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The Three Pillars of Authenticity for Heritage Digitization

By the Digital Object Authenticity Working Group (DOAWG)

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Introduction

Abstract & Audience

This document discusses increased concerns around authenticity in the dissemination of digitized physical collections such as drawings, books, paintings, and photographic materials. Issues around authenticity are not new to heritage institutions, but advances in AI as well as a trend toward decreased trust in institutions have exacerbated them. We propose three pillars of authenticity as it relates to digitized physical collections – origin, visual accuracy, and context. These pillars should be well understood by cultural heritage digitization stakeholders working in galleries, libraries, archives, and museums (GLAM), including program heads, data asset managers, and any other institutional decision-makers who influence what and how information is shared with users.

The audience is presumed to have strong familiarity with the goals and stakeholders of heritage digitization. We seek to empower them with a better shared understanding of what authenticity challenges affect our field, and what our community needs in order to best address them.

Corollary documents include:

- **CAI for Heritage Primer (2024)**: For both CAI technologists to better understand heritage, and for heritage to better understand CAI technologies. Written for a general audience.
- **DOAWG Recommendations for Authenticity (under development; 2026)**: Granular and technical implementation details for authenticity in heritage digitization. Written for a technical audience, especially those developing tools and standards therefore.

The two main goals of this document are to begin a productive conversation around what defines authenticity in heritage digitization and to foster community engagement, especially as this document will serve as the foundation for the DOAWG Recommendations for Authenticity. We aim to inform policy makers about the complexities of still image authenticity, but do not prescribe or endorse any specific technologies. DOAWG is a community initiative. It is not our role to prognosticate or mandate, but to act as a facilitator of community discussion, and as a strong advocate for our shared work within broader technology and cultural contexts. Accordingly, we encourage the continued engagement and collaboration of the community as we proceed with this essential work. We warmly welcome your comments, criticisms, and suggestions.

Scope and Context

In this document, we will primarily discuss cultural heritage imaging, or digitization, as the process and practice of creating still image representations of physical objects using technologies such as cameras and scanners. Still image capture is the most common and widespread type of digital imaging practiced by GLAM institutions on a programmatic level, and it is also the most mature aspect of imaging with regards to standardizing workflows, processes, and color management. Audiovisual digitization, 3D imaging, and multispectral imaging are also important and interrelated aspects of this work; however, these types of imaging require their own specialized and dedicated consideration that is currently outside the scope of this working group.

Cultural heritage institutions such as galleries, libraries, archives, museums (GLAM) share a mission to make knowledge accessible to all people. One of the core activities of these entities is to collect physical materials that enhance the learning potential of their organization, with these "artworks, books, documents, and artifacts all effectively becoming 'information resources'".[1] Historically, the initial drivers for creating digital representations of physical materials were access (being able to look at something far away without the need to hop on a plane) and digital preservation (creating "safe" digital-asset copies of physical collection holdings).

[1] Wikipedia contributors, "GLAM (cultural heritage)," *Wikipedia, The Free Encyclopedia,* https://en.wikipedia.org/w/index.php?title=GLAM_(cultural_heritage)&oldid=1333698287 (accessed January 21, 2026).

Evolution of the Field

Imaging physical objects in GLAM collections is a decades-old practice; cultural heritage professionals have been using representations long before digital imaging became the default, from conservators recording work done on collections objects to libraries providing wider access to newspaper collections on microfilm. However, programmatic digitization has developed into a discipline in its own right hand-in-hand with institutions increasing their online presence and audiences, exhibition designers embracing multimedia storytelling techniques, and heritage professionals embracing new ways to preserve rare and often fragile materials.

The need to create digital representations that capture the physical object as faithfully as possible has driven professionalization in heritage digitization, including the technological development of specialized equipment like archival scanners, reprographic copystands, targets for accurate color management, and specialized processing software. It has also driven increased training and development of staff with specialized knowledge and skills that often combine professional expertise in archival science, photography, color science, conservation, fine art, and a host of other cultural disciplines.

With such broad skillsets and backgrounds, the cultural heritage imaging community is a rich and creative amalgamation of thought leaders and practitioners, with regular exchanges of information and ideas through conferences, webinars, scientific journal papers and monographs, among others, in addition to the innovations happening in individual imaging labs and studios. Many digitizers have historically been trained on the job, though there is a growing effort around creating degree or certificate programs to formalize and recognize the unique accomplishments inherent to digitization as practice. Production coordinators and digitizers must have a deep understanding of the materials they strive to represent, and a dedication to the faithful capture and communication of their myriad physical and intellectual qualities.

Modern digital objects are more than just a stand-in or surrogate for their physical counterparts: they are sophisticated digital entities that consist of accessible high-resolution visual, textual, and other data that can be used in an endless range of research and education projects. As unique and storied cultural heritage artifacts, digitized materials can also inspire a sense of awe and wonder. These digital objects stand alongside and enhance, but do not replace, their physical counterparts: the two are interrelated, and while the digital object offers an aspect of the material one, they also each contain their own contexts and histories. The emerging concept of the *Memory Twin* seeks to create a way to refer to this cumulative aggregate of different representations of cultural heritage objects and sites, and to recognize how they come together to enrich our understanding of the whole.[2]

Standards around digitization tools, methods, and best practices are constantly evolving, and necessarily iterative as technology continues to improve, but one largely agreed upon

