
Capture Your Collections: A Guide for Managers Who Are Planning and Implementing Digitization Projects

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List of abbreviations

DLT	digital linear tape
PDF/A	Portable Document Format/Archive
SSD	solid state drive

Foreword

Since its inception in 1972, CHIN has sought to ensure that Canadian museums benefit fully from emerging technologies. Nearly fifty years later, maintaining a presence on the Internet is recognized as a core activity by all cultural and heritage institutions. To fully benefit from this medium, institutions must be capable of offering rich content, including high-quality digital images. This publication is designed to guide museum managers through the planning and implementation of a digitization project. It covers issues such as non-digital images, new photography, the exposure and care of objects, copyright and storage.

Smaller museums may benefit from the comparable resource: [Capture Your Collections 2012 – Small Museum Version](#). For additional information, consult the [Digitization](#) section of the CHIN website.

Introduction

What are digital images?

The term “digitization” refers to the creation of a digital object (one existing inside a computer) from a physical object. A digital image is composed of pixels (picture elements), similar to dots on a newspaper photograph or grains on a photographic print, which are arranged according to a predefined ratio of columns and rows. Each pixel represents a portion of the image in a particular colour or shade of grey. A digital image can be edited, manipulated, emailed, deleted or copied and inserted into other files or publications or posted on Internet pages.

Why digitize?

Digital images are used for collections management, in research, to prepare catalogues and to promote exhibits and events. Most importantly, however, is the value of a digitized object that has been placed online in an accessible manner. By placing collections online, audience reach is improved and the inspection of physical objects that are otherwise too fragile becomes possible.

Online collections also serve as powerful teaching aids and research tools, especially when institutions work together to create a critical mass of complementary material.

Digitization can also aid collections management by increasing all staff members' awareness of the content of collections, especially if images are linked to a collections management system that is networked throughout the museum. Moreover, merely selecting objects for digitization gives staff an additional opportunity to establish and record the condition of objects. All of this activity provides an incentive to improve documentation, especially if records and images are to be made public in collaboration with other institutions. The need for standards and enhanced information soon becomes obvious.

Digitization projects should be viewed as a long-term investment. Project planning must account for the time and resources necessary for the physical preparation of materials to be digitized and for the development of appropriate documentation.

The effort and funding devoted to a digitization project will have an impact on resources available for other activities. When budgeting for digitization, the following issues will need to be addressed: the redeployment of human and physical resources, staff training, acquisition and maintenance of new equipment, the preservation of digital objects, the prioritization of what to digitize and the continuation of current projects.

Although digitization is a means of preserving collections, the nature of digital information requires special attention. Digital media can be short-lived if appropriate processes and procedures are not in place. The rapid pace of technological change means that the hardware and software required to read the digital data can become obsolete. Therefore, the digitization project must take into account the ongoing cost of migrating digital data from existing storage devices to new ones. To that end, CHIN has prepared a [Digital Preservation Toolkit](#), which should also be consulted before embarking on any digitization project.

In light of these issues, museums must look to their own mandates, their programs and their priorities in order to determine how they wish to proceed with digitization. Digital technology shows great promise, but it is best viewed as one tool among many. Any digitization project, whether of entire collections or specific parts of them, should reflect the organization's core mission.

Project planning

Before an organization embarks on a digitization project, it should allocate adequate resources, in terms of time and money, for at least the following:

- assessing its needs to decide where digitization is appropriate
- defining the project
- researching technological options
- choosing standards

- developing statements pertaining to requirements
- planning the implementation of the project, including milestones and a timetable
- monitoring, evaluating and adjusting the project, as required

Future requirements should also be considered, so that rapid technological change does not limit future options. Implementing a digitization project in several stages can provide the flexibility to accommodate possible alternatives along the way. The museum should begin with a very clear idea of what digitizing its collection will achieve and how it will further the organization's goals.

Establishing a policy for managing digital assets

Establishing a policy for managing digital assets should be part of the planning process. Just as an organization needs a collections management policy, it should also have a policy on creating and managing digital assets, which form a valuable collection of a new kind.

At a minimum, the policy should include the following:

- copyright and legal policies for staff
- how digital images, once created, will be managed
- how image content and technical information will be documented
- plans for safe storage, conservation and preservation of master images and surrogate images to ensure their longevity
- reference to a preservation policy and plan
- plans for digitizing and documenting new objects

The management policy should be reviewed periodically to determine if adjustments are required.

Defining the audience

Before a single image is digitized, the intended users of the images, both inside and outside the organization, should be determined. Furthermore, they should be involved in the development of the project, if possible.

Identifying potential internal uses will help define the organization's digitization strategies. Ask different members of the organization to define the organization's digital imaging needs. Establish organizational goals for making use of digital images, and identify the departments and staff who need to participate.

