digitisation

Guidance

Digitisation: A strategic approach
for natural history collections

Bryan Kalms

ATLAS OF **LIVING**
AUSTRALIA
sharing biodiversity knowledge

Contents

Glossary

In this glossary, 'DOHM' indicates that the definition is based on that given in *DOHM: Digitisation of Heritage Materials* (Reference 21).

ABCD

Access to Biological Collections Data. A data schema developed by TDWG for accessing and sharing biodiversity data.

See *www.tdwg.org/standards/115/, TDWG*

archive file

The original digital file captured at the highest practicable quality stored for long-term use and accessed only to produce a master file. May be subject to post-processing. (DOHM)

See *master file, post-processing*

Atlas

Atlas of Living Australia

See *ala.org.au*

bit depth (image)

Also referred to as colour depth, is the number of bits used to record the colour of each pixel. Greater bit depth allows a greater range of colours or shades or grey to be represented by a pixel, eg

- 1 bit = black or white

- 8 bit = 256 shades of grey or colour

- 16 bit colour = 65 536 colours

- 24 bit colour = 16.7 million colours

- 30 bit or higher colour = billions of colours

For natural history collections, 16 bit colour is usually sufficient for the final image, though an image may be captured and processed at higher bit depths. (DOHM)

calibration

The process of adjusting the colour of one device relative to another, eg a monitor to a printer, or a scanner to a film recorder; or the process of adjusting the colour of one device to an established standard. (DOHM)

checksum

A datum calculated by an algorithm used to determine the integrity of, or presence of errors in, a digital file.

CMS

Collection Management System. An information system (usually computer-based) designed to manage objects in a collection, along with their metadata, multimedia and other relevant information.

compression

An algorithm applied to a digital file to reduce its size. Algorithms may reduce the detail of the original file—lossy compression—or retain the detail—lossless compression. (DOHM)

DAMS

Digital asset management system. An information system designed specifically to manage digital assets of all types. Some include the capability to share assets over the internet.

derivative

A digital file created from a master file as a working copy of the file or to meet specific user needs, eg publication, web-based sharing. Derivatives are usually created using lossy compression by resampling the master file at a lower resolution.

See *master file, compression*

digital asset

A digital representation of an object that is managed as an asset; exists as a digital file.

digital SLR

A digital single lens reflex camera that allows the user to view a scene through the taking lens rather than through a viewfinder.

digitisation

The process of creating and exploiting a digital representation of an object or artefact. It has six core activities:

- Making digital
- Databasing
- Managing data
- Sharing data
- Using technology
- Governing digitisation

See section 2.2 (p14)

.dng

A digital image file in Digital Negative (DNG) format, an open raw image format owned by Adobe used for digital photography. It is based on the TIFF/EP standard format and mandates significant use of metadata. (en.wikipedia.org/wiki/.dng)

See RAW, TIFF

dpi

Dots per inch. A measure of the number of dots a printer can print per inch.

Dublin Core

A metadata standard for describing digital assets.

See dublincore.org/

DwC

Darwin Core. A standard developed by TDWG for sharing metadata about species observations and specimens.

See www.tdwg.org/standards/450/, TDWG

ftp

File Transfer Protocol. A standard network protocol used to transfer files from one host to another host over a TCP-based network, such as the Internet. (en.wikipedia.org/wiki/Ftp)

GBIF

Global Biodiversity Information Facility. A global network of 57 countries and 47 organisations, GBIF promotes and facilitates the mobilisation, access, discovery and use of information about the occurrence of organisms over time and across the planet.

See www.gbif.org

HISPID

Herbarium Information Standards and Protocols for Interchange of Data. A file format designed to allow the storage and transmission of herbarium plant specimen data.

See hiscom.chah.org.au/wiki/HISPID_5

HTTP

Hypertext Transfer Protocol. An application protocol for distributed, collaborative, hypermedia information systems. HTTP is the foundation of data communication for the World Wide Web. (en.wikipedia.org/wiki/Http)

indexed colour

A reduced colour mapping, 8 bit or less; done to reduce images to their smallest size. Commonly used for images published on the web. (DOHM)

JPEG

A digital image file in JPEG format. JPEG s a commonly used method of lossy compression for digital photography (image). The degree of compression can be adjusted, allowing a selectable trade off between storage size and image quality. JPEG typically achieves 10:1 compression with little perceptible loss in image quality. (en.wikipedia.org/wiki/Jpg)

See compression

master file

A copy of the archive file used to generate derivatives.

See archive file, derivative

migration

Preservation of the integrity of a digital file by transferring it across hardware and software configurations and across subsequent generations of computer technology to ensure the file's continuing availability and accessibility. (DOHM)

MP3

MPEG-1 or MPEG-2 Audio Layer III, more commonly referred to as mp3, is a patented digital audio encoding format using a form of lossy data compression. It is a common audio format for consumer audio storage, as well as a de facto standard of digital audio compression for the transfer and playback of music on digital audio players. (en.wikipedia.org/wiki/Mp3)

MP4

MPEG-4 Part 14 or MP4 (formally ISO/IEC 14496-14:2003) is a multimedia container format standard specified as a part of MPEG-4. It is most commonly used to store digital video and digital audio streams, especially those defined by MPEG, but can also be used to store other data such as subtitles and still images. (en.wikipedia.org/wiki/Mp4)

OCR

Optical Character Recognition, the process of converting an image of a text document into a computer readable text file.

Post-processing

Manipulating a digital file once created to enhance or modify it to create the archive file.

See archive file

ppi

Pixels per inch. A measure used to describe the resolution of a digital image. An image that has a higher number of pixels per inch will show more detail than one with fewer pixels per inch. (DOHM)

.psd

An image file created by Adobe Photoshop.

quality control

Activities associated with monitoring the systems and procedures used in a process to ensure that the outputs of the process are within defined tolerances. (DOHM)

RAID

Redundant array of independent disks (originally 'redundant array of inexpensive disks'). A storage technology that combines multiple disk drive components into a logical unit. Data is distributed across the drives in one of several ways called 'RAID levels', depending on what level of redundancy and performance (via parallel communication) is required. (en.wikipedia.org/wiki/RAID)

RAW

A digital image file format. A camera RAW image file contains minimally processed data from the image sensor of a digital camera, image scanner or motion picture film scanner. RAW files are so named because they are not yet processed and therefore are not ready to be printed or edited with a bitmap graphics editor. (en.wikipedia.org/wiki/Raw_image_format)

RGB

Red, green, blue. An additive colour model in which red, green, and blue light is combined to create colours, combining full intensities of all three to make white. Digital cameras, scanners and monitors use RGB to record and display colours. (DOHM)

resolution

The fidelity with which an object is digitised. Higher resolutions provide greater fidelity.

TDWG

Biodiversity Information Standards (TDWG), also known as the Taxonomic Databases Working Group. A not for profit scientific and educational association that is affiliated with the International Union of Biological Sciences. It was formed to establish international collaboration among biological database projects. (www.tdwg.org/about-tdwg/)

TIFF

Tagged Image File Format. A file format for storing images controlled by Adobe Systems. Originally created for use in desktop publishing, the TIFF format is widely supported by image-manipulation applications, publishing and page layout applications, scanning, faxing, word processing, optical character recognition and other applications. (en.wikipedia.org/wiki/Tagged_Image_File_Format)

zip

A file format for compressing and archiving digital files.

About the guidance

Introduction

All natural history collections engage in digitisation: they database specimens, image specimens for publication and research, and share (digital) information. Digitisation is firmly part of their activities. Unfortunately, most digitisation (apart from databasing) is *ad hoc*, uncoordinated, not strategic and so incomplete.

This document takes a strategic approach to digitisation, one that recognises both the need to digitise what is un- or incompletely digitised, and to support and enhance existing digitisation activities. Its prime focus, however, is on tackling the undigitised and incompletely digitised in a strategic and cohesive manner.

A major challenge for anyone tackling this problem is to do so without adversely impacting on existing digitisation or collection management activities within an institution.

About this document

This document:

- outlines the context of digitisation in natural history collections (section 1)

- nominates the key concepts in digitisation, including a model for assessing an institution's relative digitisation performance (section 2)

- explains the main challenges an institution must overcome for effective digitisation (section 3)

- discusses and provides guidance on planning for and organising a digitisation project (sections 4 and 5).

The document is not a text book on digitisation; nor is it about digital preservation *per se* or managing a digital collection. It is simply intended to guide an institution along the path of developing a digitisation program and point to resources that can inform particular aspects of the digitisation process.

Intended audience

While many people associated with natural history collections (or other types of collections) will benefit from this document, its intended audience is curators, collection managers, business managers, digitisation managers and digital collection managers in natural history collections.

Basis of the guidance

Guidance is based on the outcomes of digitisation activities in natural history collections along with consultations with museums, herbaria, imaging experts and publicly available information, eg the *Just do it!* approach (section 3.4.1, p28) represents current practices in some natural history collections. As well, the approach adopted is consistent with Poole's supply chain model for digital content in museums (Reference 29) illustrated in Figure 1 (p8).
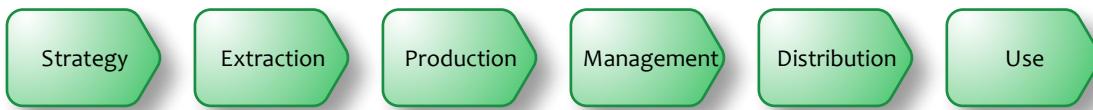
Figure 1 Poole's supply chain model for digital content in museums

Using the guidance

Because of the range of digitisation capabilities and experiences in natural history collections and the variety of objects to be digitised, the information in this guide is necessarily general. As such, you should consider the guidance as a basis for action, and amended it as necessary to reflect the circumstances of your institution.

Additional insights and guidance on digitisation are available from other sources, including those listed in section 15 (p86). Consult these as necessary.

Finally, this guide is not intended to be read from front-to-back. Each section is self-contained and cross-referenced with related sections. Explore the document as you choose to understand different aspects of digitisation.

Part 1
DIGITISATION CONTEXT

1 Digitisation in natural history collections

1.1 Role of digitisation in natural history collections

Institutions engage in digitisation for a variety of reasons, such as research, online publishing, marketing and developing exhibitions. Seldom though is digitisation approached systematically or strategically.

In today's competitive world, digitisation must be seen for what it is: an integral part of managing a natural history collection. It is not an optional extra; it must become a core business activity, delivered in accordance with a digitisation strategy. Thus, the basic question is not *Should we digitise?* but *How are we performing against our digitisation strategy?*

Strategic approaches to digitisation allow consideration of the impact of technology options, priorities for digitisation, digitisation objectives and resource management. They support other institutional objectives and allow an institution to more readily respond to changing circumstances, user needs and resource constraints.

While digitising every object in a collection is a laudable objective it is not necessarily practical or essential. Taking a strategic approach to digitisation allows you to decide what's important to digitise and what's not. Around these priorities you can establish digitisation projects, obtain resources and develop digitisation practices that supplement existing work practices rather than replace them. And by starting small, the overall task becomes more manageable, as well as palatable, to stakeholders.

1.2 Benefits of digitisation

Digitisation brings benefits to an institution including:

- **prestige**. If a collection is unique or nationally or internationally important, digitisation of the collection makes it available to a wider audience. This can bring acclaim to a collection and its host institution and facilitate gaining additional resources

- **reduced workload and costs**. Effort expended in providing access to, or lending, physical collection objects can be avoided or minimised by providing a digitised version of an object

- **new research opportunities**. Digitisation technologies can open new ways to analyse objects in a collection

- **discoverability**. Publishing specimen information online—database entries, images, genomes—allows people to discover what's in a collection without having to directly approach an institution

- **improved collection management and curation**. Having digitised versions of collection objects reduces their manual handling, allows for easier accounting and provides a basis for assessing the condition of objects

A detailed discussion of the benefits of digitisation is given in Reference 15.

1.3   Digitisation of collections within collections

Some natural history collections are part of collecting institutions that include cultural, social and art objects. In these cases, the natural history collection usually has to operate within a policy, and digitisation, context applicable to the whole institution. Implementing a digitisation program in isolation from the broader context is thus often impractical or, at best, challenging.

Even so, experience has shown that low scale digitisation programs can be effectively implemented in a natural history collection (within a broader collecting institution) and that this can influence digitisation activities in the wider institution. Thus, the information in this document can be used to inform the development of a whole-of-institution digitisation program.

> *The processes and procedures developed during this project for digitising specimens and their labels are designed to be completely scalable and adaptable to the resources available in an institution. This approach was taken because it is well understood that the funds available at any particular institution will vary greatly.*
>
> —Rapid Digitisation Project: Final Report, Australian Museum, 2011

2 Key concepts in managing digitisation

This section outlines the key concepts in digitisation, concepts that are explored in later sections:

- digitisation management framework—section 2.1 (p13)
- core digitisation activities—section 2.2 (p14)
- digitisation governance—section 2.3 (p15)
- digitisation strategy—section 2.4 (p16)
- Digitisation Maturity Model—section 2.5 (p16)
- digital assets as a collection with a manager—section 2.6 (p17)
- digitisation process—section 2.7 (p17)
- digital asset—section 0 (p18)
- objects for digitisation—section 2.9 (p21)
- specimen (object) management process—section 2.10 (p22)
- ways of making a digital asset—section 2.11 (p23)
- users of digital assets—section 2.12 (p24)
- uses of digital assets—section 2.13 (p24).

2.1 Digitisation management framework

The key concepts in managing digitisation are all components of the digitisation management framework illustrated in Figure 2 (p8) and discussed elsewhere in this document:

- core digitisation activities—section 2.2 (p14)
- resources for digitisation—section 5.2 (p54)
- digitisation plans—section 4 (p37)
- governance for digitisation activities—section 2.3 (p15)
- digitisation strategy—section 2.4 (p16)
- digitisation performance management, via a Digitisation Maturity Model—section 2.5 (p16)
- role of a digital collections manager—section 2.6 (p17).

See also section 4.4 (p41).
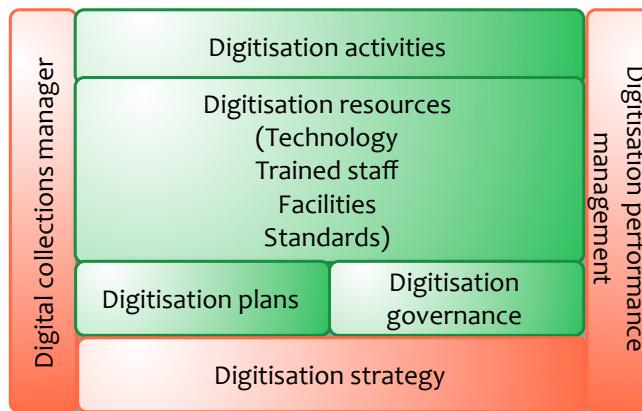
Figure 2 Digitisation management framework

2.2 Core digitisation activities

Figure 3 (p14) shows the six core digitisation activities:

- making digital: analogue to digital conversion to create a digital asset—section 2.7 (p17)

- databasing of the object and its digital equivalent, as well as transcribing text—section 2.7 (p17)

- managing data (and digital assets) for the long term—section 3.7 (p32)

- sharing data (and digital assets)—section 4.6 (p49)

- using technology in support of the other core activities—section 4.6 (p49)

- governing digitisation including the other core activities—section 2.3 (p15).
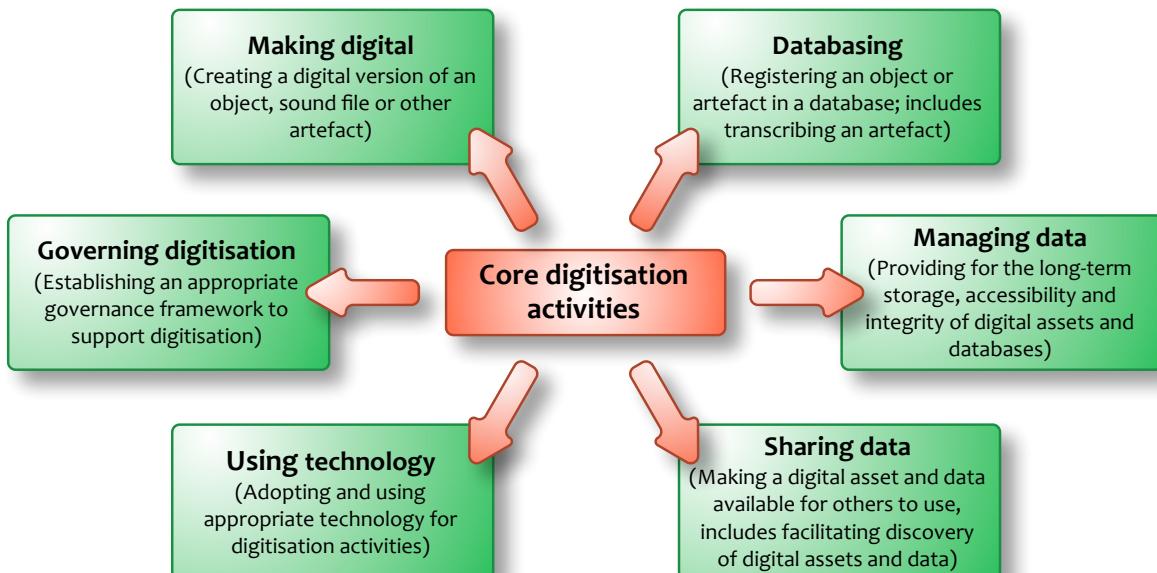
Figure 3 Core digitisation activities

2.3   Digitisation governance

Governance for digitisation consists of the principles, policies, procedures, roles and responsibilities associated with digitisation activities. Of these, the digitisation principles given in Box 1 (p15) (based on those in Reference 17) are possibly the most important, as they can apply without a formal digitisation regime and be followed by everyone involved in digitisation.