[2] "From Digital Twin to Memory Twin: A New Horizon for Cultural Heritage," Digital Heritage Research Lab, April 5, 2025: https://digitalheritagelab.eu/from-digital-twin-to-memory-twin-a-new-horizon-for-cultural-heritage/

benchmarking method is the Federal Agencies Digital Guidelines Initiative (FADGI) which is "a collaborative effort started in 2007 by federal agencies to articulate common sustainable practices and guidelines for digitized and born digital historical, archival and cultural content." (https://www.digitizationguidelines.gov) It is important to note that while standards and guidelines outline best practices, imaging practitioners, curators, and subject specialists at GLAM institutions must also follow their intuition and use subjective observation in order to ensure that resulting images capture and express noteworthy attributes, whether or not they are defined under existing capture parameters. For example, top-down photography might not make a particularly hefty bound volume's depth clear, but including a shot of the spine or an isometric three-quarter angle image in the file set quickly remedies this oversight.

With this blend of science-based precision methodology and artistic, humanistic understanding of the many different representational needs a particular object may have, it is no wonder that the heritage digitization field has struggled to agree upon a way to present digital object metadata and paradata to users. While knowledgeable practitioners who are deeply embedded in the field may have a feel for the quality of a digital representation, without a way to communicate about how that representation is made, even that expert has a limited understanding. As digital objects become an increasingly common way for the public to encounter heritage objects–indeed, sometimes they are the only way for users to encounter certain objects–a deeper understanding of those representations is necessary.

Users are entirely at the mercy of diverse institutional practices when it comes to viewing materials that illuminate our knowledge of the world; one university's digital collections discovery system may be substantially different from that of a museum or local archive. Even within institutions, collections are often processed to different standards. While imaging programs obviously cannot address this much-wider problem in the cultural heritage field, perhaps they can solve at least one part of the problem in tracing the authenticity of digital representations.

Defining Digital Object Authenticity

The *Dictionary of Archives Terminology*, an archival lexicon created and maintained by the *Society of American Archivists*, describes digital objects as “information in binary form and its associated metadata,” and lists the synonyms data objects, digital assets, information objects, and information packages.[3] Digital representations–a specific subset of digital objects–are DOAWG’s main focus. In a digital representation of a cultural heritage object, what needs to be understood by users, and how can we best convey this information to them? We believe that these questions are best answered by turning to a three-pronged approach to authenticity: provenance, visual accuracy, and context.

Provenance

First, and most basically, is the provenance of the digital representation. Who created this file and what technology was involved? Has the image or metadata been significantly altered since its initial creation? In short, can a user trust that the visual contents of that file and the information about it are what they say they are? For example, if a user views an image of a religious icon shared on a museum’s social media page, what resources do they have to verify that the image is of a genuine physical object rather than an AI-generated rendering? What resources do they have to understand whether or not the image has been altered? This aspect of authenticity is currently the most widely-considered amongst GLAM institutions as well as other groups concerned with trust in media, including the Content Authenticity Initiative, the Trust in Archives Initiative, and others. It applies to all forms of digital objects, not just digital representations of physical items.

Visual Accuracy

Secondly, we are interested in the visual accuracy of the digital representation, which is where the conversation becomes specific to the heritage imaging field. The main question here is how well the representation, or representations, correctly and accurately depict the physical object. (example here) A tremendous amount of work has gone into color management and workflow practice already, but this remains a difficult metric to clearly relay to end users. Moreover, as the cultural heritage imaging field has professionalized over many years, the number and quality of representations held by institutions varies greatly and it often proves difficult for staff and end users alike to analyze and decipher the relative visual accuracy of any given file.

Context

Lastly, we are invested in the need to establish the context of digital representations as they relate to physical objects. There can be many factors involved in creating a digital representation of a physical object that are not obvious, or even knowable, to end users without context often not found in standard image metadata fields. For example, a digital representation of a glass plate negative is often indistinguishable from a digital representation of a black-and-white print. There are also more complex use cases, for instance focus-stacking

[3] Dictionary of Archives Terminology, https://dictionary.archivists.org/entry/digital-object.html.

multiple images to produce a more accurate representation of a three-dimensional object. We believe that by implementing standardized language and processes to relay the context of still image digital representations, institutions greatly aid their audiences in gaining a full and meaningful understanding of the digital object they are interacting with, especially when that object is standing in for the real thing.

It is important to note that in our view, these three pillars of authenticity must be understood in tandem to truly establish a clear understanding of digital representations, and professional expertise must inform each of these markers of authenticity.

Provenance

Defining Provenance in Heritage Digitization

Provenance is the first of the three pillars of authenticity for digitized physical still image collections. Provenance for still images has many definitions and complexities. From an archival standpoint, provenance is "a fundamental principle of archives, referring to the individual, family, or organization that created or received the items in a collection."[4] Historically, provenance is complicated by global issues including colonial collecting and when "creating digital collections from analog materials whose provenance is disputed or more complex than existing descriptions or metadata suggest."[5]

For the purposes of still image authenticity, provenance refers to the chain of custody that starts when the digital file was originally captured at digitization. Provenance encompasses ways to identify the source of an image and methods for verifying and detecting original image tampering and alteration since digitization. From a policy standpoint, digital provenance is not established to *create trust*, but to extend *existing trust* in institutional sources. If a user does not trust the authenticity of a digital image, they are likely to distrust the source institution. If users do not trust the still image's source, provenance for authenticity is irrelevant.