The project leader should interview staff members, volunteers and others who will use museum images, asking them about immediate and future uses. Internally, digital images have many uses across an organization (Table 1). Images may link to collections management systems in order to illustrate objects and collection records for loans, insurance and other collections management functions. Or they may be used to document the organization's intellectual property. High-resolution

images may be required for publication purposes or to illustrate newsletters, brochures and postcards. Specialty uses for high-resolution images, such as detailed conservation or analysis, should also be considered. For public access and outreach, images could be added to a website, a museum public access terminal or publications.

These requirements must be known at the outset, because how the images are to be used will determine their quality and the resolution required, which will later affect both the choice of scanning technology and overall system requirements. Although future use determines the choice of quality and resolution, as a general rule, images digitized at the highest resolution possible serve the greatest number of purposes.

Table 1: uses of digital images in different museum activities

Museum activities	Uses of digital images	Type of photo required	Format of digital image on screen	Reproduction of printing of digital image	Quality of reproduction for print
Collections management	<ul style="list-style-type: none"> • identification of object • image in database • acquisitions committee • cultural property application preparation • loans • inventory • donor records • condition reports • permanent archives • web publishing 	<ul style="list-style-type: none"> • inventory • documentary 	<ul style="list-style-type: none"> • small • full-screen 	<ul style="list-style-type: none"> • collection management reports • archival and inventory reports 	<ul style="list-style-type: none"> • high • medium • low
Conservation	<ul style="list-style-type: none"> • research • object analysis • condition report • record of object treatment • electronic transmission for treatment consultation 	<ul style="list-style-type: none"> • inventory • documentary 	<ul style="list-style-type: none"> • large-format 	<ul style="list-style-type: none"> • conservation reports • treatment requests or reports 	<ul style="list-style-type: none"> • high • medium • low

Museum activities	Uses of digital images	Type of photo required	Format of digital image on screen	Reproduction of printing of digital image	Quality of reproduction for print
Research	<ul style="list-style-type: none"> • general and specific research • development of exhibition concepts • structural analysis • research results 	<ul style="list-style-type: none"> • inventory • documentary • professional 	<ul style="list-style-type: none"> • small • full-screen • large-format 	<ul style="list-style-type: none"> • research reports and publications • object lists 	<ul style="list-style-type: none"> • high • medium • low
Education	<ul style="list-style-type: none"> • general and specific research • courses, conferences, colloquia • workshops • presentations • museum kiosk • development of educational goals 	<ul style="list-style-type: none"> • inventory, • documentary • professional 	<ul style="list-style-type: none"> • small • full-screen 	<ul style="list-style-type: none"> • educational publications and brochures • educational multimedia products 	<ul style="list-style-type: none"> • high • medium • low
Marketing and communications	<ul style="list-style-type: none"> • preparation of brochures • promotional materials, public relations materials, press kits, flyers for exhibitions • fundraising campaigns 	<ul style="list-style-type: none"> • professional 	<ul style="list-style-type: none"> • small • full-screen 	<ul style="list-style-type: none"> • PR materials • fundraising brochures • flyers, press kits 	<ul style="list-style-type: none"> • high, • medium • low
Electronic media	<ul style="list-style-type: none"> • web content • virtual exhibitions • multimedia products • museum installations 	<ul style="list-style-type: none"> • documentary • professional 	<ul style="list-style-type: none"> • small • full-screen 		<ul style="list-style-type: none"> • high, • medium • low
Print media	<ul style="list-style-type: none"> • preparation of exhibition materials • posters • postcards • catalogues • museum publications 	<ul style="list-style-type: none"> • documentary • professional 	<ul style="list-style-type: none"> • small • large-format 	<ul style="list-style-type: none"> • publications • posters • postcards 	<ul style="list-style-type: none"> • high • medium
Library	<ul style="list-style-type: none"> • general and specific research • books 	<ul style="list-style-type: none"> • documentary 	<ul style="list-style-type: none"> • small • full-screen 	<ul style="list-style-type: none"> • research reports • reports on collection 	<ul style="list-style-type: none"> • medium • low

Museum activities	Uses of digital images	Type of photo required	Format of digital image on screen	Reproduction of printing of digital image	Quality of reproduction for print
Bookstore	<ul style="list-style-type: none"> posters postcards books 	<ul style="list-style-type: none"> documentary professional 	<ul style="list-style-type: none"> full-screen large-format 	<ul style="list-style-type: none"> promotional material catalogue 	<ul style="list-style-type: none"> high

Evaluating assets

A careful assessment is needed of the images currently held by the organization. Consider the following questions:

- What objects have already been photographed?
- In which formats have the images been saved?
- How are the images stored?
- What is the quality of the images?
- Are digitized images from a previous project available, and if so:
 - At what resolution have the digital images been stored?
 - What file formats were used?
 - What metadata accompanies each image?