See also section 4.5 (p43).

Box 1 Digitisation principles

Digitisation principles

- ❦ Appoint a digital collections manager.
- ❦ Maintain a digitisation strategy.
- ❦ Digitise strategically.
- ❦ Convert to digital once, at the highest possible resolution appropriate to expected uses of the digital asset produced.
- ❦ Digitise new collection items during accession and at significant stages in their life, eg when loaned.
- ❦ Allocate persistent, unique identifiers to each digital asset and its subject. Use this identifier to link related items recorded in different databases.
- ❦ Use non-proprietary file formats that are likely to be around for a long time and that can be easily migrated.
- ❦ Capture metadata to facilitate long-term discovery, description and management of digital assets.
- ❦ Store data in management systems that are cost-effective, manage data integrity, facilitate discovery and accessibility, and are preferably OAIS-compliant*.
- ❦ Implement and audit effective backup, disaster recovery and data management arrangements.
- ❦ Migrate digital asset formats and media to maintain data accessibility and integrity.
- ❦ Respect objects being digitised; care for and protect them.
- ❦ Freely share digital assets.

---

* 'OAIS—Open Archival Information Systems Reference Model (ISO 14721:2003). The OAIS model applies to the whole life-cycle of digital assets, from capture, storage, and distribution with the aim of providing long-term access to the digital assets through effective preservation.' (Reference 25.)

2.4   Digitisation strategy

A digitisation strategy is simply a statement of how digitisation will be implemented and what is to be achieved through a digitisation program. It may be formal or informal and apply to an individual collection or the institution as a whole.

See also section 4.4 (p41).

2.5   Digitisation Maturity Model

Digitisation is an ongoing activity that, like the other activities in an institution, needs to be reviewed from time to time to take account of, eg changing circumstances, new technology, new opportunities. But digitisation, as a series of activities, can also be improved by enhancing the performance of individual digitisation activities, eg managing data.

The digitisation maturity model shown in Figure 4 (p16) is a framework for improving digitisation within an institution (or collection) and comparing the relative digitisation performance of one institution (or collection) with another. It consists of six levels of maturity (Levels 0–5) with associated characteristic behaviour in each of the six core digitisation activities (section 2.2, p14). These behaviours are described in section 6 (p67).
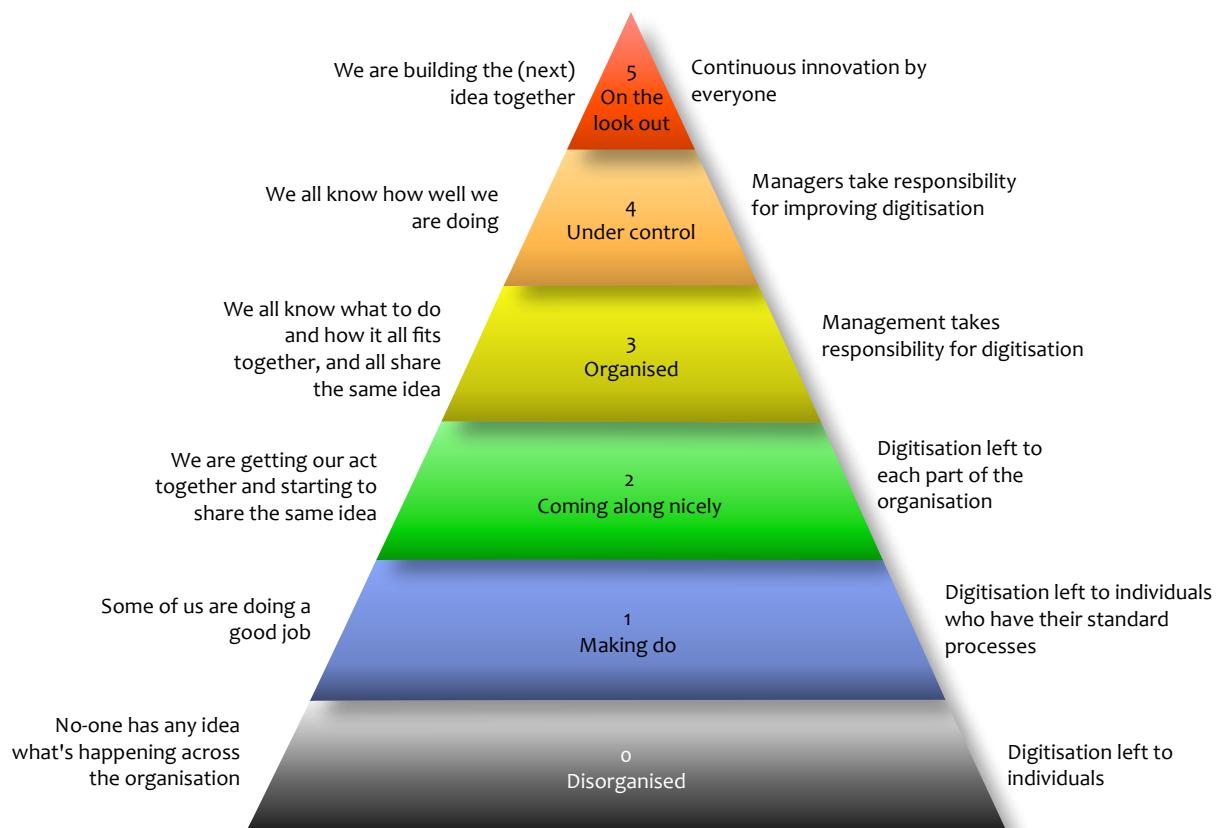
Figure 4 Digitisation maturity model

2.6   Digital assets as a collection with a manager

Digital assets as a group of artefacts represent a collection in their own right—a digital collection (though for many institutions there may be many digital collections)—and should be managed as such, just like any other collection. A digital collection should have its own manager (digital collections manager), development plan (based on the digitisation strategy) and preservation strategy.

Examples of the role of a digital collections manager:

- *A Framework of Guidance for Building Good Digital Collections* (Reference 26)
- *Cedars Guide to Digital Collection Management* (Reference 13)
- *Checklist for Creating a Preservation Policy* (Reference 7)

See also section 7 (p71).

2.7   Digitisation process

This document takes a very broad view of *digitisation*: allowing it to encompass a range of activities all intended to produce a digital object that can be shared with others. This broader view, as will be shown in section 3, is essential to developing a strategic approach to digitisation and implementing an efficient and effective digitisation regime.

The five stage digitisation process outlined in Figure 5 (p17) and expanded in Figure 6 (p18) through Figure 10 (p20) contains the six core digitisation activities (section 2.2, p14). (Activities in the Plan and Organise stages are discussed in sections 4 (p37) and 5 (p52) respectively.) By necessity, the activities occurring in each stage—and hence the overall models—are generic and thus may not be representative of how a stage is performed in a particular institution. Further, in practice, the boundary between stages may be blurred or varied depending on the circumstances of an institution, the nature of collections and the approach to digitisation adopted. For example, in the *Just do it!* approach (section 3.4.1, p28), it may be appropriate to consider some organising activities during the planning stage. Notwithstanding these reservations, the activities mentioned in the model will all occur at some time during a digitisation program.

Plan   Organise   Convert and database   Manage   Share

Figure 5 Outline digitisation process
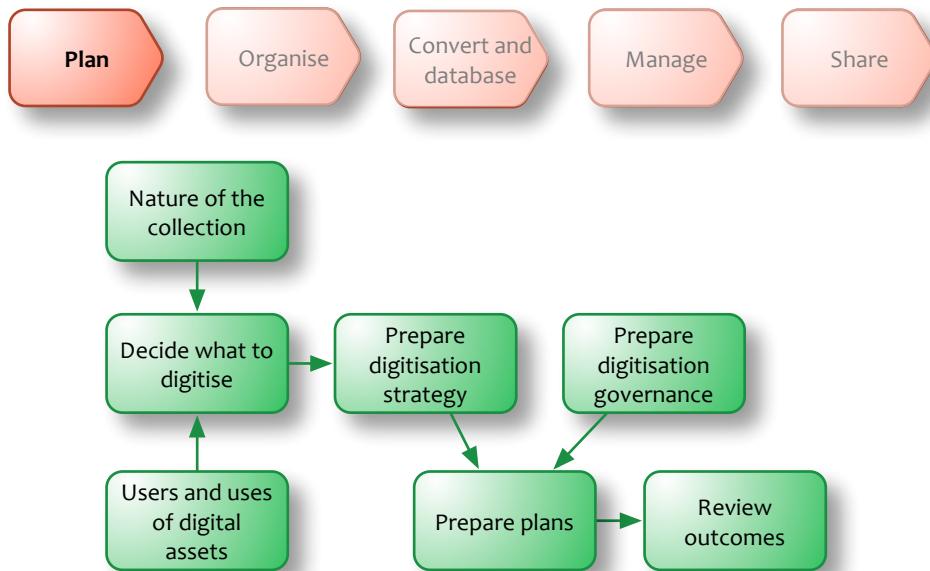
Figure 6 Digitisation planning stage
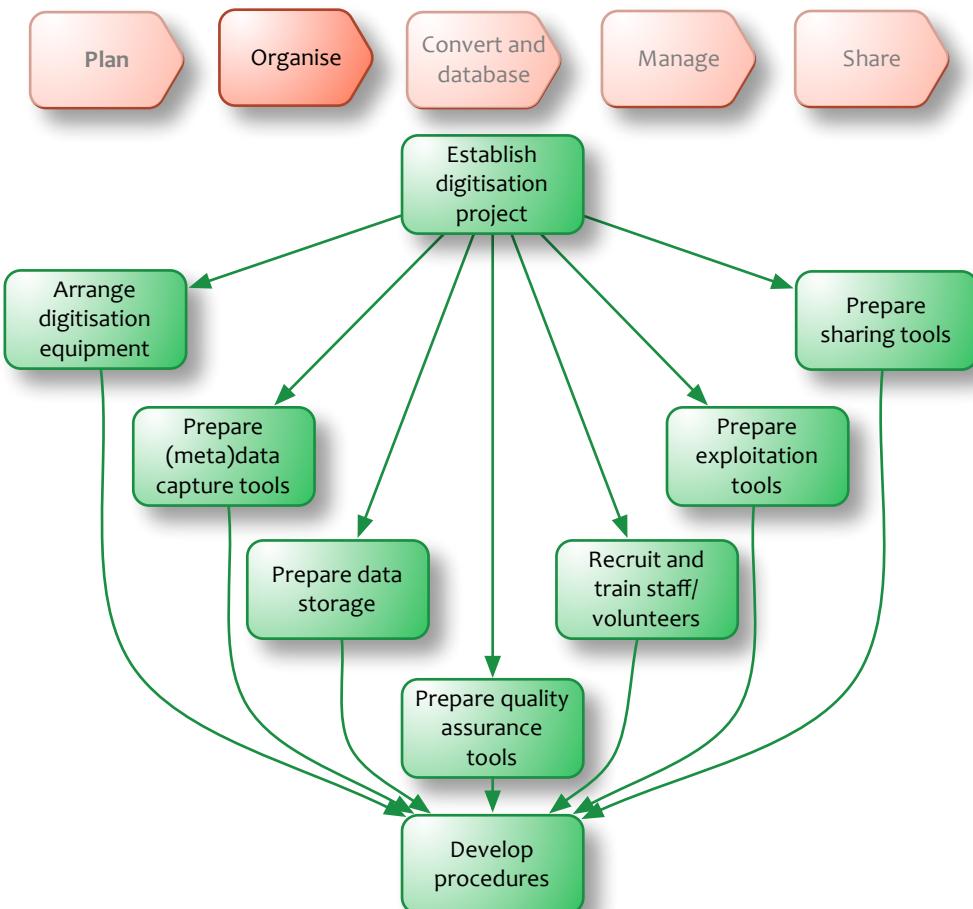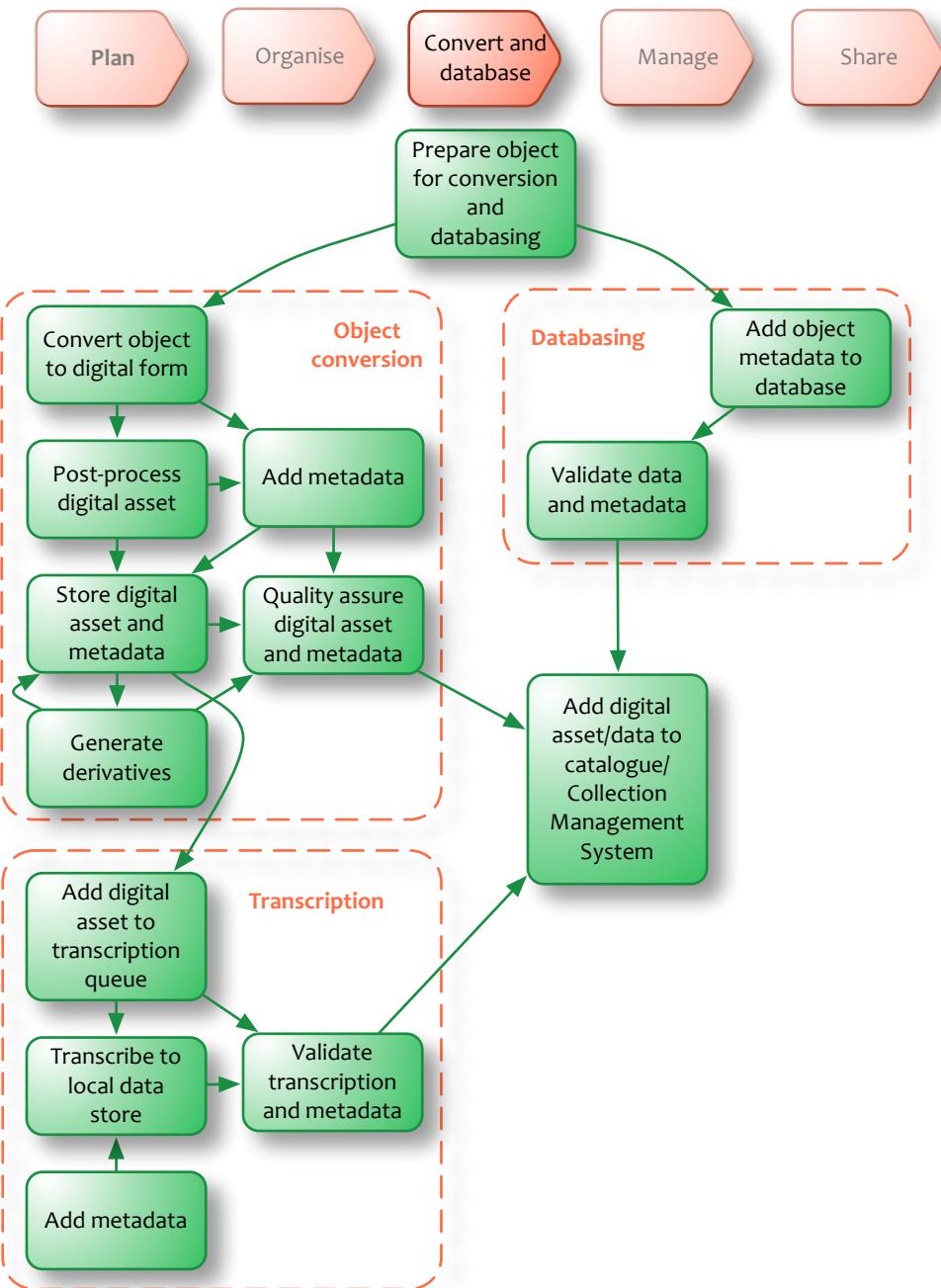
Figure 7 Organising digitisation stage