Ways to Assert Provenance

There are several tools that can be used to assert provenance:

- **Links:** A direct path back to the original source.
- **Captions:** Text labeling on, near, or seen via user interaction (e.g. mouse hovering, clicking a drop-down pane).
- **Metadata:** Data about data, usually embedded into the file itself.
- **Watermarks:** Data placed on or into the image content, potentially invisible (e.g. brand logo, copyright text, password).
- **Cryptographic Signing**: A mathematical way to verify and detect if an image was tampered with or altered by signing the data (the bits that make up the image) with an algorithm (e.g. place a digital analog of a maker's mark or legal name).

These provenance assertion tools have varying ease of use, standardization, adoption, and robustness to intentional or unintentional misuse and abuse.[6] They can also impact other institutional priorities such as open access.

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[4] Society of American Archivists, "Provenance", Dictionary of Archival Terminology, January 18, 2026, https://dictionary.archivists.org/entry/provenance.html.
[5] Clara Drummond, Director of Northwestern University Libraries Special Collections and Archives
[6] Monitoring methods for anti-abuse and misuse enforcement of these tools are available, but outside the scope of this document.

Viewing Modalities

Where and how the image is viewed is the most significant factor in digital provenance. There are three major modalities in which a digitized asset might be presented to a user: websites, personal distribution, and print. Each has a significant impact on the tools available to assert digital provenance thus impacting user engagement and their trust—or distrust—of the source and digital image.

Websites

When the digitized asset is hosted on a website, that website may be directly controlled by the source of the image producing little ambiguity about its provenance[7] or the image may be found on a third party website where more effort is needed to maintain provenance.

On a third party website–whether it is a search engine, social media site, or personal blog–typical use of digital images involves creating a copy of the digital image on a third party server and often involves users reposting or sharing within and across disparate platforms.

All of the tools (Links, Captions, Metadata, Watermarks, and Cryptographic Signing) have web accessible components and, as we'll discuss in the Tools section, each of them have strengths and weaknesses to forge and maintain digital provenance.

Personal Distribution

When an image is passed directly from one person to another, the level of effort to maintain provenance is high. This can be the case when an image is sent by email, social media messaging platforms, or text message.

Print

An image printed and displayed in physical form requires the highest level of effort to maintain provenance. Whether it's a paper sign stapled to a wooden pole, or an image printed in a prestigious magazine, the digital tools such as links and embedded metadata are entirely lost and the only tools that can be passively maintained are visible watermarks and captions.

[7] There are two notable exceptions: spoofing and hijacking. Neither spoofing nor hijacking have been prevalent in the heritage field so far, but AI technologies are anticipated to decrease the cost of these code-based attacks, making them easier to deploy and increasing risk.

Technological Tools

There are many tools for asserting provenance, with varying strengths and weaknesses.

Tools	**Strengths**	**Weaknesses**	**Notes**
Links	● Highly visible ● Provides context ● Easy to use	● Fragile ● Unreliable	Broken links or links to other than authoritative sources are major issues
Captions	● Rich metadata ● Familiar format ● Flexible	● Unstructured ● Limited to site	Captions provide a lot of freedom for better source description but are not consistent in structure and not persistent
Metadata	● Structured ● Portable ● Multi-Source	● Fragile ● Limited	Embedded metadata can easily be stripped and is sometimes limited by the nature of its structure.
Watermarks	● Persistance ● Traceability ● Deterrence	● Interference ● Opaque ● Tool dependency	Visible and invisible watermarks both have downsides and rely on a tool for consistency.
Cryptographic Signing	● Tamper evident ● Transparency ● Standards based	● Reliance on Keys ● Maintenance	Signing relies on key technology and maintenance.

Links

The first and most robust tool of provenance is to link back to the original source because the source proves its authenticity. Links (especially those that appear in the form of a clickable, familiar icon, the entire image itself, or underlined word in a caption) are highly visible and easily used by the viewer. Viewers can directly examine the image at the source, and if desired, compare it to the version they started at.

Links as provenance are limited when the source itself is not in control of there being a link or if it connects to something other than the authentic source of the image: Party A can take an image from Party B and then Party C can post that image and link to Party A as the source.

Captions

Captions with information about the source can be persistent within a website or other viewing experience, adjacent to the image, or made accessible via user interaction (e.g. clicking a drop-down, mouse hovering over an image). . Even if caption text is not read, automatic translation and screen reading tools can access it.

Metadata

Administrative metadata (data like file type, access rights, creation date, camera equipment) is embedded by the imaging equipment or added by digitizers. Metadata helps manage the data governance and access controls. There are several metadata standards that allow a Creator or Source or other related field to be written into the file that is then retained upon download. Some browsers and/or operating systems (Mac OS) will also automatically add metadata to the downloaded file describing when and from where it was downloaded. This may or may not be the ultimate source in terms of provenance.

However, metadata is often stripped when uploading to a website, and is always stripped when a screen grab tool is used to capture the image. Unintentional loss of metadata is an issue and there are widely used tools to remove metadata. Bad-faith actors can inject false or misleading metadata into an inauthentic image.

From an average user's perspective, metadata and paradata (metadata about the technical specifications of the still image) can be challenging to locate in the file properties unless they know how to find it.

Watermarks

A watermark is a visual representation of the source imposed onto the image content itself. This approach has analogies in the pre-digital era with the use of physical watermarks on historical documents or artist signatures.

