are not possible, best-guess order of magnitude numbers are given in Figure 1, illustrating our forecasts at 2016, 2019 and 2026. Because of the large differences in scale between the various categories, the figures are displayed on a logarithmic scale. This chart shows the number of items stored (roughly equal to the number of files); it is not possible at this point to give volumes in terms of storage capacity (in, say megabytes); the number of items is more important for digital preservation planning than the actual quantity of storage needed.

For the years 2016 and 2026 we have added comparison estimates for the library's digital holdings, including digitisation of all their concert programmes (red squares); the volume of in terms of number of items is likely to exceed the Museum's by an order of magnitude. This would have implications for digital preservation at the RCM level, something we discuss below in section D.

The 2D scans of materials are forecast to cover between 30,000 and 45,000 items in total. We forecast that in the next ten years, each year will generate up to 200 or 300 audio-visual files, in particular performances using Museum instruments (or facsimiles or similar), some possibly up to two hours in length. Whether 500 or 5,000, this is not a massive number of audio-visual files, relatively speaking; however, these big files will take up a lot of storage – a consideration, of

course, common to the College as a whole. Another consideration for time-based media⁶ - audio-visual files, for example - is the level of detail in mark-up, in particular to provide information to support discovery of sections within the recording; we would not expect this to be particularly detailed for the RCM or RCMM.

3D files are also very big objects, particularly those from 3D imaging, and these 3D files in particular will be of high value to the RCMM. So storage space and storage strategy will become an increasing issue, particularly as it is likely that energy will cost more and push up the cost of many forms of computer storage⁷. Using 3D imaging files can require specific software tools and also large computational/computer-processing power. These issues have been addressed in depth, at policy, strategy but above all in practical terms, by national and international bodies – the ‘solutions’ are there, and we summarize these in a separate support paper. There can also be file processing issues in relation to 3D scans (eg normalization), which we discuss briefly in the support paper.

The complexity of digital objects is more challenging. As the following sections note, the RCMM will not face the extremely wide heterogeneity of data formats in (for example) climate modelling or medical research, both at any one time and over time. But there will be some. Heterogeneity increases with multi-disciplinary work, and it is likely that the Museum will increasingly be involved in multi-disciplinary work. Materials allowing user inter-activity also introduce complexity.

The RCMM will certainly face an increase in **compound** objects (a simple example is a video file included in a PowerPoint presentation), including materials with elements generated and ‘owned’ by other departments or institutions.

There will be an increasing amount of **collaboration**, in projects and resources, internally within the College and with other institutions. This will present issues of governance (including clear identification of roles and responsibilities), collection management, rights management, and the maintenance of links.

Data will arrive from and be delivered to a **variety of platforms**, including smartphones. There is an increasing trend to introduce smartphone ‘apps’ in museums and galleries.

There are particular problems with preserving references to other materials using **hyperlinks**, URLs and other techniques, particularly where referenced materials are out of the control of the

⁶ **Time-based media**, so-called as they have duration as a dimension and unfold to the viewer/listener over time.

⁷ There are also environmental concerns, relating to the impact of electricity generation on the environment.

organisation. However there is increased use of persistent identifiers, including identifiers for organisations, and for objects, digital object identifiers (DOIs). In the case of DOIs, assignment and maintenance of a DOI is a cost; unless the Museum (or College) opts for DOIs, for example for research publications, we believe it is unlikely the Museum will need to consider DOIs. URLs – unique resource locators – also present an increasing challenge.

Another evolving factor is the nature of **information literacy**. Older generations, like the authors of this preservation report, were brought up with indexes and classification systems such as Dewey, and we were taught ‘soft’ and reputational measures of information quality and reliability, in particular the reputation of an information source. Younger generations (from young pupils to undergraduates to professors) use Internet search engines and expect swift search results. They tend to be expert at using latest technology, but not so good at assessing the information they find, and many will be unfamiliar with the standard vocabularies and algorithms which underpin the search results they receive. This is a consideration for addressing the maintenance of authenticity of the materials.

B.2 Museum’s current status re preservation and vulnerabilities

We examine preservation status and vulnerabilities in the tables in sections B.2.1-2.3, which look at factors extrinsic and intrinsic to the data itself. B.2.4 looks at other factors and provides a summary.

We were given the interesting phrase “digital health” by the Museum in regards to documenting its current status vis-à-vis preservation, and to highlight vulnerabilities and future actions - this is to be done within the constraint of having an ability to “do the best within the means available”.

This question of ‘digital health’ goes to the heart of the problem of digital preservation. Without reproducing a treatise on the subject (and the philosophical issues raised), digital preservation involves the deployment of management actions, policies, standards, techniques, and processes which ensure that digital information can have as secure a future as is currently possible. In section D we present a plan to achieve the desired goal, applying best practice, and taking into account the Museum’s current and forecast resources. In Section F we provide a list of publications and other resources which treat the subject in detail.

Issues where remedial action is required are identified in tables below and are addressed in the digital preservation action plan.

Here we summarize the RCMM’s current position in terms of the current health of its digital assets and important holdings.

To assess digital health, from a digital preservation perspective in particular, it is important first to draw attention to the fundamental nature of digital information and consequences for its preservation; it is very different to analogue preservation. The critical issues are as follows:

1. Information rendered using digital technologies is **always** the result of bringing together three things at one time: information that is digitally encoded on some medium (data), that is read by one or more computer programmes (software) specifically designed to accept that encoded information and deliver an expected output, which runs on specific computer system(s) (including its peripherals) to deliver their outputs (hardware)⁸.
2. All these three elements are subject to continuing rapid technological change, particularly software, hardware, and digital storage media (encoding methods are rather more stable). Obsolescence resulting from these changes can occur, typically, within 10 years.
3. Maintenance of the data (and possibly the software and hardware) required to render digital records demands continuous, rather than spasmodic, management actions to guard against loss, decay and obsolescence. Benign neglect will not work; unlike putting a manuscript on a shelf and being able to read it, unaided, in 50, 100 or even 500 years hence, assuming no intervening disasters.⁹

When considering digital preservation we normally identify the “digital record” with the data file, despite the considerations noted above. The preservation of software and physical computers is a highly specialised area, and normally preservation methods are used which circumvent their preservation. Given this, digital preservation depends on (i) the **intrinsic** qualities of a data file and its storage (section B.2.3), and (ii) maintaining, continuously, **extrinsic** factors favourable to continued accessibility of the desired information (the outputs, which include data and metadata) Section B.2.1 and B.2.2).

⁸ Interestingly in the context of the RCMM this coming together can be compared to a musical performance. The analogy is quite strong: compare the music to data, the performer to the software and the instrument to the hardware; if there are errors present, misinterpretation, or if there is a malfunction, or a combination of these, the performance will be compromised or impossible.

⁹ Even for printed materials, longevity is not a given. High acid content will lead to browning and crumbling paper within a few decades, printing on thermal paper will fade in less than a decade, and storage in sub-optimal conditions will cause mould, rot, etc. The lifespan still exceeds that of digital technologies however.

To this technical view of the preservation health of information, we add here other health criteria related to the appropriateness of the information itself in relation to the business purpose of the organisation; this is an addition to the externalities.

At this level of analysis, assigning a parameter, or parameters, to measure or characterise digital health is somewhat subjective. We have adopted a five-point scale here as follows (with indicative colour codings):

1. In immediate danger (☐)
2. Needs extensive remediation (☐)
3. Needs attention soon (☐)
4. Good, but care needed (☐)
5. Very good (☐).

We supplement these figures with notes as appropriate.

This review covers the six goals identified in the SPOT model¹⁰ for assessment of digital-preservation threats:

Availability	The object has been captured and is maintained in suitable repository, and can be accessed
Identity	The object can be distinguished from other objects, it can be discovered and retrieved
Persistence	The bits are intact on media and can be read uncorrupted
Renderability	The object can be used in a way that retains significant properties (see below, Section D)
Understandability	The object can be interpreted by its designated community (as defined in the OAIS standard – see below, Section D)
Authenticity	The object is what it purports to be.

The categories of digital objects covered in B.2.3 are:

- Digitised documents
- 2D digitised images of objects

¹⁰ See Identifying Threats to Successful Digital Preservation: the SPOT Model for Risk Assessment. Vermaaten et al in the Bibliography.

- 3D digitised images of objects
- Born-digital office documents
- Audio-visual materials
- Cataloguing information
- Museum web pages.

B.2.1 Extrinsic to the digital objects – “business” factors

In this subsection we examine in table format business factors which may cause vulnerabilities for digital information the RCMM, and note action points which may be needed in the short term (next three years) and longer term (beyond 3 years). We also provide a digital health index, as noted above.

Extrinsic business factors (extrinsic to the data itself)			
Area	Commentary and vulnerabilities	Health index	Vulnerability action points
Criticality of the information and processing capabilities to the Museum’s mission.	While the physical instruments and other artefacts are the Department’s raison d’être, digital information about them and surrogates are also key to the successful mission of the Museum.	5	Short term: None Long term: Will not change.
Criticality of the information and processing capabilities to the College’s mission.	Primarily the College is a teaching and research institution; however, the information in the Museum can inform these functions in all categories, not least for Historical Performance studies. The role and visibility of the Museum need strengthening; indeed, the Museum and its enhanced capabilities and resources represent a strategic opportunity and strength.	4	Short term: A need to strengthen presence in the teaching areas in particular. Long term: Continuation as above

Extrinsic business factors (extrinsic to the data itself)			
Area	Commentary and vulnerabilities	Health index	Vulnerability action points
Appropriateness to the organisation's mission	The information now being collected, though still incomplete, appears appropriate to achieve the Museum's and the College's missions.	4	<p>Short term: A need to complete the digitisation process and indexing.</p> <p>Long term: Continuation as above.</p>

Extrinsic business factors (extrinsic to the data itself)			
Area	Commentary and vulnerabilities	Health index	Vulnerability action points
<p>Existence of (and adherence to) strategies, policies and plans related to information which are regularly reviewed, updated and disseminated.</p>	<p>At the level of the College there is a Digital Strategy 2015-2018 (understood to be in the process of final sign-off, not seen by the DAC), but no written policies regarding data preservation.</p> <p>At the level of the Museum there is a Museum Strategy (incomplete), and a Digitisation Strategy (finalised – but note not a digital strategy per se).</p> <p>There is no digital preservation strategy or policy documents.</p> <p>This document provides a plan for digital preservation plan (Section D) based on a notional policy and strategy.</p> <p>Documentation on other strategies, policies does not seem to apply clear records management information.</p> <p>There is an excellent College guide on project management, which we strongly recommend should be followed, as we identified gaps in this area</p>	3	<p>Short term:</p> <p>The gap in policies and procedures for digital preservation needs to be remedied. Ditto records management shortcomings.</p> <p>Long term:</p> <p>Maintenance of the policies and good records management practices.</p>

Extrinsic business factors (extrinsic to the data itself)			
Area	Commentary and vulnerabilities	Health index	Vulnerability action points
<p>Staff continuity, particularly related to curation and preservation activities.</p>	<p>Our understanding is that some key staff are on short/medium term contracts. When these people leave, and particularly if there is insufficient continuity planning together with documentation of policies and procedures then information is put at risk. Also risk of knowledge/information loss when staff in other departments leave the College – for example, re the location of audio-visual files which relate to Museum instruments, activities. The RCM's and RCMM's staff are extremely able and 'know where and what stuff is' (though less so with materials which pre-date their presence). Different file-naming conventions in different departments increase the risk of loss of stuff.</p>	<p>2</p>	<p>Short term: A need to address staffing and information continuity issue.</p> <p>Long term: Maintenance of staff continuity planning.</p>

B.2.2 Extrinsic, technical factors

Not all extrinsic risk factors relate to management issues, but to technical questions. We treat these in the next table.

Extrinsic technical factors			
Area	Commentary and vulnerabilities	Health index	Vulnerability action points
Assignment of sufficient and appropriate metadata , and its continued management	An impressive amount of descriptive metadata is being collected to describe objects, supported at a higher level by important and valuable collaborative, domain-level standards work. This descriptive metadata needs to be supplemented with metadata to facilitate digital preservation.	4	<p>Short term:</p> <p>A need to supplement recorded metadata for preservation purposes.</p> <p>Long term:</p> <p>Development and maintenance of preservation metadata.</p>

Extrinsic technical factors			
Area	Commentary and vulnerabilities	Health index	Vulnerability action points
Adequacy of storage and management of it to minimise loss or corruption	<p>Data is predominantly stored in three main areas:</p> <ul style="list-style-type: none"> ■ Adlib (on local servers) ■ Scanned, image objects in cloud storage proved one or more third parties, managed by the IT department. Cloud storage may not provide the optimal stage environment for long-term preservation. ■ Audio-visual file on areas managed by the Planet eStream system (managed by the Studios), or in other storage forms at the Studios 	4	<p>Short term:</p> <p>Confirmation of suitability of the Cloud and eStream for archival purposes.</p> <p>Long term:</p> <p>Continuation.</p>

Extrinsic technical factors			
Area	Commentary and vulnerabilities	Health index	Vulnerability action points
The existence of back-up , or fall-back, positions in case of loss	Back-up of files is professionally managed. Regarding fall back positions in case of loss, scans can always be reconstituted (supposing the originals are unchanged); however this would represent cost. We strongly recommend that there is at least one uncompressed copy of 'original' masterfiles of images. We also strongly recommend one back-up of key/most valuable digital files (eg Adlib database, expensively generated files, or difficult to re-do, is kept at a location at least 35 miles from all other copies.	5	Short term: Confirmation of good management of the Cloud and eStream for archival purposes. Long term: Continuation.
Restrictions on legitimate use , such as privacy or copyright constraints	These appear to be minimal, with expert knowledge in the Museum.	5	Short term: None Long term: None.

Extrinsic technical factors			
Area	Commentary and vulnerabilities	Health index	Vulnerability action points
Dependencies on other information or external bodies and processes	These appear to be non-existent or minimal, except with regard to stable, well used standards, thesauri, data models.	5	Short term: None Long term: Assuming sustained resources to maintain standards etc, none.
Expertise present in the organisation (or readily available externally) to support the data formats and the software they rely on over the longer term.	Apart from a general awareness in the Museum, and amongst some in the wider College, of the need for digital preservation actions, there is little expertise available internally; the College does not employ a trained archivist, though the library does have one part-time librarian in an archival role. The IT department has some awareness, but no specific expertise. Web archiving was included in the latest version of the 2013-2017 College IT strategy, and we assume that it will figure in the next IT strategy.	2	Short term: There is need to plug a gap of lack of specialist expertise regarding digital preservation. Long term: Continuation.