Plan | Organise | **Convert and database** | Manage | Share

Prepare object for conversion and databasing

Object conversion

Convert object to digital form

Post-process digital asset → Add metadata

Store digital asset and metadata

Quality assure digital asset and metadata

Generate derivatives

Databasing

Add object metadata to database

Validate data and metadata

Add digital asset/data to catalogue/ Collection Management System

Transcription

Add digital asset to transcription queue

Transcribe to local data store

Validate transcription and metadata

Add metadata

Figure 8 Creating the digital asset stage
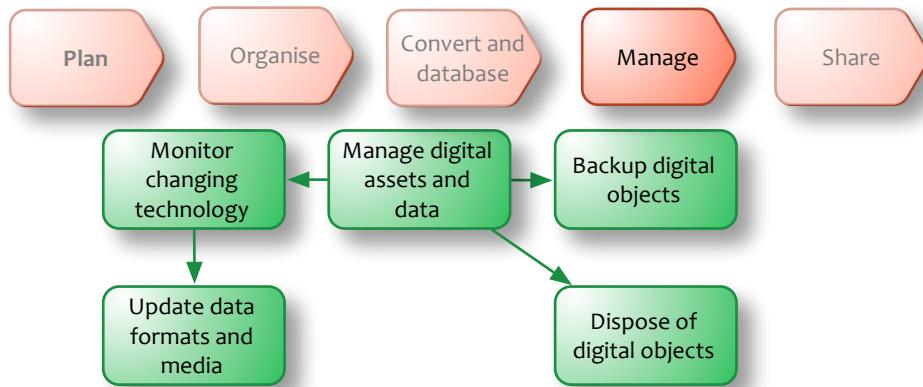
Figure 9 Managing digital assets stage
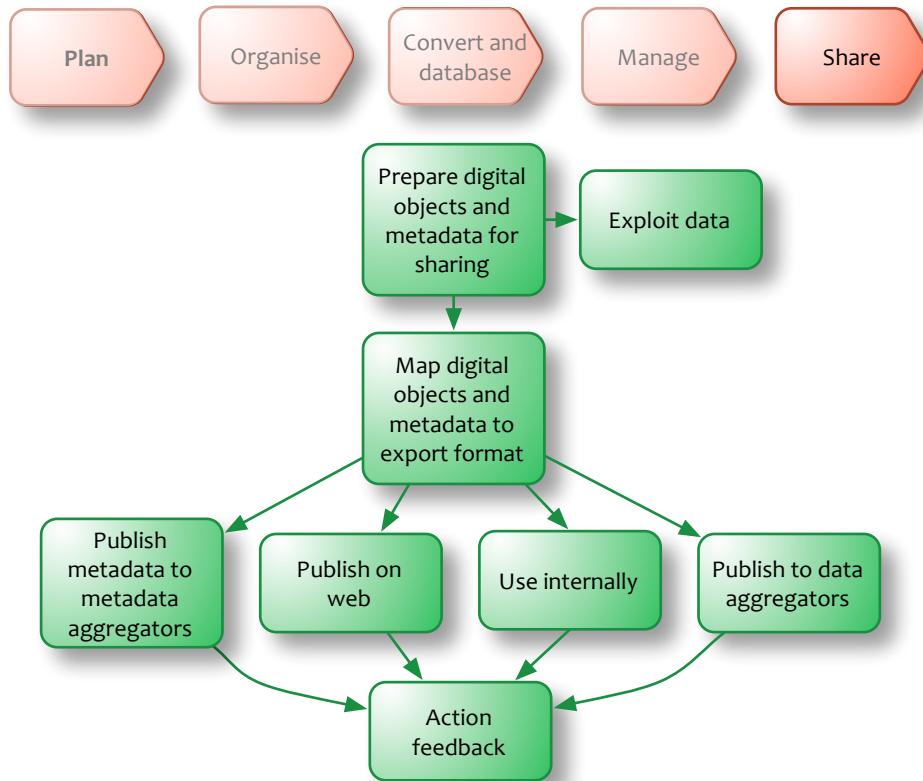
Figure 10 Sharing digital assets stage

2.8 Digital asset

A digital asset is the outcome of the make digital core digitisation activity (section 2.2, p14) and is what is managed and shared.

Types of digital assets found in natural history collections are given in Box 2 (p21). These are a consequence of the ways in which digital assets are created (section 2.11, p23).

Box 2 Indicative types of digital assets

Types of digital assets

- Data in a database
- Digital image
- Digital audio file
- Species observation on a web site
- Digital version of a microscope slide
- Web-based species profile
- Multimedia file in a digital asset management system

- Digital image of a collection item
- Digital CT scan of a specimen
- Digital video file
- Genetic sequence
- OCR'd document
- Electronic journal
- Scanned version of a field note-book

2.9 Objects for digitisation

Each natural history collection has a wide range of objects suitable for converting to a digital asset; typical categories are listed in Box 3 (p21). Different categories may have different uses and users (section 4.2, p38) and often require different tools for their creation (section 2.11, p23), standards (section 4.5.4, p46) and metadata (section 4.5.5, p48).

Box 3 Categories of objects for digitisation

Categories of objects for digitisation

- Documents, eg monographs, journals, notebooks, ledgers, field notes, photographs, maps
- Preserved and dried specimens—as individuals
- Preserved and dried specimens—in groups or drawers
- Living specimens
- Field work activities
- In-situ specimens and scenes
- Analogue images, eg photographic slides, paintings and drawings, x-ray plates, microfilm, CT scans
- Analogue multimedia
- Microscope slides
- Analogue sound files

2.10 Specimen (object) management process

The most important objects in a natural history collection are the specimens; they are also often the most numerous. Understanding the process of managing these specimens provides insights into the role of digitisation in their management and use. It also provides a context for understanding the users and uses (section 4.2, p38) of the digital versions (digital assets) of the specimens.

Figure 11 (p22) shows the overall process for managing objects in a collection: digital assets, specimens, documents and other physical artefacts.

Figure 11 Outline object management process

For specimens, there is also an Identify stage, as illustrated in Figure 12 (p22). (Sometimes, this additional stage is also needed for other types of objects, eg to identify the subjects in a photograph. And for specimens often the Identify stage will be combined with the Collect stage.)

Figure 12 Outline specimen management process

Major activities within each stage are shown in Figure 13 (p37) where opportunities for digitisation are indicated in by the 𝑑 icon. Similar digitisation opportunities exist for other types of objects in a collection.

Again, the activities occurring in each stage—and hence the overall models—are generic and thus may not be representative of how a stage is performed in a particular institution. And the boundary between stages may be blurred or varied depending on the circumstances of an institution, the nature of collections and the approach to digitisation adopted.
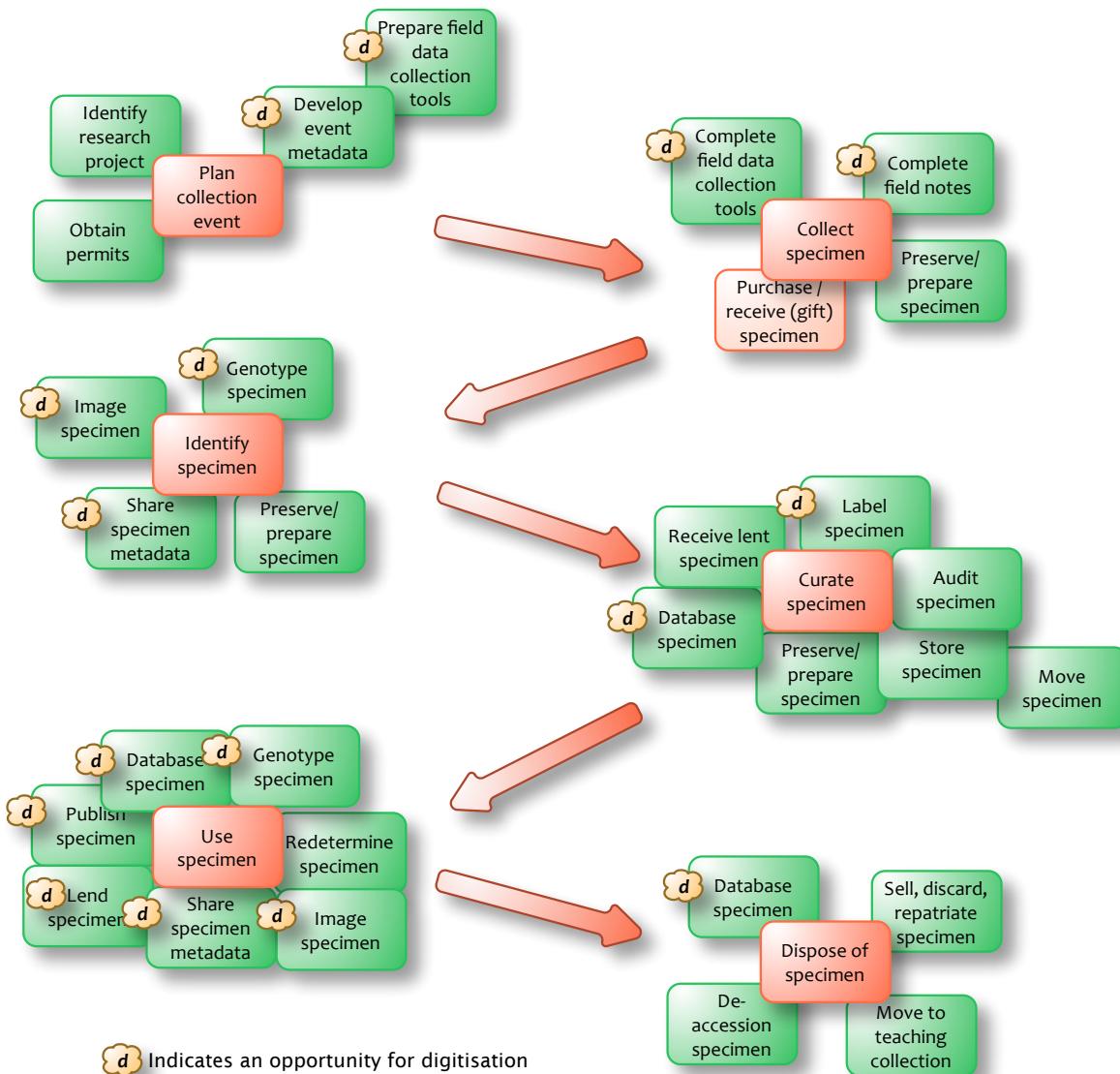
Figure 13 Digitisation opportunities in specimen management

2.11 Ways of making a digital asset

Typical means of making a digital asset in a natural history collection are given in Box 4 (p24). Not every collection or institution will use all these means and some may have additional capabilities.

Box 4 Typical means of making digital assets

Ways to make a digital asset

- Add data to a database
- Recode an audio file to mp3
- OCR a document
- Take a digital photograph
- Record an observation in a database
- Convert location descriptions to decimal latitude and longitude
- Transcribe a field notebook
- Make a digital CT scan
- Make a digital video
- Scan a book or field notes
- Transcribe a specimen label

2.12 Users of digital assets

Indicative users of digital assets from a natural history collection are given in Box 5 (p24) though a collection may have a more narrow range of users.

See also section 4.2 (p38).

Box 5 Indicative users of digital assets

Users of digital assets

- Researchers
- Teachers
- Students
- Marketers
- Citizen scientists
- Policy makers
- Natural resource managers
- Land developers
- Consultants
- Auditors
- Collection managers
- Curators

2.13 Uses of digital assets

Potential uses of a digital asset in a natural history collection are given in Box 6 (p25). While a single user, eg a policy maker, may favour a particular use for a digital asset, eg species conservation, a different user is likely to have in mind a different use for the same asset, eg specimen identification. Often, a user will use a digital asset in ways not intended or considered when the asset was created. Hence, it is important when creating a digital asset to not delimit its use unnecessarily by constraining its features such as resolution, bit depth or associated metadata.

See also section 4.2 (p38).

Box 6 Indicative uses of digital assets

Uses of digital assets

- Education
- Policy making
- Resource management
- Biodiversity modelling
- Publication
- Taxonomic research
- In lieu of specimen loans
- Online viewing
- Species conservation

- Species identification
- Transcription
- Entertainment
- Collection valuation
- Collection management
- Collection planning
- Recordkeeping
- Mapping

3   Major challenges in digitisation

When embarking on a digitisation program, several significant challenges may need to be confronted:

- reluctance to accept the need for digitisation—section 3.1 (p26)

- arguments as to why digitisation can't be done—section 3.2 (p26)

- deciding what to digitise—section 3.3 (p28)

- deciding how to begin digitisation—section 3.4 (p28)

- deciding who will do what—section 3.5 (31)

- mobilising data for sharing—section 3.6 (p31)

- long term data management—section 3.7 (p32)

- changing culture to support digitisation—section 3.8 (p32)

- managing intellectual property rights—section 3.9 (p32)

- maintaining momentum once you actually begin digitisation—section 3.10 (p33).

3.1   Accepting the need for digitisation

Why digitise? is a common question often asked by those who will be affected by a digitisation program, eg , managers, curators and collection managers. And simply pointing out the benefits of digitisation may not overcome concerns about the cost of digitisation and its impact on the institution and its people.

Recommended practices

Highlight the benefits of digitisation for an organisation (section 1.2, p11).

Recognise that some people will be more affected than others, eg curators and collection managers will be more involved than senior managers; assure them that their needs and concerns will be taken into account.

Make it clear that digitisation is a long-term process that is manageable in small chunks; avoid becoming overwhelmed by the size of the task.

Develop a digitisation strategy (section 2.4, p16) to show how digitisation will happen.

If possible, undertake a small digitisation project to demonstrate what you want to do (section 3.4, p28).

3.2   Overcoming the can'ts

Often digitisation activities just *can't* be done. Usually, this is another way of saying *It's all too hard and I don't want to do it anyway*.

Three issues tend to be behind can't:

- data quality concerns—section 3.2.1 (p27)

- data sensitivity concerns—section 3.2.2 (p27)

- lack of resources—section 3.2.3 (p27).

Recognise that all *can'ts* are probably *can bes*, but that you may have to work out how to make them happen.

The best way to overcome can'ts is to just do them, anyway.

3.2.1   Data quality concerns

Poor quality data is often used as reason to avoid digitisation; it should not be. While digitisation will highlight data quality issues, it also provides an opportunity to remedy these issues. The challenge is to decide how to deal with the quality issues.

Recommended practices

Accept that data quality issues exist.

Use the digitisation program to identify and quantify the nature and extent of data quality issues.

Use digitisation strategically to overcome data quality issues, eg if determinations are unclear, image specimens, publish the images and encourage external experts to comment on the nominated species name.

Use the Atlas's tools to validate digitised data, eg use the Volunteer Portal (volunteer.ala.org.au to have specimen labels transcribed, or the sandbox (sandbox.ala.org.au) for bulk checking of geolocations and species names.

3.2.2   Data sensitivity concerns

Similarly, concerns about releasing sensitive data can become a can't.

Again these will be highlighted through digitisation and again they are not an excuse to not digitise. Deciding how to deal with them is, yet again, the challenge.

Recommended practices

Accept that data sensitivity issues exist.

Use the digitisation program to identify and quantify the nature and extent of data sensitivities.

Use the Atlas's tools to identify and manage sensitive data, eg use the sandbox (sandbox.ala.org.au) to bulk check species sensitivities and the sensitive data service to restrict access to sensitive data published through the Atlas.

3.2.3   Lack of resources

No natural history collection or collecting institution has all the resources they desire or consider necessary to operate effectively. Digitisation is often seen as an additional activity and one that will replace other curatorial tasks.

Further, new digitisation activities may require new equipment or facilities for which there are no, or limited, funds.

Unfortunately, there are no simple or quick answers to dealing with inadequate resources.

Recommended practices

Establish a digitisation project using volunteers to do the digitisation—but equipment and facilities are still required.

See section 8 (p72) for a discussion on the use of volunteers in digitisation projects.

3.3   Deciding what to digitise

Decisions on what to digitise are made as part of the development of the digitisation strategy (section 4.4, p41). These decisions tend to be difficult as the 'right' answer depends on factors such as:

* the nature of the collection and the range of items it contains, eg large, wet and very small specimens tend to be difficult to image; bulk items like insects require considerable effort to database

* the condition of the items in the collection, eg photographic or microscope slides in danger of physical deterioration may warrant priority digitisation

* the purpose of digitisation, eg for accounting purposes digitisation of the whole collection (in some form) may be appropriate

* likely users of the digital assets and their expected uses.

Recommended practices

Unless there are good reasons to do otherwise, eg inventory management or accountability, do not plan to digitise the whole collection.

Make decisions on what to digitise on the basis of the nature of the collection (section 4.1, p37) and the users and uses (section 4.2, p38) of the digital assets produced.

See also section 4.3 (p40).

3.4   Deciding how to begin

Deciding how to begin a digitisation program is a key decision, one that will fundamentally influence longer-term digitisation activities as well as the immediate-term ones.

Recommended practices

Consider the decision on how to begin a digitisation program as a strategic decision.