The primary advantage of watermarks is passive preservation. Watermarks remain with the image when it is downloaded, uploaded, or shared peer-to-peer unless someone takes specific action to remove them. This contrasts with metadata, which is often stripped without user action, and captions or links, which must be actively carried forward when an image is removed from its source.

Traditional visible watermarks include logos, text, or other identifying marks intended for human viewing. They can be placed over the image area, making them less likely to be cropped out but obscuring content, or can be placed on an extension of the canvas. Visible watermarks can also directly link to a website of origin using a short text URL or QR Code with potential aesthetic cost.

Invisible watermarks use mathematically generated perturbations that are invisible to the standard human viewer but can be read digitally. This approach preserves the full visual quality of the image while maintaining provenance information that can be detected and verified by specialized software.

Cryptographic Signing

Cryptographic signing uses mathematical algorithms to digitally sign a file, creating a verifiable record of its provenance and providing for detection of any subsequent tampering or alterations. This is a mathematically-based method with built-in verification/detection potential. The Coalition for Content Provenance and Authenticity (C2PA) has developed an open technical standard that embeds "content credentials" into digital files, allowing institutions to assert authenticity and enabling end users to trace an image back to that assertion. When a heritage institution signs an image using C2PA, any modification to the image content or metadata after signing will be flagged as occurring after the institutional signature, clearly distinguishing authorized versions from altered ones.

Unlike other provenance tools, cryptographic signing is passively preserved and mathematically secure—it cannot be forged or removed without detection. The technology works similarly to online banking security: institutions use a private key (like invisible ink) to sign their files, and anyone can verify that signature using a public key (like a special flashlight) registered with a trusted Certificate Authority. This means that while bad actors can still create fake images and claim they come from an institution, they cannot cryptographically sign those fakes as if they were the institution. C2PA also allows institutions to embed additional metadata—such as image quality analysis results, spectral documentation, or information about post-processing steps—that is cryptographically locked alongside the image. For a comprehensive overview of how C2PA technology can be applied specifically to heritage digitization workflows, see the DOAWG publication "Content Authenticity Initiative for Heritage – A Primer".

Enforcement

From a provenance perspective, enforcement is concerned with:

- copyrights
- data protection and privacy laws – notably the *General Data Protection Regulation (GDPR)* and its Article 17 the "Right to Erasure" or "Right to be Forgotten" (Data subjects –in this case subjects in still images– can request the photo be removed from public access)
- *Digital Millennium Copyright Act* (DMCA) take down requests (USA law where users/copyright owners can assert their copyrights and have stolen content that was published unauthorized to a third-party website)[8]
- emerging regulations on Generative Artificial Intelligence (GenAI) algorithms and tools (e.g. ChatGPT, Claude, OpenAI)

[8] "The Digital Millennium Copyright Act," Copyright.gov, accessed January 22, 2026, https://www.copyright.gov/dmca/.

Creators own copyright over their material full stop. Still images do not need copyright statements attributed to them in order for copyright to apply. Generally, copyright information is watermarked to still images as a best practice. Note that current USA copyright law does not protect metadata[9], which is relevant to emerging GenAI global regulations and laws. There are currently no comprehensive federal or national laws regulating Artificial Intelligence. The Internet as a whole was used as training data for GenAI tools, which international courts are currently deliberating whether or not that is a breach of copyright of the original content owners.

There are also ethical and cultural protocols that cultural heritage institutions should consider for enforcement in terms of take downs and metadata. Colonial collecting leading to the mass systemic erasure, looting, and stealing of Indigenous knowledge, bodies, and data also impacts provenance; since the 1990s there is mass movement to rectify descriptive metadata including authorship/creator and return ownership/enforcement rights over to Indigenous communities. For example, in many Indigenous cultures faces of the dead should never be displayed and those still images should be treated accordingly.

Implementation and Maintenance Costs

Heritage institutions rarely build technology and IT systems maintenance and repair costs into their budgets for reasons like competing priorities, the high cost of licensing content/collections, or institutional priorities. Costs (e.g. licensing, cloud hosting, staffing, skilling up, new equipment) for maintaining and repairing IT systems, tools, and databases are a practical consideration for provenance.

Prior to the GenAI boom around 2021, cloud-hosting infrastructure was relatively cheap compared to buying and maintaining onsite servers. Simultaneously, hosting costs were cheap because web crawlers--robots that indexed the Internet and made our online content searchable--took up little server bandwidth. Now, estimates argue that GenAI crawlers–robots who take snapshots of our web content to train GenAI–make up over 70% of web traffic effectively driving up hosting and storage costs for institutions.[10]

Technologically, institutional websites have no long-term strategies to fully stop or effectively slow down GenAI crawlers and it's an issue the courts need to address. Policy-makers should expect more frequent server crashes and higher costs that might spike per month. This will impact internal and external access, search, and findability of still images.

Cloud-hosting is still considered the best model for cutting IT systems costs. Institutions could also enter into cost-sharing agreements with peer institutions using similar technologies like IIIF.

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[9] Maureen Whalen, “Rights Metadata Made Simple,” in Murtha Baca (ed.) *Introduction to Metadata* (Getty Publications, 2016). http://www.getty.edu/publications/intrometadata/rights-metadata/.
[10] Starchy Grant, “Keeping the Web Up Under the Weight of AI Crawlers,” EFF, June 5, 2025, https://www.eff.org/deeplinks/2025/06/keeping-web-under-weight-ai-crawlers

The Effect of Provenance on Trust

Provenance does not *create* trust, but rather extends it. Provenance is the pillar of authenticity most actively being worked on by a variety of interested communities of practice, like C2PA, and industries like insurance, art sales, and news and media.

