Recommendations for Improving Digitisation Practices in the UK Cultural Heritage Sector

A Comparative Study of UK and USA Digitisation Practices

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Contents

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2. Author's Background

I am a professional photographer based in the UK, specialising in providing technical object photography, digitisation services, and consultation to museums and businesses in the UK, Europe, and USA. I have six years of experience running my business 'MacroPro Photography' in the industry. My work focuses on the accurate technical imaging of important objects and documents, for archival museum purposes, accessibility, and marketing. I also have a Master's degree in Biology and three years' experience working in ecology research. This professional background has provided me with a unique understanding of the challenges and opportunities within the UK museum sector regarding digitisation.

3. Abstract

The USA has established itself as a leader in museum and cultural heritage digitisation, driving significant improvements in the sector over the last decade. Common standards for quality have been developed and widely adopted, leading to measurable improvements across the industry. Effective advocacy has helped institutions recognise the importance of preserving their collections, resulting in substantial funding being allocated to digitisation, and a collaborative culture has enabled institutions to share knowledge more freely. We see some essential factors emerging in all high quality digitisation projects: advanced equipment, highly skilled operators, and efficient project workflows. UK institutions must recognise the importance of digitisation, and should adopt a similar approach, developing strategically planned, future-proofed projects to digitally preserve cultural heritage for future generations.

4. Introduction

4.1 Background

The storage and preservation of culturally important items is a task entrusted to museums, archives and cultural institutions around the world, with the fundamental aim of protecting and preserving the physical object. With technological improvements, this obligation has been expanded to digital preservation. Digitisation is the process of converting physical objects into digital formats, often through photography and other imaging technologies. It plays a crucial role in preserving our cultural heritage, ensuring that future generations will be able to access and learn from the insights held in these historic materials. Even with expert preservation, many valuable historic artefacts such as photographs and documents have a finite lifespan and we will eventually lose the physical copies. This is true not only for significant documents and objects held in large museums, but also those in smaller community museums and private collections. The UK has so many world-leading institutions storing historically important objects not only from our own history, but also from around the world. However, the UK approach to digitisation has been somewhat fragmented. While some larger institutions have developed their own successful programs, there is a lack of cohesion and consistency across the sector, especially at small and medium-sized institutions. Institutions across the USA, however, have been working towards a common goal of high-quality digitisation, with a more collaborative culture to support this. This project seeks to learn from the successes of the USA and address the gap in progress by applying those lessons to the UK's digitisation efforts.

4.2 What is Collections Digitisation?

The focus of most museum-based digitisation projects is to create high-quality, accurate digital representations of physical objects for long-term preservation. The focus is on accuracy to the original, ensuring that the digital version can serve as a digital representation for the physical object. 'Preservation grade digitisation' is a term sometimes used for high-quality, future-proof digitisation. Digitisation can take a number of different forms.

Digital Photography and Scanning

Most digitisation efforts centre around high resolution imaging of objects and documents. Developments in digital camera sensors, and the speed at which cameras take images compared to scanners, has led to cameras becoming the primary method in modern digitisation. Medium format cameras are generally the preferred tool for professional digitisation, due to higher resolution images, and better colour accuracy. Photographic images make up the vast majority of digitisation efforts, but there are other methods being used in the USA.

3D Imaging

This is a growing field that involves capturing three-dimensional objects as 3D models, using either photogrammetry, Reflective Transformation Imaging (RTI) that can exhibit the depth of an object, or other technologies such as Light Detection and Ranging (LiDAR) to measure the 3D nature of an object. While 3D imaging colour accuracy is still a challenge for preservation grade imaging, advances in technology are making this more achievable. Programs like those at the Smithsonian Digitisation Program Office (DPO), which use images from multiple camera angles to capture intricate details of objects, demonstrate the potential of 3D digitisation. The inclusion of audio descriptions and interactive annotations further enhances accessibility. This area faces even more challenges to standardise and reproduce than 2D photography – but it is hoped that more accessible tools will make this easier. For example, some phones such as Apple iPhone™ include LIDAR

scanners with 3D model creation capabilities. The end goal is to combine the accuracy of 2D imaging for colour accuracy and detail with 3D modelling of the object's shape; this may yield best results, but is time intensive. 3D digitisation has unique possibilities for accessibility, in technologies such as Virtual Reality (VR) and Augmented Reality (AR). The Smithsonian DPO has developed open source software to display 3D models online in a viewer.