3.4.1   Comprehensive or *Just do it!*?

There are two basic approaches to beginning a strategic digitisation program: comprehensive—Figure 14 (p29)—and *Just do it!*—Figure 15 (p30).
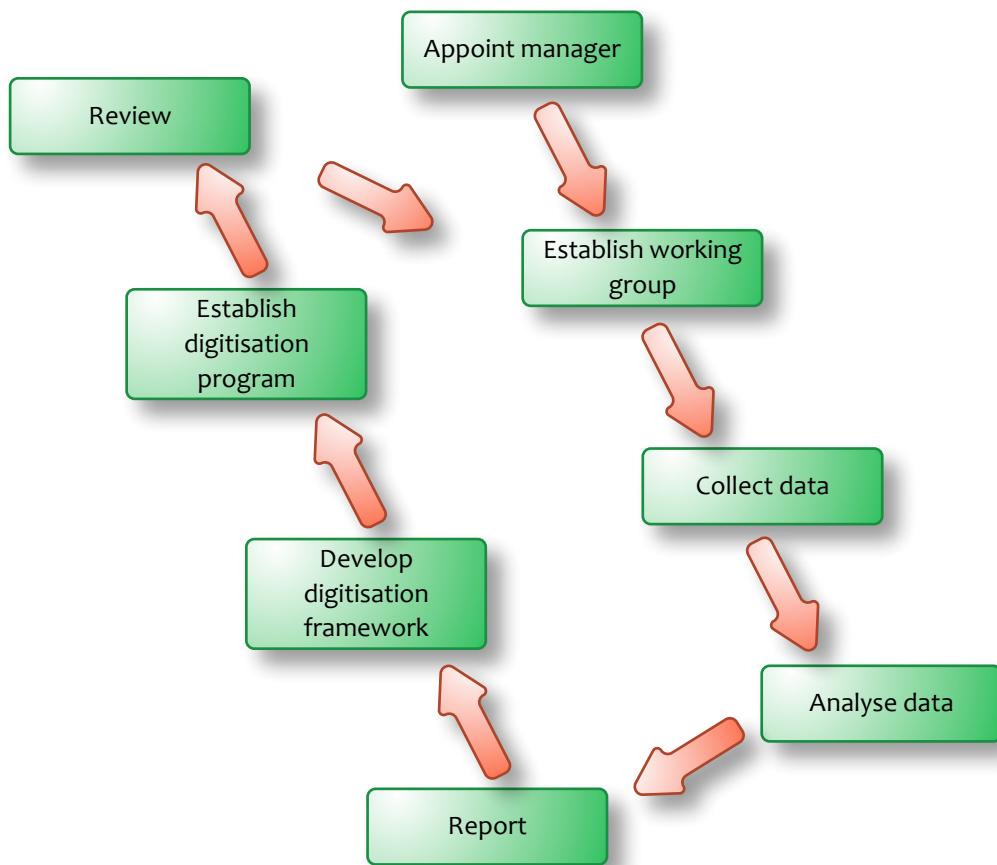
Figure 14 Comprehensive approach to digitisation

The SA Museum's experience is somewhere between the 'Just go for it' approach and the 'Shortcut' approach. Without a background in organised, institution-wide digitisation, we needed to start by 'just going for it', to build some experience and knowledge upon which to base a digitisation strategy. Charging ahead with minimal planning has helped us evaluate, measure and gain a real understanding of some of the challenges, that we had previously only been able to guess at and worry about.

If the scale of planning a digitisation strategy for the whole institution seems daunting, selecting a discrete project (perhaps all the types from a particular order of animals, or scanning all the photographic slides from one museum department) is a way of setting an achievable goal within a realistic time frame. Then review and document and that knowledge will help you build a digitisation strategy as you go.

—Alexis Tindall, Digitisation Project Manager, South Australian Museum

While the comprehensive approach is ideal, it takes time, resources and effort that can be quickly diffused. It is also probably impractical for most natural history collections.
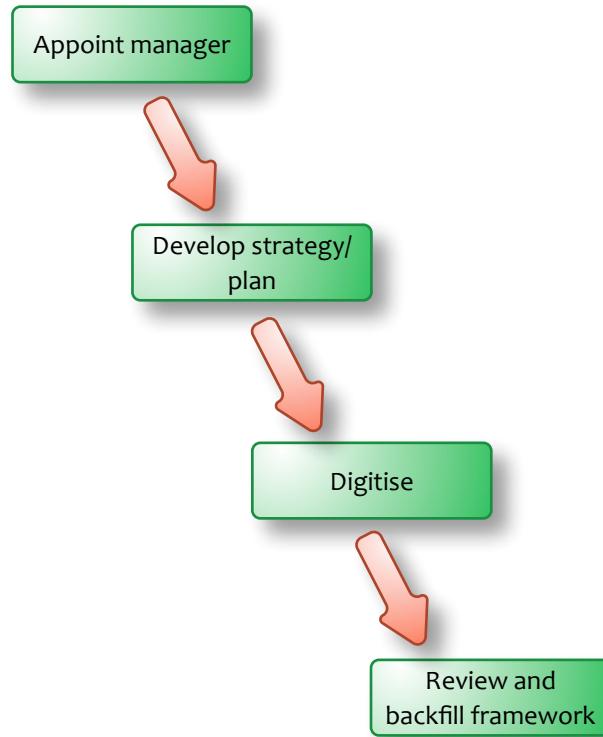
Figure 15 *Just do it!* **approach to digitisation**

In contrast, the *Just do it!* approach lends itself to easy implementation, learning lessons and delivering quick outcomes that can be used to inform further digitisation activities. It can also be readily combined with the use of volunteers to create a volunteer digitisation project (*see* section 8, p72).

Key to a successful *Just do it!* program is to select a manageable scope of work, eg digitise type specimens in a particular order or family, and use the program to identify the real can'ts. Strategies can then be developed to address the can'ts and create the digitisation management framework.

Recommended practices

Consider adopting the *Just do it!* approach, especially if the range of issues likely to be encountered during digitisation is not clear or is extensive.

Consider creating several small projects rather than a couple of larger ones as this may have less disruptive impact on the institution.

Document everything—lessons, procedures, solutions—and use the information to create the digitisation management framework (*see* section 2.1, p13).

Solve problems as you go, rather than try to anticipate them all at the beginning.

Bring the organisation with you by showing what can be done with the limited resources used.

3.4.2   Create a legacy problem

Irrespective of the approach chosen, the primary focus of the program will likely be the backlog of digitised specimens. But an important part of the digitisation strategy and program is digitisation of new specimens so that the backlog does not grow.

Recommended practices

Create a legacy problem: ensure all new specimens are digitised as part of their accession. Then develop a digitisation program specifically to digitise the backlog—the legacy collection.

Consider using volunteers to digitise the legacy collection—*see* section 8 (p72).

3.5   Deciding who will do what

Everyone involved with digitisation should have well-defined responsibilities and be familiar with those responsibilities.

Section 2.6 (p17) suggested that a digital collections manager should be appointed. As well as looking after all the digital assets, this manager should be charged with developing and implementing any strategic digitisation program.

Recommended practices

Large institutions with significant digital collections should appoint a full-time digital collections manager.

Allocate responsibilities to the digital collections manager as suggested in section 7 (p71).

Ideally, include digitisation responsibilities in duty statements for those positions involved with digitisation, including curators and collection managers.

3.6   Mobilising data for sharing

Preparing data for sharing and actually making it available can be difficult. While data may be stored in standards-compliant databases, not all implementations of the standard are necessarily equivalent. And not all data is stored in standards-compliant databases. Such situations require mapping of data fields from one database to another where the mappings are on the basis of the semantics of the fields in each database not the names.

In addition, exporting data from a database often requires development of export scripts and software to parse and re-format data before creating a standards-compliant export file or data feed.

Finally, many databases sit behind firewalls that must be penetrated to allow data to be automatically shared with external organisations.

Recommended practices

Use standards for capturing, recording and storing data, eg Darwin Core.

Automate export scripts as much as possible.

3.7   Managing data for the long term

Digital assets (data files) are subject to the vicissitudes of changing technology: new file formats, new media, new standards, new computer operating systems. All digital collections face the same problem of retaining access to data in the longer term. At the moment there is no simple solution to this problem.

Recommended practices

Adopt standard, common file formats as indicated in the digitisation principles (Box 1, p15).

Monitor changing technology and migrate digital assets to new formats and media from time to time.

Develop a technology management plan—section 4.6 (p49).

3.8   Managing culture change

Digitisation of new specimens as part of accession can create additional workloads on curators, researchers and collection managers. In addition, it may require changes to long-standing work practices and new skills, not to mention new technologies. Introducing such systemic changes can be problematic and may be resisted. Careful management is thus required.

Importantly, digitisation programs for legacy specimens (section 3.4.2, p31) may impact curators and collection managers as much as will changing accession processes. These people will have to provide specimens for digitisation and this activity can consume much of their time (*see also* section 3.10.2, p33).

Recommended practices

Include a culture change program as part of a digitisation program to minimise adverse impacts and engage staff with the new way of doing business.

For *Just do it!* projects, consider the impact of the project on others in the institution. A more informal approach to changing behaviour and attitudes may be more effective than a formal one. And remember that a *Just do it!* project can, itself, be part of a larger culture change project.

3.9   Managing intellectual property rights

Intellectual property in digital assets is a major issue for many institutions, curators and researchers. Too often ownership of intellectual property is unclear, especially with digital assets and hard copy documents like photographic slides. Further, the role of moral rights (essentially the right to attribution) is often unfamiliar or poorly handled.

Many governments now have 'right to information' legislation that requires information to be publicly available by default, at no or very minimal cost. Existing processes may need to be revised to comply with such legislation and this can involve reviewing how digital assets are commercially exploited.

Recommended practices

Develop a clear intellectual property policy covering ownership and sharing of digital assets, including licensing conditions for sharing and attribution of moral and other rights.

As part of the induction of volunteers into a digitisation project, require each volunteer to assign to the institution ownership of copyright in the digital assets they create. Such action does not waive or negate the moral rights held by a volunteer in the digital assets they create.

Share digital assets freely, preferably using creative commons licences, notably CC-BY (any use allowed provided the source is acknowledged). *See* creativecommons.org.au for more information on creative commons licenses.

Embed as metadata within a digital asset the intellectual property rights, including moral rights attribution, to ensure that the rights accompany an asset when it is shared or distributed outside an institution.

3.10 Maintaining the momentum

Once a new or enhanced digitisation program is established, maintaining it can be challenging, especially when resources are limited. But if the appropriate mechanisms are established as part of the program, eg a culture change program, digitisation plans, maintaining the digitisation momentum should be less troublesome.

Three issues in particular may affect the longevity of a digitisation program:

- getting resources—section 3.10.1 (p33)

- feeding the digitisation process—section 3.10.2 (p33)

- embedding digitisation in 'business as usual'—section 3.10.3 (p34).

3.10.1 Getting resources

Inadequate resources was cited in section 3.2.3 (p27) as a reason why digitisation can't be done. Resources for digitisation will always be limited; hence the need for the digitisation strategy to be written around likely available resources. As circumstances change so the strategy can be amended to reflect those circumstances.

Recommended practices

Accept that resources will be limited and plan to make the best use of those that are available.

Consider using volunteers and crowdsourcing to supplement available resources—*see* section 8 (p72).

3.10.2 Feeding the digitisation process

Experience has shown that even small scale digitisation projects require considerable support from curators and collection managers, primarily in providing specimens for digitisation and processing them after digitisation.

> *It is difficult to estimate how much time is required specifically for the curation of specimens for digitising because curation is a normal part of collection management. What is clear though is that a dedicated rapid digitising project shifts the priorities of collection staff onto curation of specimens that may otherwise not have been in their workplans. Unless effectively resourced this can lead to conflict over work priorities in the collection.*
>
> —Rapid Digitisation Project: Final Report, Australian Museum, 2011

Recommended practices

Employ a digitisation manager or other assistant to work with curators and collection managers to reduce the impact of providing specimens for digitisation.

3.10.3 Digitisation as normal business

Digitising legacy specimens (section 3.4.2, p31) without ensuring that new specimens are also digitised only increases the size of the digitisation backlog and makes the digitisation challenge even more onerous.

Recommended practices

Revise accession processes to include digitisation activities, eg to taking more but different images to avoid having to take such images later and risk damage to a specimen through greater handling.

Consider establishing a digitisation project specifically to review accession processes and identify changes needed to support accession-based digitisation.

Part 2
IMPLEMENTATION MATTERS

4 Planning for digitisation

Establishing a digitisation capability begins with planning—however brief. Planning activities as shown in Figure 6 (p18) are:

- understanding the collection—section 4.1 (p37)
- understanding the users and uses of digital assets—section 4.2 (p38)
- deciding what to digitise—section 4.3 (p40)
- preparing the digitisation strategy—section 4.4 (p41)
- preparing digitisation guidance—section 4.5 (p43)
- preparing digitisation plans—section 4.6 (p49)
- reviewing digitisation activities—section 4.7 (p50).

These activities are relevant to both the comprehensive and *Just do it!* approaches (section 3.4, p28) to digitisation. However, they are likely to be given different emphases in each approach, eg the necessity to understand the nature of a collection is much greater for a comprehensive approach than it is for *Just do it!*, given the broader coverage of the former approach.

Particular benefits of planning digitisation are that it minimises the duplication of effort across different parts of an institution; and allows early consideration of issues that inevitably arise during the practice of digitisation and that can impede progress while they are being resolved.

While the structure of this section may suggest that the activities mentioned should occur in the sequence in which they are discussed, this is not necessarily the best way to proceed, eg information collection and analysis may be more appropriately conducted in parallel.

Recommended practices

Consider establishing a digitisation working group to plan the digitisation program. Indicative terms of reference for this working group are given in section 10 (p76).

Ideally, have the digital collections manager lead the planning process.

Plan *Just do it!* programs, even if the planning is minimal and has limited detailed analysis. However, if the strategy is to use a *Just do it!* project to inform a more comprehensive approach, ensure sufficient planning is done to identify the issues that need to be 'tested' during the *Just do it!* project(s).

4.1 Understanding the collection

To gain a full understanding of a collection or group of collections, consider performing all the activities is this section.

4.1.1 Collect background information

Understanding current digitisation activities and the nature of the objects to be digitised is central to understanding the digitisation challenge facing an institution. With this information an effective digitisation program can be developed.

Recommended practices

Consider collecting the information listed in section 9 (p74).

Document the information collected.

> *Key questions*
> ❏ What is the context of digitisation within the institution?
> ❏ What is the nature and size of the collection?

4.1.2   Analyse background information

Background information is analysed to allow informed decisions to be made about how an institution should approach digitisation in future.

Recommended practices

Consider performing analysis in parallel with information collection and use the analysis to inform collection activities.

Group objects into categories and understand the digitisation issues associated with each category.

Document findings in a report.

> *Key questions*
> ❏ What is the extent and nature of the digitisation challenge?
> ❏ How can the challenge be made manageable?
> ❏ What are the main factors affecting the challenge and its resolution?
> ❏ What are the digitisation strengths within the institution that can be built on?
> ❏ What are the digitisation weaknesses that need to be overcome?
> ❏ What issues and constraints may impede or foster digitisation?
> ❏ What are the potential priorities for digitisation?

4.2   Understanding the users and uses of digital assets

Understanding who uses an institution's digital assets and how they will use them is essential to understanding the real value of digitisation activities. Users may be internal—eg curation, researchers—or external to an institution—eg policy makers.

Collected background information (section 4.1.1, p37) may illuminate who uses the digital assets or who might use them if they were available. It may also indicate how the assets are used.

Recommended practices

Use the specimen management process shown in Figure 13 (p23), as well as the background information, to identify current and potential internal users and uses.

Use the digital asset value chain shown in Figure 16 (p39, based on that given in Reference 9, Figure 2.6.5, p11) to identify current and potential external users and uses. Modify this chain as necessary to reflect the circumstances of your institution.

Prepare a matrix of users and uses of digital assets.

Develop a list of the characteristics of the digital asset that are likely to be important to users. An indicative list is in Box 7 (p40) while guidance on selecting an appropriate digitisation standard for many of these characteristics is given in section 11 (p78).