B.2.3 Intrinsic - data qualities

This section looks at the intrinsic qualities of the various data collections. The key digital health indicators for each type of data are the following:

- The choice of file formats, influencing the likelihood of future obsolescence
- The chance of being superseded, even despite satisfactory file formats being used (e.g. by market forces)
- Suitability for purpose and flexibility for re-use/re-purposing.

In addition and common to all the data types is the presence or not of inhibitors to access, such as passwords, encryption, compression and bundling¹¹. We can represent that here in a short table:

Area	Commentary and vulnerabilities	Health index	Vulnerability action points
Presence of access inhibitors.	As far as we are aware, no use is made of these mechanisms, except where possibly files are compressed for storage/back-up in the Cloud (to be confirmed). This will need to be monitored.	5	<p>Short term: None, apart from checking Cloud storage</p> <p>Long term: Nothing further.</p>

The following table describes each of the digital holdings of the museum in more detail and assesses their current “digital health” and highlights any vulnerability and the timescale(s) over which it may be manifested.

Re long-term vulnerabilities identified, the analysis assumes that basic digital preservation actions/practices are applied; a score of “5” for long-term vulnerabilities does NOT mean that no action is required.

¹¹ That is, the “wrapping” of information together in a larger digital structure for the purposes of transmission, storage, etc.

Information type	Digitised documents		
Description	<p>Letters, manuscripts, conservation reports and other documentation which have been scanned. These originate from object dossiers and boxed documents. The originals are retained and kept in deep storage.</p> <p>In addition, printed catalogues have been scanned (made available on Issuu), and also instrument plans, available for purchase</p> <p>RCMM uses the unique catalogue identifier; this is good practice as regards resilience of links between digital objects.</p>		
Current preservation parameters	Volumes	ca 2000 files	
	Rate of increase	Moderate, ca 2-fold over the next three years	
	Format(s)	PDF	
	Storage	Cloud	
	Conservation	Bit-level ¹²	
Health indicators (current health)	File formats	For items with a simple structure PDF/A ¹³ would be preferable, but not considered critical.	5
	Supersession	Low probability.	5
	Suitability/flexibility	Adequate, as the files are for read-only use.	5
Vulnerabilities identified and action points	Short-term	None	
	Long-term	Preference for PDF/A for long-term conservation.	

¹² This term is described in Section D – it may be interpreted as just keeping the bit streams comprising files uncorrupted.

¹³ An archival version of PDF – see <http://www.pdfa.org/2011/06/pdfa-faq/>

Information type	3D digitised images of objects		
Description	3D digitised images of objects are likely to be almost exclusively obtained from musical instruments, and may be of primarily two types: (i) 3D images showing the exterior view of instruments, and (ii) 3D solid representations, taking images by using a penetrating wave in sections through an object. A third type might be 3D models using computer-aided design. No 3D tomographic data as yet, but planned.		
Current preservation parameters	Volumes	No CT, probably no 3D exterior views.	
	Rate of increase	Slow, but large storage sizes for each object.	
	Format(s)	To be decided. (DICOM-related)	
Health indicators	File formats	No existing stable, non-proprietary standard for file formats, but the DICOM standard is very widely used for handling, storing, in particular in medicine. There are open-source software systems for 'playing' 3D CT, MRI, X-ray etc data; free-ware/open-source players for DICOM images ¹⁴ .	2
	Supersession	Standards evolving.	2
	Suitability/flexibility	Assumed those chosen fit for purpose. Avoid compression for master file.	4
Vulnerabilities identified and action points	Short-term	Not a great concern, as standards are still evolving, and data volumes are extremely low or zero.	

¹⁴ Eg: <https://ncia.nci.nih.gov/ncia/imageViewers.jsf> The DAC's report on data sharing (for UK Research Councils, the Wellcome Trust, the Department of Trade & Industry, JISC, available from the DAC) presented analysis & recommendations on data sharing – the re-use of data produced by others – including coverage of brain data and related community resources. This domain, and anthropology, would be useful areas to investigate for a wider Museum investigation into 3D imaging, use, opportunities, resource requirements, tools, etc.

	Long-term	Raised. Mitigated by RCMM's involvement in collaborations with peers (eg GNM ¹⁵). Useful work in collaborative brain imaging resources ¹⁶ . NB Imperial College has a brain sciences centre.
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Information type	2D digitised images of objects		
Description	2D image files obtained from physical objects, either by photography or by use of a flatbed scanner ¹⁷ .		
Current preservation parameters	Volumes	Ca. 2000	
	Rate of increase	Rapid, to ca. 30,000 objects by 2019/2020	
	Format(s)	TIFF, (master), JPEG, (copies, plus some thumbnails)	
	Storage	Cloud (see above re compression and master files)	
Health indicators (current health)	File formats	Good	5
	Supersession	Low probability	5
	Suitability/flexibility	Good	5
Vulnerabilities identified and action points	Short-term	None	
	Long-term	None	

¹⁵ Germanisches Nationalmuseum. Carrying out MUSICES project into 3D scanning of musical instruments.

¹⁶ Brain database, publicly funded research generating publicly funded resources – images, raw, processed, with interpretive information. Global/national resources created so that public users can use the resources, even though the public users do not have specialist software or tools.

¹⁷ The Museum has an Epsom EU-22 A3 scanner. There are plans to acquire a more modern scanner to fulfil the Museum Project. The photographic equipment's suitability and quality is not known.

Information type	Born-digital documents		
Description	Administrative, research documents: Various types including word processing files, spreadsheets, emails, we believe using Microsoft Office software. Also facilities management data.		
Current preservation parameters	Volumes	Low	
	Rate of increase	Low	
	Format(s)	Microsoft Office; some CAD-CAM/BIM.	
	Storage	RCM servers.	
	Conservation	To be decided/clarified. Formal archival responsibility we believe lies at College level, but we have not seen detailed archival policy re retention criteria.	
Health indicators (current health)	File formats	Not ideal, unless the MS XML versions are used. Even then doubts remain; software updates can cause problems. Non-proprietary but a large installed base available. CAD-CAM formats are challenging, but not a major issue for the Museum.	4
	Supersession	Medium probability	4
	Suitability/flexibility	Good	5
Vulnerabilities identified and action points	Short-term	Not a great concern, as current formats are de facto standards due to the enormous installed base. Special care is needed with Excel documents to ensure any internal formulae and links will be preserved appropriately.	

	Long-term	Raised risk. But again mitigated by the large installed base. Conversion to PDF/A recommended, unless functionality is to be preserved as well (e.g. spreadsheets). We also assume governance and clear allocation of archival responsibilities.
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Information type	Audio-visual materials		
Description	Mainly audio and video recordings related to the instruments and to performance in or by the Museum.		
Current preservation parameters	Volumes	Low	
	Rate of increase	Medium, but will probably accelerate once the refurbishment is complete	
	Format(s)	Varied. Some .wav. There may be old materials of interest/value in analogue form, for digitization.	
	Storage	Some materials relevant to Museum held in other departments. eStream used by Studio as video management and streaming system.	
Health indicators (current health)	File formats	Include .wav and video (see below)	5
	Supersession	Medium probability, but probably good format choices used now.	4
	Suitability/flexibility	Good	5
Vulnerabilities identified and action points	Short-term	In digital format terms, not a great concern as standards such as .wav suitable for archival purposes. However, materials may be at risk of becoming lost due to file naming, governance issues.	
	Long-term	None	

Information type	Cataloguing information		
Description	Descriptions comprising the metadata used to describe objects of all kinds		
Current preservation parameters	Volumes	Ca. 2000 object records	
	Rate of increase	Rapid over the course of the project	
	Format(s)	Relational database (Microsoft SQL Server)	
	Storage	Local networked disk	
	Conservation	Continued maintenance	
Health indicators (current health)	File formats	Satisfactory	5
	Supersession	Low probability	5
	Suitability/flexibility	Good	5
Vulnerabilities identified and action points	Short-term	As long as Adlib is kept and maintained [by Axiell or any new parent company], high preservation probability. Adlib conforms to major relevant standards, such as CIDOC CRM.	

	Long-term	<p>Should the systems become obsolete, then export of data will be needed in a preservation-suitable format (such as to XML schema developed for museums and archival data). It is noted here that there are currently no satisfactory methods of archiving functioning relational databases [though there are interesting initiatives, eg SIARD in Switzerland¹⁸], as opposed to static exports of their contents.</p> <p>It would be helpful to take and store regular “snapshots” of the database files – say, monthly.</p>
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¹⁸

See: <http://www.digitalpreservation.gov/formats/fdd/fdd000426.shtml>

Information type	Web pages		
Description	Museum web pages, on the RCM web site.		
Current preservation parameters	Volumes	Small, but accumulated over 20 years	
	Rate of increase	Fairly flat and slow during building project, likely to grow in size and complexity thereafter.	
	Format(s)	HTML, PDF	
Health indicators (current health)	File formats	HTML, PDFs	4
	Supersession	Low (good) – but this is an evolving field and new forms may arise	4
	Suitability/flexibility	Good, though evolving Javascripts and other embedded materials may be an issue. Also need to be aware of risks of embedded links to URLs which move/vanish.	5
Vulnerabilities identified and action points	Short-term	We understand there are HTML files stored digitally, with old web pages. Not a major issue at present, as past materials posted on the web are not critical to the Museum's current priorities. We also understand that web archiving is to be undertaken (see RCM IT strategy 2013-2017)	
	Long-term	At present it is recognized that web archiving represents a technological challenge. We provide fuller discussion below.	

B.2.4 Summary of review, actions

Our review of the Museum's digital 'assets' and holdings shows the Museum to be in a generally reassuring position at the moment. Thanks to the excellent work on the Adlib catalogue, in particular the information fields set up and information being captured, and to the use of MIMO, LIDO and CIDOC (the latter two embedded in the Adlib programme), and semantic standards, the Museum has strong foundations for setting up digital preservation. The MINIM-UK work is also highly relevant.

In terms of scores in our review, there are none in the '1' category (in immediate danger).

There are four entries in the (2) category, two of which are for 3D imaging. The (2) category is labelled 'needs extensive remediation' – which does not necessarily mean that a very large amount of work is required to address the issue. The three groups/areas highlighted are:

Staff continuity: this needs to be addressed on a continuing basis, and also action is needed fairly early, to avoid risk. The ramifications of loss of staff, in particular staff leaving the College, are potentially significant, in particular because of the loss of knowledge in the heads of the staff. This matters, for example, when there is no shared framework of file-naming is ad hoc, non-systematic, file 'filing' ditto.

We also recommend that at least one other member of the Museum acquire a good level of digital preservation knowledge, so that there are at least two members of the team with a good core of knowledge, for resilience.

We recommend an early, structured, planned review with other departments, in particular The Studios, to check for, locate materials which are of importance to the Museum (analogue or digital) – for example, recordings of performances/use of Museum instruments, particularly those which are fragile and rarely used. This review will raise wider governance, collection and information management issues - who is the custodian, the owner? Will that change? How will that material be found? How are the files named? Shall we digitize it? There may be materials of value which need remedial action.

Expertise present: lack of expertise on digital preservation in the Museum and the College more widely. Thanks to the Digitisation & Documentation Officer's work in particular, no immediate action is required (for example, to prevent catalogue fields having to be altered for digital preservation), but we do recommend early awareness-raising and training, as set out in the digital preservation plan below.

The third group is 3D imaging; as there are no files at the moment, this is not an immediate concern. However, we strongly recommend that a working group on this is set up – we make notes on this in the support paper on 3D imaging.

One area of concern and potential risk relates to **records management**. We note that, of the documents we have seen in the Museum and in the College, only one had appropriate document information. Many had no date, did not provide information about the status of the document (eg, which version), the authority of the document, no author information. This should be rectified as a matter of urgency, and become simple, non-onerous routine. We also recommend that for Microsoft Office materials, a little care is taken to complete basic file properties information, as routine. With regard to storage of back-ups, our general recommendation is that there are three copies of files, particular the most valuable/important (eg catalogue, master TIFF files). Our only near-term concern, however, is that the Museum and IT department should check to ensure that at least one copy, in particular of the most important/ most valuable digital files, should be kept at a location at least 35 miles (preferably 50) away from the others. Actions to address all issues raised are in the digital preservation plan. The more detailed plan in Appendix 3 gives a cross-walk to the audit tables in Section B, and a little more detail.

Section C – Strategic background

This section summarizes the expected outcomes of the digital preservation plan and work, and the rationale for the approach taken in the digital preservation plan.

This section notes first why the need exists for digital preservation, the expected achievements of the digital preservation plan and activity, and secondly it looks briefly at how the plan fits into the wider digital strategy of the Museum, wider strategies in the Museum, and in the wider context of national and international archiving activities.

Most output and transactional materials are now captured and/or created in digital form. An increasing proportion of on-digital materials and objects are being 'copied' into digital form.

C.1 Rationale

A large proportion of these materials need to be kept over time, either for evidential reasons, for research, for continued access, or for investment reasons. All these materials will need digital preservation actions – if only minimal - in order to survive, and to be discoverable, available, readable, understandable, and to maintain at least a measure of authenticity.

Therefore, to a large extent, the rationale for digital preservation is exactly the same as the rationale for and the benefits of the digital form.

Paraphrasing The UK's National Archives, the impact of losing digital continuity, or not addressing digital preservation, is:

- You can't find the information you need
- You can't open the information you need
- You can't use or work with your information in the way you need
- You don't understand what your information is and what it's about
- You don't trust your information and can't be confident it is what you say it is.