A survey of all the photographic holdings of an organization should be carried out to determine not only what images (both digital and otherwise) are already held in different parts of the organization, but also in which formats these images are currently available. In a large organization, many departments will have images for their own use; a smaller one may have fewer existing photographic resources.

Because any good digitization plan includes a digital preservation plan, CHIN's [Digital Preservation Toolkit](#) should be consulted, as this kit contains a [Digital preservation inventory template for cultural heritage institutions](#). This template will be useful not only in developing a digital preservation policy and plan (consult [Developing the project plan](#)), but also in the asset evaluation component of your digitization project. More information on using the Digital Preservation Toolkit can be found in the [Digital preservation](#) section.

Next, conduct a detailed assessment of the images. If previously created digital images are available, consider whether the quality is high enough for reasonably foreseeable needs and whether the associated documentation is adequate. New photography will add significantly to the time and money required for a digitization project, particularly when a lot of preparation time is needed with regards to the objects to be photographed. For example, large objects such as canoes may have to be transported from storage to a suitable place to be photographed. Complex objects, such as costumes, may require a great deal of preparation.

Existing holdings of analogue (physical, non-digital) images should also be assessed for quality and documentation, as digitizing these will be less costly and time-consuming than beginning from scratch. Some objects may need to be photographed digitally again if existing analogue images are in poor condition or are not good representations of the original object. Ideally, only good, professionally photographed images created with a colour bar or grey scale should be digitized.

Appropriate information (metadata) relating to the image, such as technical capture information, provenance, copyright, usage policy and image management history, must also accompany an image. Some of this information is likely recorded along with the underlying museum object, and a reference to the object's accession number will ensure a tie to that information. Consult the section [Standards and guidelines to consider](#) for more information. This documentation will require a significant amount of staff time, but it is crucial to the long-term success of an imaging project and to the future management and repurposing of the digital assets created in the project.

Other important aspects of an evaluation phase include:

- ensuring that the organization has copyright to both the objects and any photographs of them
- ensuring that a digital preservation policy and plan are in place prior to digitizing
- surveying current digitization equipment and software
- considering physical space requirements (both disk storage and physical space for staff and equipment)
- examining existing staff resources to help define needs

Understanding the importance of planning

If we are to use digitization as a tool to provide worthwhile, enduring access to some of our most treasured cultural and historical resources, then we must take the time at the outset to become informed and to establish guidelines, so as to proceed in rational, measured steps. Once the museum's current image assets are determined and the need for digitized images has been assessed, the scope of the project can be defined.

Some institutions choose to digitize a small component of their holdings, whereas others systematically digitize all or very large parts of their collections. Whether the project aims to digitize all or only part of the collection, before proceeding, a plan is needed that outlines what will be digitized and in what order.

Successful digitization projects require sufficient resources, including:

- trained personnel
- digitization technology and equipment (hardware and software)
- physical space sufficient for the process
- funding to support all of the above, as well as any outsourced activities

All digitization plans should consider the following:

- Does the material have enough intrinsic value to warrant digitization?
- Will digitization significantly enhance access or increase use by an identifiable constituency? (Digitization increases visibility for the many objects museums are unable to display.)
- What institutional or project goals might be met by digitizing (internal or external visibility)?
- What are the costs and benefits of digitizing an entire collection versus digitizing images for which there is a specific need?
- Does a product already exist that meets the identified needs?
- Are rights and permissions for electronic distribution secured or securable?
- Does current technology yield images of high enough quality to meet the stated requirements and allow for the intended uses?
- Does technology allow digital capture from a photo intermediate? Will the project need to start from scratch with either a new photo or digital image capture?
- Does the organization now have expertise in the necessary technology?
- Will all or part of the collection be digitized to promote effective collection management practices or public access to the collection's information?
- How will objects be chosen for digitization?
- Will ongoing activities (such as exhibit development) help determine what objects are digitized?
- Will digitization take place in-house or be contracted out?
- What quality of digitization is required? Is the cost affordable? What compromises between cost and quality might be needed?
- How will digital objects be stored and categorized? What metadata about each one will be included?
- How will digital objects be searched for and located once they have been created? How will they be linked to the original object?
- How will the digital assets so created be managed on an ongoing basis?

Developing the project plan

Organizational goals and requirements will determine how the project should proceed. Project members should try to think of all the ways images can be used and reused to make the broadest possible use of the material.

Here are some questions to consider when determining requirements:

- What will the images be used for?
- How will the images be made available?
- What standards will be used?

