Ethical Responsibilities & 3D Approaches to Cultural Heritage

A Living White Paper and Resource

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Request for Comments

This is a first draft and pre-publication circulation copy of a document that will continue to grow and evolve, taking less static forms in the future.

We encourage translations of this paper; please contact us with links, so that we can link back out to them.

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Abstract·s

The intent of this white paper is to collect advice, resources and issues related to the responsible use of 3D practices in cultural heritage. Current practices of 3D imaging techniques in cultural heritage are well established although not always framed within the ethical issues that can arise when applying these technologies and methods. Through a combination of existing practice, readings and recommendations, readers will be encouraged to think about the ethical implications of their practice, and the responsibilities that come with conducting institutional or funded 3D work, including equitable access, indigenous heritage, data ownership, environmental impact and sustainability. As a living document, we hope this resource continues to grow and be useful for community contribution and engagement, especially through the involvement of and leadership by the communities most directly affected.

Résumé

L'objectif de ce livre blanc est de rassembler des recommandations, des ressources et des questions concernant l'utilisation responsable des pratiques 3D dans le domaine du patrimoine culturel. Bien que les pratiques actuelles des techniques d'imagerie 3D dans le domaine du patrimoine culturel soient bien établies, elles ne sont pas toujours encadrées par les enjeux éthiques qui peuvent survenir lors de l'application de ces technologies et méthodes. Grâce à une combinaison de pratiques actuelles, de lectures et de recommandations, les lecteurs et lectrices sont encouragé(e)s à réfléchir aux implications éthiques de leur démarche et aux responsabilités qui accompagnent la réalisation institutionnelle ou financée de travaux 3D, y compris l'accès équitable, le patrimoine indigène, la propriété des données, l'impact sur l'environnement et la durabilité. En tant que document évolutif, nous espérons que cette ressource continuera à se développer et être utile pour la contribution et l'engagement de la communauté, en particulier grâce à l'implication et au soutien des communautés les plus directement touchées.

Resumen

El objetivo de este documento (libro blanco) es reunir recomendaciones, recursos y cuestiones relativas al uso responsable de los métodos 3D en el ámbito del patrimonio cultural. Aunque las prácticas actuales de las técnicas de imagen 3D en el ámbito del patrimonio cultural están bien establecidas, no siempre se enmarcan en las cuestiones éticas que pueden surgir al aplicar estas tecnologías y métodos. Mediante una combinación de prácticas actuales, lecturas y recomendaciones, se anima a los lectores a reflexionar sobre las implicaciones éticas de su planteamiento y las responsabilidades que acompañan a los trabajos 3D en instituciones o financiados como el acceso equitativo, el patrimonio indígena, la propiedad de los datos, el impacto medioambiental y la sostenibilidad. Como documento vivo, esperamos que este recurso siga desarrollándose y sea útil para las aportaciones y el compromiso de la comunidad, en particular mediante la participación y el apoyo de las comunidades más directamente afectadas.

Preface

Before we begin, we should emphasise that nothing in this document is meant to be criticism of or attack on digitisation practices and 3D methods as a whole. We all love 3D technologies, and have found them to be hugely valuable in contributing to the understanding, appreciation, conservation and communication of heritage. We argue that taking care to recognise sensitivities, responsibilities and ethical practice is essential to the sustainability of the practice and discipline. This document is in support of the use of 3D and related digital practices in the GLAM domain; more responsible practice is better practice.

3D methods and technologies of many kinds may be applied to heritage, including imaging/scanning, modelling, printing, publishing and engagement, archive and documentation. In this document we mean to include the broadest range of applications, from photogrammetry, laser, CT and other imaging methods, CAD historical reconstruction and visualisation, common use of desktop 3D printers, to cloud hosting and download sites, virtual reality, augmented reality, and extended reality. In many cases the issues addressed apply to many of all of these technologies; in others questions or concerns will be specific to an approach or tool.