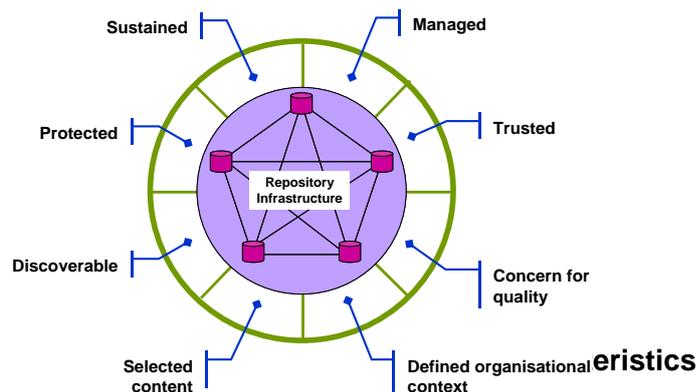
Therefore, conversely, for the Museum and its users and stakeholders, fundamental outcomes of digital preservation (part of and underpinned by good information and records management frameworks and practices) are:

- You can find the information you need
- You can open the information you need
- You can use and work with your information in the way you need

- You do understand what your information is and what it's about
- You do trust your information and you can be confident it is what you say it is.

Another fundamental achievement of this plan will be to provide digital preservation at low cost (see section D8 below). The main resource will be in terms of staff time; by providing the framework and infrastructure (e.g. the metadata fields relating to digital preservation), many actions can be automated. In a few years, planning, framework, infrastructure, documented processes will mean that resource requirements remain modest, even with more complex data types (e.g. 3D imaging). Perhaps the most valuable outcome will be staff knowledge and expertise relating to digital preservation. As we have stressed throughout this report, digital preservation is a part of wider functions, and supports and is supported by good information management. An understanding of digital preservation requires but also provides an understanding of the fundamentals of digital information technology and digital information and functionalities.

Overall for the Museum, the digital preservation plan will support a role, capability and a repository with the following core characteristics:



The Museum will accrue significant benefits from its digital preservation and wider information management capabilities, as a trusted repository and trusted custodian, building and maintaining high-quality access to more and unique materials, and more. A fuller list of benefits is set out in Section D below.

Together, these capabilities will support the Museum's drive to become and remain a world-class institution in its field.

C.1.1 Rationale summary

The digital preservation plan is drawn up so that the Museum can achieve these outcomes. The plan takes an incremental approach, and here the period of the More Music development work

provides an excellent opportunity to build the framework for digital preservation and implement the capability.

The plan is designed in the light of the resources available now and in the future, and also the low level of awareness more widely in the College. The plan is designed to be light, but resilient, for the eventuality that resources may be limited at any time.

C.2. National and international polices

There are no current formal (i.e. governmental) initiatives on this issue, but there are many initiatives conducted by institutions (private, public, not-for-profit, academic, also commercial), and consortia of these, actively working with the issue.

Regarding governmental-level action, historically an exception can be made for the DLM-Forum initiative which was initiated in 1994 by the by the European Commission¹⁹. This did pioneering work and was hugely influential on subsequent developments. The DLM Forum is now a limited company based in the UK²⁰ and has a membership mainly composed of National Archives, and has a strong focus on records management. It is still active but probably of little value to the RCMM. The major developments and initiatives in this area have come from Europe, Australia and New Zealand, and the USA.

C.2.1 International collaborations or projects with an international scope

a) Commercial or commercially biased

Most of the work done on digital preservation comes from the academic and government sectors, and is therefore publically funded for the most part. However it is worth noting that the pharmaceuticals industry did have a project some ten years ago resulting in the publication of a guidance for the industry (GAMP Good Practice Guide: Electronic Data Archiving²¹) and similarly the aircraft manufacturing business funds the Lotar (Long Term Archiving) project. Both these initiatives are firmly grounded in the very specific needs of these industries.

Perhaps more relevant, there is a current initiative called PASIG22 (Preservation and Archiving Special Interest Group) which has a strong technical and commercial bias. It is probably worth

¹⁹ See: http://ec.europa.eu/archival-policy/index_en.htm

²⁰ See <http://dlmforum.eu/>

²¹ See <https://www2.ispe.org/IMIS/ItemDetail?iProductCode=4EDAUS&Category=GAMP4US&WebsiteKey=c4731c35-1fc8-49c2-9b55-59c13c225a92>

²² See: <http://preservationandarchivingsig.org/>

watching this group, particularly in relation to archiving standards for 3-D imagery and database preservation.

b) Public sector initiatives

These are current; see the DCC resources for references to earlier initiatives:

- Open Preservation Foundation – a European initiative, from the Open Planets project (with EU funding initially), now a private company.
- OCLC, based in the USA (Note – this is primarily an library organisation, but has an interest in this area)

C.2.2 National initiatives

For the UK:

- Digital Curation Centre
- Digital Preservation Coalition

USA:

- Library of Congress: The Library maintains the PREMIS standard for preservation metadata.

Section D – Digital preservation plan

This plan describes the actions that the RCMM needs to undertake to enable its digital information to be preserved for the longer term. The first four introductory subsections below outline the context of the plan, the rationale for preserving information, describes the nature of the RCMM's digital information, and gives a brief overview of digital preservation good practice. Following four subsections address the elements of the plan, including skills needed, actions to be performed, costs and timings.

D.1 Introduction to the plan

This Section D sets out a plan for The RCMM to establish and implement digital preservation within its operations, set in the context of the bid by the RCMM to obtain funding from the Heritage Lotteries Fund (HLF) for creating a new Museum infrastructure between 2016 to 2019, part of which includes the digitisation of the materials in its collection. This renewal project sits within the wider RCM's More Music initiative.

The plan:

- a. Covers in some detail the period 2016-2026, and in outline beyond the 'project' phase, from 2019/2020 to 2026 after the digital preservation capacity is largely installed. We note that a digital preservation capacity is needed to preserve the information created within the HLF project itself, as well as digital materials in or generated from the RCMM's various collections, and the digital information resulting from the exhibition and other activities it will undertake;
- b. Also sets out some notes re wider use of the plan to guide other departments in the College with a similar need to preserve their digital assets (such as the Library, the Studios, etc.)

The plan is drawn up to fit and support the resources available to the Museum over the period of the plan.

D.2 Why preserve RCMM's digital information?

The museum, on its own initiative and partially helped by the HLF is, and will be creating a large volume of digital assets. Alongside born-digital information, the Museum will be creating digital copies/surrogates of items in its collections, catalogued using information standards in the online catalogue, with the objective of providing, achieving, obtaining:

- a. Vastly increased access, via the Internet in particular, to all the Museum's holdings, and widening the range and type of visitors both online and to the Museum
- b. Greatly enhanced discovery of Museum holdings, through the online catalogue and the application of standards such as MIMO, LIDO, CIDOC CRM
- c. A permanent means of recording the conditions of materials, such as instruments, at a point in time;
- d. More detailed and new forms of analysis of instruments, through the detail provided by technology;
- e. Reduced risk to instruments and holdings, through reduced handling, greater knowledge provided by technology (e.g. tomographic scans)
- f. An enriched experience for visitors to exhibitions curated by the Museum, and the possibility to record these experiences for later use;
- g. Enhanced contributions to cultural and scientific collaborations in and beyond the RCM; the Museum is already engaged with peer organisations in on-line initiatives such MIMO, ArtUK, the Google Cultural Institute, Europeana;
- h. Greater and new opportunities for collaborative research
- i. Meet its contractual obligations.

These substantial advantages to the Museum, and to its users, need to be matched by a robust preservation plan to ensure the continued success in providing these and further benefits, and to ensure the investments made in the creation of digital materials are sustained and not lost. Below we list benefits of digital preservation per se.

At the same time, actions for successful digital preservation overlap with good information management, and contribute to strong information governance, and to reduced costs.

Here we state some specific benefits of digital preservation:

- a. Continued access over time, by a wide range of users
- b. The Museum's capabilities in terms of digital preservation and more generally in digital access and information will mean that it will be a preferred place for donations of digital materials and will support its credentials as trusted custodian generally
- c. Staff will gain knowledge of digital preservation challenges and solutions

- d. Digital preservation will support continued income from digitised materials.

The function of digital preservation is to maintain the integrity, authenticity, discoverability, accessibility, meaningfulness, usability and use (fairly and appropriately) of digital materials. In many cases, the elements needed to achieve digital preservation are the same as those which enable easy, rich everyday use and good information management. Because these elements overlap, and must be shared between professional groups, coordination within the organisation is critically important, to ensure that, where possible, the same or interoperable formats and architectures are used, and information is coded using shared standards. In today's networked world, coordination is very important at national, international, domain and increasingly multi-domain levels.

Of course, it is important that the cost of digital preservation is contained. As this report sets out, anticipation and early planning, interoperability (at multiple levels) and the use of standards are absolutely fundamental in facilitating and containing the cost of digital preservation. Not only that, but the use of standards throughout the organisation will vastly increase the level and quality of use of resources at every stage of the resources' life, will enhance and strengthen the organisation's position in the digital information age, and will decrease operational and other costs.

D.3 The nature of the Museum's information

In order to provide a context for the following subsections a model of the Museum's information collections is presented here, also introducing some useful distinctions and terminology.

First a couple of distinctions:

1. Information for the purposes of this report can be in two fundamental forms: Digital and Analogue. **Digital** information is held as discrete bits (or states) residing in or on some machine readable medium (such as a CD, magnetic disk or a memory stick). **Analogue** information is recorded as a human readable inscription on some medium (such as a manuscript, a printed book, a label in Braille). We also count physical objects (like a lute, or a medal) as being in analogue, tangible, form
2. Some information (and objects) are described as "**content**" - they have a primacy as a thing existing or kept for its own sake; content can be in either digital (a Word file) or analogue form (a printed plan). Note a physical object (such as a painting) is counted as "content" in this context. Other information exists to describe or enhance some content – we call this information **metadata**. Aggregated metadata is sometimes variously called description, indexing, cataloguing. Nowadays it is usually

in digital form (as in the Adlib database), but a card index a way of holding it an analogue form.

We can make further useful distinctions regarding content by typing it according to the information role it performs:

Content type	Function or roles performed
Native:	Native content is the information kept in the Museum for its own sake – it is the source other types of information. We distinguish
Primary	two subtypes: <ul style="list-style-type: none">■ Primary content held by the Museum in its collections
Complementary	(whether in digital or analogue format) – typically a musical instrument; <ul style="list-style-type: none">■ Complementary content – which is associated with some Primary content – such as a letter, or a conservation report on an instrument.
Surrogates	Copies of native content made with the intention of using these in their stead for most instances of user access (such as internet delivery or providing thumbnails). Usually digital in format, the process of obtaining digital surrogates from analogue native content is called digitisation.
Transformed	In the digital context, content which has been created by transforming a file from one format standard to another (newer) for the purposes of preservation (by a process such as migration to newer file standards as earlier ones become obsolete).
Metadata	Metadata can describe all these information types
Back-ups	All the above can be copied to secure locations for the purposes of protection against loss and media failure.

These data types and the interrelationships showing associations and derivations is summarised in the following, Figure 3:

2. All such information obtained either as images or scans of the objects (“surrogates”), or as born-digital information, whether sourced internally from the College or externally.
3. Digital information collected or generated through dissemination activities related to the collections.
4. Cataloguing and indexing information related to the collections and thesauri associated with it.

D.4 Digital preservation overview and best practice

D.4.1 The need for digital preservation

Contrary to popular conceptions, digital information is very fragile, and prone to corruption, loss, inaccessibility over periods of just a few years unless properly managed; this is in stark contrast to most non-digital (analogue) objects which can survive comparative, benign, neglect. The causes for this are discussed further in this report – but the major issues are the rapid turnover and obsolescence of the very technologies which are necessary to support digital information, and the need for continuous management and oversight.

Over the last 20 years or so it has been realised that digital information is much more fragile than that in analogue form. The complex nature of this fragility is generally not well realized; more generally, the over-riding view sees the massive attractions of the flexibility and the power of the digital form – the ease with which it can be copied, distributed, made accessible to wider, global, audiences, and manipulated and (re-)used. The fragility arises primarily from dependences on technologies and secondarily on the intangible and fluid nature of digital information:

- Digital information always relies on technologies – both hardware and software – to be accessible and useable, needing a medium to store it, a device to read information from the medium, software to control the device and to read the information into a computer (a “driver”), software to process the information and to display or present the information, a computer system (hardware and operating system software) to run this software, and an output device and its driver to present the information. Contrast this with a printed page which can sit on a shelf for decades or even centuries with no further intervention and still be readable with no further ancillary equipment needed.
- The technologies listed in the previous bullet are all subject to rapid obsolescence as manufacturers upgrade and change hardware and software. The typical lifecycle of IT products is measured in a few years, at most a couple of decades.

- The conventions (standards) used to encode information as bits are often dependent on contemporary technologies, sometimes they are proprietary and protected commercially; they are therefore as subject to obsolescence as are technologies. Therefore use of, or conversion to, more stable independent, non-proprietary or publicly available standards is recommended – though over the very long term even these are not guaranteed.
- The intangible nature of digital information contributes to its invisibility, and therefore leads to neglect if it is not well managed in a continuing fashion, so as to be under continuous surveillance. Think, for example, of the difficulty finding specific information in a morass of other information on a disk drive when the disk is not well managed and well structured.
- The art of preserving digital information is still a new and evolving discipline, calling for many new skills, very often lacking in the wider information world. Good practice for digital preservation today may change tomorrow, so policies, processes and practices need to be monitored regularly in future to ensure that the latest best practice is maintained.

D.4.2 Successful digital preservation

Successful preservation of digital materials over the longer term is not just a technical question, but one which also depends on appropriate wider management structures and processes being in place, and these being supported **on a continuing basis** by senior management and funders. In any complex organisation it also requires good coordination between different departments concerned with managing information, not least the good communication between IT departments and curatorial departments. But above all it requires constant vigilance over the management of digital information.

Other elements make a major contribution in easing digital preservation work, in particular the application of standards at multiple levels and interoperability (again, at multiple levels).

We discuss in detail all the various elements for achieving this in the context of the RCMM in section D5 below, but note here that they encompass:

- Appropriate, agreed, supported and implemented policies and strategies
- Appropriate organisational structures, coordination and access to requisite specialist skills, together with continuing management support, including continuing funding

- Applying realistic and achievable goals at a technical level – details are discussed below, but include:
 - Setting realistic objectives for determining significant properties to be preserved in digital objects
 - Having sufficient, accurate metadata attached to digital objects
 - Adherence to recognised, open, stable, and/or well-used standards
 - Good planning of execution of “preservation actions” to rescue files (akin to analogue conservation actions)
 - Having clear guidance on rights and permissions, and avoidance of encryption and similar inhibitors to access.
- Constant vigilance over the management of the digital collections, and continuing application of good information management and archival practices.
- Use of well structured, well managed repository systems and storage.

