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D4.2 Impact Assessment Report

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Authors:
John Balean, Valentina Bachi, Antonella Fresa (PhotoConsortium)

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EXECUTIVE SUMMARY

The D4.2 Impact Assessment Report provides the details and findings of the impact analysis, measurements and reflections that were performed in the course of the project, supported with the Impact Assessment Playbook and methodology by Europeana.

The starting point of the project's workflow was the VIGIE 2020/654[1] Study on Quality of 3D digitization of tangible heritage, which drove the digitization actions of the EUreka3D partners, served to develop the EUreka3D Data Hub of resources and tools, and was the cornerstone of the training and capacity building programme developed in the course of the project.

In line with this, three change pathways were identified that affect the main stakeholder group i.e. cultural heritage institutions (CHIs) engaging with 3D digitization:

- **CP1: Digitisation workflow** - i.e. how the implementation of VIGIE 2020/654 Study recommendation impacts the 3D digitisation process in a CHI. Creating a best practice methodology for consistent high quality 3D digitisation including metadata and paradata.
- **CP2: The Pilot action and EUreka3D Data Hub experience** - i.e. proof of concept of the EUreka3D Data Hub to store, display and integrate the 3D models, metadata and paradata created in the project: Creating a secure, affordable, EU cloud based platform, supporting the EU data space for cultural heritage and to enable CH professionals to enter and engage with the 3D transformation.
- **CP3: Capacity Building / Knowledge Transfer** - i.e. how the information created in the project is impacting all stakeholders who may be at any point in their journey with 3D digitisation or use. Building a valuable knowledge hub within and for the sustainability of the EUreka3D project. An important resource for all Stakeholders including CHIs and the Users of 3D models.

The change pathways were focusing on behavioural changes by the priority stakeholder groups, that happened because of the work done in the project. Challenges in adopting the best metrics to evaluate the impact were encountered, and can be summarized in:

- Qualitative measurement about the 3D digitisation experience and the use of the EUreka3D Data Hub and workflow: sourced from the experience of the 4 content providers who are beneficiary in the project and via testimonies of the advisory board and some associate partners. All this is reported in narrative form in the Final Booklet. Additionally, a survey was circulated to stakeholders to collect information about the expectation in the reuse of high quality 3D models.
- Quantitative measurement about global outreach of the capacity building programme: sourced from events and post event data, and integrated with data about visitors of the collections and blogs published in Europeana.

Considerations on economic impacts from the point of view of Cultural Heritage Institutions were also made, particularly reflecting on the costs of adopting high quality digitization, metadata and paradata curation, of sharing and dissemination efforts, and of establishing innovative workflows and tools compared to existing ones.

[1] https://digital-strategy.ec.europa.eu/en/library/study-quality-3d-digitisation-tangible-cultural-heritage

The impact objectives of the project were successfully met, but it is also important to note that, although the project did not set out to create standards, it did build on some important work that, while it was not tasked as deliverables of the project, was deemed essential and impacted on the expected outcomes of the project:

- creating a simplification guide to the VIGIE Study 2020/654 on high quality 3D digitisation, to help CHIs understand what they have to take into account when starting a digitization project;
- performing a deep investigation into 3D Viewers as it was found that having a services platform to store and manage 3D assets is not complete without being able to also present the models on the internet in a way that users can visualize, also accepting the challenge of compromises, due to the variety of formats in 3D.

EUreka3D also took into account aspects related to Environmental sustainability and contribution to European Green Deal goals, and particularly the project supported and collaborated with the ENA Climate Action Community.

The work done in EUreka3D will be leveraged in the next DEP project EUreka3D-XR, building on existing methodologies and the EUreka3D Data Hub to improve and expand the tools and methods for sharing and reusing 3D collections, in the light of creating XR scenarios and exemplary success stories. This effort contributes to innovating the way CHIs leverage their investment on 3D digitization to easily create engaging and more modern presentations of their content to general users, online and onsite visitors and other stakeholders in neighbouring domains such as education and tourism.

1. INTRODUCTION

This document forms Deliverable D4.2 The Impact Assessment Report for the EUreka3D project. It sums up the findings of the investigation done in Task 4.4, about the impact of the project, and the consequences of the availability of tools and other results produced by the project. In particular, the document reflects on the impact and the increased knowledge that the project delivered to individuals, organisations and other stakeholder communities involved in the pilot action for digitizing and sharing 3D cultural collections and in the capacity building programme that EUreka3D delivered to cultural heritage professionals.

The impact assessment research was presented at the final conference of the project on 13th December 2024 in Girona, in a dedicated session, which also presented reflections on the sustainability and maintenance of the project's outcomes.

Fig. 1 The session about Impact and Sustainability presented at the EUreka3D Final Conference in Girona, 13 December 2024

The structure and overall approach of this document follows the recommendation and Impact Assessment Playbook and templates as developed by Europeana Foundation.

1.1 About the project

The EUreka3D project addressed the growing need of enabling the 3D digital transformation of the Cultural Heritage (CH) sector. Museums, galleries, libraries, archives and archaeological sites are witnessing a context of technological change and need to review and modernise their internal processes, from digital capture to end-user access and re-use. This context of change was fuelled by the EU Recommendation issued on 20/11/2021[2] to digitise in 3D by 2030 all monuments and sites deemed at risk and half of the most physically visited cultural and heritage monuments, buildings and sites. The Recommendation sets ambitious targets on Member States and the CHIs in Europe, but started from a base where standards and knowledge on 3D digitization and coherent methodologies, infrastructures and workflows are lacking. Especially in the Cultural

[2] https://digital-strategy.ec.europa.eu/en/news/commission-proposes-common-european-data-space-cultural-heritage

Heritage sector, the challenge is not just in capturing the geometry of heritage objects, but in addition to that, recording the full memory in the highest quality is critical to the usefulness of collections to present and future users. Hence, the need for capacity building, guidance and e-infrastructures risks become a barrier to the achievement of the Recommendation goals.