In May 2023, a hybrid workshop was hosted in London to discuss emerging issues in the ethical use of 3D technologies in cultural heritage digitisation and research. The workshop had two goals: first, to bring a wide range of people, communities, and multidisciplinary professionals and experts together to scope the issues; and second, to collect, aggregate and synthesise any existing work or projects addressing them. We discussed wide-ranging topics from disability accessibility to Indigenous rights and data sovereignty, and from intellectual property and open access to environmental impacts and sustainability. And we asked: what shared responsibilities do we have as institutions, practitioners, communities and individuals to support more ethical practices, policy, governance and change? What aspects of power and ethics in 3D methods and cultural heritage need greater attention? After the workshop, we produced this document to serve as a living resource for researchers and practitioners working in this area.

We hope this resource will support improved good practice around 3D digitisation and research, particularly on complex topics so far underexplored. It identifies and confronts a wide range of issues arising around the application of 3D methods to cultural heritage documentation within the realms of: Indigenous rights and data sovereignty, sensitivity of 3D digital representation of traditional knowledge and cultural expressions, digital and intellectual property restitution, environmental sustainability, access and accessibility, and digital sustainability and long-term preservation. By raising awareness about the issues that should be considered when applying 3D methods to cultural heritage documentation, this resource aims to foster a deeper understanding and appreciation of material and immaterial cultural heritage. Our expectation is that this will lead to change in ideas and actions about the care of these materials and their digital counterparts.

There is a growing need for this type of work. In academia, the heritage sector, creative industries, and public spaces, methods using 3D imaging, architectural modelling, virtual reality and gaming technologies are increasingly applied to the study of the world's material and immaterial heritage. There can be a tendency to be blasé or even triumphalist about these tools, the ways in which they change our interaction with heritage, and the legal and ethical implications of the new kinds of digital objects and rights created by them. At the same time, when such issues arise around collections, projects may perceive risk and be deterred from

engaging with them. This can skew the types of 3D projects pursued, as well as the types of 3D data produced for public consumption.

Another goal of the resource is to question *whose* ethics shape digitisation projects. The current landscape on the ethics of, and critical approaches to, digital heritage creation and management demonstrates a growing need to explore ethics localisation. For example, variations in international copyright laws that produce *in*access to heritage have galvanised the very open access movements that seek to ensure mission-driven work that is funded by the public is subsequently made available to that public as openly as possible. However, open access movements themselves can produce new inequities when digitisation projects are led by dominant groups or well-funded organisations, and therefore are guided by dominant frameworks that often centre universal access and unencumbered reuse as an ethical standard in itself. We hope this resource will help identify and support plural understandings of the ethical layers involved in digitisation and open access to complement ongoing 3D digitisation programmes and future projects.

Our longer-term goals are to support the development of a community network for any interested in further addressing and developing these topics and good practice. We see this resource as an opportunity to gather and address questions emerging from that community itself, and to support a wider network that continues to address questions related to 3D and ethics through collective action and organisation.

This resource is for anyone in the cultural sector (broadly defined) working on 3D projects. It should support skills development around: digital practitioners of 3D imaging, modelling, printing and other methods; heritage management, digitisation and communication; how to apply and communicate the appropriate access and reuse parameters using standardised licences and labels; and other skills relevant to supporting (more) ethical 3D projects.

The resource is organised by the key areas identified. Each section focuses on the interplay of 3D technologies with a given topic and highlights or builds on existing knowledge or collaborations. You will find a short summary with framing questions and publicly available resources to support those researching or working in each area. The document is in no way exhaustive. This version is but a first edition, valuable in itself but also serving as a call for further collaboration and contributions. We encourage suggestions on resources, projects, readings and new topics that should be included. To keep in touch with the community of development, suggest improvements, or request direct editing access, please join the discussion group and mailing list at <https://groups.google.com/g/3d-ethics/>.

We hope this resource will continue to grow and reflect the important work being done on ethical responsibilities and 3D approaches to cultural heritage. We are keen to see a network of collaborations grow around the topics it addresses, which lead to new good practice in heritage management, research, teaching and advocacy.

1. Indigenous/Community Knowledge(s), Heritage and Data

The use of 3D technologies in the documentation of cultural heritage is becoming more accessible and hence extended among practitioners and the general public. These technologies enable the reproduction or digitisation of existing heritage, as well as the total or partial reconstruction of heritage and objects that no longer exist. Both approaches pose different ethical questions relevant to Indigenous communities and knowledge holders that should be considered from the outset of any 3D project.