Note: Decisions made while planning the project affect the entire process. For example, decisions about the resolution of scanned images or the amount of documentation can dictate how the images

themselves are used. The project will not be successful if images must be rescanned a few years later because of poor initial choices of technology or documentation.

The following broadly defined tasks or phases should be part of the overall plan.

Planning

- Define the purpose, goals, scale and scope of the project.
- Survey current images to assess the strengths of the collection.
- Develop a digital preservation policy and plan.
- Evaluate current documentation and standards used to create it.
- Analyze technical standards.
- Make an inventory of available equipment.
- Set priorities.
- Develop and document a plan, including a workflow strategy.
- Identify staffing needs.
- Assess costs and implications of doing the project in-house versus contracting out the work.
- Secure funding.
- Recruit, select, hire and train staff to form a working group or project team.

Data preparation

- Select data documentation standards and technical formats and standards.
- Establish copyright.
- Determine and record information about copyright restrictions and permissions.
- Properly document photographs of collection material, whether they are being contracted out or digitized in-house.
- Where images exist, ensure that each image is stored together with its documentation.

Image capture

- Purchase and set up equipment.
- Take high-quality photographs of objects.
- Where photographs already exist, scan the photographs of the objects (or send them to an outside source, with explicit instructions about requirements).
- Store high-resolution images securely.
- Perform quality control and evaluation.

Storage and delivery

- Store the photographs of collection materials properly.
- Store archival-quality digital images as per your digital preservation plan.
- Link digital images to the collections management database.

- Perform an internal evaluation.
- Make images available to a variety of online users.
- Maintain and refresh data.
- Ensure off-site storage of copies for security purposes.

Establish a realistic timeframe for the project, realizing that the time allocated to each stage will depend upon the size of the collection, the staff available to work on the project, the preparation time required and the current state of the collections management system and documentation. The decision whether to digitize all or only parts of the collection will also have a major impact.

Prioritizing the work

Even if the long-term goal is to digitize the entire collection, the project will probably be done over time, as financial and staff constraints allow. The work to be carried out should be prioritized according to the project plan previously defined. Generally, priority should be given to the following:

- images for which there is copyright clearance of both the object and the image itself
- iconic images significantly associated with the organization
- images for which there is good documentation
- objects used in current or upcoming exhibits
- images of the museum that could be developed into a virtual tour or used in promotional publications
- new objects
- well-formed collections of particular significance or of special public and/or educational appeal
- images following a particular theme or subject area
- natural groupings in the collection

Documenting the plan

Documenting the plan and process is important. A project plan normally consists of a time line, indicating the start and end dates for the main activities as well as milestones or major deliverables. It may also identify staff members or departments responsible for each activity. This documentation is particularly valuable in laying out a staged approach and in ensuring continuity should staff members responsible for part of the process leave the organization.

Determining a long-term strategy is key. The plan should include periods for assessment to determine whether strategies need to change. A well-planned project makes the best use of resources and yields successful results.

Defining the resources required

A digitization project will have an impact on budget, staffing, workload, available space and equipment. Staff with the necessary skills will need to be hired or trained (at a minimum, to document

and manipulate the images if the work is contracted out). If existing staff is trained, consider how the ongoing workload will be affected. Think about how the digitization project will affect the organization's overall plans and whether the organization has other major plans that will entail significant use of the same resources as those needed for that project.

Skills required

Skills required in a digitization project include the following:

- **Administration**
 - project management
 - project leadership
- **Collections management and/or subject specialists**
 - knowledge of cultural material documentation practices, including descriptive information about objects as well as data about the images
 - cataloguing and documenting digital objects
 - familiarity with requirements for reproducing cultural materials
- **Preparation**
 - preparation of detailed instructions for digitization, whether the work is done in-house or contracted out
 - preparing objects for digitization
 - preservation, archiving and disposal of digital objects
- **Systems support**
 - technical expertise in operating digitization hardware and software
 - experience with image scanning, processing and quality control
- **Reproduction services**
 - monitoring digitization procedures and performing quality reviews

In small institutions, many of these tasks are performed by the same people, some of whom may be volunteers. In other cases, many of these functions may be contracted out.

Establishing responsibility

For a digitization project to be a success, management must have a well-established commitment to its realization. The capabilities of current staff members and their interest in learning new technologies must also be realistically assessed. The person serving as project leader can survey the various parts of the organization, ensuring that staff members understand the goals of the project. Tasks for departments and managers will change as new tools are obtained and new priorities are set. Rather than forcing staff members to take on new tasks that they had not anticipated assuming, it is much better to stress the positive opportunities for professional development that the digitization project makes available.

When responsibility for these tasks has been established, it is crucial to make sure that all staff members understand that this responsibility has been assigned. Good staff communication is key to a successful project.