Multispectral Imaging

Different wavelengths of light can show different details in an object, document or painting. For some objects it is useful to isolate certain frequencies of light. From infra red, to visible, or ultraviolet, different slices of the spectrum can show different things and can be used for determining authenticity, material makeup, and material distribution all in a non-destructive fashion.

X-ray Imaging

X-ray imaging can be useful when the internal structure of objects cannot be seen, and need to be imaged non-invasively. It can make repairs or alterations visible, and identify flaws in objects. It is a more niche process that requires specialist training and expensive equipment. Some large institutions have the capability to do this imaging, and may allow surrounding institutions to access the equipment.

Exhibition and Promotional Digitisation

This subset of digitisation requires creativity and aesthetic considerations, which depend on the application it is to be used for. Creating engaging digital content for exhibitions, marketing materials, social media and public outreach is extremely important for museums to maintain their cultural relevance. Most museums across the USA utilise interactive technologies, such as touchscreen exhibits utilising assets from digitisation efforts, as well as online exhibitions. Sometimes archival digitisation assets are used for this, but often there is a specific effort to create further assets for this purpose.

4.3 The Necessity for High Quality Digitisation in the UK

1. ***Digital preservation of important objects and documents*** – fragile objects have a finite lifespan, especially when they are handled and studied. But with a digital surrogate, there is reduced handling of objects, and ultimately a backup in case of degradation or loss of an object.
2. ***Increased accessibility*** – from anywhere in the world, and at any time of day, collections can be accessed. Collections can also be made more accessible to those with disabilities through assistive technologies such as text-to-speech, descriptive audio and voice-activated search.
3. ***Worldwide collaboration*** – to continue the UK's leading contribution to global research. Digitisation resources are a common source of data for scientific and historical research. For example, many climate change studies rely on historic records of animals that were collected and are now stored in museums – digitisation makes these studies practical to conduct.
4. ***Education and exhibitions*** – by using intuitive user interfaces we can interact with digital objects in a more thorough way than would be possible even with the original object.
5. ***Integration into emerging technologies*** – combined with new technologies, including AR and Artificial Intelligence (AI), accessibility and education could be improved even further.

4.4 Aims and Objectives of the Project

1. Evaluate the current state of digitisation in the USA.

2. Identify key practices and standards that could be implemented in the UK.

3. Recommend actionable steps for improving digitisation in the UK.

This report aims to inform UK institutions about the best practices in digitisation observed in the USA. By applying their strengths, we can improve the UK's approach to preserving cultural heritage. By presenting clear, actionable recommendations, the report seeks to effect change within the UK digitisation sector.

4.5 Institutions Visited in the USA

In April and May 2024, I travelled to the USA, supported by the Churchill Fellowship, where I investigated how digitisation is conducted at institutions in New York City and Washington, D.C. Time spent at the following world leading institutions, departments, and commercial businesses gave an understanding of the USA's digitisation landscape. This report aims to combine the common processes seen across all institutions.

Washington, D.C.

- Smithsonian National Museum of Natural History.
- Smithsonian American Art Museum and Renwick Gallery.
- Pixel Acuity. Private digitisation branch of Digital Transitions (Working at the Smithsonian National Museum of Natural History).
- Smithsonian DPO.
- American National Archives.

New York City

- Digital Transitions – a private commercial business, working closely with the museum industry. Supplying technology such as cameras, lighting, and workstations for digitisation projects.
- Digital Transitions Digitisation Certifications Program DT101 Course.
- The Metropolitan Museum of Art.
- American National Museum of Natural History.