D.4.3 Terminology issues

There are a number of terms used by the digital preservation community which can be confusing to both traditional archivists, IT personnel and the layman; there are also terms used which are ambiguous. We draw attention to them here and note our usage in this document. We also strongly recommend that (a) these terms are explained, adopted and applied strictly – inaccurate use of terms is a major source of risk, and (b) /?

“Archival”: It is fairly common to see the adjective “archival” used erroneously as a noun or verb to mean an archive or to archive. Beware of this error!

Archive: This term has different meanings for archivists and the IT community. The IT community often understands “archive” (verb) as the process of simply placing digital information in a secure environment for longer-term storage (sometimes just to free-up space on file servers), and as a noun to denote that storage. The archivist sees the act of archiving as a much wider and fuller activity. These differing meanings can be misleading for the unwary. We will make the usage intended clear here.

Back-ups: A back-up of computer files is an activity which is taken on a regular basis by IT departments to make copies of all information which is in current use so that, should the master copies be lost or corrupted, the lost information can be restored to the point at which the back-up was made. Back-ups are sometimes confused with archives.

A digital archive should of also course be backed-up to guard against loss – best practice suggests three or more back-up copies are made, each kept at geographically separate locations.

Bitstream preservation: This phrase is somewhat ambiguous. The PREMIS standard uses the word “Bitstream” to denote a steam of bits within a computer file to be preserved as an entity in its own right (such as a picture embedded in a word processing file”. Bitstream Preservation is also used more generally to mean preservation of the integrity of the stream of bits which computer files are composed. In this sense it is almost synonymous with good data management in the sense that data is managed to keep the integrity of the information, that it is not corrupted.

Conservation: The term “conservation” is rarely, if ever, used by digital preservation practitioners. The use of the term as understood by museums and traditional archivist communities to indicate specific actions undertaken to halt the decay of an object is therefore not used in the digital context; rather the phrase “preservation actions”, or “preservation interventions” is used, or more specific terms describing the actual actions undertaken such as migration (see below). We use the term “preservation actions” here.

Digital curation: This phase is used fairly frequently in the research community, and has been developing in meaning over the last 10 years or so to denote a whole range of activities from the planning of the collection/creation of digital information, its use, archiving, preservation and reuse/repurposing.

Digital vs electronic: We sometimes speak loosely of electronic information, or electronic data, to denote digital information. Though widespread, use of the term electronic in this sense is inaccurate. Though many carriers of digital information are indeed electronic in their technologies (a USB memory stick is a good example), other digital media are not – consider a CD-ROM, which is an optical technology. Conversely some electronic information forms are not digital – an audio cassette tape is a good example, so is an old reel-to-reel tape recording. We use the more precise term “digital” in this report.

Emulation: A method to achieve logical preservation of digital files by retaining not only the original data stream but the original software also, and using software (emulators) to make contemporary computers act like the original computer(s) used to run that software using that data.

File: Archivists use this term to mean a physical or intellectual subdivision of a collection of objects in the archive (e.g. in reference to a file folder, or perhaps to papers relating to some activity – say, financial affairs). To the IT community (and wider) it denotes a single addressable unit of information on a computer storage device (e.g. a word processing file on a disk drive). In the digital archiving context this can be confusing – thus a single file of digital objects (in the archival sense) may be represented by many files on some storage device (in the IT sense).

File format: The standard to which the bits in a bit stream conform to satisfy the requirements of a particular program or set of programs.

Logical preservation: Preservation which attempts to retain the full capabilities of a digital object when used with its appropriate software. This can encompass a range of properties: that the behaviour of the combination of the software and data is maintained (as one may wish in say a computer game, or spreadsheet), that colour and sound fidelity is maintained, calculations remain valid, and so forth. It is also called Functional Preservation.

Medium: This term refers to the substrate on which digital information is recorded – such as a CD-ROM, memory stick, hard disk, etc. Sometimes the term is used mistakenly to denote the file format of a digital object. Plural is Media.

Migration: To be distinguished in the digital preservation context from mere copying from one place to another, or one medium to another. A preservation method employed to try and retain as much as possible of the original functionality provided by the data when run on its original hardware by converting (migrating) the bit stream so that it conforms to an undated file standard for contemporary software.

Preservation: This is used in the way usually understood as being all those activities undertaken on a continuing basis to ensure the longevity, accessibility and usability of a digital object.

Preservation actions/interventions: Specific actions undertaken on a digital object to ensure its continued accessibility and usability. This is analogous to conservation action in the analogue arena.

Preservation planning: This phrase can be interpreted in two ways - (i) in the general sense of planning for all aspects of digital preservation of collections or groups of collections within an organisation covering policy, strategy, process, resource and technical questions, or (ii) in a more restricted sense as used in the OAIS standard for digital archives, of a specific function within an archive of the planning for and execution of preservation actions (qv).

In this report we use the phrase “Planning for preservation” to denote sense (i) and “Preservation planning” to denote sense (ii).

Restoration: This term as understood by archives, libraries and museums is not used, or only rarely, in the digital preservation context.

Some of the more common abbreviations used in this report are defined here, with references as appropriate:

EAD	Encoded Archival Description - a standard for encoding archival finding aids using Extensible Mark-up Language (XML), used for the interchange of archival descriptions. See: http://www.loc.gov/ead/index.html
HLF	Heritage Lottery Fund

ICT	The RCM organisation delivering ICT (including access to the Janet network) and IT-based services
ISAD(G)	International Standard Archival Description (General) – A standard for archival description developed by the International Council on Archives (ICA) See: http://www.icacds.org.uk/eng/ISAD%28G%29.pdf
IT	Information technology – the techniques and materials for processing and transmitting information
METS	Metadata Encoding and Transmission Standard - a standard for encoding and transmitting descriptive, administrative, and structural metadata. From the Library of Congress. See: http://www.loc.gov/standards/mets/
OAI-PMH	Open Archival Interchange – Protocol for Metadata Harvesting.
OAI-ORE	From the Open Archives Initiative.OAI-Object Re-use and Exchange. See: http://www.openarchives.org
OAIS	Open Archival Information System (ISO 14721:2003) – A reference standard “to establish a system for archiving information, both digitalized and physical, with an organizational scheme composed of people who accept the responsibility to preserve information and make it available to a designated community”. See: http://public.ccsds.org/publications/archive/650x0b1.PDF
PREMIS	PREservation Metadata: Implementation Strategies – A data dictionary for core preservation metadata needed to support the long-term preservation of digital materials. From the Library of Congress. See: http://www.loc.gov/standards/premis/

D.5 Preserving the RCMM’s digital information

Preservation of digital information, as shown in earlier sections, depends on:

- a. Having in place a set of policies, standards and support mechanisms which enable digital preservation supported by the wider organisation

- b. Defining, documenting, following and maintaining a set of processes conforming to the above at managerial and technical level, and
- c. Maintaining a sufficient level of expertise.

In this section we specify actions and requirements to achieve the first two elements (a, b), in the next section (D.6) we discuss staffing and expertise. In the subsequent section D.7 we place these as a plan of action, in broad headings. Finally, in section D.8 we give some indicative costs relating to the digital preservation activity. Appendix 3 provides slightly more information on the plan (eg suggested responsibilities).

Section B of this report shows that in many respects the RCMM is in good shape to take on the challenge of digital preservation. It will have a period of some two years during which to put in place a very solid framework and programme for digital preservation, involving low input of resources for its maintenance.

Section B also shows that the RCMM's digital preservation requirements are, in the main, straightforward and relatively light. We do not believe that, at present, the RCMM needs any special software or third-party services. The application of basic rules and best practice combined with wide awareness and appropriate training will be enough.

The set of actions set out here should enable that good start to be maintained and capitalised upon.

D.5.1 Digital preservation policy

A preservation plan must be based on an agreed policy (or set of policies) which set out the parameters which inform and drive the plan. In turn, these policies should be based on the information strategies of the organisation, and other policies, plans and strategies which affect the information or records under consideration.

As yet, the RCMM does not have a digital preservation policy (nor a strategy document for information management on which to base the plan). This policy needs to be developed – we have drafted a sample policy, specifically for the RCMM (but see below). This plan should be signed off by the RCMM's senior manager, and also senior management in the RCM, and it must be regularly reviewed, updated and authorised; these responsibilities must be documented within the plan. We suggest sign-off includes the head of the IT department.

Given the similar roles and responsibilities in the Library, we recommend that in due course, digital preservation policy should be merged with the Library. In due course, it may be sensible for the College, Library, Museum, to consider merging systems, possibly under the umbrella of a wider digital asset management system (see separate paper by the DAC on a DAMS for the Museum). It is essential for the RCM itself to address digital preservation, which will also entail a College-level

digital preservation policy. When it does so, it may be preferable to have a single policy for the whole College, also covering the Museum and Library, though we note that the Museum and Library both share specific custodial roles, because of the unique collections they hold, not shared by other College departments. The following diagram (Figure 4) shows the overlap in holdings types of the Museum, Library and Administrative functions:

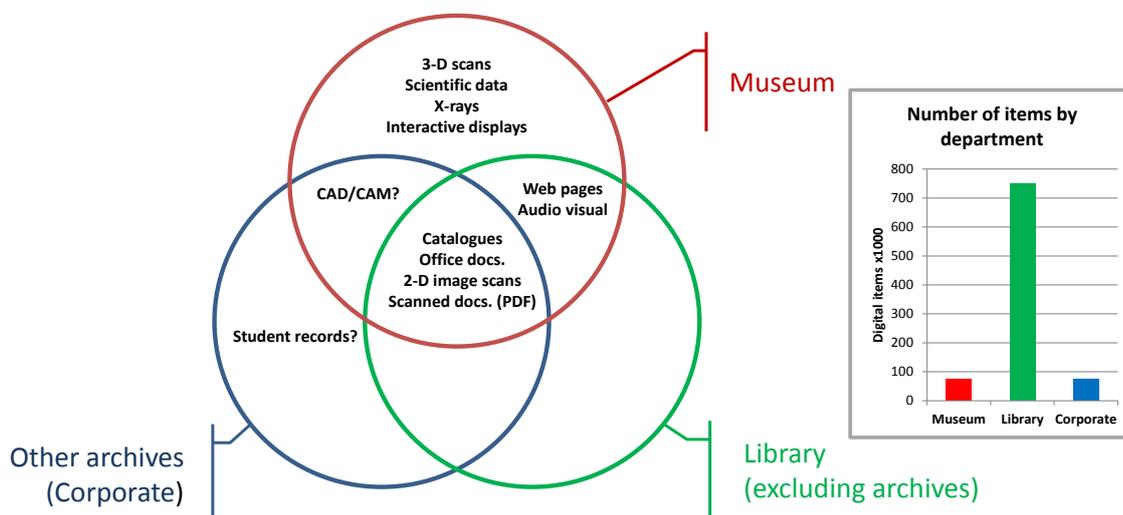


Figure 4: Departmental overlap – data types for retention (and expected number of retained items by 2016)

D.5.1.1 Digital preservation policy headings

Appendix 3 sets out a **draft** preservation policy which the DAC has drafted, for the purposes of this plan, and to provide an initial draft plan for the RCMM.

The policy needs to set out why the entity is ‘doing’ digital preservation, how digital preservation helps the entity to achieve its core objectives, how digital preservation aligns with the broader strategic goals of its parent entity, and what the benefits of long-term availability/access to data, and risks.

The policy also acts as authority for those undertaking digital preservation: it should set out governance information, identify roles and responsibilities (internal and also external, if any), set out the coverage/scope of the digital preservation activities, including broad categories of records; it should indicate criteria for success. It should indicate standards to follow for:

- File format standards for the various information types acceptable for long-term preservation
- Metadata to be recorded for digital preservation
- Default significant properties to be preserved for the various information types.

It should also define and specify the characteristics of the Museum's designated Community. The digital preservation policy also needs to set out its relationship to other policies and sets of procedures. The policy needs to set out who are the owners of the digital preservation strategy (may be the same as for the policy).

The digital preservation policy also needs to articulate its relationship to other digital preservation activities outside the Museum.

Some institutions' digital preservation policies are more detailed, covering acquisition and 'technical' aspects such as 'ingest'. We suggest that initially the RCMM's digital preservation policy should remain shorter, and include these more detailed headings as its activity matures. Indeed, at this early stage it would be premature to decide on some approaches. Typically, institutions go through a similar evolution in their digital preservation policies and programmes – start simple, gradually expand number of headings covered in policy documents.

D.5.2 Digital preservation strategy

Strategy for digital preservation tends to cover two levels - high-level strategy, and 'technical' strategy, relating to 'technical digital preservation approaches (such as opting for migration rather than emulation). Overall, digital preservation strategy is the broad approach adopted by an entity to ensure that digital records remain in a usable form over time (the strategy or policy need to define the entity's definition of 'usable form'.

The British Library's digital preservation strategy stresses that "digital preservation is a lifecycle concern and an organisation's shared responsibility". Its strategy implements a cross -directorate governance structure to ensure it can be achieved.

The strategy we have outlined here takes account (i) of the resources available to the RCMM, (ii) of the RCMM as a museum within its parent organisation, the RCM. The DAC stresses that this is a draft strategy; it needs to be reviewed, adjusted if necessary, adopted and maintained. Indeed, we believe that it should be adjusted once the RCM has a digital preservation policy and plan, in order to apply efficiencies.

It does not need to wait for an out-of-the-box solution, instead taking **incremental steps** to provide a **good digital preservation environment**.

We strongly recommend setting simple measures of success and recording performance. Metrics for museum performance are also extremely important. These metrics will help ensure that appropriate resources continue to be available for digital preservation.

D.5.3 Standards to observe

In a small organisation like the RCMM, whose primary function is not digital preservation, strict application of archival and related /standards/processes is not practical (though it may be in a wider College context). However, designated staff in the department must become familiar with the basic principles set out in the most relevant standards. See also the attached Bibliography (Section F).