Digital preservation

Digital assets have preservation and storage needs. While making multiple backups is part of addressing the issue, it does not stop there.

If plans are not made to properly preserve the image collection, access to it may be compromised for various reasons, including:

- obsolescence of equipment, operating systems, software or file formats;
- loss of metadata;
- confusion over authoritative copies;
- damage to physical carriers;
- manmade or natural disasters;
- loss of information during migration to new formats;
- inadvertent edits or deletions of files;
- confusion over copyright or usage policies; and
- failure to provide access in a timely and effective way.

The scope of the measures to take in order to address these problems is too great for the topic to be discussed at length in a digitization guideline. However, all institutions intending to digitize should have a preservation policy and plan in place. For that reason, CHIN developed its [Digital Preservation Toolkit](#) and also offers [training workshops](#) (through the Canadian Conservation Institute) on how to carry out digital preservation in your museum.

First, the toolkit will walk you through the basic steps of conducting a survey (an inventory) of your current and anticipated digital assets. The survey template includes questions related to the risk and impact of losing access to these digital assets, and these questions may be helpful in the [Evaluating assets](#) step. Next, the toolkit will help you develop a digital preservation policy through the use of a policy framework template. Finally, it will help you create a digital preservation plan.

The toolkit can be used by institutions of any size, and it includes case studies of museums of various sizes that have implemented it or components of it. The toolkit also contains [Digital preservation recommendations for small museums](#), since it is understood that resources in these institutions are limited. Indeed, one community museum case study outlined in the toolkit produced a solution for under \$200 that was carried out by volunteers who had only average computer skills.

At this stage, if your museum does not yet have a digital preservation policy and plan in place, it is recommended that the lead for the digitization project read all of the information in the toolkit. If you

are a smaller organization, the lead should also focus on the case studies for small museums found in the toolkit as well as the [Digital preservation recommendations for small museums](#).

Digital preservation is also core to any sustainability plan, and evidence that you have implemented one according to best practices will likely help your organization, not only in achieving its long-term goals, but in obtaining future funding.

You have to maintain your digital assets regardless of which method you chose. It makes sense to do it using best practices.

Legal issues related to digitization

Copyright issues associated with digitizing images

The protection of museum copyright as well as the copyright of artists and creators for which museums may be responsible is of paramount importance when digitizing images. Digitized images cannot only be made available and accessed via the Internet; they can also be reproduced quickly and with astonishing clarity. More than ever, therefore, copyright protection is an issue.

Appropriate copyright clearances

When the underlying work is still protected by copyright

Before photographing and digitizing an image, a museum should ensure that the work it intends to photograph and then digitize has been licensed for reproduction. Authorizations should be obtained from the artist or creator of the work that is the subject matter of the digitized photograph. If the work at issue is in the public domain, such authorization is no longer required.

When the photograph is still protected by copyright

Since the digitization of an existing photograph is also a reproduction, museums should ensure that they hold the rights to digitize the photograph. Such rights can be obtained in two ways: by ensuring that the museum holds the copyright on the photograph through an agreement with the photographer or by negotiating these rights when the photograph is later digitized. If the photograph being digitized falls into the public domain, then these authorizations are no longer required.

When the digitized image is to be modified

If, in the course of digitization, the image is somehow modified (either cropped or discoloured), rights associated with copyright, such as moral rights, may become an issue. Moral rights are held by the artist or author of the original work that is the subject matter of the image. Photographers also hold

moral rights in their photographs even when copyright has been assigned to another party. Moral rights run for the length of copyright and cannot be transferred; they can, however, be waived.

In either case, a museum should ensure that it obtains a waiver of moral rights from the artist, creator and/or photographer if the image is to be manipulated so as to discolour it, crop it or modify it in any way that may prejudice the artist, creator or photographer. If the work that is the subject of the image or the photograph being digitized falls into the public domain, then the moral rights of the artist, creator or photographer are no longer an issue.

Rights management and protection technologies

For works distributed over networks, licensing to end-users, as in the software industry, alleviates some problems but will require fewer restrictions on usage on the part of owners, as well as an emphasis on educating end-users. Licensing, even if supported by registration, may provide too little protection for aesthetic goods that retain their value over a long period. Hence, the issue of protection of digital images has attracted considerable attention, and a number of technologies including watermarking, encryption, digital signatures and fingerprinting have been developed and are being marketed.

As currently implemented, watermarks, signatures and fingerprints primarily have value as deterrents to misuse and copyright infringement. Encryption can achieve high levels of security, but even it cannot provide absolute protection.

New technologies aimed at protecting museum and copyright holders' interests include the following:

- encryption technology
- visible and invisible watermarking
- digital signatures as proof of ownership
- digital fingerprinting
- secure container technology
- various rights management systems

Note: the [Copyright Modernization Act of 2012](#) makes it illegal to tamper with a technology protection measure for any purpose.