5. Findings: Key Features of Successful Digitisation Programs in the USA

5.1 Imaging Standards

Imaging standards are foundational to developing a digitisation program. They are a minimum quality threshold to which digitisation assets should adhere, and the standard chosen to work to can determine the digitisation program design and equipment required. Working to imaging standards ensures consistency in the quality of digitisation, and allows the comparison of assets across different projects. The below standards are generally applied more often to document digitisation than to objects. This is because it's much simpler to apply consistent digitisation standards to an effectively two-dimensional object, since camera placement relative to the object is much easier to define – which means measurements like resolution in pixels per inch (PPI) can be obtained and kept consistent and sharpness is also easier to define in a single fixed plane of focus. Lighting can also be kept consistent, making colour management easier. For 3D objects there are more variables to consider, and lighting may be changed between objects, which makes it harder to maintain consistency. However, working under the same guiding principles of imaging standards can improve 3D object digitisation quality, even when it cannot be directly labelled as meeting a certain standard.

Federal Agencies Digital Guidelines Initiative (FADGI)

FADGI provides best practices for digitising cultural heritage materials and the guidelines are used by most US institutions, including federal agencies, but are also adopted by other institutions globally (Beckerle et al., 2023). FADGI adopts a star system to denote the quality of digitisation. The 1 to 4 star rating system helps to classify the quality of digitisation within a project: 1 star is acceptable quality, and 4 star is excellent. In some cases 1 star might be all that is necessary but, generally, aspiring to the highest standard is encouraged.

FADGI imaging standards are specified for various types of materials including documents, photographs, audio, and video. There are technical guidelines for assessment of quality specified in the documentation, including resolution, tone and colour accuracy, illumination uniformity, noise and artefacts, sharpness, and geometric accuracy. There are also guidelines for working with metadata and which file types to work with.

The adoption of these guidelines by institutions in the USA has resulted in a focusing of the whole digitisation process, resulting in the commercial sector manufacturing equipment to a standard that is required for achieving 4-star ratings, such as high resolution camera sensors from Phase One, and lighting options from Digital Transitions to ensure colour accuracy to FADGI standards.

Metamorphoze and ISO 19264

Metamorphoze (van Dormolen, 2019) is a collaboration between the National Library and National Archive of the Netherlands and is a similar framework of classifying digitisation efforts by quality. ISO – the International Organization for Standardization has attempted to harmonise the imaging standards from around the world including FADGI and Metamorphoze into ISO 19264 (ISO, 2021; Wueller and Kejser, 2016). All these standards share the same goal in providing a framework and criteria for high-quality digitisation. Different countries and institutions may have preferences on which to adhere to based on regional adoption.

5.2 Workstation Design

The workstation setup is extremely important for consistency, efficiency, and image quality. Table and camera vibrations must be kept to a minimum to maximise image sharpness, therefore digitisation programs are situated ideally in lower level basement rooms with concrete floors. This reduces the vibrations that may come through a building, whereas higher level floors will introduce vibrations that cannot be mitigated. The table is just as important; a lightweight table will be more prone to vibrations, so heavy metal tables are often used. In some instances, for example extreme macro photography, tables with active vibration reduction may even be used – such as those designed for optical research. An organised workstation should include a preparation area for objects situated next to the photography station, designed to maximise efficiency of object handling and photography.

5.3 Object Handling Workflow

The importance of workflow efficiency is especially evident in commercial projects where speed is directly correlated with profitability. It is an area where great gains in productivity can be made. Objects must be taken from the preparation area, photographed, and moved to a completed area in a fluid motion, all while ensuring object safety and minimising time. A 'production line' type design is generally adopted, sometimes including a conveyor belt, for the working area allows operators to move objects between areas quickly. When aiming to digitise vast numbers of objects, reducing the time taken per object by even a few seconds can make significant increases in the total number of objects digitised over long-term projects.

5.4 Photography and Image Processing Workflow

A consistent workflow is essential for producing high-quality digital assets. This includes standardised processes for image capture, post-processing, and quality control. By adhering to these workflows, institutions can ensure that their digitisation efforts are both efficient and high quality. A camera tethered to a computer is generally advised and this provides a number of benefits to the operator. Checking focus before and after taking an image on a high resolution screen is essential. Tethering also allows files to be catalogued and named during the photography rather than importing from camera later.