In the past, the use of technology to document Indigenous and Community Knowledge(s) has failed to recognise the rights, expertise, and diversity of communities of origin and knowledge holders. It has also, in some circumstances, neglected Indigenous Peoples and knowledge holders the access and rights to share and benefit from the outputs of the application of this technology. In this section we bring up questions and considerations that we think are key for the responsible development of any project that involves 3D technologies and Indigenous and Community Knowledge(s).

The following questions are inspired by and follow the structure of CARE Principles for Indigenous Data Governance (see resource [1] below).

Questions

- *Preliminary questions:*
    - What is the origin of the heritage you are digitising, and what obligations or sensitivities does this bring?
        - What cultures originated the objects or other heritage, and what meaning or importance does this heritage hold for them today?
        - Have you spoken with the originating communities to understand their priorities/interests in this project?
    - Under what conditions did the object/knowledge come into the curation of the institution? Was trade, colonialism, war, coercion or any other controversial or ambiguous processes involved?
        - Do any other administrations or institutions make a legal, political or moral claim on this heritage?
- *Collective Benefit*
    - Does the project bring any benefits to indigenous peoples/communities?
    - Who is leading and making decisions about the digitisation of heritage? To what extent are the original or local communities or knowledge holders involved or taking the lead?
        - Who is making the request to digitise this heritage or knowledge and why?
        - Who will benefit from the skills and knowledge acquired and transferred in the process of this project (institution staff vs local community capacity)?
        - Who will benefit in the long term from purchases and other investment (financial or in-kind) of this project?

        - Under whose institutional banner will the 3D models be published? (See also below, “Release or publication of outputs”.)
    - How will you enable multiple voices to be reflected in the creation and presentation of 3D models of heritage?
- *Authority to Control*
    - Permissions and consent before digitisation
        - Have you considered what kind of permissions you will need and who are the main stakeholders in the project?
        - How are you collecting permissions and informed consent from knowledge holders and participants involved?
        - How are you communicating ownership and provenance to knowledge holders?
        - How are you planning to involve/consult with the community about the planning and development of the project?
    - Release or publication of outputs
        - If you are considering publishing results in open access, how are you communicating the implications of open access to your participants?
        - How will your project contribute to the long-term empowerment and enfranchisement of original or local communities in the management of the heritage?
        - How will open access consent be given or withdrawn after the project has ended?
    - Data storage and stewardship
        - Where will the data be stored and stewarded?
        - Who will be responsible for the sustainability and resilience of the storage capacity?
        - What indigenous rights and data sovereignty frameworks are there for 3D models of objects held by heritage institutions?
        - What does relational accountability look like? How is relational accountability understood by institutions in practice?
        - Sharing resources? Building reparative/healing relationships?
        - Navigating community ownership?
- *Responsibility*
    - How are you going to ensure the development of positive relationships with the knowledge holders, grounded in respect, reciprocity and mutual understanding as defined by the communities of origin?
    - In what languages will metadata, text or narration of your models be presented?
- *Ethics*
    - What safeguards will you put in place to ensure sensitivity of 3D digital representation of traditional knowledge and diverse cultural expressions?
    - How will your 3D practice affect engagement of both original communities and new audiences with the heritage?

Resources

General Resources

1. **CARE.** Research Data Alliance International Indigenous Data Sovereignty Interest Group (2019). “CARE Principles for Indigenous Data Governance.” The Global Indigenous Data Alliance. Available: https://www.gida-global.org/care.
2. Global Indigenous Data Alliance (GIDA) - Promoting Indigenous Control of Indigenous Data. https://www.gida-global.org/.
3. Anticolonial Research Library - https://www.anticolonialresearchlibrary.org/.
4. RDA COVID-19 Indigenous Data WG (2020). "Data sharing respecting Indigenous data sovereignty." In *RDA COVID-19 Working Group. Recommendations and guidelines on data sharing*. Research Data Alliance. https://doi.org/10.15497/rda00052
5. 3D Data Management and Sharing and Indigenous Cultural Heritage in Museums: Guidelines for RiddoDuottarMuseat. https://rdm.no/wp-content/uploads/2022/06/Data-management-plan_RDM_Approved-24.03.2022.pdf
6. University of Melbourne Indigenous Knowledges Research Hub - https://unimelb.libguides.com/c.php?g=932536&p=6741079
7. Local Contexts - global initiative that supports Indigenous communities with tools that can reassert cultural authority in heritage collections and data. https://localcontexts.org/