Determining the costs of a digitization project

Costs to consider

Whether in-house or contracted out, all digitization projects include costs based on the requirements as defined. It is important to anticipate these costs and budget for them, being realistic about the expectations of savings from the digitization of images. Management needs to expect initial costs

based on the requirements determined in the project planning phase, but it should also understand that long-term benefits are great. The benefits include, among others, enhanced collections management documentation, the preservation of original objects, enhanced information on the museum's intellectual property, increased public access and increased visibility for the organization.

The total cost for a digitization project includes the following:

- documentation
- cost of hardware and software for image capture, manipulation and storage
- human resources, either hiring new or training existing staff
- sufficient space and facilities for equipment and any necessary new staff
- transportation and handling of objects to be photographed or images going to an outside source (mainly for two-dimensional objects; costs will be higher for three-dimensional objects)
- insurance costs related to transportation
- set-up time
- photography and/or treatment of current photographs
- film processing and/or scanning
- quality control
- image manipulation (adjusting images for their intended purpose)
- ongoing maintenance

It may also be helpful to consider possibilities for cost-sharing with another organization as well as pooling resources for equipment or staff costs.

The largest expense will not be related to the actual scanning or photographing of images, but rather to the subject expertise required for documentation, locating, reviewing and assembling source material, preparing and tracking it, and performing quality control. On a project done in-house, these costs will be associated, more specifically, to the training of current staff, the hiring of new staff and the purchase of new equipment. It would be wise to investigate possibilities such as hiring interns or students from a community or technical college to do the image manipulation. Costs for a short-term project are determined by examining the hourly salary of each member of the team involved in the project. Adding tasks to a current staff member may increase workload stress, and the redistribution of work should be considered. A project that is contracted out will still require some staff training.

If photographs suitable for scanning are not available for all objects, it is necessary to consider costs for preparation time, transportation of heavy objects, unbinding manuscripts, checking of objects for damage by a conservator, the photographic set-up and the expertise required for all of these tasks.

Digitizing images in-house versus contracting out

Table 2: comparison of digitizing images in-house versus contracting out

Type of project	Advantages	Disadvantages
In-house digitization	<ul style="list-style-type: none"> • learn by doing and develop in-house expertise • build production capability • retain control over all aspects of imaging • maintain some flexibility in defined requirements • ensure security of source material 	<ul style="list-style-type: none"> • larger investment • no set price per image • need to set up technical infrastructure: space, digitization equipment, computers • limits on production capabilities and facilities • organization incurs costs of technological obsolescence • impact on other activities • organization pays for equipment, maintenance and personnel rather than for product • need for trained staff or need to provide training • equipment support
Contracting out the digitization	<ul style="list-style-type: none"> • expertise and training of the digital service provider • set cost per image (prices can be negotiated based on volume, which facilitates budget and project planning) • lower labour costs • costs of technological obsolescence are absorbed by the digital service provider • limited risk • variety of options and services • specialized equipment for rare formats 	<ul style="list-style-type: none"> • museum removed one step from imaging functions • possible inexperience with museum needs • quality control not on site • images will still need to be manipulated by museum staff (evaluation of random samples of the images produced should be conducted) • needs must be clearly defined in the contract or there will be communication problems • transporting of material (security and handling issues, especially with 3-D objects) • vulnerability due to instability of digital service providers (companies in business for over two years are considered viable)

If contracting out is chosen, contract specifications for the digital service provider must be carefully defined, with a clear statement of the need for consistent results.

Contracting and in-house activities might also be split. For example, a museum could send out work for unusual formats or where low volume does not justify the purchase of equipment in-house. Another possible compromise between the two approaches may be to hire a professional photographer to work on-site with museum staff.

Obviously, the decision about whether to produce images in-house or by contracting out will be influenced by many factors, which are all part of the planning process. This is why it is important to have a realistic appraisal of the organizational situation.

Standards and guidelines to consider

The type of data accompanying digitized materials determines how they can be searched, sorted and displayed. Museums are more capable of managing their collections when they use proper database management technologies and documentation in conjunction with digital imaging projects.

Metadata

Metadata may be defined as data describing one or several discrete data objects. Cataloguing or indexing information created to arrange, describe and otherwise enhance access to an information object. In other words, metadata describes information objects and gives them meaning, context and organization.

Content metadata is information about the object captured in the image. If a computerized collections management system is in place, this information may be available, although many museum collections management systems may lack this type of information. However, this information must be available if data sharing and public presentation are part of the project plan. [CHIN's Humanities data dictionaries](#) and other related documents on content standards are schemas that can help a museum determine what type of content metadata it needs to record and how to record it.