Images should be named appropriately to maintain file organisation. This is a simple but essential aspect of the process, and can be automated with a combination of printed QR codes or barcodes that contain naming information, and scripting that can extract the name and apply it to the file. This can improve efficiency and reduce risk of operator error in entering file names, but must be checked regularly to ensure systematic error is not being introduced.

A RAW image file photography workflow is preferred for modern digitisation applications. Images are captured to the camera's RAW format and saved to the local storage. RAW files include the complete data output from a camera's sensor, which gives us the maximum dynamic range and colour information available from the camera. The original RAW file should be kept untouched as a master file, but must be processed before it can be a usable image. RAW files should be worked on using non-destructive image processing software. One preferred software is Capture One Pro™, which also has a Cultural Heritage version with extra features for digitisation workflows. But other RAW processing programs can also be used such as Hasselblad Phocus™, Adobe Lightroom™ and Photoshop™, and most camera manufacturers also provide their own software.

Editing images should be kept to a minimum but calibrating white balance and colour, and small adjustments to exposure, dynamic range, and cropping, are generally necessary. Things that should

be avoided in editing are rotations of any angle that aren't multiples of 90 degrees, lens corrections, and alignment corrections. These all cause the original pixels within the image to be interpolated to a new pixel arrangement that best fits the original grid pixels, and therefore new image data is being created in a way that makes it unsuitable for archiving. Once the file has been processed, it can then be exported as any file type required – while still retaining the original RAW file untouched. Multiple file types can be exported, and this also allows files to be edited again if any issues are spotted, or if RAW file processing becomes more sophisticated in the future.

Most professional digitisation efforts in the USA will involve at least one level of quality control (QC), and often more. The first level of QC will be from an operator on site who is processing the images. Images will also be checked again by an operator or manager, and there should be further checks after an image has been processed. This can be done remotely by a team overseeing the project. Any images where issues are spotted will be flagged to be either taken again, or edited again. Re-shoots are an important aspect of digitisation efforts and time should be allocated to this.

5.5 Data Storage and Validation

The RAW master files must be exported as suitable file formats for usability, long-term storage, and access. FADGI guidelines suggest a number of different formats that may be suitable for different applications (Beckerle et al., 2023). Common formats used are TIFF, JPEG2000, PNG, PDF. Decisions on which format should be used can depend on a number of factors. For example, how widely adopted is the file format, will it be supported into the future, is technical documentation available, does the format support descriptive metadata necessary for the institution's practices? Further considerations are: file size, lossless compression support, compatibility with software, International Color Consortium (ICC) colour profile support, and Optical Character Recognition (OCR) support. A good overview of strengths and weaknesses of common file formats can be found in the FADGI documentation (Beckerle et al., 2023). These files need to be stored reliably, and validated to ensure consistency of the files over time. Checksum reports validate data by testing its integrity when being stored for long periods, to see if any changes have occurred where they shouldn't have. This can be particularly important when transferring or copying files, to validate the process. Information should be attached to an image file in the form of metadata. Each institution will have its own practices relating to metadata. This data can explain many aspects of the object shown in the image (Miller, 2022), but practices will vary between institutions, and object types.

The amount of data generated by high-quality digitisation efforts require robust and scalable storage solutions. Large institutions will likely have these assets already, but smaller projects may have to build in extra costs for storage. When using any cloud storage, institutions should assess its viability and ensure that data integrity is regularly verified.

5.6 Camera Technology

High-quality camera technology is fundamental to good digitisation efforts. Large USA institutions and commercial digitisation businesses generally use medium-format cameras, such as those from Phase One which are specifically designed for cultural heritage digitisation. Alternatively, Hasselblad are widely used in some museums. These cameras require significant investment but offer very high resolutions and are built for the long-term demands of professional use. When working with medium-format cameras, sufficient computing power and file storage are important due to large file sizes. Some modern cameras, famously Hasselblad, have sensor-shift multi-shot capabilities to output images higher than the resolution of the sensor by taking multiple images, and shifting the sensor by one or half a pixel in between. These generally aren't output as RAW files, and usually require processing to combine the image files, so the use-case may be limited. Pixel

shift technologies often work best under continuous lighting, since they generally utilise the electronic shutter, so setups using flash strobes may also not be suitable for this method.