Individuals and institutions will assume that images posted to a publicly accessible website can be found somewhere else on the Internet. The provenance tools used during the image's creation and in the viewer will determine whether that reposted image maintains a chain of provenance; whether the user is exposed to that chain of provenance; and if the provenance can be verified and trusted by the user.

Visual Accuracy

Defining Visual Accuracy in Heritage Digitization

Visual accuracy is the second pillar of authenticity for digitized physical still image collections. This defines how closely the experience of viewing the digital hems to the experience of viewing the physical object, sometimes referred to as technical image quality or verisimilitude.

The heritage digitization community has, over recent decades, developed a fairly sophisticated ecosystem of standards, physical targets, software, and shared understanding over the technical components of visual accuracy. However, this understanding is not shared with the general public or other consumers of the digital objects and the evaluation of image quality is typically not passed to the viewer in any meaningful way.

How Visual Accuracy is Measured During Digitization

Technical image quality is a measure of how well the digital object comports to the physical original as measured by technical imaging metrics such as:

- Tone
- Noise
- Color
- Details
- Geometry

In practice assuring a desired level of image quality relies on standards, targets, and software.

The Standards

Several standards exist used for the evaluation of technical image quality specific to heritage digitization. Among the most used are colloquially known as FADGI and ISO. The intended audience for these are cultural heritage digital imaging professionals and those who will be planning, managing and approving digitization projects.

- **FADGI:** The U.S. Library of Congress has developed an openly published guideline called the *Technical Guidelines for Digitizing Cultural Heritage Materials* within its Federal Agency Digital Guideline Initiative. This document defines software and targets used to measure technical image quality and four levels of quality that the results can fall into (1-star to 4-star).[11]
- **ISO:** Similarly, the International Organization for Standardization (ISO) has published *ISO 19264-1, Photography - Archiving systems - Imaging systems quality analysis - Part*

[11] Federal Agency Digital Guideline Initiative, *Technical Guidelines for Digitizing Cultural Heritage Materials*, 2023, https://www.digitizationguidelines.gov/guidelines/FADGITechnicalGuidelinesforDigitizingCulturalHeritageMaterials_ThirdEdition_05092023.pdf.

1: Reflective Originals.[12] It similarly defines metrics of technical image quality but provides three levels of quality that the results can fall into (A, B, or C).

The Targets

To measure performance of image quality these standards call for the capture of known physical targets. Device Level Targets are large targets that take up most of the capture area and can be used to holistically benchmark the digitization system. Object Level Targets are long/narrow targets that sit alongside the object and provide a more limited reference point, but one that is present for every capture.

These targets have known physical tones, colors, dimensions, and levels of detail. The digital object of the target can be compared to its known characteristics to determine the objective numerical degree to which it is visually accurate.

The Software

Image Engineering IQ Analyzer X, Zeutschel OS QM-Tool, ImageZebra, Phase One NimbusQA, Image Science Associates Golden Thread NXT, Digital Transitions NEXUS, Open DICE and the RIPT - Rijksmuseum Image Performance Tool are current softwares that provide image quality analyzes in the cultural heritage domaine.

Currently, all of these software packages generate reports in different formats, some as only human readable PDF, and others as JSON machine readable formats. DOAWG is actively working to establish a consensus standard format for the output results of such software. The goal is that independent of the software in use, the results report can be used downstream (e.g. in reporting or communication to the user).

How Visual is Communicated to End Users

Both the FADGI Guidelines and the ISO 19264-1 standard has its own dedicated systems of image quality categorization. The FADGI Guidelines uses a star rating system, one, two, three and four stars, with the four stars as the highest quality rating. Generally, FADGI suggests that three-star specifications are appropriate for most uses. The ISO 19264-1 standard uses the international grading scale, C, B and A, with the A as the highest quality rating. Grade B is generally considered acceptable for most uses.

Technical Metadata

The FADGI Guidelines and the ISO standard 19262 *Photography - Archiving Systems - Vocabulary* and the ISO Technical Report 19263-1: 2017 *Best practices for digital image capture of cultural heritage materials* are describing aspects of technical metadata and technical

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[12] ISO 19264-1:2021,Photography - Archiving systems - Imaging systems quality analysis - Part 1: Reflective Originals, 2021, https://www.iso.org/standard/79172.html.

process metadata.[13][14] In addition the *ANSI/NISO Z39.87 Data Dictionary - Technical Metadata for Digital Still Images* chapter 9.3.4 Performance Data give guidance of a logical structure of target data.[15] The ISO standard refers to "*the results of the image quality analysis may be embedded in the image test file together with the technical metadata and saved for future reference..*"[16]

Because only cultural heritage imaging professionals are aware of these dedicated systems with its rating and grading scale, there is an urgent need to communicate the image quality to the end user in a clear and understandable way. The use of common language in addition to the established systems could be a way to go: high quality, fair quality and insufficient quality.