- a. The most important of these is the Open Archival Information System (OAIS) also known as ISO 14721:2012. This recommends a set of processes, metadata structures and information structures to enable organisations to preserve their digital information indefinitely; it also introduces a useful vocabulary for talking about these. We describe the essential features of this standard in D.5.3.1 below.
- b. Recording suitable metadata to enable preservation is a key tool. The recommended standard is PREservation Metadata: Implementation Strategies (PREMIS) maintained by the Library of Congress. The recommended metadata elements to record are based on this (see Schedule A below – preservation metadata). Again, in a small organisation like the RCMM the strict application of this is not is not practical (though it may be in a wider College context).

The standard which specifies (i) the metadata to be used for the purposes of digital preservation systems (via a data dictionary); (ii) a metadata schema in which to express this metadata for interchange purposes. In doing so it enables repositories to describe precisely for preservation purposes: (a) digital objects (at several levels), (b) agents affecting digital preservation actions, (c) events associated with digital preservation, and (d) rights associated with digital objects.

- c. Trustworthy Digital Repositories: Audit and Certification, ISO 16363:2013 re certification. This may be more appropriate in a few years' time; for demonstrating adherence to good practice in a more rigorous fashion see the Data Seal of Approval, DIN 31644, and SPOT for small entity, early stages (and note that SPOT can be mapped to PREMIS metadata). These are referenced in the Glossary.

Preferred file format standards to adopt for long term preservation are dealt with in the next section. Staff should also be familiar with the basics of CIDOC CRM, LIDO, MIMO and any successors.

D.5.3.1 Open Archival Information System (OAIS)

This is a non-prescriptive standard which specifies (i) the overall architecture of a digital archiving system, (ii) the classes of metadata needed for digital preservation (see the Metadata Report), and at a top level (iii) functions to be implemented.

We adopt some OAIS terminology here, as this is now common in the digital archiving and preservation community and because of this we spend some time here to present the terminology.

The main terms and ideas include:

- | | |
|------------------------|--|
| Consumer | An organisation or individual who uses information (Dissemination Information Packages - SIP) from the archive |
| Designated community: | The set of organisations or individuals which are defined to be potential consumers of information in an archive, now or in the future. |
| Dissemination: | The function of packaging and delivering to a Consumer (qv) requested information from the archive. The package of information delivered is described as a Dissemination Information Package (DIP) |
| Information Packages: | Information - Content and Metadata – to be delivered to archive, stored and preserved in the archive, and delivered on a valid request from the archive in whole or in part to some Consumer. Abbreviated as IP. |
| Ingest | The set of functions which the archive performs to receive Submission Information Package from a Producer (qv), to check it, process it and to store it in the archive as an Archival Information Package (AIP). |
| Preservation Planning: | A function within the archive to plan for and execute preservation upon Archival Information Packages in the archive. It is this function which is the chief characteristic separating a digital archive from other information processing systems. |
| Producer: | An organisation or individual who delivers information (Submission Information Packages) to the archive under some Submission Agreement. |
| Submission agreements: | An agreement between the Producer and the Archive about the submission of materials to the archive. These can cover technical matters, specifications of materials and metadata delivered, ownership and rights information, disposition rules, timing |

of submission and many other factors needing agreement between the Producer and the Archive.

Submission: The function of a Producer providing information to the archive under a Submission Agreement (qv). The package of information delivered is described as a Submission Information Package (SIP).

In this brief overview here we map how this plan is related to the major functions and entities in OAIS, as shown on the diagram (Figure 5) adapted from the standard:

From CCD5D, 2003

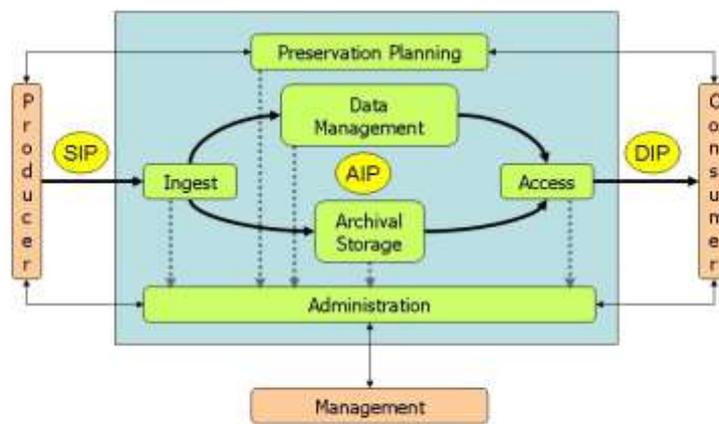


Figure 5: The OAIS Model

We move from left to right through the diagram:

- Producers:** The donors of information to the Museum;
- Ingest:** The processes described under phases B and D to enter content and related metadata into the digital archiving environment.
- Data management:** The stored metadata as described above, and its management in the various systems within the Museum and College more widely. Includes the functional details of managing that information
- Archival storage:** The stored content as described above, and its management in the various systems within the Museum and College more widely. Includes the functional details of managing that information It includes the active management and checking of storage systems as described below

Preservation planning	In the restricted sense (see the glossary in section 2) the planning for and execution of specific preservation actions on at-risk objects. Also an area to be addressed by any DAM project
Administration:	The set of actions, management structures and instruments to manage the day-to day business of the archive. See the description of phases A through D below (and in particular phases G and A). Also on the DAM project's agenda.
Management:	The wider management in the RCM, where policies and strategy are determined and signed off. This includes the work of the DAM project team.
Access:	The processes associated with serving users (Consumers in OAIS terminology)

D.5.4 File format standards for long-term preservation

An important factor in increasing the ability of an item of digital information to remain accessible and useable over time is the file format standard to which it conforms. Wherever possible the file formats used for preserved objects should conform to some or all of the following requirements:

1. Open file formats – where the format and its specification are freely available
2. Non-proprietary, and free from use restrictions
3. Endorsed by a recognised standards body or institution
4. Stable, and preferably with a large user base
5. Specifically created for archival use
6. Loss-less and with high resolution (for files obtained by a digitisation process, either visual or aural). This often means that little or no digital compression is used.

Minimising the number of formats used will reduce future costs, of course.

For text in files, it should be the practice to retain these to the Unicode standard (UTF-8, and where needed UTF-16).

For specific file types, this policy recommends that wherever possible the following formats be used for the various types of information: This could be an attached schedule

- Documents: Preferred in an “image form” (see below), but if processing is still required, then in a neutral XML (more dubiously MS WORD XML, i.e. .docx format, or use Open Office .odt)

- Documents in image form: Preferred PDF/A, or failing that PDF if some dynamic content is still required
- Spreadsheets: Preferred in an “image form” (see below), but if processing is still required, then in XML (more dubiously MS Excel XML, i.e. .docx format)
- 2D images – photographs and scans: Masters: TIFF or DNG
Use copies: Preferably high-resolution TIFF, except for thumbnails.
- Audio files: Lossless: .wav
Use copies: mp3 (at highest practical resolution)
- Music notation files: MusicXML, Sibelius (.sib). It is possible further, more open notation file formats will follow.
- Video files: TBC: .AVI, .JP2, .MOV, .mp2, .mp4, .MXF and .WMV with sustainable codecs. Archival master preservation files should be saved with uncompressed or lossless compression and in a widely used file format
- CAD files: DGN or DWG (but note the latter is proprietary to Autodesk Inc.). More open standards may yet emerge in this area, to satisfy various industries, so commercial pressure may push this issue.

Special considerations apply to some rather more complex or unusual data types and where standards are non-existent or not yet established for archival purposes:

- 3D images (photographic or scanned) – photographic is relatively straightforward (as photos, videos); from tomographic machines (we provide fuller information about 3D imaging in a separate, dedicated support paper) – entails multiple issues relating to choices on information levels, processing levels, with factors such as computational capacity.
- Relational databases: Some work is being carried out in this area, but it is sorely neglected. See the SIARD materials referenced in the Glossary.
- Web sites: see work of IIPC (the International Internet Preservation Consortium), and W3C.
- Interactive displays, social media includes aspects of gaming technology
- Software – though there is a vibrant community preserving old video gaming software, usually by the technique of emulation. (See Rothenberg reference in the Glossary).

D.5.4 Information-processing considerations

This section follows the recommendations of the OAIS standard; the names of the high-level functions in OAIS are given in brackets after relevant headings.

D.5.4.1 Data creation or receipt (“Ingest”)

This is the process of receiving digital information - IP (information packages) - into the long-term preservation environment. While some digital information will be received from external sources, most of the digital information for preservation in the RCMM is generated internally, the most important (in this context) being digitisation from scanning:

- Where digital information is obtained from external sources for long-term keeping, inasmuch as is possible the receipt of such materials shall be accompanied by documentation which specifies: authority to keep the materials, the source of the materials and a description of them (including dates of creation), technical information specifying the technology producing the materials (such as the software used and its version, the file format standard and version to which it conforms, the computer architecture needed to run it – e.g. Windows or Macintosh), specifications of restrictions on use and restrictions of access. In OAIS terms this document is termed a Submission Agreement. This document shall be archived too and be linked permanently to the information.
- All information received externally shall be checked for viruses and other malware on receipt and the information safely copied to the organisation’s secure disk storage devices (see Storage below).
- If materials are received on portable media such as optical discs, memory sticks, hard drives, then the information from external sources shall at the earliest convenience be checked to ensure the media is readable. Media should be retained until sufficient copies of the information are stored and the information catalogued in Adlib; it will be kept permanently if it is deemed to have its own archival value (such as the artwork on a CD).
- For scanned images, copies for general use and as thumbnails shall be made and stored permanently using the standards specified in D.5.4.3.

D.5.4.2 Storage considerations (“Data Storage”)

- At least three copies of archived information should be stored at geographically separated places. At least one of these shall be backed up daily.
- Regular checks shall be made on the storage media to ensure that it is not deteriorating, and where found wanting, information should be copied by a verified process to new storage.
- Storage areas are to be kept free from unauthorised intrusion behind an accredited firewall.
- Avoid storing information in “inhibited” form unless there are strong reasons to do so. ‘Inhibited’ forms include files with passwords, encrypted forms, compressed forms (and other “bundling”), and digital signatures – since loss of the keys to unlock these will result in the loss of the data.

D.5.4.3 Management of metadata (“Data Management”)

- Continue providing the full descriptive information describing the object according to current practice in the RCMM in the Adlib system. As with all key processes, these should be described in formal process documents, which are maintained, as SOPs.
- Additional metadata should be associated with the information being described in Adlib to facilitate and control preservation. This should conform to items specified in the PREMIS metadata dictionary. The recommended set of items to record is set below – noting the importance of providing full and accurate technical specifications of the object, and recoding the significant properties to be preserved.
- Details of all interventions on stored information to preserve it (preservation actions) should be recoded as metadata.
- The PREMIS metadata standard should be studied to determine the relevant metadata elements to record, and fields set up in Adlib to take these. N.B. In the table shown below, information about linkage to other objects, to events (such as preservation action descriptions) and rights have been omitted, pending investigation as to whether they are already recorded in some manner.
- A suggested minimum set of items of metadata to record against each object to be preserved (in Adlib) is shown in the following table. Subject to review by RCMM, those items shown in bold type are deemed essential for preservation purposes. The last

column of this table contain the references to the relevant entries in the PREMIS metadata Data Dictionary. Note in this table we have only provided suggestions for the files themselves (“objects”), not for events, rights and agents:

Metadata Element	Notes	PREMIS References
Type of identifier (i.e. the namespace of identifiers)		1.1.1 objectIdentifierType
Unique identifier of the object		1.1.2. objectIdentifierValue
Type of preserved object	Value likely always to be “File” – if so it can be omitted (See PREMIS notes).	1.2 objectCategory
Level of preservation required		1.3.1 preservationLevelType
Indicator of the functions to be applied		1.3.2 preservationLevelValue,
Attributes considered significant for preservation		1.4.1 significantPropertiesType
Property of this deemed important to preserve		1.4.2 significantPropertiesValue
Number of any levels of decoding (e.g. decrypting) needed to access information	If always zero then may be omitted	1.5.1 compositionLevel

Metadata Element	Notes	PREMIS References
A value (checksum) by which the file can be checked as unchanged	Two items: <ul style="list-style-type: none"> • The checksum algorithm used • The checksum value 	1.5.2 fixity 1.5.2.1 messageDigestAlgorithm 1.5.2.2 messageDigest
File size in bytes		1.5.3 size
The file format or standard by which the object conforms	Two items: <ul style="list-style-type: none"> • Format name • Format version <p>If a format registry is used to determine a format, such as PRONOM, then this too could be specified</p>	1.5.4 format 1.5.4.1 formatDesignation 1.5.4.1.1 FormatName 1.5.4.1.2 FormatVersion
Application creating the object	Two items: <ul style="list-style-type: none"> • Application name • Application version 	1.5.5 creatingApplication 1.5.5.1 creatingApplicationName 1.5.5.2 creatingApplicationVersion
Original name of the object	This is probably good to record for trace-back reasons	1.6 originalName
Description of the storage used	Probably optional, if always on a known, fixed storage device.	1.7 storage 1.7.1 ContentLocation 1.7.1.1 ContentLocationType 1.7.1.2 ContentLocationValue 1.7.2 StorageMedium

D.5.4.4 Actions to preserve digital data (“Preservation planning”)

In order to preserve digital data, interventions may be needed periodically on stored information to guard against inaccessibility due to obsolescence of technology and deterioration of stored files.

This is akin to “conservation” in the analogue environment. The RCMM should:

- Technology watch: Review on an annual basis the set of file formats in which information is stored and make judgements as to the continued viability of the file standards being used. If a format is becoming obsolete, set up a programme of preservation actions to undertake remediation. (Note, in IT terms, such remediation programmes may be infrequent (of the order of 10 to 20 years); for analogue archives this would be very frequent intervention).
- Regular audits of the storage areas should be undertaken to ensure that it is not degrading. If issues are detected, then data should be moved to new media by a verified process.
- Whenever information sources are used, use the fixity metadata recorded for the item to check the file's continued integrity. If a file is corrupted, replace it with an unimpaired copy from the alternative stores (see D.5.4.2).
- When a preservation action is performed, undertake the following:
 - Choose a suitable choice of action: in practical terms this will mean either migrating a file to a current standard, or undertaking emulation. The former is to be preferred for most information, the latter possibly more appropriate to complex data types, but expensive.
 - Take note of the stored preservation metadata, especially that specifying significant properties.
 - Keep both the input file and the new output file from this process in case of having to back track.
 - Document processes, actions and outcomes as metadata.