High-quality lenses are just as important, to ensure the digital sensor gets the maximum amount of information it can resolve, with minimal chromatic aberration. They must also limit the amount of distortion present in the image. Generally, in digitisation settings lenses will be used in the more narrow aperture ranges, around F8-F11 to maintain image sharpness, and keep the whole object in focus. Sometimes objects are too large to maintain focus throughout, and focus stacking can be utilised. Multiple images are taken at different focus points, then digitally stitched together later to create a single image with the whole object in focus. This can cause significant errors if done incorrectly, however, and operators must be careful to maintain colour consistency throughout the image stack. Tilt-shift lenses can also be useful when photographing objects that require the plane of focus to be tilted either due to the shape of the object, or the angle at which the image is to be taken. The shift function can be helpful for panoramic imaging, where an object can be photographed in two or more images, then stitched together to increase resolution. Lens filters may be useful for certain objects, for example, polarising filters can reduce reflections in some cases, but can reduce the amount of light entering, alter colour rendition, and sometimes negatively impact sharpness. While the camera system is important for many reasons, the lighting can be just as important when striving for colour accuracy.

5.7 Lighting

Two types of lighting are generally used in digitisation photography – continuous lighting from LED panels, or flash lighting from strobes. Issues of object degradation through exposure to light can inform which type of light source should be used, as well as the budget of the project. High-quality lighting is a key factor in image and colour quality (Korytkowski and Olejnik-Krugly, 2017): it must be consistent, powerful enough to allow desired camera settings to be used, and suitably diffused to avoid harsh shadows and reflections. Colour Quality Scale (CQS) values are an important measure of the colour consistency of light sources, and are a better index than Colour Rendering Index (CRI) values when informing purchases.

Lighting can influence the look of an object more than almost any other part of the photography setup. For example, it can be used to improve visibility of the surface texture of an object, but if done incorrectly it could obscure important elements in shadow. This means operator training and skill is extremely important when setting up lighting systems. Generally, flat objects are lit with at least two lights at 45 degrees to the flat plane of the object. However, 3D objects vary more significantly and may require unique setups depending on the object, including more light sources.

5.8 Colour Reproduction with Object and Device Level Targets

Precise colour reproduction is essential in digitisation, to capture the true colour of an object or document in the image file (Korytkowski and Olejnik-Krugly, 2017). To calibrate the colour of images it's essential to use an object level target, which is a physical card that contains a grid of colours, of known colour values. Object level targets are placed in the frame and photographed alongside objects. Resulting images can then be colour calibrated by referencing the known colour values on the object level target, usually with proprietary software from the target's manufacturer. Some targets can also provide information on dynamic range, true image resolution and sharpness, and object size. When photographed next to the object we gain this extra data in each photograph. Device level targets are larger and are photographed across the whole imaging frame. They tell us about the illumination uniformity, spatial distortion and resolution variability over the whole camera's frame.

5.9 Operator Training

Professional training is critical to ensure that operators can work to the potential of the equipment. In the USA, training programs are stringent, often including certifications and ongoing professional development to keep up with technological advancements. One example of this is the Digital Transitions Digitisation Certifications Program, which has a tiered structure to introduce operators to concepts. Operators are often not from a photography/creative background, since digitisation workflow is more of a scientific operation. Therefore a scientific background is often more useful, but understanding the photographic process and the physics of photography and optics is essential.

5.10 Long-term Operations

Beyond equipment and training, the long-term success of digitisation programs is also dependent on the institution's support systems in place. Equipment and software require regular maintenance and upgrades to remain effective. Institutions must plan for the long-term sustainability of their digitisation programs, ensuring that they are not only future-proof but also adaptable to new developments in technology.