Specific Publications

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8. Abira Hussain & Mnemoscene. 2020. *Nomad: A collaborative project*. https://nomad-project.co.uk/.
9. Isaac, Gwyneira. "Perclusive alliances: digital 3-D, museums, and the reconciling of culturally diverse knowledges." *Current Anthropology* 56.S12 (2015): S286-S296.
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12. Rebecca Kahn & Rainer Simon. 2023." Skulls, skin and names: The ethics of managing heritage collections data online." In: Palladino, C. and Bodard, G. (Eds.), *Can't Touch This: Digital Approaches to Materiality in Cultural Heritage*. Pp. 205–224. London: Ubiquity Press. DOI: https://doi.org/10.5334/bcv.k.
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2. IP and Equitable Access

IP - [property (data is property). Intellectual property, limited access / intentional digitisation, ethical and responsible sharing, transparency]

Summary

Digitisation of cultural heritage has become more and more present within the GLAM sector, with cultural institutions creating digital surrogates of their collections. With the development of 3D technologies, the concept of digitisation and accessibility has evolved with the printing of 3D models of artefacts, especially in the restoration and preservation of those which are endangered. Intellectual property law has always been at the forefront of discussions regarding potential issues that may arise.

Indeed, 3D technologies pose further challenges in the area of intellectual property law. Various questions arise concerning copyright law, data ownership, the attribution of Intellectual Property Rights (IPRs), the usage of open licences, and much more. While the development of 3D technologies within the cultural sector has its benefits, intellectual property law will always overlap and affect ongoing digitisation efforts.

This section seeks to outline some of the key questions pertaining to IP and 3D technologies in digital heritage, with the aim to reach equitable access. It intends to evoke considerations rather than provide definitive answers.

Questions

- *Copyright law*:
    - Ownership/authorship
        - Have you thought about the copyright ownership in 3D models of cultural objects?
        - Who gets to decide on the ownership of the data?
        - Who holds ownership over the digital scanned 3D copies?
        - Do you assume there are IP rights in 3D copies at all?
        - Have you thought of whether those 3D copies should be in the digital public domain?
    - Are indigenous peoples benefiting from those projects?
        - Are the indigenous communities involved in projects and taking a part in it? Are the projects led by someone from the particular indigenous community in question?
        - Are they controlling those rights?
        - Who are the IP rights being assigned to?
        - Have you thought about the moral rights of indigenous communities and how this will be attributed?
        - In your project, are you distinguishing between claiming IP on a digital asset and claiming indigenous knowledge? Have you thought about this distinction?
    - Access

        - Have you thought about what approach to take in regards to the access of the 3D digital surrogates of works?
        - Will you take the open access approach?
        - If not, you should perhaps be careful about the licences and tools that are being used.
    - Jurisdiction
        - Have you taken into account whether other jurisdictions could apply?
        - If so, have you looked into how they handle IP law compared to your jurisdiction?
        - More specifically, will you research the legal differences pertaining to digital cultural heritage and 3D technologies?
- *Open Licensing tools and solutions*:
    - Authorisation
        - Will you receive informed consent from the originating community?
        - Will you explain the implications once the data is released and what open access entails?
    - What is being done with licensing to help ensure fair use?
        - Have you thought of open licensing?
        - Have you thought of using public domain licences?
        - Do you have control over the licensing? If not, who would have control?
        - Will you implement licensing agreements? And how will they be structured?
    - Will any restrictions be implemented?
        - If any are needed, would it be concerning the commercial use of 3D copies?
        - Will you allow transformative/derivative uses of the 3D copies?
        - Are you considering the long term of open access if you will be able to effectively respond to takedown requests?
- *Contracts and other policies*:
    - If you make your models available for download or reuse, what terms and conditions do you apply to this use?
        - Does this impose restrictions on the freedom of use of the models?
        - Does this protect the heritage and its community?
        - Will you ensure that such reuse would be ethical?
        - Will permission be needed from the originating community?
    - If the digitisation process or production is outsourced, what contract/agreements do you have in place to protect the IP and other rights of the heritage originating community?
    - Software choice:
        - End User Licence Agreements (EULAs)
            - Will the EULAs on software be affecting yours and others' rights?
            - Have you thought of the governing law and jurisdiction with EULAs?
            - To what extent will such agreements restrict or limit a user's rights on the usage of the 3D models?
            - How will you address data privacy and collection concerns?