D.5.4.5 Preservation and use of information ("Access")

Use of stored information should not interfere with the long-term preservation of digital information, thus copies in preference should be used of objects stored for the long term. Use (for exhibitions, displays etc.) should be viewed as a read-only operation, except that records of usage could be recorded, and of files generated, which may be of value in the future for preservation actions and planning.

D.5.4.6 Overall management of preservation (“Management”)

From a digital preservation viewpoint a number of management functions need to be instituted over and above the normal management functions of reporting, control and planning, maintaining control of costs, assuring quality, and keeping written policies, strategies and operating procedures up to date. These are:

- Maintaining a technology watch function, to detect when technologies used within the stored information are likely to be endangered by obsolescence. The process will need to take into account the file formats used for information storage, the nature of the significant properties to be preserved (to ensure these really are in danger) and the needs of the designated community.
- Planning and executing preservation actions. For the more straightforward data types this will in almost certainly mean migration to more contemporary file standards, and ensuring the transformations accord with policies, and that full documentation of processes used are undertaken. The function also requires a careful attention to quality controls over the processes.
- In later stages management of the archive should consider certification as a trusted digital repository, as discussed earlier.

D.6 Skills acquisition and staffing

We examine this under two phases – (A) during the period of the HLF funded project, 2016 to 2019, and (B) beyond 2019 to 2026 completing a ten-year period. Beyond 2026 it is not possible to say more than to give a few indicators.

More detail on skills acquisition is provided in the plan appendix. We also provide a sample Capability Maturity Model, aligned to the skills acquisition plan, as a separate MS Excel file.

Given the Museum’s small size, the budget constraints on the Museum, and the fairly low initial volumes of information and their relatively undemanding preservation requirements, we do not believe a case can or should be made for dedicated, full-time digital preservation personnel.

However we do believe there is a case for hiring within the HLF project an internship to assist the Digitisation manager with preservation related tasks.

At College level, as the College’s digital information volumes rise as a whole, and given the proportion of audio-visual material, this might be reviewed at College level, but possibly not until the phase B period. In this case consideration should be given as to where the digital preservation function might lie in the college and consider recruiting a specialist to work in this area; the museum may well be the best organisational place.

Phase A – HLF funded project.

We note that the RCMM's Digitisation & Documentation Officer has been allocated digital preservation responsibility. The skills needed initially are a good understanding of the basic principles of digital preservation, an awareness of on-going initiatives, standards, and methods. Only later will more in-depth knowledge be required. We therefore recommend:

- Awareness and skills acquisition. For the Digitisation & Documentation Officer and possibly for the internship:
 - Attend further and more specific training events hosted by the DPC and other similar organisations
 - Sign up for a more structured approach to skills by following relevant modules providing Continuing Professional Development credits, such as on the courses hosted on-line by the University of Dundee and others.
 - Maintain a small library of relevant reference documentation covering the field (see Section F); follow e-mail newsletters, groups, lists
 - Sign up for relevant information feeds (see Section F for a selection).
 - Seek attendance at relevant meetings and events, in the UK and if funds permit abroad. See Section F for organisations which host events. We note that iPRES²³ is the major international digital preservation meeting, held annually.
- We would suggest that a RCMM host a workshop event to inform a wider group of staff in the basics of the issue and methods to solve it. It is strongly suggested that in view of the small numbers of staff in the Museum, and the almost identical need in some other areas of the College (and certainly the Library), this be opened to a wider internal audience.
- The RCMM should develop and subsequently maintain a plan for the acquisition and retention of skills.
 - Make documentation of the departments policies and procedures (such as recording the type of metadata stored in Adlib and the rationale for doing so)
 - Again, elements of this plan might usefully be shared with the Library and other departments in the College.

²³

See: <http://ipres-conference.org/>

- Alongside this, provision should be made for continuity planning – that is to develop the capacity to ensure that as staff with digital preservation skills leave, there is remaining capacity to fill any interim need and to pass on knowledge to new recruits.
- Suitable staff should be assigned back-up roles in order to take over work should there be an absence of those directly involved in preservation. Again consideration might be given to collaboration with other departments.
- In case there is any need to recruit in this area then skills (and better still qualifications and/or experience in digital preservation) should be included in the job specification.

Phase B – Beyond HLF funded project. – 2019 to 2026

We believe that beyond the HLF development period there is very little more that can be recommended for the Museum alone beyond that set out above, except:

- Continuing to maintain the structures set up in phase A, albeit kept under constant review and revision.
- Continue to hold regular awareness events in the Museum (and more widely in the RCM)
- Keep a watch on developments in the area though the fora referred to above, and any others that may arise or succeed them.

D.7 Digital preservation action plan

This action plan is suggested for the development of a digital preservation capacity in the RCMM. Like the skills acquisition plan above, it is presented in two phases - to 2019/2020 (completion of the building/More Music project), and then from 2019/2020 to 2026.

The first phase is made up of three sub-phases; (1) Development/initiation, (2) execution, and (3) consolidation. There may be some overlap of activities between these sub-phases, or activities conducted in parallel.

Providing precise dates on given information is impossible, and so the plan is presented in terms of a suggested order of execution (noting again that some activities may be conducted in parallel), with suggested execution elapsed times. The overall scheme is shown diagrammatically below. A more detailed presentation is set out in Appendix #.

We stress that we believe the amount of time – duration – required for activities under this plan is relatively short. However, the elapsed time may cover months.

In our view, the governance elements of the plan, and their punctual continuation, are critical to the success of the programme.

The following diagram (Figure 6) shows the indicative phasing of the actions listed below, subject to further analysis within the RCMM. Numbers refer to the numbering of actions (per phase) shown below.

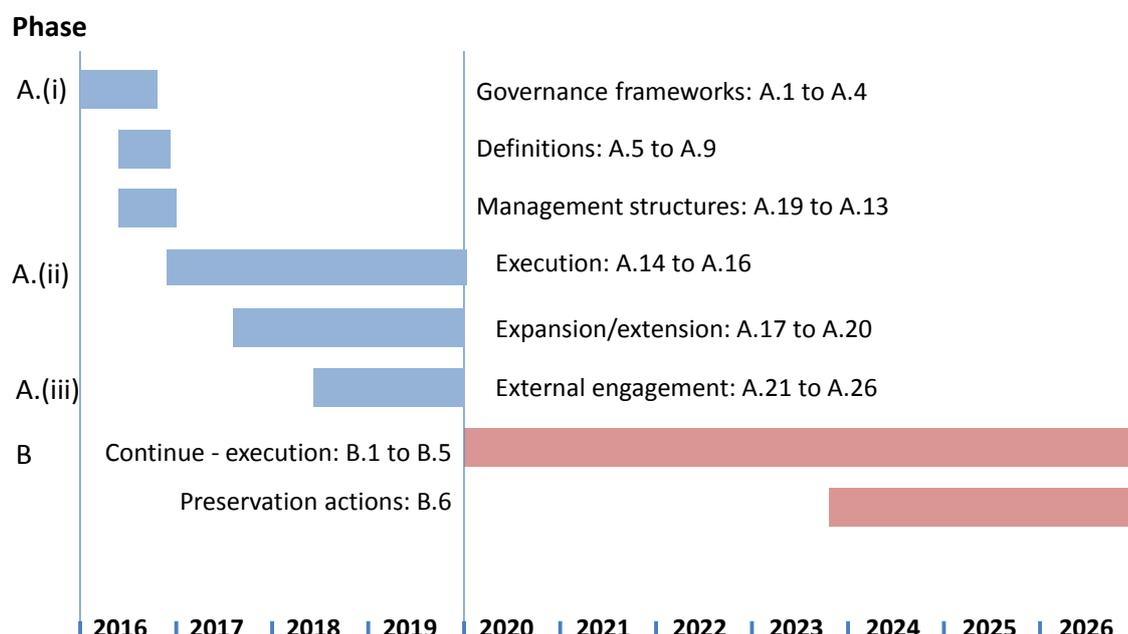


Figure 6: Indicative phasing of actions

D.7.1 Phase A – HLF-funded project period

Phase A (i): Development and initiation

- A.1. Agree initial governance framework (identifying people and/or departments) for Museum’s digital preservation activities; this should agree and appoint a small digital preservation board, which will sign off the digital preservation policy, which identifies and allocates core responsibilities.
- A.2. Develop, agree and sign off a digital preservation policy. Ditto for digital preservation strategy (we suggest these are combined in one document). Agree KPIs²⁴, targets. Assign/confirm responsibilities. Disseminate and promote the policy within the RCMM and more widely in the RCM (particularly those departments producing significant digital outputs).
- A.3. Review the draft digital preservation plan in the light of the digital preservation policy and strategy, modify if applicable, and confirm.

²⁴ Key performance indicators. Suggestions in the policy appendix.

- A.4. Scoping – identify, agree materials to be covered by the Museum’s digital preservation programme and/or to be archived by/for the Museum. Identify materials/records which are outside the Museum, in the RCM but which actually pertain to the Museum, are of value to the Museum and/or are needed for the Museum’s archive or core activity.
- A.5. Choose and confirm suitable file standards or the classes of digital information to be kept for the long term. Document these. Note at this point it may not be possible to be dogmatic about the standards to be applied to some classes, but note actions will required in the future (for example, 3-D images). Standards which are the “best available” should be adopted in the interim.
- A.6. Define and describe the Designated Community for the Museum’s archived digital information, as described in the OAIS standard, and determine their actual contemporary needs, or assumed needs for that part of the community which is in the future.
- A.7. Define significant properties to be preserved for classes of file types (and special individual files if need be). Identify any implications for digital preservation programme, metadata schemas, and adjust if required.
- A.8. Decide and confirm digital preservation metadata to be stored against digital items (or classes of items). See Section D.5.4 for a suggested minimum. Set up preservation metadata fields, with controls and associated controlled vocabularies, in Adlib (or in appropriate indexing systems if catalogued outside Adlib). Set up preservation-event triggers.
- A.9. Review rights management in the context of digital preservation; review rights management metadata and ensure it is sufficient and necessary. Ensure agreements, at item level and also with third parties such as Google Cultural Institute, are archived, readily accessible if required.
- A.10. Discuss and confirm archival/custodial responsibilities and digital continuity/digital preservation needs (for digital and non-digital materials), specifically regarding requirements for the More Music project, and with HLF requirements.
- A.11. Ensure storage management practices are satisfactory and conform to the preservation policy; make amendments where necessary. Ditto for data

management practices; ensure that the data management practices and the plans for digitisation are aligned with the digital preservation plan.

- A.12. Ensure good records management practices throughout the Museum. For example, documents should always be dated, authorship, status of document should be indicated, and there must be careful version management. File naming systems should be documented, and all staff/persons naming files should apply the systems; standard vocabularies, thesauri etc. should be identified, documented, and their use ensured. Decide on and set up quality control processes, as appropriate. Ensure awareness of risk and problems associated with links to files/locations outside the digital object.²⁵
- A.13. Undertake staff continuity planning, including the documentation of the department's practices (in particular with regard to information management processes and the assignment of descriptions in Adlib).

Phase A (ii): Execution phase

- A.14. As part of the documented, routine digitisation process, (i) assign preservation metadata to newly created files, and (ii) ensure that files are stored conforming to the file standards specified in the preservation plan. (See A.8 and A.9 above.)
- A.15. As part of the routine processing and archiving of non-scanned files, (i) assign preservation metadata to received and newly created files, and (ii) ensure that files are converted to archival formats where necessary and stored according to the preservation plan. This may imply conversions from PDF to PDF/A, depending on the policies determined in the Development and initiation phase.
- A.16. Develop a programme of updating existing object descriptions with preservation metadata (and consider doing this as a background operation). Execute this programme, including any file conversions to archival formats. Ensure operating practices are defined up front.
- A.17. Begin outreach into the wider RCM organisation with a view to coordinate digital preservation actions and to share costs and other resources. This could lead to more 'overarching' policies and action.

²⁵ Consider dating, naming and describing the link.

- A.18. Review and update the preservation policy and this plan on an annual basis. Review strategy initially annually for the first two years, then we suggest every two or three years.
- A.19. Set up working groups on the wider issues relating to 3-D data, data entailed in inter-active displays, exhibitions, and more complex data. Include coverage of digital preservation/ digital continuity for these information classes. Develop plans for handling and for digital preservation of more complex data, including the definition of significant properties, metadata needs, and preservation methods to be used (such as emulation and migration). Initiate collaborations to introduce 3D image standards for museums, and specifically for music instrument museums.
- A.20. Set up, maintain and act upon the risk register re digital preservation.

Phase A (iii): Consolidation phase

- A.21. Maintain a regular technology and standards watch (include joining DPC²⁶, joining mailing lists re their Technology Watch) – we suggest setting up a list of headings/areas (such as PREMIS, METS, LIDO, geospatial standards, web archiving, audio-visual archiving) and track on a regular basis (e.g. quarterly).
- A.22. Consider setting up or joining informal digital preservation grouping(s), for example with Collections Committee members (we understand with the Science Museum, Open University, V&A); also with neighbours, Imperial College, Natural History Museum; the latter has done interesting work in this context.
- A.23. Web archiving: The Museum should have a small working group, to investigate and determine its specific web archiving requirements (for example, in relation to the archiving of learning and engagement materials, activities, and virtual²⁷ exhibitions – what functionality does the Museum want to archive? What are the practical implications); the RCMM should also examine rights management issues. We understand that the RCM IT department will be undertaking a web archiving project. We strongly recommend that the Museum's digitisation officer participate in this work and that a member of the Museum staff is included in any steering group. The RCMM should conduct an internal investigation of its web archiving

²⁶ Digital Preservation Coalition

²⁷ See glossary for definition of virtual exhibition, virtual museum

requirements and benefits, whether or not a wider RCM web archiving initiative is underway (though it could be done within that initiative, of course).