IIIF Display Templates

The IIIF - International Image Interoperability Framework is a widely used global set of standards for displaying, searching, comparing, annotating, and viewing digitized still images. Users view assets and data in embeddable interfaces called IIIF Viewers; common IIIF viewers include Universal Viewer and Mirador.[17] IIIF packages data about a digital object in a IIIF Manifest , a model that presents objects (data and metadata) in a standardized, interoperable way. The Manifest allows compatible software such as viewers and annotation tools to load and present complex digital objects on the web from thousands of different providers. The purpose of the IIIF Presentation API specification is to provide a model and JSON serialization format of that model.[18]

Displaying image quality analysis results in the IIIF Manifest either with the use of the IIIF Presentation API or via the use of a IIIF cookbook will extend the potential usage and understanding of image quality results. Visualization of the results and the use of common language has been addressed in a proof of concept project and feedbacks from the cultural heritage community are awaiting for finalizing.

IPTC

The International Press Telecommunications Council (IPTC) is a global standards body of the news media. The IPTC Photo Metadata Standard is the most widely used standard and provides a standardized format for embedding metadata. It structures and defines metadata properties that allow users to add precise and reliable data about digital objects such as cultural heritage images. By embedding metadata to the digital object file, the potential of future system migration failure could be prevented. The risk of stripping of metadata in digital assets management systems and digital presentations systems is one of the aspects that the cultural

[13] FADGI Guidelines, 8.4.4 Technical, https://www.digitizationguidelines.gov/guidelines/FADGITechnicalGuidelinesforDigitizingCulturalHeritageMaterials_ThirdEdition_05092023.pdf
[14] ISO 19262:2015 Photography Vocabulary chapter 3.159.4 Technical metadata
[15] ANSI/NISO Z39.87 Data Dictionary - Technical Metadata for Digital Still Images
[16] ISO/TR 19263-1:2017 Chapter 7: Technical metadata for image quality analysis
[17] "Get Started: IIIF Viewers," accessed February 2, 2026, https://iiif.io/get-started/iiif-viewers/
[18] Presentation API 4.0 Properties, IIIF, https://preview.iiif.io/api/prezi-4/presentation/4.0/model/

heritage community has to consider. From a sustainable and long term preservation perspective this is a significant factor in IPTC's advocacy for embedded metadata.

Fortunately, work is currently in progress to improve options for embedded heritage imaging metadata. The cultural heritage community identified the need to establish a new set of image quality results metadata fields in the IPTC Photo Metadata Standard. DOAWG is actively working together with the IPTC Photo Metadata Working Group to materialize this in a proposed schema for the upcoming update on the IPTC Photo Metadata Standard this year.

Monitor Calibration Explainers

Computer monitor calibration settings impact accurate color display which affects visual accuracy. Computer monitors can adjust their brightness, contrast, and color balance using display calibration tools that build ICC profiles describing the individual computer's specifications. There are those built into Windows and Mac operating systems (OS) or hardware spectrometers and colorimeter instruments that attach to the monitor to calibrate like DisplayCAL. Institutions can consider adding metadata disclaimers to webpages indicating color accuracy may vary depending on your monitor and/or to recommend calibration. Alternatively, institutions can add a widget allowing users to change their gamma settings from the webpage.

The Effect of Visual Accuracy on Trust

The pursuit of visual accuracy is not one of technical pedantry or elitism. A digital object with insufficient visual accuracy can lead to false interpretations or understandings of the physical object. In turn, this lowers the trust of the user that they can rely on the digital object rather than needing access to the original physical object.

Moreover, when an institution's understanding of the level of visual accuracy is not clearly communicated to the user, they may make incorrect assumptions about that accuracy.

See Case Study in Visual Accuracy for examples where low visual accuracy would lead to a misinterpretation or misunderstanding of the physical object.

Context

Defining Context in Heritage Digitization

Context is the third pillar of authenticity for digitized physical still image collections. Context is perhaps the most complex pillar of digital object authenticity given that it can cover a range of object types, imaging purposes, and even philosophical outlook. Provenance and visual accuracy also add context to the digital object; however, for the purposes of our three-pronged authenticity philosophy we are defining contextual authenticity as the information that is not easily captured through technical metadata (like provenance) or inherently measurable (like visual accuracy). The purpose of contextual authenticity is to inform the viewer about otherwise unseeable or untrackable information about the object. Because context has the potential to be tremendously wide-ranging, it behooves GLAM institutions to carefully consider *where* context is captured and stored as well as *what* context is captured and stored. As much as provenance and visual accuracy, capturing certain types of context during the imaging workflow is a crucial piece of the process in order to create digital objects that can be fully understood.

Types of context range from information about the collection or the digitization project; about the object being imaged; or about the imaging workflow and postprocessing steps.

- **System-Level Context**: Context frequently captured by archivists, curators, and catalogers that is commonly held within the collection management system (CMS) or data asset management system (DAMS) above the item level. This could look like a short descriptive element in the image metadata (e.g. Item digitized as part of NEH Grant #123) or a shortened permalink to a catalog record.
- **Object-Level Context**:Information about the object being imaged including the object's original format (glass plate negative, film positive, Autochrome, etc.). This gives the viewer important information about the type of object being represented in a digital-first environment.
- **Digitization-Level Context**: Information about the workflow or postprocessing (e.g. details that a digital representation was created using focus-stacking, stitching separate images together, or algorithmic color restoration). This is helpful to users and institutional employees working on objects in the future.