Document findings in a report, which may be same report containing the analysis of background information (section 4.1.2, p38).
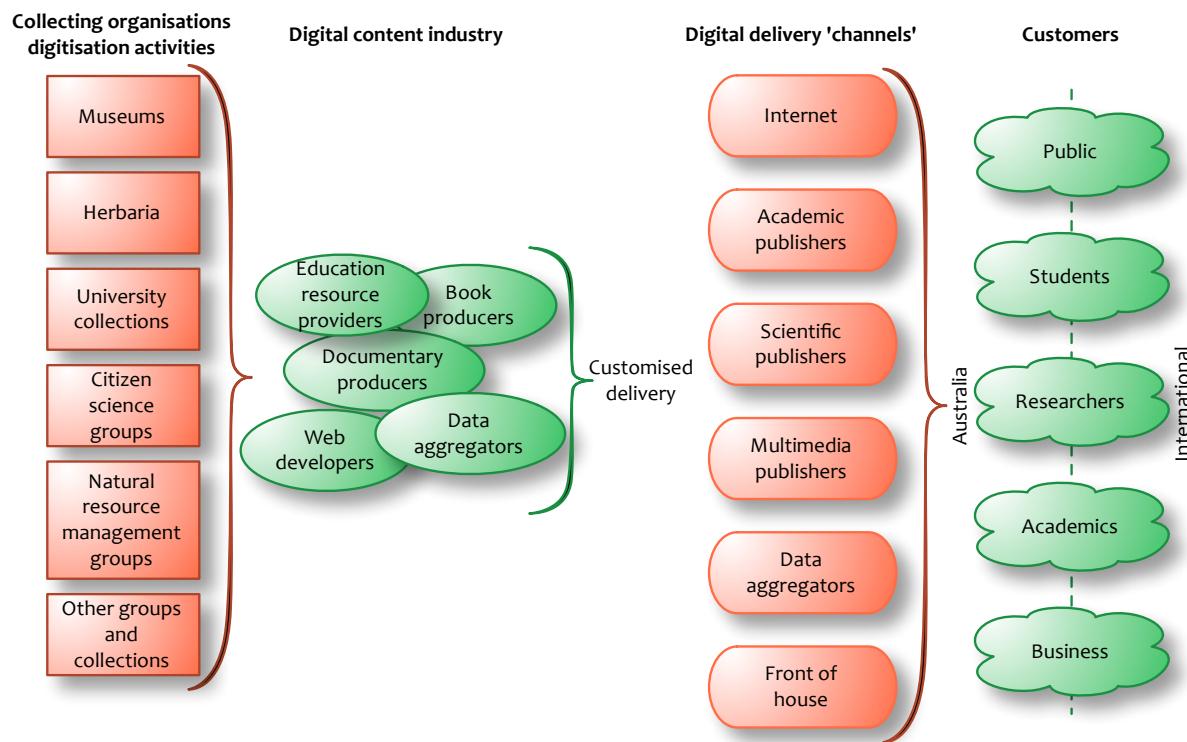
Figure 16 Digital asset value chain

Box 7 Indicative characteristics of digital assets

Characteristics of digital assets

- Image resolution
- Image size
- Image bit depth
- Audio bit depth
- Audio sampling resolution
- Audio bit depth
- Interpretation aids, eg colour patches

- Level of compression
- Calibration
- Authentication
- Encoding type
- File format
- Encoding format
- Access or delivery arrangements

See also:

- Box 5 (p24)
- Box 6 (p25)

Key questions

- ❑ Who uses the current digital assets?
- ❑ Who else might use them if they were more broadly available or if there were more of them?
- ❑ What additional assets would they like?
- ❑ How are the assets used?
- ❑ How else could they be used?
- ❑ What characteristics should the assets have to make them useable or more desirable?

4.3   Deciding what to digitise

Deciding what to digitise is a key decision in planning a digitisation program, as it affects all digitisation activities beginning with the digitisation strategy (*see* section 2.4, p16).

The UK's Joint Information Systems Committee (Reference 19) nominated the following priorities for digitisation:

- Make the hidden visible: enable access to and use of difficult or impossible to access collections.
- Address a recognised need or gap within learning, teaching or research provision.
- Map to a particular area of the curriculum or research interest.
- Inspire new avenues of research, or new approaches within learning and teaching

- Contribute to creating critical mass within a given area or help to create a theme across previously unassociated materials

- Would not otherwise be funded, or be able to attract significant funding from other sources.

- Are at risk from being lost to our community through sale, deterioration or dissagregation.

Recommended practices

See section 3.3 (p28) for recommended practices.

> ### Key questions
> ❏ What are the drivers for digitisation, eg increased public accessibility of specimens, reduced handling of high value specimens, digitisation of objects in poor condition, improved accountability for objects?
> ❏ What are the priorities for digitisation?
> ❏ What are the implications of these priorities?

4.4   Preparing the digitisation strategy

A digitisation strategy sets out the intentions and objectives of digitisation activities and nominates how these will be achieved. It may be:

- time based, eg cover a five-year period

- issued as a public statement of intent

- inspirational or factual

- a glossy or plain publication.

As shown in Figure 17 (p42), the digitisation strategy is the outcome of due consideration of:

- the institution's collection acquisition policy or strategy

- the nature of the collection(s)—section 4.1 (p37)

- users of the digital assets—section 4.2 (p38)

- uses of digital assets—section 4.2 (p38).

Digitisation plans (section 4.6, p49) are developed based on the digitisation strategy.
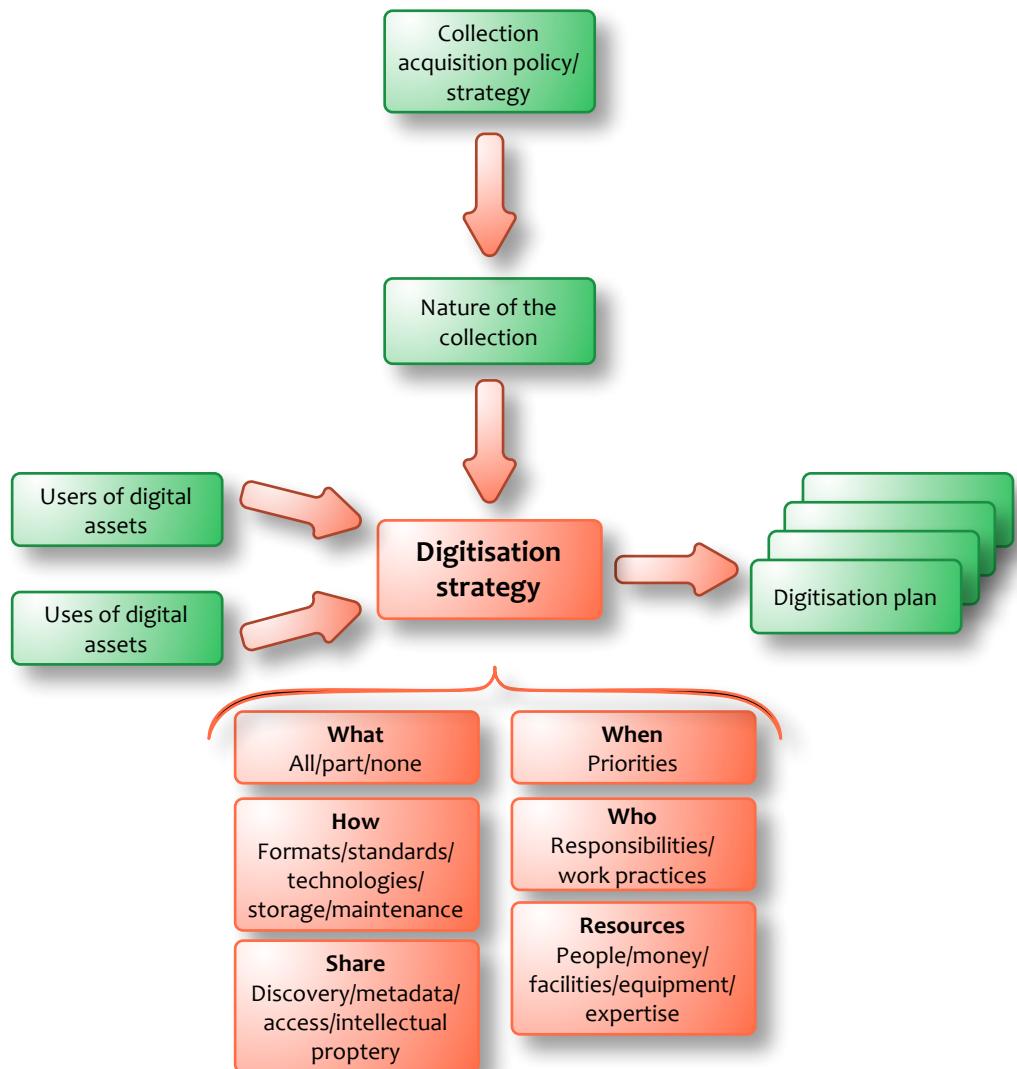
Figure 17 Inputs to the digitisation strategy

Recommended practices

Include in the strategy sections on:

- introduction—what digitisation will be done and why

- vision—the end point

- goals and objectives—to be achieved as part of the vision. Includes: digitisation of existing and new objects; improvements to current digitisation activities, eg digitise all new specimens rather than just a sample, create a legacy problem (section 3.4.2, p31); asset sharing and exploitation (section 4.6, p49)

- priorities for digitisation—covering both existing collections and new objects

- responsibilities—who will be doing what and in what timeframes

- issues—to be addressed in achieving the goals and objectives, eg obtaining resources.

Develop, as necessary, supplementary strategies for specific categories of object, eg photographic slides, multimedia files, analogue audio files.

Suggested priorities are (noting that while not everything in a collection need be digitised, everything should be prioritised for digitisation):

• objects of international significance, eg type specimens

• objects of national significance, eg explorer notebooks

• objects with high user demand

• objects of local significance

• objects at high risk of losing their integrity, eg faded photographic slides, objects in need of repair.

In setting priorities take into account:

• the preservation condition of objects

• the fragility of objects

• accessibility of objects

• resources available for digitisation: the strategy indicates how digitisation will occur using the resources currently or planned to be available.

Consider starting with small but important collections to gain experience in digitisation and achieve some early successes—the *Just do it!* approach (section 3.4.1, p28).

Examples of digitisation strategies:

• *Cross Media Preservation Plan 2010/11–2012/13 Summary Paper* (Reference 20)

• *Digitisation Strategy* (Reference 19)

• *Creating a Digitial Smithsonian: Digitization Strategic Plan Fiscal Years 2010–2015* (Reference 30)

> *Key questions*
> ❏ Who should be involved in, or consulted, when preparing the strategy?
> ❏ What topics should it cover?
> ❏ What form should it take?
> ❏ What is the role of the document, internally and externally?
> ❏ What is the intended general approach to digitisation, eg phased, outsourced, in collaboration with other institutions?
> ❏ How will progress be monitored?
> ❏ Who will approve the strategy?
> ❏ How will the strategy be marketed to stakeholders and interested parties?

4.5   Preparing digitisation governance

Digitisation governance consists of at least the following:

• digitisation principles—section 4.5.1 (p44)

• digitisation policy—section 4.5.2 (p44)

- quality regime—section 4.5.3 (p45)

- digitisation standards—section 4.5.4 (p46)

- metadata standards—section 4.5.5 (p48).

4.5.1 Digitisation principles

Digitisation principles provide a general context to digitisation activities by informing the digitisation policy and all digitisation activities.

See also section 2.3 (p15).

Recommended practices

Adopt as a minumum, the principles in Box 1 (p15).

> *Key questions*
> ❏ Are additional digitisation principles necessary?
> ❏ How are the principles to be implemented?
> ❏ Does the digitisation strategy and other governance documents support the principles?

4.5.2 Digitisation policy

Digitisation policy sets out the rules under which digitisation will occur and gives effect to the accepted digitisation principles while concurrently supporting the digitisation strategy.

Because digital assets are an integral part of a collection, they should be created and managed according to the institution's overall collection policy.

Recommended practices

Ensure the policy covers all the activities involved in the digitisation process (section 2.7, p17) and specimen management process (section 2.10, p22).

Ensure the institution's overall collection policy recognises the role of digitisation and digital assets.

Develop, as necessary, supplementary policies for specific categories of object, eg photographic slides, or specific types of digitisation, eg CT scanning.

Example digitisation policy:

- *Collection Digitisation Policy* (Reference 23)

> **Key questions**
> ❏ What policies are needed?
> ❏ Who should be involved in, or consulted, when preparing the policy?
> ❏ Who will approve the policy?
> ❏ How will people know about the policy?
> ❏ Does the institution's overall collection policy cover digitisation and digital assets?
> ❏ What are the implications of the policy for digitisation, digital assets and work practices within the institution?
> ❏ What intellectual property regime will apply?
> ❏ How will assets be licensed and shared?

4.5.3   Quality regime

Assuring the quality of digital assets throughout their life is integral to digitisation and to ensuring that the assets are accessible and viable into the future. In this context *quality* may be defined as *fitness for purpose*, so it is important that the potential uses of digital assets is known (section 4.2, p38).

The data quality regime will be informed by:

• the institution's information management policy

• digitisation standards (section 4.5.4, p46 and section 4.5.5, p48).

Information on current quality assurance arrangements collected as part of the background information (section 4.1.1, p37) will provide a basis for developing the quality regime.

> *Conveniently, the [imaging] process includes naturally occurring opportunities for quality control. This happens in addition to a rough sampling method of quality control undertaken by the project manager.*
>
> *Each image is viewed on three separate occasions by up to three separate volunteers, once at capture, again at the time of post-processing and finally, when the database record is created or checked. The volunteers are asked to watch out for any problem images. Frequently occurring problems include those who have forgotten to add a scale bar to the image, occasional images that are slightly out of focus or poor colour balance (particularly from the microsystem). The colour balance issue can be rectified in Photoshop, but the other problems lead to re-capturing the photo. This has happened fewer than ten times in the first 2000 specimens. There have been instances where volunteers have identified problems in photographs that they took themselves.*
>
> —Rapid Digitisation Project: Final Report, South Australian Museum, 2011

Recommended practices

Ensure the quality regime cover all aspects of digitisation and all factors that influence quality, including:

- operator training

- data verification, eg for OCR and transcription processes, use of checksums

- equipment calibration

- acceptable variations from standard digital outputs

- storage reliability

- validation of backup processes

- compliance with standards

- fault and non-compliance logging and analysis

- use of metadata.

Embed quality assurance activities throughout the digitisation process; do not rely on end-of-process assurance.

Key questions
- ❏ What quality regimes already exist in the institution that can be built on?
- ❏ How can the current quality of digital assets be improved?
- ❏ How will the regime be documented and implemented?
- ❏ What policy does it need?
- ❏ Who will be responsible for quality assurance?
- ❏ What user feedback mechanisms will be included?

4.5.4   Digitisation standards

Adopting standards for digitisation is a central component of the quality regime and essential for producing consistent digital assets.

A number of digitisation standards, formal or *de facto*, exist covering different aspects of digitisation, including:

- digital asset formats, eg JPEG, TIFF and .psd for images, MP3 for sound files, MP4 for multimedia

- transmitting and accessing digital files, eg FTP, HTTP

- compressing digital files, eg zip

- types of images required for different types of specimens, eg lateral, ventral and top views

- interpreting and calibrating images, eg including a scale and colour patch in an image as absolute references

- branding, eg including the institution logo in an image

- object management, eg adding barcodes to herbaria sheets and including these in images of those sheets.

Standards used in the institution should have been identified during collection of background information (section 4.1.1, p37).

For pinned specimens, we're photographing on a white background, which is made up of a sheet of good quality white tracing paper pinned over a piece of foam. In some circumstances, where the specimens are particularly light coloured, we are replacing the tracing paper with a piece of neutral grey card.

In most circumstances we are photographing three views – dorsal, lateral and labels. I understand that further views may be necessary for diagnostic purposes, but these will be taken on request. Our immediate aim is discoverability. With a sound digital asset management strategy, any further views that are captured of the same specimen will be added to the image library and made available in the same way as these initial views. In the case of Lepidoptera or Hemiptera whose wings are spread, we are only capturing a dorsal view, as a lateral view wouldn't be very helpful and would pose a risk to the specimen in the movement of it.

In all circumstances the longest part of the specimen is aligned with the longest part of the frame, with its head to the left of the frame. (In most Lepidoptera photos the longest part of the specimen is across the wings, so the head is facing 'upwards'.)

If there is dissected material or broken parts they are photographed in with the dorsal view of the specimen (usually legs or antennae in capsules, or genitalia mounted on cards).

For larger specimens (captured with a DSLR with a macro lens) we are photographing with a 10mm or 5mm reference bar in the image. In post-processing we are removing that bar and adding a scale bar and text to the image. (The microphotography equipment can calculate and add a scale bar automatically, so there is less need for post-processing.)

—Alexis Tindall, Digitisation Project Manager, South Australian Museum

Recommended practices

Adopt widely used standards as they will be more supportable into the future and will ease the burden of migrating data over time. Preferred standards for digital asset formats are given in section 11 (p78).

Wherever possible, use standards endorsed by TDWG (www.tdwg.org/), GBIF (www.gbif.org/), other international organisations or used within the collection community.

Ensure that the standards adopted can be supported within the institution, eg TDWG standards must be able to be used in association with existing specimen databases.

> *Key questions*
> - ❏ What standards are already in use in the institution?
> - ❏ What new or revised standards are needed?
> - ❏ What are the implications for your IT systems, work practices, etc of the chosen standards?
> - ❏ What policy does it need?
> - ❏ What processes will be used to implement the standards?

4.5.5   Metadata standards

Metadata is used to provide information about a digital asset to facilitate its discovery and understand its context. Three types of metadata are typically used:

- technical, eg camera settings, sampling rate; usually supplied by the digitising device

- administrative, eg copyright owner, digitiser, licensing arrangements

- content, eg subject matter.

Metadata can be stored within a digital asset (embedded metadata) or associated with it and stored separately (or both), usually in a digital asset management system (DAMS), such as Cumulus Canto and FotoWare, or collection management system (CMS), like KE EMu or Vernon. What metadata is embedded within a digital asset and how much associated with it depends on the institution's policies and the functionality of the DAMS/CMS. (In addition, each DAMS and CMS has its own metadata requirements.)

Various metadata standards exist for biodiversity data, eg Darwin Core, ABCD and the Atlas is working with relevant organisations to develop further metadata standards, eg for microorganisms, plant seeds (managed in seedbanks) and the living collections in botanic gardens.