- Cloud processing:
    - Have you thought of storage capacity in cloud service providers?
    - Is there liability for the data being stored? Are copies kept or controlled under their policies?
    - Does the cloud service provider operate under a specific legal jurisdiction?
    - How will you ensure data protection on 3D copies?
    - Can anyone have access to the data being stored in the cloud?

Resources

General Resources:

1. Community standards for 3D data preservation <https://cs3dp.org/>
2. Web Content Accessibility Guidelines (WCAG) 2.1 <https://www.w3.org/TR/WCAG21/>
3. Moore J, Rountrey A and Kettler HS (eds), 3D Data Creation to Curation: Community Standards for 3D Data Preservation (Association of College and Research Libraries 2022)
4. The implications of 3D printing for Intellectual Property - Bournemouth University <https://www.bournemouth.ac.uk/research/projects/implications-3d-printing-intellectual-property>
5. The London Charter for the Computer-based Visualisation of Cultural Heritage <https://londoncharter.org/>
6. The Seville Charter: International Charter for Virtual Archaeology <https://icomos.es/wp-content/uploads/2020/06/Seville-Principles-IN-ES-FR.pdf>
7. A Legal and Empirical Study of 3D Printing Online Platforms and an Analysis of User Behaviour, Dinusha Mendis and Davide Secch, The Intellectual Property Office (2015) <https://www.gov.uk/government/publications/a-legal-and-empirical-study-of-3d-printing-online-platforms-and-an-analysis-of-user-behaviour-study-1>
    - 3D printing research reports - IPO <https://www.gov.uk/government/publications/3d-printing-research-reports>
8. https://www.heritagefund.org.uk/sites/default/files/media/attachments/Digital%20guide%20Working%20with%20open%20licences.pdf
    a. https://www.heritagefund.org.uk/sites/default/files/media/attachments/Digitisation%20project%20planner%20and%20handbook.pdf
    b. https://www.heritagefund.org.uk/sites/default/files/media/attachments/Doing%20digitisation%20on%20a%20budget%20a%20guide%20to%20low-cost%20digital%20projects.pdf

Specific Publications:

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3. Disability Accessibility

NOTE: This section is a work in progress and what is shown below is not a complete version. In the short term, a few references are included. A more complete version, similar to the other chapters, will be available in the coming future.

Access is typically broadly framed with respect to distance, language, disability, technology, digital divide, the internet, socio-economic or other accessibility characteristics. Here, we focus on disability accessibility, as it has a specific utility for and overlap with 3D projects. Disability access can be extended through 3D projects, but it also involves access to collections for digitisation in both 2D and 3D for the purposes of creating an accessible format copy.

Areas of focus might include:

- Access to physical heritage (*e.g.*, touch of physical objects for partially sighted and blind audiences)
- Accessibility and disability accommodation in disseminating or printing 3D models
- The interplay of national laws (*e.g.*, Equality Act 2010) with international measures (2013 Marrakesh Treaty)
- Access in tension with intellectual property rights, including narrow copyright exceptions for access to print media rather than a wider scope of creative works
- Whether new rights arise in an “accessible format copy” and for whom
- Curatorial decisions on what to digitise for disability access
- How centring disability in accessibility and universal design can improve other access tension areas, such as multilingual functionality in 3D, digital accessibility, access to technology, data optimisation, or more accessible formats and platforms
- Inclusive technology developed for access purposes needs to respond directly to the needs of people with disabilities, addressing their concerns, understanding and facilitating meaning making. While 3D resources developed for people with disabilities can be beneficial for everyone, the needs of abled audiences cannot overpower those of people with disabilities.
- People with disabilities need to be involved at every stage in the development of 3D resources specifically designed to facilitate their experience
- Suggestions for both (a) projects with accessibility focus and/or work-packages, and (b) projects that hadn’t previously considered disability/sensory needs as a focus

Questions

- What does 3D bring in terms of access to the physical objects? What doesn’t it bring? What does it potentially take attention away from?
- How accessible are 3D projects for disability accessibility?
- Whose voices are represented when designing digital projects, policies, and programming?
- What types of projects can reach the widest audience available for disability access? Are they 3D projects? Or are they digital projects that enable greater 3D engagement and projects by disabled audiences?