Reconstructing context using previous versions of digital objects is also informative. Value can be added by making previous versions of digital objects visible and accessible, rather than obscuring past versions by new iterations: what was done differently, and what is the same? Researchers interested in the historiography of digitization may make observations about not only the tools and techniques, but the changing priorities and values of later methodologies. For example, microfilm has different characteristics than high end photography, oversized sheet feeders might show banding striations absent in a stitched workflow.

Digitization as Interpretation

Capture considerations, such as why the imaging of certain objects deviated from standard procedures, form a foundational aspect of digitization outcomes. Some of the choices made while considering capture protocol are defined by set guidelines, but others are in-house considerations based on material constraints and user needs. From a technical perspective, digitization is a set of curatorial choices, some of which may be undocumented. For instance, an institution with medieval holdings would choose to show a portion of each facing page rather than cropping out crucial visual information in the bindings, whereas they might crop modern theses to the gutter to prioritize online readability of text.

In most instances it is best to include all blank pages because they are part of the physical architecture of bound volumes and their existence is part of the object's story. Yet, some projects may choose to exclude blanks for efficiency or storage space. In addition to these undocumented choices, in some cases mediation was required for imaging, such as the use of tweezers to extract rolled pages from a brittle paper "band". Digitizers could include a photograph of this process to communicate contextual authenticity information about the physical state of the materials. In another example, a parchment object was too deeply creased and fragile to flatten, and the digitizers left some text obscured by necessity and not by choice. From a contextual authenticity perspective, imagery about the digitization process or notes about physicality can become invaluable aspects of the digital object's paradata.

Transparency and Institutional Responsibility

Institutions bear responsibility for making imaging decisions explicit. This transparency serves multiple stakeholders:

- Researchers who need to understand what aspects of an object a representation reliably shows
- Conservators who require documentation of object state at specific moments
- Collections managers who must track relationships between multiple representations of the same object across time

Purpose proves central to authenticity. An image captured with structural lighting for condition assessment serves fundamentally different needs than one using cross-polarized lighting for color reproduction. Neither approach is universally "correct"—each is valid when purpose-appropriate. Institutional responsibility requires making these purposes explicit rather than assuming one "neutral" representation serves all needs.

Consequences of Lost Context

When context disappears, several failures cascade: Comparative analysis becomes misleading. Researchers comparing images from different periods might incorrectly conclude an object underwent physical changes when only imaging methodology changed (for example, different lighting creating apparent tonal shifts that don't reflect actual object alteration).

Information becomes irretrievably lost. Unlike technical degradation—where corrupted files can be restored from backups or obsolete formats migrated to current standards—lost knowledge about imaging circumstances cannot be reconstructed. Attempting to deduce whether an artwork was photographed before or after conservation treatment from the image alone requires high expertise and remains fundamentally uncertain.

Archival data becomes inaccessible. When images lack documentation of physical condition at capture time, researchers cannot find relevant historical states through database searches. Current cataloging typically reflects only present condition, rendering earlier representations of different states effectively invisible to researchers who need precisely that historical information.

Semantic meaning erodes over time. Technically perfect files become mere visual records whose relationship to the physical object, whose suitability for specific uses, and whose limitations remain unknown. Archives transform from active research infrastructure into passive image repositories.

The Role of Paradata

Paradata—systematic documentation of the imaging process—makes this interpretive context authenticity chain explicit and transparent. The concept extends from the London Charter for Computer-Based Visualization of Cultural Heritage, which requires that 3D reconstructions document all interpretive decisions: what sources were used, what hypotheses were tested, why certain approaches were chosen. The fundamental principle applies equally to 2D imaging: every digital representation involves interpretive decisions that affect meaning.

Recording paradata transforms what might appear as arbitrary technical choices into transparent, documented interpretations. An operator using structural raking light isn't simply "photographing poorly" compared to one using flat lighting—they're emphasizing different object characteristics for different purposes. A condition report requires surface texture visibility; a catalog reproduction requires color accuracy. Both are valid when purpose-appropriate and explicitly documented.

Recording not just what was done but why supports contextual authenticity as well as FAIR principles (Findable, Accessible, Interoperable, Reusable), particularly the Reusable dimension.[19] Technical FAIR implementations often focus on textual or tabular data, but for images the critical question differs: not merely whether data exist and are accessible, but whether users can determine what they are suitable for.

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[19] FAIR Principles, GO FAIR, 2016: https://www.go-fair.org/fair-principles/

Types of Context in Heritage Imaging

Physical Object Context: Condition, Mounting, and Presentation

Every object undergoes various states during its institutional life: conservation treatments alter appearance, remounting changes presentation context, physical damage or deterioration affects condition, institutional decisions may even change which surface is considered "recto" versus "verso" (as can occur with double-sided paintings or drawings). Each image captures only one temporal cross-section of this biography. (See: NGP Case Study 2)

Documentation must record: Conservation state—whether the object appears before, during, or after treatment; what specific interventions occurred; whether cleaning preceded imaging. Mounting and presentation—how the object is physically configured (framed with deframing capability, permanently adhered, loose sheet, in mat or mount); whether original framing or later institutional mounting. Physical condition—current state including damage, deterioration, completeness, or fragmentary nature. (See: NGP Case Study #3 and Case Study #4)

Without this documentation, future users risk comparing images from fundamentally different epochs of an object's existence without recognizing this temporal difference. A researcher might attribute visual differences to imaging choices when they actually reflect physical changes, or conversely, might assume physical changes when only presentation methods differ.