- A.24. Similarly, consider establishing or joining a social media archiving working group. Consider 'citizen' curation working group, looking at issues/benefits.
- A.25. Join/engage in digital preservation forums, participate in selected educational events/courses, particularly with a view to the preservation of more complex data types in the future (web sites, 3D images, metadata databases, interactive materials, compound objects), and engage expert consultancy where necessary to establish methods and processes.
- A.26. Towards the end of the More Music project, consider obtaining a first level of accreditation/Certification of the repository – the Data Seal of Approval, or alternatively DIN-31644. In meantime, do annual SPOT check (see Bibliography).

D.7.2. Phase B – Beyond HLF funded project. – 2019 to 2026

Beyond 2019 there are two major aspects to the RCMM's digital preservation processes. The first of these is the embedding of the digital preservation process into the day to day work of the department:

- B.1. Continue processes and maintenance as above, as noted in the Execution Phase listed above, to archive materials as needed.
- B.2. Continue to monitor evolving technical landscape, particularly in the more difficult areas noted in A.25 above and, and continue with collaborations established as needed, and joining new ones as they arise.
- B.3. Continue to monitor the collections(s) to ensure the continued integrity of the stored information.
- B.4. Conduct regular reviews thoroughly the policies and plans in the light of the above, and amend in the light of circumstances.
- B.5. After a period of some years gaining experience , the RCMM (or wider RCM) should consider obtaining more rigorous certification as a trusted repository – either obtaining DIN 31644 certification, or preferably ISO16363:2013 certification.

It is only after some years that the Museum may be obliged to undertake conservation actions on some its digital holdings (and this may be unlikely in the 10-year time frame considered here):

- B.6. The execution of such should conform to the policies and procedures determined above, and the process should be informed by consideration of the needs of the Designated Community and the significant properties assigned to data items (or classes of data items). It is worth noting here that the method of choice (as far as technology permits today) is migration from one format to another, except possibly for the more interactive and dynamic data types where emulation may be more appropriate (but bearing in mind possible higher costs).

D.8 Estimated costs

The primary resource requirement is for staff time. As we stress throughout, good planning, a solid, practical framework and the fact that the Museum's digital preservation needs, particularly in the first plan phase, are not heavy mean that the time requirement is not large and can be planned and managed easily.

We do recommend that three copies are kept of important/particularly valuable digital files (e.g., catalogue, master files, materials which cannot be or are difficult or expensive to recreate), and one copy is kept at at least 35 miles distance from the other copies. Otherwise, the digital preservation does not entail additional storage requirements. The Museum or IT department might consider purchasing an external hard drive, for risk reasons, but this is not necessary.

There is no need for any additional, specialist software. The metadata standards etc are freely available, community resources, well supported in terms of sustained funding. We believe the College may wish to consider digital preservation software in a few years, and the Museum should review this in five years' time (see detailed plan). However, for the Museum we do not believe specialist software will be needed.

Most costs are **discretionary**, and also discretionary in terms of amount budgeted.

Membership of fora and groups will be very valuable, however, most of these require no fee. We do not believe the Museum needs membership (full or associate) of the Digital Preservation Coalition (which is costly). In due course, this might be a consideration for the College.

Attendance at conferences and events will be of great value. This applies in particular to the Digitisation Officer, but also important for other Museum staff. We would budget £3,000 for years where an important conference (such as iPRES) is held in the USA (for example), otherwise £1,000 per annum (more would be great).

There should be an allocation for in-house core training for Museum and key staff. Again, this can be managed cost-effectively. For the Museum, we believe an annual budget of £1,000 would be adequate, given the need for basic training for volunteers and student placements.

We do not believe that the Museum needs to consider certification by a third party and/or external audit, certainly not for the first phase.

Section E - Review

As we confirm in this report, the costs specific to digital preservation for the Museum relate not to capital costs, but to costs relating to staff time and training (in the form of training, attendance at events). For digitisation, we recommend a high-quality scanner.

The plan sets out how the plan and digital preservation awareness and training should be made available to staff, volunteers and contractors. It is particularly important that contractors are made aware of their obligations in regard to the provision of records and maintenance of archives (see detailed plan).

We also recommend a short preliminary paper and presentation to upper management, included a dedicated session with most senior management. The DAC outlines this in appendix.

We have prepared a separate memorandum for the head of the IT department, which we suggest we present personally in a meeting, with the Museum's DO.

The Library has similar needs in many respects to the Museum for digital preservation; we recommend that possible synergies are explored in due course.

We also recommend a meeting with the Marketing department, also HR, but these should follow:

- Distribution to upper management, library and museum staff, contractors on the project,
- Web and print. PDF/A rendition
- Annually reviewed and strategically reviewed after 5 years.
- By whom, with what intention
- Scoped over annual and five-year periods

E.1. Review of preservation plan costs

Costs need to be little over and above the costs of creating and using the digital files. Planning and preparing ahead, and having governance, roles and responsibilities in place, are key to minimizing costs.

We note that some of the 2D scans were captured only in JPEG format. We recommend reviewing how many files this represents; ideally, they should be re-scanned, to create a TIFF master file.

E.2. Putting the plan in place

Actions for putting the plan in place are included in the plan.

- How the plan is to be adopted, published, and a copy made secure in the archives
 - Set up initial governance structure (for agreeing, etc); review draft policy and strategy, amend; sign off
 - Successive sign offs up to Deputy Director level
 - Published: printed (in library and Museum); on intranet.
 - Using the rules set down herein, place in analogue and digital archives
 - Rigorous, simple version management essential
- Recommendations for updating during the project
 - Monitoring process; synchronisation with related policies and plans (to be identified)
 - How kept available during the project
 - Who by and sign off

The plan needs to include awareness in Finance, HR, Marketing, IT, ... priorities are HR, Finance and the ICT group.

- How distributed and made accessible to staff, volunteers and contractors:
 - Distribution to upper management, library and museum staff, contractors on the project,
 - Web and print. PDF/A rendition
- Annually reviewed and strategically reviewed after 5 years.
 - By whom, with what intention
 - Scoped over annual and five-year periods

Section F – Bibliography

This section provides a bibliography and references to other resources:

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<http://public.ccsds.org/publications/archive/650x0m2.pdf>

PREMIS Working Group: 'Data Dictionary for Preservation metadata', (2015). Library of Congress. Available as a PDF file at: <http://www.loc.gov/standards/premis/v3/index.html> . See also: <http://www.loc.gov/standards/premis/> for further information.

Trustworthy Digital Repositories: Audit and Certification'. ISO16363:2013. Also available from the CCSDS website <http://public.ccsds.org/publications/archive/652x0m1.pdf>

Resources and Organisations

International Council on Archives. See: <http://www.ica.org/>

Digital Curation Centre (based at the University of Edinburgh). See <http://www.dcc.ac.uk/>. Among other activities the DCC hosts the International Journal of Digital Curation and the (Digital) Curation Reference Manual.

Digital Preservation Coalition (based in Glasgow and York). See <http://www.dpconline.org/>. Among other activities the DPC hosts a Digital Preservation Handbook and publishes a series of Technology Watch Reports. Full membership of the DPC costs £9000 pa and associate membership £2500 pa.

ICOM has a Working Group on digital preservation: see <http://network.icom.museum/cidoc/working-groups/digital-preservation/>

There has been some work in CIDOC and a working group: see

<http://www.digitalmeetsculture.net/wp-content/uploads/2014/05/CIDOC-Conference-DCH-RP.pdf>,

for a recent presentation, a Working Group report of 2013 (at

http://network.icom.museum/fileadmin/user_upload/minisites/cidoc/AGM_2013/Report2013_CIDOC_WG_Digital_preservation.pdf). Some academic work using CIDOC concepts is available – see for

example: Ontology-Driven Digital Preservation of Interactive Multimedia Performances by

Mikroyannidis, A., Ong, B., Ng, K. & Giaretta, D. available at:

<http://www.leeds.ac.uk/icsrim/caspar/caspar-data/AXMEDIS2007-caspar20071022-v1-4-a.pdf>

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<http://www.dpconline.org/publications/technology-watch-reports> This link takes you to the complete list of Technology Watch Reports – a very useful resource.

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Pennock, M, DCC Curation Manual Instalment: Curating Emails, (2006) ISSN 1747-1524 Available at <http://www.dcc.ac.uk/resources/curation-reference-manual/completed-chapters/curating-e-mails>

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Ruusalepp, R & Dobрева, M. Digital Preservation Services: A State of the Art Analysis. (2012). Digital Cultural Heritage Network project. At: <http://www.dc-net.org/getFile.php?id=467>

Videos etc.

Google's Vint Cerf warns of 'digital Dark Age'. (2015) BBC. At: <http://www.bbc.co.uk/news/science-environment-31450389>

The National Museum of Computing Tour (a video about the National Museum of Computing at Bletchley Park). See http://www.youtube.com/watch?v=Sw15F2QzMQ&feature=player_profile_page

On wider data sharing:

Lord, P. & Macdonald, A. Large-scale data sharing in the life sciences. (2006).

Section G - Glossary

This glossary sets out terms and abbreviations used in the report, ordered alphabetically. In some cases we also include a slightly fuller discussion of the term (as set out in the main report). Web references cited were harvested between 25th April and 27th May 2016.

With regard to the certification entries below, the DAC will provide its information paper relating to certification, in particular the Data Seal of Approval, the German DIN on trustworthy records, and the SPOT model (see below).

The pages of this glossary section are printed on green paper for the print version of this report, for easy reference.

2D	Two-dimensional, as related to images
3D	Three dimensional
Analogue	Used here to denote documents and objects which are not in digital forms, such as a painting, a musical instrument such as a trumpet, or a handwritten letter.
Archive	This term has different meanings for archivists and the IT community. The IT community often understands “archive” (verb) as the process of simply placing digital information in a secure environment for longer-term storage (sometimes just to free-up space on file servers), and as a noun to denote that storage. The archivist sees the act of archiving as a much wider and fuller activity. These differing meanings can be misleading for the unwary. We will make the usage intended clear here.
Archiving	A curation activity to ensure that data is properly selected, stored, and can be accessed and that its logical and physical integrity is maintained over time, including security and authenticity ²⁸ .
Back-ups	A back-up of computer files is an activity which is taken on a regular basis by IT departments to make copies of all information which is in current use so that, should the master copies be lost or corrupted, the lost information can be restored to the point at which the back-up was made. Back-ups are sometimes confused with archives.
Bitstream preservation	The PREMIS standard uses the word “Bitstream” to denote a stream of bits within a computer file to be preserved as an entity in its own right (such as a picture embedded in a word processing file”. Bitstream Preservation is also used more generally to mean preservation of the integrity of the stream of bits which computer files are composed.
Conservation	The term “conservation” is rarely, if ever, used by digital preservation practitioners. The use of the term as understood by museums and traditional archivist communities to indicate specific actions undertaken to halt the decay of an object is therefore not

²⁸ The term archiving has widely different professional use. The definition used here is closest to that employed by traditional archivists. However computer scientists often use the term to refer to professionally managed storage without the selection, authenticity, and preservation tasks included here, or simply to back-ups.

used in the digital context; rather the phrase “preservation actions”, or “preservation interventions” is used, or more specific terms describing the actual actions undertaken such as migration (see below). We use the term “preservation actions” here.

CAD	Computer-aided design
CIDOC	International Committee for Museum Documentation.
CIDOC CRM	CIDOC Conceptual Reference Model., an international standard for museum documentation, ISO 21127-2006. http://www.cidoc-crm.org/
CMM	Capability maturity model
Conservation	In the analogue sphere, specific actions to halt or repair the deterioration of some object. This term is used rarely by the digital preservation community, where equivalent processes are termed “preservation actions” or similar.
Curation	The activity of, managing and promoting the use of data from its point of creation to ensure it is fit for contemporary purpose, and available for “discovery” and re-use. For dynamic datasets this may mean continuous enrichment or updating to keep it fit for purpose. Higher levels of curation will also involve maintaining links with annotation and with other published materials.
Data Seal of Approval	See http://datasealofapproval.org/en/ Aligned to OAIS. Set up first by the Dutch DANS (Data Archiving and Network Services, an institute of the Royal Netherlands Academy of Arts and Sciences, KNSW). Since 2009 run by an international board. ²⁹
Designated community	An OAIS term: The set of organisations or individuals which are defined to be potential consumers of information in an archive, now or in the future.
Digital curation	This phase is used fairly frequently in the research community, and has been developing in meaning over the last 10 years or so to denote a whole range of activities from the planning of the collection/creation of digital information, its use, archiving, preservation and reuse/repurposing.
Digital preservation	An activity, commonly within archiving (but not exclusively), in which specific items of data are maintained over time so that they can still be accessed and understood through changes in technology. ³⁰
DIN	Germany’s standards body (Deutsches Institut für Normung)
DIN 31644:2012-04	The German standard, Information and documentation – criteria for trustworthy digital archives (Information und Dokumentation - Kriterien für vertrauenswürdige digitale Langzeitarchive). http://www.langzeitarchivierung.de/Subsites/nesstor/EN/nesstor-Siegel/siegel_node.html

²⁹ The DAC will provide its information paper relating to certification, in particular the Data Seal of Approval, the German DIN on trustworthy records, and the SPOT model (see below).

³⁰ Elaborated by Hedstrom, M., 1998, and quoted in Cedars, 2002a and 2002b, as “the planning, resource allocation, and application of preservation methods and technologies necessary to ensure digital information of continuing value remains accessible and useable”.