As digitisation becomes more integral to institutional operations, retaining skilled staff is also essential. The pressures on operators, particularly in fast-paced, repetitive environments where speed is required to reach targets, can lead to high staff turnover. Addressing these challenges through good working conditions and career development opportunities is vital for maintaining a stable workforce. It can be helpful for operators to have knowledge of all different aspects of the digitisation process, and alternate between different roles to increase the variability of the job.

5.11 Community-Driven Projects

Community-driven digitisation projects play a crucial role in preserving local histories and engaging the public in cultural heritage preservation. By utilising centralised digitisation labs that allocate time and resources to surrounding areas, institutions can empower communities to digitise their own photographs, maps, and artefacts. Long Island University conducted a program where it worked with around 50 local historic societies to digitise local historic documents and photographs. This was a very successful project and the results have been made available to anyone with internet access. The digitisation lab used Phase One cameras and Capture One software and Digital Transitions workstations for the equipment behind the project.

5.12 Increasing Accessibility through Digitisation

One of the most significant benefits of digitisation is its ability to democratise access to cultural heritage resources. The use of digitisation to create interactive and educational resources demonstrates how digital technology can share otherwise hidden collections, and enhance the visitor experience. Examples include exhibitions at the American Museum of Natural History, including the 'Invisible Worlds' exhibition, and presentations at the Hayden Planetarium. We can also draw modern cultural relevance from historic materials when digitisation is utilised. One example is 'Power & Light: Russell Lee's Coal Survey' at the National Archives in Washington, D.C – an impactful exhibition of over 200 photographs from a 1946 government survey of coal mining communities in Kentucky and West Virginia. The digitised photographs are displayed as life-size projections, and large-scale prints. The images are a powerful reminder of the lives of overlooked diverse communities that helped to support the USA's development through coal

production for industry. This is just one instance where archived material is utilised by an institution, to draw visitors and give new insights into history.

Institutions in the USA strive to make digital assets available online, reaching a global audience and reducing barriers to access. This is particularly important for individuals who may not be able to visit physical collections due to geographic, financial, or mobility constraints. The Smithsonian Digitisation Program Office's has made great efforts to develop an online platform for both 2D photography and 3D digitisation assets. For those with disabilities, such as mobility or vision impairments, this may be the only way to interact with cultural heritage collections. Text-to-speech programs can read digitised documents aloud when OCR is featured in the digitisation, and audio descriptions of objects can also be created. Digital copies of resources can also be accessed by voice-activated interfaces and eye tracking software, allowing digitised collections to be searched and interacted with by those with physical or motor impairments. Assistive technologies are allowing wider access to collections for those with disabilities, and with the integration of AI systems they are improving every year in usability and scope.

Featured Projects:

Invisible Worlds Exhibition: https://www.amnh.org/exhibitions/invisible-worlds

Hayden Planetarium: https://www.amnh.org/research/hayden-planetarium

Power & Light: Russell Lee's Coal Survey: https://visit.archives.gov/whats-on/explore-exhibits/power-light-russell-lees-coal-survey

Smithsonian Digitization Program Office: https://dpo.si.edu/

Smithsonian 3D Digitisation: https://3d.si.edu/

6. Conclusion and Recommendations

6.1 Summary Key Strengths of US Digitisation Efforts

1. **Imaging Standards**: the adoption of FADGI standards across many US institutions has led to a shared standard in digitisation, and a guiding principle for all digitisation efforts. These guidelines ensure that digitisation meets a minimum quality threshold, and can be ranked, which indicates the quality of each project, allowing us to understand the objective quality of digital assets. While these standards may change over time as technology improves, and systems are revised (Williams and Burns, 2020), the current standards ensure imaging will still be relevant for decades. This consistency gives institutions confidence that their digital assets are faithful recreations of the real object or document. Standards also drive institutions to invest in high-quality equipment to reach the required quality standards.

2. **Advocacy**: strong advocacy has played a crucial role in securing funding and attention for digitisation projects in the USA. Key figures like Rebecca Wack at the New York Public Library help to successfully communicate the importance of digitisation to decision-makers, resulting in sustained investment and support. A history of internal advocacy has also led to decision makers starting to understand the importance of digitisation programs and invest the necessary resources.