The other type of metadata is data about the image itself. This is referred to as either technical or administrative metadata, and it describes information related to the management of the image, including rights management and information about the technical processes used in creating the digital image.

It is essential to document this information and integrate strategies to avoid obsolescence to ensure that future technologies can access the images. As mentioned, it is best to digitize images for which good documentation is already available.

Recording this information will require an image catalogue or database that is linked to or integrated with the existing collections management database. An image-naming convention should be developed so as to make it easy to keep track of the images and link them to collections management information.

Image standards and guidelines

Consult [Digitization Standards for the CMCC: Scan and Artifact Photography](#) for details on digital image scan resolutions and colour depths. A newer version of this document has been published as [Recueil de règles de numérisation](#) (in French only), with only slightly different recommendations. Ultimately, the resolution to be captured in a master image will depend on the intended use of the images (consult [Defining the audience](#)). However, this is bound to change as new needs arise. The

recommended rule of thumb is to capture images in the highest quality feasible, depending on the resources available and the size and scope of the project.

File formats for digitized images should ideally be TIFF or PDF/A (if the scanning process and the equipment allow it). Some cameras will only produce images in JPEG format. This is acceptable, although no edits of any sort (colour balancing, cropping or otherwise) should be made to a JPEG image before storing it as a master file.

RAW files are not a specific format. They are the generic term for the file format produced by a given image sensor's chip. As such, each manufacturer will have a distinct RAW file format. Never use a RAW file as an archival (master) format.

Master images should be stored in an offline mode or kept accessible in read-only mode. They should be accessed only infrequently to ensure that they are kept unchanged and secure. Only master images should be used to create subsequent surrogate images.

Physical carriers for long-term preservation

All digitization work should be preceded by the development of a digital preservation policy and plan as well as related procedures (consult [Digital preservation](#)). The physical carrier (electronic media) onto which files are stored will depend on the chosen preservation plan. Nevertheless, the following is a brief discussion of carriers often used in preservation.

A traditional physical carrier for digital preservation has been an archival quality optical disc, such as a CD-ROM or DVD. These discs are gold in appearance and can be purchased through a photography shop or a vendor specializing in archival materials. Both formats are desirable due to their anticipated lifespan (upwards of 50 years) as well as the read-only nature of the media. However, they have drawbacks: they are expensive, and the work involved (indexing the content, managing it as archived material and accessing it) is labour intensive.

Increasingly more common are hard drives, including cloud storage. This is the most affordable storage media available, and it requires the least labour to manage. However, hard drives may be susceptible to edits or deletions unless precautions are taken. They also require refreshing (moving content to a newer drive) every five years.

A third physical media that is used for large storage requirements is magnetic tape. It remains the most cost-effective storage solution for the largest institutions (although the drives alone cost several thousand dollars). Even for these larger institutions, however, the cost of hard drives (which continues to drop faster than that of other forms of media) may be lower than that of linear tape. Access is also slower than with other methods, as it is labour intensive and may require most of the tape to be read before the desired content is reached. The most common tape format used for digital preservation is digital linear tape (DLT).

Magnetic tape is relatively impermanent owing to its inherent instability, which leads to chemical deterioration and physical wear from use. Optical discs can fail because of warping, corrosion or cracking in the reflective layer, dye deterioration or delamination.

Storage conditions are important in preserving digital images. Cooler and dryer storage conditions will extend life expectancy. The recommended conditions for storage are a temperature between 10°C and 20°C and an RH between 20% and 50%.

At least two additional copies of all masters should be generated, with at least one copy being stored off-site for security purposes.

Transmission issues

The key factors in the transmission of digital images are the sizes of the image files and the speed of the network. Generally, the smaller the image file size, the faster the access. The primary reason for transmission of images across a network is for display, and since display devices generally have a lower resolution than print media, low-resolution surrogate images should be created for this purpose. Using formats designed for web publication (such as JPEG or PNG) will also help.

Implementation

Selecting equipment and software for the project

Several operating environments are commonly used for image capture and processing, including Windows, Macintosh and UNIX. The following are some of the important factors to consider when choosing hardware and software.

Software selection

Several types of freeware and shareware products are available on the Internet. To optimize images, high-end imaging software such as Adobe Photoshop should be used.

Computer selection

User and business needs will drive software selection, and software selection will, in turn, drive the selection of computer equipment. Verify the hardware (system) requirements of the image processing software you choose. For most of the software, any newer computer will suffice, although desktop and tower (floor-based) machines will provide more computing power per dollar than laptops or tablets. System requirements will typically specify the operating system to be used, the computer's minimum processor power and the computer's minimum RAM requirements. Ensure also that your chosen computer has the necessary ports to support your scanner equipment and other hardware.