Recommended practices

Adopt common metadata standard.

Use Darwin Core (DwC http://www.tdwg.org/activities/darwincore/) to describe, and share data about, faunal specimens in natural history collections and citizen science projects. This metadata is usually input to, and managed by, a CMS.

Use HISPID (hiscom.chah.org.au/wiki/Main_Page), a variant of ABCD (www.tdwg.org/activities/abcd/), to describe, and share data about, specimens in Australian herbaria.

For digital assets representing specimens and other collection objects, embed within each asset at least a persistent identifier (PID) that refers to the specimen or object represented by the asset. For example, a digital image of a fauna specimen should have as embedded metadata the Darwin Core fields *occurrenceID* or *collectionID* (both containing the institution's code, the collection code and unique specimen identification code) while for herbarium specimens, the HISPID fields *insid* (Institution Code) and *accid* (Accession Identifier) should be embedded. This piece of metadata facilitates identifying the current

determination of the imaged specimen using the Atlas and linking the image to the specimen record in both the CMS/DAMS and Atlas.

Preferably, also, embed in a digital asset a specimen's original determination, if applicable, and intellectual property rights information.

Key questions

❏ What metadata is currently collected?

❏ What metadata standard is appropriate?

❏ What else needs to be collected?

❏ What are the implications for your IT systems, work practices, etc of the chosen standards?

❏ What processes will be used to implement the standards?

❏ How is metadata managed?

❏ How will metadata be captured, managed and embedded in digital assets?

❏ What policy does it need?

4.6   Preparing digitisation plans

Development of a number of specific plans may be appropriate to facilitate achieving the objectives of the digitisation strategy (section 4.4, p41). Such plans may cover:

• establishing and managing digitisation projects—*see* section 5 (p52)

• sharing digital assets

• exploiting digital assets. Digitisation provides an opportunity to explore new ways of using and exploiting digital assets. This may be as simple as providing more content for an institution's web site or as complex as data mining transcribed field notebooks to identify locations, collection events, species citations or character keys

• managing digital technologies

• managing digital assets

• improving digitisation performance to achieve higher levels of maturity in accordance with the Digitisation Maturity Model (section 2.5, p16)

• managing the quality of digital assets.

Recommended practices

Consult widely when developing plans as different areas of an institution may have different views on a topic, eg what constitutes 'sharing' and the conditions or licence under which it should occur may not be universally agreed.

Develop a **digital asset sharing plan** covering at least:

• what assets will be shared—there may be excellent reasons for not sharing all the digital assets, eg commercial or data sensitivity

• how they will be shared (in as many ways as is practical)

• the standards used for sharing, eg discovery, transmission, formats, media

- licencing (Creative Commons is preferred—*see* section 3.9, p32)

- roles and responsibilities

- accounting for the use of digital assets by external organisations and individuals.

Develop an **asset exploitation plan** covering at least:

- exploitation opportunities, eg exploitation will likely produce new data, including new types of data. Be sure to plan to capture and manage this data as well

- timeframes, short- and long-term activities

- roles and responsibilities

- resource needs.

Develop a **technology management plan** covering at least (where these are not covered in other documents):

- arrangements for monitoring changes in digitisation technologies

- criteria for upgrading technology, migrating data formats etc

- arrangements for assuring the viability and accessibility of digital assets into the future

- roles and responsibilities.

Key questions

❏ Who should be consulted in developing the plans?

❏ What constraints exist?

❏ What opportunities exist?

❏ What resources and capabilities are needed to implement the plans?

❏ How will the plans be shared?

❏ What are the implications of the plans?

❏ Can the plans be reasonably implemented? (There is no such thing as a bad plan, only bad implementation.)

❏ Who approves the plans?

4.7   Reviewing digitisation activities

Digitisation activities should be reviewed from time to time to:

- assess performance against the digitisation strategy and plans

- confirm that governance arrangements remain valid

- check if digitisation activities can be improved

- check if management of the digital assets is effective

- assess if sharing arrangements are still appropriate

- assess the institution's relative performance against the Digitisation Maturity Model (section 2.5, p16).

Recommended practices

Conduct reviews no less than every five years, and if the digitisation strategy is time-based then schedule reviews around updates to the strategy.

Key questions
- ❏ What should be reviewed?
- ❏ How often?
- ❏ By whom?
- ❏ For what purpose?
- ❏ Are digitisation activities still effective?
- ❏ What digitisation maturity level is applicable?
- ❏ What needs to be achieved before the next review?

5   Organising digitisation

Organising digitisation is the process by which a particular digitisation project is planned and begun and it encompasses the activities shown in Figure 7 (p18):

- establishing a digitisation project—section 5.1 (p53)

- arranging digitisation equipment—section 5.2 (p54)

- preparing (meta)data capture tools—section 5.3 (p56)

- preparing date storage—section 5.4 (p57)

- preparing quality assurance tools—section 5.5 (p59)

- preparing sharing tools—section 5.6 (p60)

- preparing exploitation tools—section 5.7 (p60)

- recruiting and training staff/volunteers—section 5.8 (p61)

- developing procedures—section 5.9 (p62).

These activities are relevant to both the comprehensive and *Just do it!* approaches (section 3.4, p28) to digitisation. However, they are likely to be given different emphases in each approach, eg the necessity to understand the nature of a collection is much greater for a comprehensive approach than it is for *Just do it!*, given the broader coverage of the former approach.

Many organising activities will be informed by activities that occurred during planning (section 4, p37) and are intended to implement the outcomes of those activities. Therefore, many organising activities are common to all digitisation projects (to some extent at least, eg preparing data storage) so that much of the organising need only be done once with the outcomes shared across other projects.

While the structure of this section may suggest that the activities mentioned should occur in the sequence in which they are discussed, this is not necessarily the best way to proceed, eg procedures will be required for most activities and these may be better developed as part of the activity, rather than being left as the last activity.

Recommended practices

Provide digitisation equipment and resources as common infrastructure that can support a range of digitisation projects.

Vary and supplement the common infrastructure as necessary to meet the needs of each project.

Build a portfolio of equipment, techniques and resources to support digitisation of a range of objects.

Organise *Just do it!* projects based on the needs of the project but have regard to the potential wider applicability of the outcomes.

As necessary, use *Just do it!* projects to improve your understanding of organising activities and to identify or 'prove' digitisation capabilities.

5.1　Establishing a digitisation project

A number of separate digitisation projects may be established under the digitisation strategy (section 4.4, p41), reflecting aspects of the strategy such as different priorities, categories of object to be digitised or resource availability. Each project should be planned and managed.

> *Employment of a dedicated project manager has been integral. Investing in this position has meant that one person was able to identify and refine the goals of the project, research best practice, make decisions suitable to the needs of the institution and respond to problems that arose in procurement and volunteer management. This kind of project often requires organisational change, and a project manager can work as an advocate. This person is able to drive the project, tracking progress and ensuring that productivity and quality is improving from month to month.*
>
> —Rapid Digitisation Project: Final Report, South Australian Museum, 2011

Recommended practices

Consider beginning a digitisation program with a simple or trial project (not necessarily a *Just do it!* project) so that options can be explored and the foundations laid for later, more complex projects.

If embarking on a series of projects, consider developing an overall project plan with activities and outcomes for each project scheduled to support the other projects, eg equipment acquisition.

Establish each project according to the institution's standard project management methodology.

Prepare a plan for each project addressing at least:

- objectives—what is to be achieved
- project scope—what's in and what's out
- assumptions, constraints and dependencies—what may impact on the project and successful achievement of its objectives
- project approach—a general statement of how the project will be delivered
- deliverables—particular outputs and their timing, covering the other activities of planning, eg data storage, tools, documentation, as well as the digital assets
- project management arrangements—how the project itself will be managed
- risks and their treatment—what can go wrong and how such situations will be managed
- resources—money, people, facilities, technology, tools—*see* section 12 (p82) for a list of resources that may need funding
- roles and responsibilities—who will do what.

Consider the need for expertise in digitisation and management and preservation of digital assets, and seek outside advice as necessary.

Ensure the effort in planning and establishing a project is commensurate with the significance of the project.

Consider establishing a volunteer-based digitisation project as a *Just do it!* project—section 8 (p72).

Appoint a project manager to oversee the project. For large projects, the manager may be full-time. Indicative terms of reference for a project manager are given in section 13 (p83).

Key questions
- ❏ What is the nature of the project?
- ❏ What will it achieve?
- ❏ What resources are needed?
- ❏ How is the project to be resourced?
- ❏ Who will lead the project?
- ❏ How will the project be 'sold' within the institution?
- ❏ What OH&S issues need to be considered?

5.2   Arranging digitisation equipment

Equipment for digitisation are those hardware, software and facilities needed to create, manage and share a digital asset. Typical equipment is listed in section 12 (p82).

Choice of specific equipment will be informed by factors such as:

- available resources, eg availability of suitable facilities, limited budgets, limited storage for the digital files, currently used equipment (for compatibility), number of people involved

- the objects to be digitised, eg insects require different imaging equipment from fish, imaging drawers need different setups from imaging individual specimens and analogue audio files need totally different equipment from specimens of any type

- type of digital conversion, eg X-ray, micro-CT scanning, digitisation of photographic or microscope slides, transcription, databasing, video conversion

- nature of the digitisation project, eg to enhance current digitisation activities, develop new capabilities or digitise an existing collection of specimens

- project timeframe, eg high throughput equipment may be needed to meet a tight timeframe (likely to be more expensive than low throughput equipment used in a longer term project)

- general approach to digitisation, eg use of volunteers or curators to do the digitisation.

> *I have learned in all the equipment and standards research that versatility and precision are incompatible. I had unrealistic expectations when I began planning this project that I would just go and buy a microscope and camera, and that all bits of equipment would be able to be used in diverse departments of the museum in perpetuity after my project was over. This isn't the case. In order to buy a microscope and capture device that could photograph insects, I needed to have a fairly good knowledge of what the equipment was going to be used for. This was even more important when buying less specific equipment—deciding on lenses and lighting for the camera set-up meant that I had to learn a huge amount about the suitability of lenses and lighting arrangements for the task.*
>
> —Alexis Tindall, Digitisation Project Manager, South Australian Museum

Recommended practices

Do not underestimate the potential size or complexity of acquiring equipment.

Spend time developing requirements as poor technical solutions will cost more in the long run.

Seek expert technical advice on equipment choice.

Ensure that the equipment chosen can support the standards nominated in section 11 (p78) and that it will deliver digital assets suitable for their intended use (section 2.13, p24).

If in doubt about the capabilities of a particular piece of equipment, get the manufacturer or distributor to demonstrate it for you. But use 'standardised' objects for the demonstration to ensure comparability of results between different equipment options.

When resolving compromises between cost and capability, eg larger file size with associated higher and more costly storage requirements, look for novel solutions, eg adopt cheaper operational storage or keep master copies in the Atlas's Morphbank instance (morphbank.ala.org.au/).

> **Key questions**
> ❏ What equipment is needed?
> ❏ Is in-house expertise sufficient to make informed decisions about the requirements and suitability of particular equipment?
> ❏ Who will acquire them?
> ❏ Can they be used across projects, or just in one digitisation project?
> ❏ Who will manage and operate the equipment?
> ❏ How will the equipment be maintained?
> ❏ What training will be needed by the users?
> ❏ Are the proposed facilities adequate for the equipment? (Remember, eg, that copy stands tend to be tall (up to 1.8m) and need a strong, solid, sturdy base; X-ray and other radiation-producing equipment needs shielding.)

5.3   Preparing (meta)data capture tools

(Meta)data capture tools are needed to capture the:

• metadata associated with the digital asset and its physical analogue—section 5.3.1 (p56)

• data created through transcription or databasing—section 5.3.2 (p56).

Whatever the task, systems need to be developed to relate the new metadata and data to existing data bases and data sets.

5.3.1   Metadata tools

Metadata requirements should be defined as proposed in section 4.5.5 (p48). Tools are needed to capture this metadata and pass it to the various information systems that will use it, eg the collection management system (CMS) or a digital asset management system (DAMS). Or the metadata may be directly entered into these systems.

Some tools acquired or developed under section 5.2 (p54) will be able to capture part of the metadata, eg Photoshop can embed a range of metadata. Many digitisation tools also embed metadata in the digital objects they create, eg digital cameras embed exposure details. The Atlas can provide a spreadsheet for capturing image metadata to be used in Morphbank.

5.3.2   Data tools

Data recording tools will be needed depending on what data is to be captured and how it will be captured.

At one extreme, transcription of specimen labels or field notebooks may be done over the internet using volunteers and 'crowdsourcing' (see section 8, p72). Such approaches require extensive software development and maintenance along with careful management. At the other extreme, labels or specimen registers may be transcribed directly into a CMS. Somewhere in the middle is the use of a word processor to transcribe field notebooks before the transcribed notebooks are published.

Recommended practices

Use existing tools rather than build new ones, especially when those tools are designed around metadata and data standards.

Automate tools as much as possible to minimise user error.

> *Key questions*
> ❏ What metadata and data needs to be captured?
> ❏ What standards are to be used?
> ❏ Where does metadata need to be lodged?
> ❏ What tools or systems exist that should be used?
> ❏ What additional tools are needed?
> ❏ Who will develop/acquire the additional tools?
> ❏ How will they be maintained?
> ❏ Who will use them?
> ❏ How will they be used?
> ❏ What training will be needed by the tool users?
> ❏ How will the tools be integrated with other information systems and data stores?
> ❏ If an intermediate (meta)data store is used, how will the data be moved into the ultimate data store?
> ❏ What are the implications for data storage?

5.4   Preparing data storage

Three types of data store may need to be prepared:

• local

• archive

• operational.

Local stores are short-term stores used to hold the digital assets when they are first created, are awaiting post-processing or are being post-processed. They are usually associated with particular digitisation or (meta)data equipment and may not be on the institutional network, eg a tethered camera, a memory card in a digital tape recorder, a workstation for capturing transcriptions. Preparation of these stores is usually straightforward and done as part of setting up the digitisation equipment.

Archive stores may be in the nature of a recordkeeping information system and are used to hold the archive version of a digital asset. Such systems should assure the long-term preservation, accessibility and availability of digital assets. Preparing archival storage is best left to IT departments, though they do need to know any specific user requirements, such as back up and media and file format migration.

Operational stores are the databases, file shares, collection management systems (CMS) and the like used each day to store, retrieve, share, manage and generally maintain the master and operational versions of digital assets. Again. preparation is best done by the IT department in accordance with user requirements.

Digital asset management systems (DAMS), eg FotoWare, usually provide both operational and archive storage.

Institutional information management policy and practices may provide the business rules for these data stores, especially archive and operational stores, and their management and maintenance.

In addition to physically obtaining and setting up these stores, supplementary software may be needed, eg to check checksums, convert file formats or backup data.

Recommended practices

Ensure data stores are capable of handling all the types and quantities of digital assets expected to be produced: audio, video, still digital images, scanned documents, multimedia.

When determining the needs for storage, remember that, from the users' perspective, the database technology used is less important than the user interface employed to access and manage the digital assets.

Ensure all data stores are regularly backed up with the backup regime validated.

Do not use DVDs as an archival store; their longevity is doubtful and they have relatively poor capability. Use hard disks: internal, external, stand alone, network attached, fixed or portable as appropriate.

Consult the IT department when designing data stores and ensure the stores are supported by the institution.

> **Key questions**
> ❏ Should digital assets be held in a CMS or a DAMS?
> ❏ How will digital assets in a DAMS be linked with associated records held in a CMS?
> ❏ How will the assets move from one store to another, eg local to archive?
> ❏ What is an appropriate storage technology for each store: consumer grade network attached store, external hard disk, enterprise RAID, other?
> ❏ Which stores need to be networked?
> ❏ Who should have access to each store?
> ❏ What constraints apply, eg network bandwidth, no archive capability?
> ❏ How much storage of all types is likely to be needed for the project and into the future? Remember that backups require storage as well, possibly in excess of five times that of the primary stores, depending on the backup and archiving regimes used.
> ❏ What backup arrangements are in place? Are they adequate?
> ❏ How does each store integrate with other data stores and information systems, eg the operational store may also be used to publish images on the internet?

5.5   Preparing quality assurance tools

Quality assurance (QA) tools are used to ensure the quality and integrity of digital assets. Some tools will be automatic and computer-based while others will be manual and used by those doing the digitisation or using the digital asset.

Choice and application of QA tools is determined by the data quality regime developed as part of the digitisation framework (section 4.5.3, p45).

An important QA tool is user feedback.

Recommended practices

Establish a mechanism for users of digital assets to comment on the quality of the assets they use.

Automate tools as much as possible.

Use Atlas provided tools wherever possible.

Key questions
- ❏ Who is responsible for QA?
- ❏ How can the quality regime be operationalised?
- ❏ Who will develop/acquire the tools?
- ❏ How will they be maintained?
- ❏ Who will use them?
- ❏ How will the tools be integrated with the CMS and other data stores?
- ❏ What training will be needed by the tool users?
- ❏ How is user feedback dealt with?