- How to optimise and differentiate 3D for multiple disabilities and audiences using universal design principles?
- How does copyright enable or disable disability accessibility? What about copyright in the new accessible format copies?
- How might commercialization desires inhibit mission-critical and open access activities for disabled audiences?
- What alternative uses, marginalised voices, and more transparent innovations for disability access can help us rethink access, copyright and digital media accessibility?
- How does centring disability improve accessibility for all constituent groups?

Resources

General resources

1. Web Content Accessibility Guidelines 3.0. Available: https://www.w3.org/TR/wcag-3.0/.
2. OpenGLAM, “Accessibility: Making open GLAM and digital access more inclusive’, by Andrea Wallace. Available: https://openglam.pubpub.org/pub/accessibility/release/2.
3. Culture for All Service, “Accessibility and diversity checklist for museums”. Available: https://www.ne-mo.org/news-events/article/accessibility-and-diversity-checklist-for-museums.
4. Cultural Heritage Without Borders, “A Toolkit for Museums Working Towards Inclusion.” Available: https://www.bmuseums.net/wp-content/uploads/2018/07/English-Toolkit-2.pdf.

Specific publications

5. Kevin Caves, Jules Odendahl-James, Marina Tsaplina et al. 2023. “Socially Engaged Art and Tech at the Intersections of Ecology, Disability and History (2022–2023)”. *Bass Connections: Duke University*. Available: https://bassconnections.duke.edu/project-teams/socially-engaged-art-and-tech-intersections-ecology-disability-and-history-2022-2023. [Report on a team project on ethical art and heritage]
6. Cecilia, R., Moussouri, T. and Fraser, J. 2023. “Creating Accessible Digital Images for Vision Impaired Audiences and Researchers.” *Curator: the Museum Journal* 66: 5-8. DOI: https://doi.org/10.1111/cura.12536
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4. Environmental impact and sustainability

Summary

3D imaging and other digitisation practices can play a role in the conservation of heritage objects and holdings, recording information about current conditions, potentially reducing the need for handling and wear, and impacting on the management of heritage itself. These advanced technologies themselves come with a cost, in resource, energy usage and waste as well as financial, and have their own preservation and long-term storage needs.

To ensure the environmental sustainability and climate justice of a 3D cultural heritage project, we need to pay attention to all stages of work, and ideally be asking questions about impact and cost from the design stage. Decisions about materials, hardware, software and processing intensity, storage and location of data centres, disposal and recycling of waste will all impact on the environmental and social costs of a 3D project. This section tries to list some of the main questions.

These questions are intended to start a conversation about the environmental concerns around 3D technologies. You will not be able to address all of these issues, and many of them may be out of your hands as an individual researcher. You may be able to raise some issues with your institution, make recommendations and push for measurable change in policy and practice. Other questions may impact on your individual or project planning and practice.

Most of the questions should be considered and acted on at the planning and purchasing stage of a project, prior to setting a budget, especially when it comes to selecting hardware and other expensive resources and services.

Questions

- *Hardware and materials:*
    - How will you balance ecological responsibility with the feasibility of your project, keeping in mind the following considerations?
        - Purchase/rental price
        - Distance to transport
        - Power usage
        - Time to obsolescence or potential for reuse (cutting edge tech may be unproven and prone to need quicker replacement)
        - Ecological responsibility of manufacturers of hardware (computers, cameras, scanners, printers)
        - Impact of construction materials and batteries (e.g. many components are mined or sourced in the Global South under exploitative conditions)
    - Have you considered how powerful, energy-hungry, polluting and expensive your hardware is? Is this strictly needed for the processes and outputs of your project or are there alternatives/substitutes that would serve your purpose?
    - Have you thought about the quantity of copies that will be printed, and the waste produced by printing, e.g. object supports?