3. **Collaboration**: the collaborative environment in the USA is another key strength. Institutions regularly participate in conferences such as The Society for Imaging Science and Technology (IS&T), workshops, and roundtables, such as those hosted by Digital Transitions. This networked approach has accelerated the development of digitisation techniques and ensured that knowledge of best practices is widely disseminated.

6.2 Comparison of Digitisation Practices in the UK vs USA

USA: the USA has developed a unified approach to digitisation, driven by strong advocacy and the establishment of national standards like the FADGI. These standards provide a clear framework for institutions to follow, ensuring consistency in the quality of digitisation across the country. Moreover, the USA has cultivated a culture of collaboration, with regular conferences, and institutions sharing knowledge, resources, and expertise.

UK: in contrast, the UK's digitisation landscape is characterised by a wide range of practices, with no clear consensus on standardisation. Some institutions embrace advanced digitisation techniques while others use outdated technologies, or do not digitise at all – generally due to a lack of funding. This inconsistency can lead to challenges in both the quality of digital assets and the ability to compare digital assets across institutions. The lack of a national framework and standards makes it difficult to know how effectively we are preserving our cultural heritage in the UK.

6.3 Improving UK Digitisation – Actionable Next Steps

1. **Collaboration and Knowledge Sharing**: large UK institutions with high-quality digitisation programs need to share their practices in a more open fashion to foster national collaboration, either by attending already established conferences, or creating a national UK-based conference focused on digitisation to bring together experts within the UK, as well as from around the world. This event could serve as a platform for knowledge sharing and collaboration between larger and smaller institutions. This could also form a working group in the UK for digitisation practices, and help with standardising efforts.

2. **Targeted Advocacy**: institutions and the individuals within them need to become more proactive in advocating for digitisation to be a necessity. This involves not only making the case for digitisation internally but also engaging with stakeholders, as well as government agencies and private donors to attract funding. The success of advocacy efforts in the USA, such as those seen at the Library of Congress, demonstrates the importance of persistent and targeted advocacy. The conversation around digitisation in the UK needs to change from where it is a secondary objective, to one where digitisation is a primary and essential goal for all museums and institutions.

3. **Adoption of Imaging Standards**: institutions across the UK need to make digitisation standards the norm. FADGI, Metamorphoze, or ISO standards all provide good options, but consistency across the industry is important. With more collaboration common standards should emerge, and this will improve the overall quality and validity of digitisation efforts.

4. **Funding Campaigns**: launch campaigns to secure funding for digitisation projects. This could involve partnerships with private donors, government agencies, and cultural heritage organisations – highlighting the importance of preserving the UK's history for future generations.

5. **Investment in Community Projects**: following the example of community-driven programs in the USA, UK institutions should explore partnerships with local communities to create digitisation projects that serve both institutional and public needs. This could involve partnerships with universities, libraries, and local museums to create accessible digitisation labs and resources. These projects can democratise access to digitisation services, allowing communities to preserve their own histories and contribute to the national narrative. Granting access to resources owned by larger institutions to allow access for smaller digitisation efforts will help to preserve parts of our national history. These projects not only expand the reach of digitisation efforts but also foster a sense of ownership and pride in preserving cultural heritage.

6. **Develop Training Opportunities**: as the digitisation sector grows, there will be a need for highly skilled operators. Operator training programs should become more widely available, catering for in-person and online options, for practical and theoretical aspects.

6.4 Summary of Key Factors for High-Quality Digitisation Programs

Key Area	Recommendations
Imaging Standards	Choose a standard to work to. Options include FADGI, Metamorfoze, or ISO. Minimum thresholds for resolution, colour accuracy, and metadata.
Workstation & Location	Use heavy metal tables to minimise vibrations; ideally place digitisation stations in basement rooms with concrete floors.
Camera Technology	Invest in professional medium-format camera systems (e.g., Phase One, Hasselblad); tether cameras to computers; ensure sufficient computing power and local storage.
Lighting	Use consistent, high-quality lighting (LED or strobe); choose lighting based on object degradation risks and budget; ensure proper diffusion and CQS value.
Colour Management	Use object and device level targets to calibrate colour, resolution, dynamic range, and other image quality aspects.
Operator Training	Implement stringent training programs, often with certifications and ongoing development; prioritise technical/scientific expertise.