5.6 Preparing sharing tools

Data sharing arrangements are detailed in the data sharing plan (section 4.6, p49) and are tightly linked with the metadata needed to facilitate sharing (sections 4.5.5, p48 and 5.3, p56).

In the main, data sharing tools will be used by the IT and informatics departments and these organisations should be responsible for their definition, acquisition and implementation, based on the data sharing plan and supplementary user needs analyses.

Recommended practices

Automate sharing as much as possible.

Use sharing tools developed by the Atlas or GBIF wherever possible.

Key questions
- ❏ What digital assets will be shared? With whom?
- ❏ How will the digital assets be shared?
- ❏ Who will develop/acquire the tools?
- ❏ How will they be maintained?
- ❏ Who will use them?
- ❏ How will the tools be integrated with the CMS and other data stores?
- ❏ What training will be needed by the tool users?

5.7 Preparing exploitation tools

Plans for data exploitation were developed in section 4.6 (p49) and tools are required to implement these plans.

Recommended practices

Use existing tools where possible though new or upgraded tools are likely to be needed.

> *Key questions*
> ❏ What assets are to be exploited?
> ❏ How are they to be exploited?
> ❏ What new data will be produced?
> ❏ How will the new data be captured and managed?
> ❏ Who will use these tools?
> ❏ How will the tools be integrated with the CMS and other data stores?
> ❏ What training will be needed by the tool users?

5.8 Recruiting and training staff/volunteers

Effective and efficient digitisation requires skilled people along with the correct equipment. Depending on the nature of the digitisation project, volunteers and/or other specialists will be needed and used in different ways and for different tasks.

Volunteers can be recruited directly or engaged through crowdsourcing over the internet, eg as in the Atlas's volunteer portal (volunteer.ala.org.au/). Directly recruited volunteers should receive some training in handling objects and artefacts, using the digitisation equipment and other tools that are part of the project. Volunteer engagement through crowdsourcing cannot provide individual training unless that training is also delivered over the internet.

Recommended practices

Use crowdsourced volunteers strategically and carefully manage them (see section 8, p72).

As necessary to improve digitisation maturity (section 2.5, p16), recruit specialists in different aspects of digitisation, digital preservation and management of digital collections.

Give volunteers interesting tasks, with the work arranged inefficiently if necessary to allow them to remain interested. 'Whole jobs' are best.

Develop training materials for volunteers. For example:

• *A Guide to Handling and Digitising Archival Material: 1. Registers* (Reference 3)

• *Digitisation Volunteer Handbook* (Reference 2)

> **Key questions**
> ❏ What (additional) people are needed for the project?
> ❏ What skills are needed?
> ❏ Should volunteers be used? Online? Within the institution?
> ❏ How will they be recruited?
> ❏ How will they be managed and supported?
> ❏ How will they be trained?
> ❏ What training material is needed?

5.9 Developing procedures

All the work thus far becomes consolidated and documented in procedures, work practices and workflows and these become the basis of training for those involved with digitisation.

Recommended practices

Have at least draft versions of procedures available before engaging volunteers/staff to conduct digitisation. Suggested topics for procedures are listed in section 14 (p85).

Consider producing multimedia demonstrations as well as, or instead of, written procedures.

Trial all procedures to ensure they work before finalising them.

Review and update procedures from time to time.

Examples of procedures:

• *A Guide to Handling and Digitising Archival Material: 1. Registers* (Reference 3)

• *Digitisation Volunteer Handbook* (Reference 2)

• *A Guide to Handling and Digitising Specimens* (Reference 4)

• *Digitisation Project 2011 Procedures Manual* (Reference 31)

• *Digitisation Project 2011 Procedures Manual Supplement: Macrophotography* (Reference 32)

• *Digitisation Project 2011 Procedures Manual Supplement: Post Processing Images (Photoshop)* (Reference 33)

Key questions

❏ What procedures are required?

❏ How are they best presented?

❏ Who should prepare them?

❏ How will they be trialled?

❏ What training is required to support them?

❏ How often should they be revised?

❏ Who will approve them?

Part 3
ANNEXES

6 Annex: Digitisation Maturity Model

Table 1 (p68) lists the characteristics of each of the six maturity levels for each of the six core digitisation activities.

An institution's digitisation maturity is assessed by identifying (from the table) the level of maturity that best characterises the institution's behaviour in each core activity. It is likely that an institution will have different levels of maturity for each activity so that a single maturity level cannot be determined.

Where the disparity in maturity across activities is large, an institution should focus on improving its performance (maturity) against the least mature activity. Small disparities may or may not require attention, depending on factors such as the:

- desired level of maturity—it is not necessary for an institution to achieve any particular level of maturity; maturity is strategic decision

- core activities involved—being discrepant in one or two areas may have little adverse impact on digitisation.

Improving maturity involves adopting the behaviour of the next level.

Recommended practices

If possible, focus on improving governance as an effective governance regime can drive improvements in the other activities.

Consider including maturity improvements in digitisation strategies and plans.

Treat maturity as if it were just another institutional function and manage it accordingly.

Key questions
- ❏ What level of maturity is appropriate for your institution?
- ❏ How will the next level of maturity be achieved?

Table 1 Digitisation maturity characteristics

Level	Core activity					
	Making digital	**Databasing**	**Managing data**	**Sharing data**	**Using technology**	**Governing digitisation**
0 *Disorganised*	• Inconsistent practices by individuals • Conversion is part of normal business	Individuals may have maintain their own databases	• Reliance on paper ledgers • Individuals manage their own data	Limited and ad hoc sharing of personal data as requested by others or as needed by an individual	• Use whatever technology is at hand	• Physical objects managed • Little or no overall governance
1 *Making do*	• Consistent practices by individuals • Conversion is part of normal business	• Paper ledgers are undigitised and sometimes used • Individuals do own databasing • Incomplete coverage of physical collection(s) • No processes for databasing	• Wide use of file shares and personal stores for storing digital assets • Limited backup	• Wide ad hoc sharing of personal data based on personal relationships • Value of sharing poorly appreciated • Restrictive licences applied to shared data	• Each person choses their own technology • Personal technology used to supplement institutionally provided • Inadequate equipment used to just 'get it done' • Technology duplicated throughout the institution • Much technology unused	• No recognition of strategic role of digitisation • No policies and procedures in place

Level	Core activity					
	Making digital	**Databasing**	**Managing data**	**Sharing data**	**Using technology**	**Governing digitisation**
2 *Coming along nicely* Focus on establishing basic discipline	• Standardised digital formats used • Some conversion processes formally established and documented	• Central database (CMS) used for new acquisitions • Central database (CMS) includes links to related digital assets • Databasing embedded in business-as-usual for new acquisitions • Controlled vocabularies and metadata schemas in use	• Central database (CMS) established • Plans in place to migrate personal databases into central database • Assets on file shares being migrated into central storage • Central repository for front-of-house images	• Manual sharing of selected data with selected organisations from central database (CMS) • Limited ad hoc sharing of personal data • Some creative commons licensing of data	• Standards compliance part of selection criteria for new technology • Technology acquired at departmental level • Training in use of technology widely available	• Executive support for strategic approach • Digital collection/ digitisation manager oversees digitisation • Information management plan in place • Digitisation strategy in place • Procedures in place for common digitisation activities and technologies
3 *Organised* Focus on identifying and building key competencies	• Qualified conversion expertise available in-house • Training programs in place for converters	• Digital asset management system used for all digital assets • Initial crowdsourcing activities to populate	• Personal databases being migrated into central database (CMS) • Digital asset management system in place	• Automated sharing of a broad range of data from central database (CMS) • Most data shared under creative commons licences	• Coordination of purchases across the institution • Selective use of bleeding edge technologies • Sharing of experiences in	• Procedures usually followed • Digital collection/ digitisation manager as senior manager • Digital collection valued

Level	Core activity					
	Making digital	**Databasing**	**Managing data**	**Sharing data**	**Using technology**	**Governing digitisation**
		databases	for all digital assets • Data management planned into the future around anticipated needs		using technologies widespread	• Digitisation projects firmly established
4 *Under control* Measurement	• All conversion processes documented • All converter staff suitably trained • Quality control regime in place • Regular reviews of activities	• Data quality regime in place • Automated processes to capture metadata	• Data quality measures in place • Data custodians appointed within departments • Databases and data sets integrated	• Metrics on sharing collected • Use of shared data understood and monitored	• Use of technology monitored • Technology budget established	• Compliance with procedures monitored through quality regime • Digitisation strategy and policy regularly reviewed
5 *On the look out* Continuous improvement	Converters actively seeking better ways to do conversions	Databasers actively seeking better ways to do databasing	Digitised data managed as a strategic asset	New opportunities sought for sharing	Regular technology reviews to identify potentially useful new technologies	• Individuals propose changes to procedures and governance regime • Support and IT systems optimised to support work practices

7 Annex: Suggested duties for a digital collections manager

Duties

The digital collections manager will:

- manage the collection(s) of digital assets

- develop and maintain the governance regime for digitisation, including the digitisation strategy and policy, the digital collection development plan, the data quality regime (as it relates to digital assets), the data sharing plan (for digital assets), the data exploitation plan and the technology management plan

- establish digitisation projects to meet the objectives of the digitisation strategy

- oversee digitisation activities and digitisation projects

- participate in acquisitions of technology solutions for digitisation to ensure the proposed solutions are consistent with digitisation standards and the digitisation strategy

- liaise with the IT department to ensure the long-term viability, accessibility and availability of digital assets; advise on storage and access needs for digital assets

- monitor developments in digitisation and initiate projects to capitalise on applicable developments

- develop and lead activities intended to improve the digitisation maturity of the institution, including refinement of digitisation work processes and adoption of new technologies

- develop and maintain a program of work to improve digitisation

- consult with other collection managers, curators and researchers on digitisation issues relevant to their activities.

Experience

Ideally the digital collections manager will be experienced in all aspects of digitisation and the management of digital assets. Some understanding natural history collections or biodiversity would be beneficial.

> ### Key questions
> ❑ Who of the existing staff is best placed to assume the role of digital collections manager, if a new position cannot be created?
> ❑ Does the digital collections manager position need to be full-time?

8 Annex: On using volunteers

During 2011 the South Australian Museum (SAMA) and Australian Museum (AM) worked with teams of volunteers to digitise portions of their insect collections. Projects were intended to:

- increase the institution's understanding of the issues involved in using volunteers in digitisation projects

- digitise type specimens (SAMA), and image specimens and their labels (AM) for transcription on the Atlas's volunteer portal (volunteer.ala.org.au).

Both projects demonstrated the value of using volunteers in *Just do it!* digitisation projects. In particular:

- in SAMA, 15 volunteers captured about 2200 high resolution, focus stacked, post-processed images and created around 500 new database records in about 1200 hours

- in AM, 50 volunteers photographed 20 528 specimens and their labels in around 1972 hours.

> *With the assistance of the Atlas of Living Australia (ALA) and coordinated by the Council of Heads of Australian Fauna Collections (CHAFC), the Australian Museum (AM) and South Australian Museum (SAMA) have been developing rapid digitisation programs that utilise the services of volunteers under the supervision of dedicated project coordinators. These projects have allowed the two museums to develop and test complimentary programs that explore rapid digitisation methodologies from individual holotypes to bulk processing of whole drawers of terrestrial invertebrate specimens. Both museums have developed procedures, policies and documentation covering volunteer recruitment and training, imaging techniques and processes, data capture and quality assurance as well as ongoing assessments of imaging equipment, real-time use and fitness for purpose. [These are available on each institution's website.]...*
>
> *The knowledge and experience gathered through these projects has proven invaluable for planning future digitisation activities and will inform digital imaging strategies well into the future...*
>
> *The development and implementation of volunteer based rapid digitisation programs at AM and SAMA have proven to be enormously successful not only in terms of enhanced data capture but also in informing future implementation strategies for the collections sector. Critical to the success of these programs has been the development and deployment of sound methodologies against agreed standards under the supervision of dedicated project coordinators.*
>
> —Rapid Digitisation Project: Final Report covering letter, 2011

Tips and observations

Volunteer coordinators are essential. Induction, training, regular feedback and ongoing support are integral to maintaining high-performing volunteers.

Be careful not to underestimate the time required to prepare and supply material for volunteers to digitise. Curation and management of the movement of specimens must be done by staff and these inputs increase with the productivity of the volunteers. These projects could be scaled down— while these organisations have a team of volunteers working four or five days per week, a single day of volunteers working on a single workstation will help us chip away at the backlog of digitisation. Good preparation helps the volunteers' work integrate with the museum—ensure that data is created in a way that can be incorporated into existing collection management systems; ensure that IT staff are prepared to store, manage and back up large numbers of digital images.

Good preparation also helps develop a repeatable procedure that a volunteer can be trained in, and their performance can be monitored. It also helps make sure that the images are consistent.

The most successful and useful volunteers were those that were digitally confident. If a good procedure has been designed, they can be taught specimen handling, photography techniques and databasing, but were quicker to pick these things up if confident in the use of computers.

Volunteers work best when well supported, which means regularly expressing appreciation for their work, but also providing feedback and critique of their work when required. Most volunteers want to learn something from their experience at the museum, and providing feedback that will help them improve their work is an essential part of that process.

—Alexis Tindall, Digitisation Project Manager, South Australian Museum

9 Annex: Suggested background information to be collected

Consider collecting the following information to better understand the nature and context of the collection and your institution:

Documents

- collection strategy/policy
- information management policy
- data management plans, policies etc
- quality assurance arrangements
- digitisation procedures (formal or informal) used
- digitisation standards used
- metadata standards used
- other digitisation-related matters

Details of current digitisation activities

- what is being done (digitisation as normal business and as projects)
- who is involved
- roles and responsibilities
- objectives of digitisation activities

Details of digitisation technologies used

- technologies used
- users
- management arrangements
- capabilities
- standards used, including metadata schema
- their condition

Details of current digital assets

- numbers
- types (*see* Box 2, p21)
- storage arrangements
- storage space (in bytes)
- ownership and control arrangements
- management arrangements
- users and uses (*see also* section 4.2, p38)
- who digitised them
- their condition

- expertise in digitisation available within the institution

- sharing arrangements

- information systems (or databases) used to access, manage and share the assets

Details of objects in the collection

- categories of objects (*see* Box 3, p21)

- number in each category

- number (proportion) digitised as images and/or registered in a database

- storage arrangements

- condition of objects

- management and control arrangements

- special characteristics of objects, eg national significance, type specimens

- for specimens, numbers

  – of each type

  – described

  – undescribed

  – databased

  – not databased

  – imaged

  – not imaged

Other information

- user feedback on digitisation and digital assets, eg through institution web site, management statements

- potential standards for metadata, digitisation etc

- anything else relevant to digitisation

10 Annex: Digitisation working group terms of reference

When planning or reviewing digitisation activities, the digital collections manager should be supported by a digitisation working group (DWG). The group may operate formally or relatively informally, as appropriate to the culture of the institution.

Terms of reference

The digitisation working group will:

- advise the digital collections manager on digitisation matters

- assist the digital collections manager develop the digitisation management framework

- conduct research into digitisation matters as agreed with the digital collections manager

- consult stakeholders in relation to digitisation matters

- develop and maintain an annual work plan supporting its activities.

Membership

The DWG consists of, at least:

- the digital collections manager (Chair)

- a representative curator or collection manager—to ensure the needs and experience of other collection managers and curators are considered

- a digital imaging expert[*], eg in-house photographer, external adviser—to provide expert imaging advice and guidance

- a representative researcher—to ensure the needs and experience of researchers are considered

- at least one (technical) person who does digitisation—to ensure the needs and experience of those doing the digitisation are considered.

Other institution staff should be members as necessary.

---

[*] Given that most natural history collecting institutions have extensive support from IT departments but more limited digital imaging capability, providing expertise in digital imaging is likely to be more valuable than focusing on databasing. Where non-imaging conversions are extensive, consider including an expert in those areas also.

Key questions

❏ Who should be on the working group?

❏ How will the group operate?

❏ What will be its initial focus?

❏ How will the group facilitate development of the digitisation management framework?

❏ How will digitisation expertise be provided?

11 Annex: Digitisation standards

Table 2 (p78) lists the preferred standards to be used when creating digital assets. They reflect the digitisation principles given in Box 1 (p15) and may be modified to take account of the:

- use of a digital object, eg digitising a specimen label to be used in transcribing the label could be done using a .jpg format image with 8 bit resolution with a file size of less than 1MB

- digitisation technology used, eg CT scanners, microscope imagers and digital X-ray machines often use proprietary formats and resolutions that are difficult to vary.

Integral to these standards is the concept of creating a number of versions of a digital asset:

- an archive version—the 'true' version of the asset from which all derivatives are made. This version is stored and managed for long-term preservation and access and access is tightly controlled

- a master version—a copy of the archive version widely accessible for creating derivative version

- operational versions—derivatives of the master version for use in particular roles, eg publishing, viewing online, sharing.

Many digital asset management systems provide functionality to manage an archive and master version as the same file and can generate derivatives on demand or automatically.