Beyond this, a quick and affordable way to improve the speed and the useful lifespan of any computer is to purchase it with as much RAM as possible. RAM is affordable (compared to the rest of a computer). Adding it to any machine improves speed because all modern operating systems use a feature called “page swapping” to manage software and this feature requires more memory than is available in the host computer. By swapping “pages” of information into and out of active memory (to and from the disk) as they are needed, the operating system creates an environment with more virtual memory than the machine actually has. This swapping process takes time. In the case of traditional hard drives, this time is determined largely by the speed at which the hard drive physically rotates (a timespan which is considerably greater than the movement of electrons across a circuit board). Even with newer solid state drives (SSDs), page swapping slows machines down. By adding RAM to your machine, you reduce the need for this process.

Adding RAM also increases the effective lifespan of your computer. This is because as newer and more powerful hardware becomes available, newer releases of software take advantage of (and ultimately require) the greater processing power, thereby rendering older machines obsolete. This becomes apparent to the user as newer software tends to lag or freeze periodically on an older machine. Ensuring your machine has as much RAM as possible at the outset to reduce page swapping and, thus, reduce lag is one of the most affordable ways of addressing this problem.

Disc storage

Your digital preservation plan will determine the type of physical media used and the amount of storage space required for preservation copies. Regardless of the storage media chosen in your preservation plan, you are likely to need at least one copy of the master images on a hard drive (or array of drives) so that these can be easily accessed. Image resolution and file formats will determine file size. This, in turn, will help determine drive requirements. Creating a few test images or using an [image file size calculator](#) can also help assess storage needs.

Drives are sold in terabytes, and in modern Windows operating systems, disk arrays (referred to as [storage spaces](#)) can be used by any Windows user to effectively create a larger single disk out of many. For most small or medium-sized institutions, buying the largest drive available in consumer-end electronics stores before the cost per terabyte increases (it can sometimes increase dramatically at the highest end of available drive storage capacities), and then pooling this drive into an array along with comparable drives at a later date, if necessary, is typically a cost-effective solution.

SSDs can also be used and are practical where images may be accessed frequently (as access time is better than with traditional hard drives). However, at the time of writing, SSDs remain more expensive than traditional hard drives and are not absolutely necessary. If you are using external hard drives, be sure to research brand names, as not all are made the same.

Display monitor

All modern monitors support the basic requirements for image processing. However, larger monitors will make work easier. Image quality varies between manufacturers. It is best to select a monitor by comparing competing brands side by side.

Preparing materials for digitization

Imaging projects that entail either traditional or digital photography of three-dimensional objects require time and skill. As mentioned earlier, large objects will need to be moved from storage to the photographic set-up. Some objects (such as costumes) that might need to be installed with other objects require both time and expertise. Different views of the same object may be required when three-dimensional objects are photographed. All equipment, including supports and accessories, should be on hand before photographing to avoid unnecessary delays.

For the capture of two-dimensional objects, the materials should be reviewed before an imaging plan is decided upon. Some objects, such as photographs (historical photographs, not photographs of objects in the collection), may be scanned directly. Others, such as medieval manuscripts, may be more delicate and may require expert curatorial and conservation help before the image capture technique is decided upon.

Projects that entail scanning images already on hand will require staff to check the images for quality, to ensure that the images are not blemished and to ensure that accession numbers are correct. This pre-scanning quality control is important to create digital images of the highest quality possible.

Workflow process

Staff will need to be designated for all stages of the actual digitization process. Generally, duties will fall under broad categories such as documentation, followed by preparation, which will include setting up for photography, locating and inspecting objects and the photography itself. The actual digitization of images will include scanning, image manipulation, quality control and creating the image metadata. Follow-up processes will include refiling and storing any new or pre-existing images and maintaining the image preservation strategies used by the organization.

Maintenance and management

As mentioned, the planning process for digital imaging projects must include a policy for managing the digital assets. Typical imaging projects consist of 5000 to 50,000 images or more. With this quantity of data, planning the management of the digital assets must become an integral part of the overall digitization project.

Quality control

Standards for the images created must be clearly defined and documented so that image quality can be evaluated, whether digitizing in-house or contracting out. The digitizing should begin with only good-quality original images. The task of assessing the quality of the digitized images should be assigned to a staff member.

Migration and refreshing of media

As part of any digital preservation plan, images in older file formats should be periodically transferred to more current file formats (migration), as necessary, in order to retain the ability to retrieve, display and use them. Content on older physical carriers should also be transferred to newer carriers (refreshing) to alleviate the problem of physical media degradation. This and other preservation strategies (such as fixity checking, file naming, backup procedures and preservation metadata standards) are addressed in the [Digital Preservation Toolkit](#).

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