- *Software and processing:*
    - How much computing power is needed to produce and process the highest quality 3D scans, models or environments possible? Would lower quality, and therefore lower power usage and impact, models be adequate to your project needs?
    - Are there optimised software options or processes that would reduce the power usage of your project?
    - Can “minimal computing” principles help to reduce the impact of your outputs?
- *Sustainability of data and formats*
    - WIll your data formats and media be of sufficiently high standard to ensure sustainability and continuing value in as long a term as needed by your project?
    - Have you assessed what quantity and scale of data you need to create, keep and conserve to achieve your project’s goals? How will you keep digital waste to a minimum?
    - Have you considered the CARE principles (Collective Benefit, Authority to Control, Responsibility, and Ethics), particularly with regard to environmental justice and impact, when planning your data preservation and dissemination?
    - How sustainable are the 3D printed objects created by your institution? Will they need to be replaced over time, and what impact does this have on environmental cost?
- *Storage and data centres*
    - Have you considered the location, environmental sustainability and community impact of the data silos used by cloud services on which you are hosting or backing up your 3D models?
    - Could you use alternatives to the huge, multinational cloud and repository services such as Amazon, Microsoft, Google, Apple, Facebook, etc.?
    - Have you considered the relative merits of local drive storage, large repositories and cloud storage, or a mix of both?
- *Disposal, reuse and recycling*
    - What will you do with outdated or no longer functioning hardware, or computers no longer needed at the end of the project?
        - Can they be used by other projects or institutions?
        - Can they be resold/repurposed?
        - How much landfill waste or pollution will be created by obsolete components?
        - Are any materials genuinely recyclable/upcyclable without shipping offshore for cheap disposal?
    - Can the materials you use for the 3D imaging and printing of your objects be recycled or otherwise safely and responsibly disposed of?
    - Are your/your institution’s practices and policies compliant with the relevant laws on e-waste recycling and reuse?

Resources

General resources

1. Anne Baillot, James Baker, Jenny Bunn et al. 2022–. *Digital Humanities Climate Coalition Toolkit*. Available: https://sas-dhrh.github.io/dhcc-toolkit/. (*cf.* https://www.cdcs.ed.ac.uk/digital-humanities-climate-coalition)
2. Climate Heritage Network Toolkit. https://www.climateheritage.org/communicating-climate-heritage-toolkit/
3. Coalition of Museums for Climate Justice. https://cmcj.ca/
4. The Horsfall Group. *Research*. https://horsfall.bio.ed.ac.uk/research.html. [works on EV batteries, recycling metals using sustainable biotechnology principles to disrupt existing, polluting industrial manufacturing]
5. Danielle Zoe Rivera, Eliza Breder, Adrienne Dodd, et al. 2023. Environmental + Climate Justice Syllabus. *Just Environments Lab*. Available: https://www.just-environments.org/the-syllabus.

Specific publications

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credits/carbon-ecological-footprint-calculators/carbon-footprint-of-data-centers/. [calculator for carbon footprint of data centres and data storage per country - a useful model for assessing environmental impact]
17. Loïc Lannelongue, Jason Grealey, Michael Inouye. 2020. “Green Algorithms: Quantifying the carbon footprint of computation.” *Computers and Society.* https://arxiv.org/abs/2007.07610.
18. Josh Lepawsky. 2018. *Reassembling Rubbish: Worlding Electronic Waste*. MIT Press.
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Glossary (to be added)

Original communities / Communities of origin	
Local communities	
Indigenous communities	
Knowledge holders	
Descendant Stakeholders	

Get involved

- To keep in touch with the community of development, suggest improvements, or request direct editing access, please join the discussion group and mailing list at <https://groups.google.com/g/3d-ethics/>.
- Wiki for archive and future revisions: <https://github.com/SAS-DHRH/EthicalResponsibilities3D/wiki>
- Watch this space for future events.
- Email any of the editors for one-off contacts, questions or suggestions. (But we really recommend the discussion group for this.)