Table 2 Preferred digitisation standards[*]

Object	Feature	Original capture	Archive/master	Operational
Audio	Format	Device dependent	BWF	.mp3
	Resolution	Highest practical	• 96 kHz, 24 bit • 48 kHZ, 24 bit from low quality tapes	44.1 kHz, 16 bit
Video	Format	Device dependent	• .mxf or .601 or YUV • Soundtrack as .wav	• .MXF for data exchange • MPEG-2 for broadcast • MPEG-1 or MPEG-4 for online delivery
	Resolution	Highest practical	Uncompressed or original format	• MPEG-2 @50 Mbs/s i-frame to

---

[*] Standards are based on those given in Reference 17, p 7 and Reference 24.

Object	Feature	Original capture	Archive/master	Operational
				5 Mb/s long GOP for broadcast
				• MPEG-1/4 @ 1.8kb/s to 500 kb/s for online delivery
Colour reflective documents, including: • coloured maps • sepia or coloured photographic prints • manuscripts • field notes	Format	RAW	• Uncompressed RGB .tif • Colour corrected • Post-processed	JPEG with suitable compression
	Resolution (spatial^ and tonal)	• Highest possible • RGB	• 24 bit • Larger than A5: 300 ppi • Smaller than A5 but larger than A6: 600 ppi • Smaller than A6: 1200 ppi	Not less than 72 dpi, but dependent on intended use
Specimens—fauna	Format	RAW or device native	• Uncompressed RGB .tif • Colour corrected • Post-processed	.jpg with compression suitable to intended use
	Resolution (spatial and tonal)	• Highest possible • RGB	• Not less than 8 bit; preferably 24 bit • Highest possible number of pixels	Not less than 72 dpi, but dependent on intended use
Specimens—flora with Herbscan	Format	RAW or device native	• Uncompressed .tif • Colour corrected • Post-processed	.jpg with compression suitable to intended use
	Resolution (spatial and tonal)	• Highest possible • RGB	• 24 bit • 600 ppi	Not less than 72 dpi, but dependent on intended use
Specimens—flora non-Herbscan	Format	RAW or device native	• Uncompressed .tif • Colour corrected • Post-processed	.jpg with compression suitable to intended use

---

^ Spatial resolution is optical, not interpolated.

Object	Feature	Original capture	Archive/master	Operational
	Resolution (spatial and tonal)	• Highest possible RGB	• 24 bit • 600 ppi	Not less than 72 dpi, but dependent on intended use
Colour transparencies (all sizes)—the image area	Format	RAW	• Uncompressed RGB .tif • Colour corrected	.jpg with compression suitable to intended use
	Resolution (spatial and tonal)	• Highest possible • RGB	• 48 bit • 2000 ppi	Not less than 72 dpi, but dependent on intended use
Colour transparencies (all sizes)—the mount (to capture metadata on the mount); similarly for transparencies in storage sheets	Format	.jpg	Low compression JPEG	.jpg with compression suitable to intended use
	Resolution (spatial and tonal)	Highest possible	• 24 bit • Largest possible pixels	Not less than 72 dpi, but dependent on intended use
Colour negatives (all sizes)	Format	RAW	• Uncompressed RGB .tif • Colour corrected	.jpg with compression suitable to intended use
	Resolution (spatial and tonal)	• Highest possible • RGB	• 48 bit • 2000 ppi	Not less than 72 dpi, but dependent on intended use
B&W reflective formats, including: • photographic prints • black and white line art • black and white maps • field notes	Format	RAW	• Uncompressed RGB .tif • Colour corrected • Post-processed	.jpg with compression suitable to intended use
	Resolution (spatial and tonal)	• Highest possible • RGB	• 24 bit • Larger than A5: 300 ppi • Smaller than A5 but larger than A6: 600 ppi • Smaller than A6: 1200 ppi	Not less than 72 dpi, but dependent on intended use
B&W negatives—35mm	Format	RAW	• Uncompressed greyscale .tif • Positive image	• .jpg with compression suitable to

Object	Feature	Original capture	Archive/master	Operational
			• Colour corrected • Post-processed	intended use • Positive image
	Resolution (spatial and tonal)	• Highest possible • Grayscale	• 16 bit • 3000 ppi	Not less than 72 dpi, but dependent on intended use
B&W negatives—larger than 35mm	Format	RAW	• Uncompressed greyscale .tif • Positive image • Colour corrected • Post-processed	• .jpg with compression suitable to intended use • Positive image
	Resolution (spatial and tonal)	• Highest possible • Grayscale	• 16 bit • 2000 ppi	Not less than 72 dpi, but dependent on intended use
Print publications—non-BHL (Biodiversity Heritage Library)	Format	RAW	• Uncompressed greyscale .tif • Positive image • Colour corrected Post-processed	• .jpg with compression suitable to intended use • Positive image
	Resolution (spatial and tonal)	• Highest possible • RGB	• 24 bit • 300 ppi @ 100%	Not less than 72 dpi, but dependent on intended use

12 Annex: Digitisation resources to be funded

Resources for a digitisation project that may need to be funded or purchased include:

- project management, eg project manager, volunteer coordinator
- expertise to assist in digitisation activities
- labour to perform the digitisation, eg imaging, transcription, databasing
- activities to recruit and induct volunteers and other staff, eg advertising, interviewing
- facilities to support volunteers and staff, eg lunch room, coffee
- software and hardware—commercial, open source and bespoke, eg digital asset management system, focus stacker, audio editing, checksum allocation and validation, file format converters
- digitisation equipment, eg cameras, scanners, audio mixers and other audio equipment, video editing decks, microscopes, lights, colour patches, copy stands, calibration equipment, magnification scales, logos to appear in images, CT scanners, X-ray machines
- storage for digital assets, eg hard disks attached to digitisation work stations, corporate RAID storage
- training (staff and volunteers)
- documentation, eg training materials, digitisation procedures, equipment manuals
- fit-out or establishment of facilities, eg rooms, lighting, cabling, furniture, shelves
- transport and handling equipment for objects to be digitised
- resources to select, retrieve, move and return objects to be digitised, eg curator time, fumigation
- equipment repair, maintenance and replacement
- communications, eg web site content, newsletters
- miscellaneous items for handling specimens, eg gloves, labels, pins, pin boards, forceps, unit trays
- miscellaneous costs, eg electricity, cleaning

Key questions

❏ What resources are needed for the project?
❏ Which of these already exist or can be repurposed for the project?
❏ Which are available at no cost to the project?

---

13 Annex: Terms of reference for a digitisation project manager*

Responsibilities

The Digitisation Project Manager will report to the Digital Collections Manager and be responsible for:

- establishing and managing a digitisation project

- recruiting, training and managing onsite volunteers and other staff associated with the project

- establishing the digitisation capability including acquiring, setting up and maintaining the digitising equipment and databases

- liaising with collection staff

- assuring the quality of the digitised output

- monitoring and reviewing digitisation practices and procedures.

Selection criteria

- Understanding of, or experience in, working with natural history collections.

- Ability to prioritise work, work with minimal supervision and supervise others.

- Experience in digitisation.

- Experience in managing small projects and managing staff and volunteers.

- Confidence in using a computer and, in particular, Microsoft Office, Adobe Photoshop and other digitisation-related software.

Skills and knowledge

- Ability to prioritise workloads, work with minimal supervision and supervise others.

- Familiarity with the operation of digital SLR cameras, other photographic equipment and audio analogue to conversion tools and techniques.

- Ability to critically evaluate work practices and procedures.

- Commitment to a collaborative team approach.

- Excellent interpersonal and communication skills.

- Experience in the use of collection management systems.

- Experience in the use of digital asset management systems.

- Ability to work with a broad range of people, and demonstrate respectful, inclusive and culturally sensitive behaviour.

- Experience in supervising and coordinating volunteers.

Daily tasks

- Ensure digitising equipment is set up and operating effectively.

---

*These terms of reference are a combination of those used by the Australian Museum and South Australian Museum for their project managers for the rapid digitisation project.

- Maintain photographic and computer equipment.

- Assess the quality of work and initiate remedial action as needed.

- Develop work timetables/schedules, considering the particular skill-set available and the needs of tasks set by collections staff.

- Work with collections staff to ensure there is a continuous stream of work available for digitisation.

- Provide technical assistance to volunteers/staff when needed.

- Provide inductions for new volunteers/staff.

- Supervise volunteers/staff and ensure their safety and wellbeing.

- Maintain daily diaries and log books.

- Communicate timetables/schedules to volunteers/staff.

Other tasks

- Report to the Digital Collections Manager on progress and other issues.

- Monitor staffing levels and recruit volunteers/staff when required.

- Communicate the project to institutional staff and the wider community.

- Work with collections staff to devise realistic digitisation goals and monitor and evaluate achievement of those goals.

- Assist in and provide training to volunteers/staff.

- Implement improvements to digitisation procedures and practices.

- Manage and respond to all enquiries relating to the project (both internal and external).

- Create a workplace that supports the needs of volunteers/staff.

14 Annex: Suggested procedures

Suggested procedures that may need to be developed to support digitisation include:

- recruiting volunteers

- inducting volunteers

- training volunteers

- training other staff

- using particular pieces of equipment

- post-processing digital assets

- handling specimens and objects

- maintaining equipment

- entering data in databases

- checking the quality of digital assets

- performing different types of digitisation, eg digitising photographic slides, imaging insects, converting audio files

- managing archive, master and operational versions of digital assets.

15 Annex: Bibliography
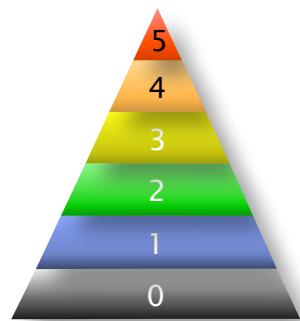
1. Australian Institute of Aboriginal and Torres Strait Islander Studies. *Audiovisual Archive Collection Management Policy Manual.* Canberra 2009 [updated 17 March; cited 18 July 2011]; http://www.aiatsis.gov.au/ava/docs/AVAPolicyManual2009.pdf.

2. Australian Museum. *Digitisation Volunteer Handbook.* 2011.

3. ---. *A Guide to Handling and Digitising Archival Material: 1. Registers.* 2011.

4. ---. *A Guide to Handling and Digitising Specimens.* 2011.

5. ---. *Rapid digitisation project: Final report.* Sydney 2011.

6. Australian Tax Office. *Information Management Strategic Framework.* Canberra 2004 [cited 26 July 2011]; http://www.ato.gov.au/download.asp?file=/content/downloads/cor48331nat11852.pdf.

7. British Columbia Ministry of Finance. *Information Management and Information Technology Management.* No date [cited 26 July 2011]; http://www.fin.gov.bc.ca/ocg/fmb/manuals/CPM/12_Info_Mgmt_and_Info_Tech.htm - 1221.

8. Canadian Heritage Information Network. *Checklist for Creating a Preservation Policy.* No date [cited 29 July 2011]; http://www.pro.rcip-chin.gc.ca/contenu_numerique-digital_content/preservation_numerique-digital_preservation/annexeA-appendixA-eng.jsp.

9. Canadian Heritage Information Network (CHIN). *Canadian Heritage Information Network.* 2011 [cited 3 August 2011]; http://www.rcip-chin.gc.ca/index-eng.jsp.

10. Clarke R, Higgs, P. *Economic Benefits from Cultural Assets.* 2003 [updated 19 June; cited 18 July 2011]; http://pandora.nla.gov.au/pan/21007/20100630-0906/www.culture.gov.au/cics/benefits.pdf.

11. Collections Trust. *Collections Link.* 2011 [cited 3 August 2011]; http://collectionslink.org.uk/.

12. ---. *Collections Trust.* 2011 [cited 3 August 2011]; http://www.collectionstrust.org.uk/.

13. Consultative Committee for Space Data Systems. *Reference Model for an Open Archival Information System (OAIS).* 2002 [cited 26 July 2011]; http://public.ccsds.org/publications/archive/650x0b1.PDF.

14. Council of Heads of Australian Faunal Collections. *Rapid digitisation project: Final report covering letter.* 2011.

15. CURL Exemplars in Digital ARchiveS. *Cedars Guide to Digital Collection Management.* 2002 [updated March; cited 29 July 2011]; http://www.webarchive.org.uk/wayback/archive/20050410120000/http://www.leeds.ac.uk/cedars/guideto/collmanagement/index.html.

16. Geser G. 6.5. *Technology Watch Report. STERNA (Semantic Web-based Thematic European Reference Network Application);* 2008 [updated 26 November; cited 3 August 2011]; http://www.sterna-net.eu/images/stories/documents/sterna_del.6.5_technology-watch_full-report_20081210.pdf.

17. Global Biodiversity Information Facility. *GBIF Training Manual 1: Digitisation of Natural History Collections Data.* 2008 [cited 18 July 2011]; http://www.gbif.org/communications/resources/print-and-online-resources/online-publications/gbif-training-manual-1-digitisation-of-natural-history-collections-data/.

18. Hauser CL, Steiner A, Holstein J, Scoble MJ, editors. *Digital Imaging of Biological Type Specimens. A Manual of Best Practice. Results from a study of the European Network for Biodiversity Information.* Stuttgart: Staatliches Museum für Naturkunde; 2005.

19. Information Management Office. *Digitisation of Records Better Practice Checklist 18.* 2004 [cited 13 July 2011]; http://www.finance.gov.au/e-government/better-practice-and-collaboration/better-practice-checklists/docs/BPC18.pdf.

20. International Association of Sound and Audiovisual Archives. *IASA-TC 03 The Safeguarding of the Audio Heritage: Ethics, Principles and Preservation Strategy.* 2005 [cited 3 August 2011]; http://www.iasa-web.org/IASA_TC03/TC03_English.pdf.

21. JISC. *Digitisation Strategy.* 2008 [updated February; cited 15 July 2011]; http://www.jisc.ac.uk/media/documents/programmes/digitisation/jisc_digitisation_strategy_2008.doc.

22. National Film and Sound Archive. *Cross Media Preservation Plan 2010/11–2012/13 Summary Paper.* 2010 [cited 18 July 2011]; http://nfsa.gov.au/site_media/uploads/file/2011/05/04/Cross-Media-Preservation-Plan.pdf.

23. National Library of Australia. *DOHM: Digitisation of Heritage Materials.* Canberra2007 [cited 11 July 2011]; http://www.nla.gov.au/preserve/dohm/material/DOHM.pdf.

24. ---. *Collection Development Policy.* 2008 [updated December; cited 18 July 2011]; http://www.nla.gov.au/policy/cdp/CDP.pdf.

25. ---. *Collection Digitisation Policy.* No date #1 [cited 12 July 2011]; http://www.nla.gov.au/policy-and-planning/collection-digitisation-policy.

26. ---. *Image Capture Standards.* No date #2 [cited 18 July 2011]; http://www.nla.gov.au/standards/image-capture.

27. National Museum of Australia. *Digital Preservation and Digitisation Policy, POL-C-028.* 2009 [updated 20 August; cited 28 July 2011]; http://www.nma.gov.au/about_us/nma_corporate_documents/policies/.

28. NISO. *A Framework of Guidance for Building Good Digital Collections.* 2007 [updated December; cited 18 July 2011]; http://www.niso.org/publications/rp/framework3.pdf.

29. NSW Department of Finance and Services. *Guide to the Information Asset Management Assessment Tool.* 2011 [updated 30 June; cited 26 July 2011]; http://services.nsw.gov.au/sites/default/files/IAMS Guide 2011_0.pdf.

30. Office of the Australian Information Commissioner. *Principles on open public sector information: Report on review and development of principles (May 2011).* 2011 [cited 26 July 2011]; http://www.oaic.gov.au/infopolicy-portal/reports_infopolicy.html.

31. Poole N. *Position Paper: Managing the Digitisation Supply Chain.* 2010 [updated 20 September; cited 18 July 2011]; http://www.collectionslink.org.uk/index.cfm?ct=assets.assetDisplay/title/Digital Content Supply Chain Model/assetId/504/fileDownload/true.

32. Smithsonian Institution. *Creating a Digital Smithsonian: Digitization Strategic Plan Fiscal Years 2010–2015.* 2010 [cited 15 July 2011]; http://www.si.edu/Content/Pdf/About/2010_SI_Digitization_Plan.pdf.

33. South Australian Museum. *Digitisation Project 2011 Procedures Manual.* 2011 [updated 2 June].

34. ---. *Digitisation Project 2011 Procedures Manual Supplement: Macrophotography.* 2011 [updated 14 June].

35. ---. *Digitisation Project 2011 Procedures Manual Supplement: Post Processing Images (Photoshop).* 2011 [updated 22 June].

37. The Museums, Libraries and Archives Council. *Supporting Long Term Access to Digital Material – Principles Paper.* 2011 [cited 3 August 2011]; http://www.mla.gov.uk/what/programmes/digital/~/media/Files/pdf/2010/programmes/Supp_Long_Term_Access_to_Dig_Mat_Principles.

Digitisation:

What's your maturity?