EAD	<p>Encoded Archival Description - a standard for encoding archival finding aids using Extensible Mark-up Language (XML), used for the interchange of archival descriptions.</p> <p>See: http://www.loc.gov/ead/index.html</p>
Emulation	<p>A method to achieve logical preservation of digital files by retaining not only the original data stream but the original software also, and using software (emulators) to make contemporary computers act like the original computer(s) used to run that software using that data.</p>
File format	<p>The standard to which the bits in a bit stream conform to satisfy the requirements of a particular program or set of programs.</p>
HLF	Heritage Lottery Fund
ICA	International Council on Archives
ICT	<p>The RCM organisation delivering ICT (including access to the Janet network) and IT-based services. Sometimes (but not here) used to mean “Information, Computing and Telecommunications”.</p>
IIPC	International Internet Preservation Consortium
ISAD(G)	<p>International Standard Archival Description (General) – A standard for archival description developed by the International Council on Archives (ICA)</p> <p>See: http://www.icacds.org.uk/eng/ISAD%28G%29.pdf</p>
IT	Information technology – the techniques and materials for processing and transmitting information
JPEG	<p>Method of ‘compression for digital images, used in a number of image file formats. Named after the Joint Photographic Experts Group which created the method, now a standard.</p>
LIDO	<p>Lightweight information describing objects. SML schema for cultural heritage institutions. See http://www.lido-schema.org/schema/v1.0/lido-v1.0-schema-listing.html</p>
Logical preservation	<p>Preservation which attempts to retain the full capabilities of a digital object when used with its appropriate software. This can encompass a range of properties: that the behaviour of the combination of the software and data is maintained (as one may wish in say a computer game, or spreadsheet), that colour and sound fidelity is maintained, calculations remain valid, and so forth. It is also called Functional Preservation.</p>
Medium	<p>This term refers to the substrate on which digital information is recorded – such as a CD-ROM, memory stick, hard disk, etc. Sometimes the term is used mistakenly to denote the file format of a digital object. Plural is Media.</p>
Metadata	<p>Information recorded about other information (sometimes referred to as “content”). It can be in digital form (as in Adlib) or in Analogue form (qv) as in a card index.</p>
METS	<p>Metadata Encoding and Transmission Standard - a standard for encoding and transmitting descriptive, administrative, and structural metadata. From the Library of Congress.</p> <p>See: http://www.loc.gov/standards/mets/</p>
Migration	<p>To be distinguished in the digital preservation context from mere copying from one place to another, or one medium to another. A</p>

preservation method employed to try and retain as much as possible of the original functionality provided by the data when run on its original hardware by converting (migrating) the bit stream so that it conforms to an undated file standard for contemporary software.

MIMO	Musical Instrument Museums Online. http://www.mimo-international.com/MIMO/ European Commission-funded project that consolidates the collections of over 20 museums
MINIM-UK	Musical Instruments Interface for Museums and Collections UK. HEFCE-funded project
OAI-PMH OAI-ORE	Open Archival Interchange – Protocol for Metadata Harvesting. From the Open Archives Initiative.OAI-Object Re-use and Exchange. See: http://www.openarchives.org
OAIS	Open Archival Information System (ISO 14721:2003) – A reference standard “to establish a system for archiving information, both digitalized and physical, with an organizational scheme composed of people who accept the responsibility to preserve information and make it available to a designated community”. See: http://public.ccsds.org/publications/archive/650x0b1.PDF
PDF/A	Portable Document Format / Archival. ISO 19005-1:2005 A standard which defines a format for the long-term archiving of electronic documents based on the PDF Reference Version 1.4 from Adobe Systems Inc.
PREMIS	PREservation Metadata: Implementation Strategies – A data dictionary for core preservation metadata needed to support the long-term preservation of digital materials. From the Library of Congress. See: http://www.loc.gov/standards/premis/
Preservation	This is used in the way usually understood as being all those activities undertaken on a continuing basis to ensure the longevity, accessibility and usability of a digital object.
Preservation actions/ interventions	Specific actions undertaken on a digital object to ensure its continued accessibility and usability. This is analogous to conservation action in the analogue arena.
Preservation planning	This phrase is used in two ways, the second specific to OAIS: (i) in the general sense of planning for all aspects of digital preservation of collections or groups of collections within an organisation covering policy, strategy, process, resource and technical questions, or (ii) in a more restricted sense as used in the OAIS standard for digital archives, of a specific function within an archive of the planning for and execution of preservation actions.
RCM	The Royal College of Music
RCMM	The Royal College of Music Museum
Records management	A specific subset of information management where the information in question is declared as a record - that is, of being the evidence or trace of some (business) transaction. Records management is generally much more tightly controlled than information

	management.
SIARD	Software-independent archiving of relational databases, developed by the Swiss National Archives. See https://www.bar.admin.ch/bar/en/home/archiving/tools/siard-suite.html
SOP	Standard operating procedure
SPOT model	Simple Property-Oriented Threat Model for Risk Assessment (re digital preservation)
Surrogates	Copies of native content made with the intention of using these in their stead for most instances of user access (such as internet delivery or providing thumbnails). Usually digital in format now.
TIFF	Tagged Image File Format. A computer file format for storing raster graphics images.
Transformed	In the digital context, content which has been created by transforming a file from one format standard to another (newer) for the purposes of preservation (by a process such as migration to newer file standards as earlier ones become obsolete).
URL	Uniform Resource Locator. A type of URI that specifies where an identified resource is available and the mechanism for retrieving it.
Virtual museum	"A digital entity that draws on the characteristics of a museum, in order to complement, enhance, or augment the museum experience through personalization, interactivity and richness of content." (Wikipedia)

Section H - Report method and interviews

The following people at the RCMM and RCM were consulted, either in formal interviews or in more informal settings, at the Museum and in the College. We met or spoke to several on repeat occasions. One meeting was held via Skype. The authors would like to thank them all very much for their assistance and friendly help, and giving so generously of their time.

We held repeat meetings and phone conversations with the Museum's Digitisation Officer, Richard Martin. Once again, we would like to record our deep thanks to Richard for his exceptional support.

A * indicates meeting only by phone.

RCMM:

Richard Martin

Gabriele Rossi Rognoni

Lydia Cracknell

RCM Library:

Peter Linnitt

Maria Canzonieri (Archivist)

Michael Mullen

RCM IT dept:

Mark Soole

RCM Marketing dept.

Adam Ferguson

RCM Studios:

Matt Parkin*

In addition meetings were held by phone and Skype with Katie Norgrove of Cultural Consulting Network.

The method used to produce the report was:

- i. Gather information from interviews and from documentation received from the RCMM
- ii. Gather information and further documentation from the RCM web site, including from the RCMM section, and from extensive web research more widely
- iii. Examine the Adlib system, the RCMM's Adlib catalogue, structure, and sample content; also examine the systems used in the RCM Library (Koha, Heritage Documentation Management System (from the University of Melbourne), eStream in The Studios, and more briefly TerminalFour (web platform), and Canvas (a VLE, virtual learning environment system).

- iv. Site visits to the Museum. Site visit also to the V&A. (The authors are familiar with other musical instrument museums, such as St. Cecilia's Hall, the Horniman).
- v. Informal conversations with DAC contacts – professional musicians who have visited the RCMM, instrument makers who have used the RCMM, an instrument collector, a commercial instrument maker,
- vi. Drafting of report and support materials for delivery and discussing these internally in the DAC.
- vii. Finalisation and delivery.

The DAC hopes to provide presentations of the report and conduct one or more workshops, about digital preservation and the plan prepared and set out in the report, post submission.

Section I - Draft sample digital preservation policy

This sample policy is provided in addition to the material requested by the Museum in its brief for our work. We provide it, (a) because digital preservation plans for institutions should be prepared in line with a digital preservation policy, and (b) because preparation of the policy is one of the early actions in the preservation plan, and we thought it would be helpful.

A digital preservation policy is important because it provides a mandate under which the Museum can set up, oversee the processes for carrying out actions for digital preservation (actions which may overlap with actions needed for other contexts, in particular to support efficient data discovery and re-use). The policy provides clarity and clear direction.

Unlike analogue records, the digital records benefit significantly from assessment as early as possible for any preservation requirements. This presents a significant challenge for archives who will need to be able to identify, collect and manage the content of these records to ensure it remains authentic and accessible. The digital preservation policy provides a mandate under which an archive can oversee these processes and manage digital preservation.

The following pages set out a draft, sample text specifically for the Museum.

I.1 General notes, and Museum, Library, College contexts

As discussed in the main report, the preservation plan is drawn up specifically for the Museum.

However, at some stage, we believe it will be important to consider merging the Museum's digital preservation work with digital preservation in the Library (which we do not believe has been instigated as yet). The Museum and Library both have similar custodial roles, holding collections of unique and extremely rare items of significant musical, historical and scientific significance.

(The DAC has put together a short note with some observations we have relating to what one might call 'collections' which are held/accumulating in the various parts of the College, and the various systems used in their management. The note also touches on some wider information management and governance points. These are issues outside the context of the report on digital preservation and planning, outside the brief from the Museum, and therefore kept separate.)

We also believe that the College will need to address digital preservation – indeed, it surely has a duty to its stakeholders to do so. At that stage, the Museum and College should consider whether the Museum's digital preservation policy (or joint Museum/Library policy, if applicable) should come under the College policy. If so, we very strongly recommend that a member of the Museum staff (and Library, if applicable) should form part of the body responsible for the policy, and responsible for drawing up the policy. This is because the Museum has specific and significant custodial responsibilities (ditto the Library).

I.2 Relationship with other policies

The policy **must** be drawn up with reference to other official College policies, in particular other Museum policies. We suggest it is kept separate from the digitisation policy; a major reason for this is that the digital preservation policy does not just cover digital materials which are created by the process of scanning. The policy must make specific reference to these other policies.

The DAC has not seen or heard mention of College policy documents relating to archival policy, including retention criteria. In the Museum, retention criteria are implied by collection strategy, which is covered in various strategy documents.

I.3 Policy maintenance and evolution

Whether or not the Museum's preservation policy remain stand-alone, joins with the Library, and/or comes under the umbrella of a College policy, the policy **MUST** be maintained on a regular schedule. For the first two years, we suggest a formal annual review, and thereafter informal review by the preservation officer. The policy itself should be formally reviewed and updated at least every three years.

The policy must be dated, its 'ownership' must be indicated, and must be formally approved by a group of people appointed to do so.

The policy must be circulated within the Museum and within the College.

The Museum might consider using a 'document control' table such as the one below.

Policy:			
Description:			
Version no.			
Verson date:			
Document status			
History			
Review date:			
Responsible officer:			
Circulation & availability			

We strongly recommend that the digital preservation policy take a gradual approach. This is what good digital preservation programmes in organisations with significant custodial responsibilities, and with significant 'knowledge' institutions have done (though this was in part due to the general increase in understanding of the area, starting from a very low base, just 10-15 years ago). This

gradual approach is reflected in the number of headings in the policy. At this stage, we recommend that the number is small to begin with, and gradually extend to include more detailed headings.

I.4 Draft sample RCMM digital preservation policy

Introduction

Summary about the Museum, its role and status.

Digital preservation policy framework and mandate

This digital preservation policy is approved by a formal Museum digital preservation policy board, made up of the Museum Curator, the Digitisation & Documentation Officer, [the Deputy Director and the Head of IT].

The policy owner is the [Museum Digitisation & Documentation Officer], who is responsible for oversight and implementation of the digital preservation programme in the Museum.

This policy shall be reviewed and approved annually.

This policy shall be circulated to the Museum and College staff.

Objectives, purpose

This policy aims to ensure the ongoing availability of, and access to, items in the Museum's collections and other records and content materials, regardless of the carrier or digital file format on which they were originally created or acquired. It also provides a framework for achieving best practice outcomes when undertaking digital preservation and digitisation activities. These outcomes ensure that:

- The risk of permanent loss of content, through software/hardware obsolescence or degradation or damage to the carrier is minimised
- International standards for digitisation and preservation, including the adoption of interoperable file formats, are met
- Metadata required for ongoing preservation, discovery, access and rights management of digital assets are captured
- Legal obligations are met, specifically those relating to copyright and intellectual property, when copying content for preservation purposes
- Digitisation work performed at the Museum is compatible with ongoing preservation requirements

- Digitisation and digital preservation is prioritised to meet public access requirements and mitigate the risk of content being lost.

Benefits

[Digital preservation supports the Museum's objectives. Insert text from main report, section D.]

Principles

Core principles of the Museum's digital preservation programme are:

Preventive spend – prevent problems before they occur: We recognize the importance of the creation stage (when a digital record is created), standards and interoperability for managing the costs of digital preservation and for supporting efficient access to older digital materials.

Openness – A commitment to openness is essential, in order to build and maintain trust in our digital preservation activity.

Scalability – We will develop our digital preservation work gradually, in order to ensure robustness.

Scope

The Museum's digital preservation policy applies to all digital collection items and collection-related content materials that are held by the Museum and that are considered by the Museum to be valuable and worthy of long-term preservation. This policy also applies to physical items, such as documents, photographs and audio/video recordings, which contain information that should be digitally preserved to enhance public access or to prevent loss through degradation, physical damage or technological obsolescence. It covers databases and other digital files related to collection management, including the catalogue(s).

This policy [also covers] [key] Museum corporate records, in digital or analogue formats.

[transactional, legal/contractual, environmental]

The policy covers materials generated by/for the Museum in relation to Learning and Engagement, marketing, and research activities.

This policy applies to collection items and other collection-related content materials managed by the Museum that are in either digital or analogue forms and that have been 'born-digital' collection items and collection-related works in all formats. This material includes:

- 'born-digital' collection items and collection-related works in all formats
- digital records of collection items
- physical and analogue collection items and related material requiring digitisation to preserve content or improve access.

This material is held on a variety of formats, including:

- audio recordings, audio-visual recordings
- digital files containing digitised material in the categories listed above
- documents, such as electronic and paper documents
- images and photographic materials, including [transparencies, negatives (glass and acetate),] prints on paper, and digital photographic images
- moving image material, such as documentaries and other footage held on film, videotape or as digital files
- multimedia software, including Flash, HTML interactives and other digital formats that may emerge.

Digital preservation strategy

Digital preservation strategy is drafted by the [Digitisation Officer (responsible for the digital preservation programme)] and approved by the [Museum Digital Preservation Policy Board.] The strategy is reviewed annually. Circulation and availability are as for this policy.

Audit and risk management, monitoring

It is premature for the Museum to consider certification and audit (with regard to digital preservation and the materials it holds) at this stage. However, it shall review this during each review of this policy.

The Museum shall maintain a risk register with regard to digital preservation and conduct six-monthly reviews, applying the SPOT model. The results of these reviews shall be formally documented and archived.

The Museum will collect and maintain statistical information on its digitisation and digital preservation activities.

Relationships with other policies

[Indicate relevant policies, eg Museum Collection Management/Care; ensure aligned]

Superseded policies

This is the Museum's first digital preservation policy. Future versions shall always indicate the version number of the superseded policy, the version date and the approval date of the superseded policy.