Imaging Process Context: Lighting

Lighting choices exert the greatest influence on visual appearance among all imaging process decisions. The relationship between "objective" standard-compliant representation and interpretive lighting proves more nuanced than simple opposition suggests: institutions can comply with technical standards while simultaneously changing representation meaning through lighting decisions.

Critical aspects requiring documentation include:

- **Light source type (flash, continuous LED or halogen, daylight)** affects spectral characteristics and exposure duration, impacting potential motion blur and color rendering.
- **Light character (flat, raking, diffused through softbox or umbrella, cross-polarized)** determines the balance between surface structure visibility and tonal/color information accuracy. Raking light emphasizes texture and three-dimensional surface qualities but may suppress accurate color relationships; flat lighting or cross-polarization provides accurate tonal and color information while suppressing texture that may be essential for certain object types or research questions.
- **Light direction** affects reflection degree, their suppression, and potentially accurate rendering of decorative elements like gilding, where gloss characteristics prove significant.

- **Color temperature and spectral characteristics** influence white balance and color accuracy, requiring documentation for proper interpretation of color relationships.
- **Spectral band (visible light, UV, IR, multispectral, hyperspectral)** determines whether representation depicts surface appearance or reveals hidden layers, underdrawings, alterations, or material composition.

Imaging Process Context: Digitization Mode

The circumstances under which imaging occurs—whether in optimal controlled conditions or under practical constraints—fundamentally affect what representations can be created and what they reliably show. This context often remains invisible in final images yet critically affects interpretation.

- **Systemic Digitization** occurs in imaging labs where all circumstances affecting quality and comprehensiveness are optimized per best practice. The process aims for highest technical standards compliance and all essential documentation types (recto, verso, details, various lighting) can be obtained.
- **Ad Hoc Digitization** occurs when ideal conditions cannot be ensured due to factors such as location, physical access to materials, lighting constraints, or time and equipment limitations. Resulting representations may not meet systematic digitization standards yet may be the only documentation possible.

Recording digitization serves multiple purposes:

- Preventing false assumptions that absent representations (such as verso documentation of an installed painting) indicate those views lack significance, when actually they were simply inaccessible
- Establishing that image quality limitations resulted from practical constraints rather than technical deficiency
- Creating realistic expectations about what representations can reliably show
- Justifying re-imaging when circumstances change

Imaging Process Context: Source Type

The transformation chain from physical object to final digital representation profoundly affects interpretation. Documentation must include information about the representation's source:

- Film negative (requiring electronic inversion to positive during digitization, potentially introducing artifacts or tonal shifts)
- Slide or transparency (already positive, different characteristics)
- Direct digital capture without film intermediate (different technical properties, no analog-to-digital conversion artifacts)
- Composite creation (stitching, focus stacking, etc)
- Version (photographic prints, internegative duplicates, enlargements, etc.)

Understanding Previous Imaging Attempts

Historical representations of collection objects function as archaeological evidence of imaging practice evolution. Previous imaging attempts reveal contextual authenticity information about how institutional priorities changed, how technologies have advanced, and the evolving understandings of documentation purposes. These earlier representations retain research value beyond their original intent because they document object states at specific historical moments, show institutional decision-making about what aspects merited emphasis, and demonstrate available technical capabilities. (See NGP Case Study #1)

Previous imaging attempts thus function as both valuable historical documentation and potential source of misinterpretation—their value depends entirely on available contextual documentation. This could include:

- Creation circumstances and purposes (conservation, preservation, access, outreach)
- Technologies employed (scanners, digital cameras)
- Decisions that shaped their appearance (lighting approaches, object condition, equipment resources)

Representations from different periods look fundamentally different not due to object deterioration but due to imaging methodology changes. Without systematic documentation, future researchers cannot distinguish genuine physical changes from methodological variations.

The Effect of Context on Trust

Context documentation must function across the full diversity of cultural heritage materials: paintings and drawings, archival documents and photographs, medieval manuscripts and modern prints, three-dimensional objects and flat works on paper. This universality is achievable because context focuses on the imaging process rather than object-specific characteristics.

The framework applies equally whether documenting textiles (where lighting choices affect visibility of both structure and pattern), paintings (where lighting determines surface texture versus color relationships), or archival documents (where lighting affects legibility of faded text). The underlying question remains constant: what interpretive decisions shaped this representation, and what do users need to know to correctly interpret what they see?

Conclusion

The increasing complexity of the digital landscape, amplified by advances in AI and evolving public trust, necessitates a robust and shared framework for asserting the authenticity of digitized cultural heritage. We have proposed that digital object authenticity is best understood and communicated through three pillars: Provenance, Visual Accuracy, and Context. These pillars—addressing the origin and history of the digital file, measuring and communicating the fidelity of the visual representation to the physical object, and documenting and communicating interpretive decisions made during digitization—must be considered in tandem by GLAM stakeholders to ensure full and meaningful understanding for end users.

By establishing a common vocabulary and structure around these three pillars, the heritage digitization community can move toward standardized policies and practice that empower users to properly assess the level of trust they should have in digital objects they encounter. The principles outlined here serve as the foundational step toward developing concrete, technical implementation policies. The next phase of this work will be the publication of the DOAWG Recommendations for Authenticity (working title; expected late 2026), which will provide the granular technical details necessary for developers and practitioners to begin implementing these authenticity assertions across digitization workflows and presentation platforms.

[note this document contains an Appendix: User Stories / Visualizations]