Workflow Efficiency	Establish a RAW file workflow with standardised processes for image capture, post-processing, and quality control.
Archival File Formats	Choose suitable long-term file formats (e.g., TIFF, JPEG2000); consider longevity, compression, metadata, and OCR compatibility.
Infrastructure & Support	Maintain robust data storage, perform regular equipment/software updates, and ensure staffing retention through training and quality working conditions.
Community-Driven Projects	Engage local communities by providing access to digitisation labs for preserving local heritage, following successful US models.
Accessibility & Inclusion	Use digitisation to democratise access to collections, incorporating features such as audio descriptions and interactive content.

6.5 Funding

The fundamental issue that most institutions face when making decisions around digitisation is how to allocate resources. The process of budgeting often makes it difficult to convince higher management to invest in new areas, when a budget is already spread across other areas. Most will have modest budgets for photography and digitisation that are maintained every year, which is usually overshadowed by other larger allocations to running costs, staffing, maintenance, and marketing budgets. There needs to be a shift in the mindset from short-term costs to longer-term strategies, as there has been in the USA. For example, some UK museums will allocate funding to ad hoc digitisation where collections are photographed in parts. Per month and per year, this may seem like a modest cost, but when looking at a cost-per-object value for digitisation it may be very expensive. Due to the ad hoc nature, workflows aren't particularly efficient, usually involving setup times on the day, and photography is often conducted by different specialist contractors, rather than employed staff, due to the skill required.

In a more structured digitisation program, with dedicated workspace and staff, the digitisation process can be efficient, and cost per object significantly reduced through high output of images per day, on more regular days. The initial cost for setup may be high, but this is the only real way to maintain consistency in a digitisation project. How much funding is required will be determined by the quality of digitisation that is aimed at. A high-quality, preservation grade, digitisation setup may cost in the region of $100,000 or more, and adding in staffing costs will far exceed that over time. However, if we look at the project as a long-term 10-year project, the cost per object digitised becomes far lower than that of ad hoc digitisation.

Some projects and contracts in the USA have ranged from $500,000 to $1.6m in cost but have yielded hundreds of thousands of preservation-grade assets that can last indefinitely. These projects bring the cost per object down to between $1 and $2 compared to ad hoc projects that may cost $5 to $10 per object. Similar results may be obtained from more budget conscious options, but overall to maintain quality and cost per object, significant investment is required.

One option to obtain this funding is through donors and philanthropic organisations. With clear actionable goals, and a driving philosophy of preserving historic cultural heritage, donors may be attracted to invest. Government agencies may also be lobbied to allocate funding to such things when they are in the national interest. There are also options for licensing assets to recoup some of the upfront costs. Publications and researchers will often license high-quality images from museum digitisation records, and the highest quality digitisation will attract more of this income. This must, however, be weighed up with the democratisation of cultural heritage, for example, assets should be made available for free for educational purposes.

6.6 Final Thoughts

The UK has a rich historic cultural heritage, unlike any other country's, but this legacy could be vulnerable without proper forethought in our approach to digitisation. An increase in quality and scope of digitisation in the UK will lead to greater preservation and accessibility of cultural heritage for future generations. Most museums are beginning to embrace these technologies, and good work is being done in some larger institutions, but there is still a lot of work to do. We must strive to make these practices more universal. If we do not, we risk losing parts of our cultural history. High-quality digitisation should be an obligation for museums to fulfil. If we lose objects to degradation before we have digital copies, they will have failed their major objective. Institutions must look beyond immediate financial constraints, and think about the part they have to play in documenting history. In the coming centuries, future generations will use the resources that are being created now to look back and gain insights into human history, long after the physical objects or documents are gone. Cultural heritage institutions need to take their obligations seriously, to increase accessibility and democratisation of important materials, while also ensuring their digital preservation to secure our cultural legacy for the future.

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