EUreka3D had impact at its heart, driving the project from its inception. It aimed to deliver 5 high-impact outcomes:

1. wide-outreach capacity building programme to CH professionals;
2. a 3D digitization pilot in line with high-quality requirements that foster reuse;
3. a Services and Resources Hub (named EUreka3D Data Hub) that CHIs can use to host, manage and share their collections;
4. exemplary new contents and stories published in the Europeana environment that is at the core of the data space for cultural heritage;
5. resources, case studies and other learning and additional elements provided for the Data Space for Cultural Heritage for others to learn and replicate the experiences.

To achieve its goals, EUreka3D brought together nine Project Partners together with a wide network of international stakeholders that have an interest in 3D transformation. A key indicator to the success of the project were the 4 Content Partners who were at different stages of their 3D transformation journey, from first steps with objects in controlled environments to highly experienced digitisation experts with complex objects in uncontrolled environments. The four content providers were exemplary of the variety in capacity and digitization knowledge that exist in the sector. Their experiences, the challenges they encountered and the solutions they found were documented and disseminated throughout the project and helped prove the impact viability of the project's methodologies and tools, and supported the capacity building efforts of the project. The stories of their journeys and lessons learnt were collected in Case Studies which formed an integral part of the EUreka3D Final Booklet, available to other CHIs to take inspiration and learn from.

The resulting 3D models produced in project, plus accompanying metadata and paradata, not only added to the previously underrepresented number of 3D assets In Europeana but also were used to test the workflow of the Pilot infrastructure and Services and as experiential models to the pre-identified external stakeholders of the project, who are in a position use 3D e.g. educators, researchers, cultural tourism professionals. This group was surveyed in July 2024 to estimate the potential impact that high quality 3D models, with corresponding detailed information, might have on them over traditional materials they currently have available.

A wide programme of training and capacity building events, onsite and online, and a rich production of learning resources openly accessible, supported the expected and ambitious impact on improving the professionalism and expertise of workers in the cultural heritage sector, by creating new knowledge about high quality 3D digitization to foster the creation and sharing of datasets and collections for different purposes of use and reuse by stakeholders communities. The success of the EUreka3D Training and Capacity Building programme is shown both with qualitative and quantitative measurements.

In summary, the impact objectives of the project were successfully met, and while all the expected outcomes from the Grant Agreement were fully delivered, additional important work that was not tasked as deliverables in the project took place: most notably, creating a simplification guide to the VIGIE Study

2020/654 on high quality 3D digitisation, to help CHIs understand what they have to take into account when starting a digitization project; and performing a deep investigation into 3D Viewers, as it was found that having a services platform to store and manage 3D assets is not complete without being able to also present the models in the internet in a way that users can easily visualize.

1.2 Approach to impact

The EUreka3D project described several expected Impact objectives in the Grant Agreement, and clarified that the methodology would make use of the Europeana Impact Assessment Playbook. During the first year of work, project representatives attended a series of four Impact Assessment workshops run by Europeana from July to November 2023. Each 3-hour workshop session covered a different phase of the playbook, resulting in a detailed overview of methodologies to assess and effectively measure impact. As a result, the EUreka3D project objectives illustrated in the Grant Agreement were converted into Change Pathways which conform to the Europeana Impact Playbook. These change pathways clearly outline the anticipated behavioural impact changes that a given stakeholder may/should have as a result of the EUreka3D project activities, resources and tools.

The two major areas of expected impact were considered at the inception of the project and became more evident during the planning phase of the project:

- Firstly, to **improve and modernise the 3D digitisation workflow in CHIs** - created from the guidelines of the VIGIE 2020/654 Study, and supported in the digitization Pilot by the development of an integrated data and resource hub that acts as an entry point, from storage to content management to visualization and publication on Europeana;
- Secondly, **to support the digital transformation process of the cultural heritage sector** - educating CH professionals, via a wide programme of training and capacity building including production of learning resources, online and onsite events, collaborations with stakeholders and dissemination activities.

Following the recommendations outlined in the VIGIE 2020/654 Study, and using the Pilot tools and infrastructure were both important parts to assessing the potential impact of an efficient workflow to CHIs. For this, the project partners were the stakeholder sample set, whose impact could be carefully monitored throughout the project. Although a small group, their differing expertise regarding 3D transformation meant that a reasonably accurate impact assessment of the pilot could be extrapolated, to judge whether EUreka3D methodologies and tools were a successful proof of concept and workflow for other CHIs to follow. In addition to the project partners, a number of associate partners and external stakeholders joined the Pilot by testing its infrastructure and providing their feedback, also in some cases delivering test collections to Europeana via the EUreka3D Data Hub.

For the capacity building, much of the impact assessment is perceived and prospect, as the benefits of the experiential knowledge gained by stakeholders who received training and knowledge from the project will only be realised in the future. Therefore, in the nascent area of 3D digital transformation, we could only assess the outreach that was delivered within the project, and determine if a knowledge transfer was achieved. This can be measured via quantitative data such as attendance and survey data, and other feedback to gain some more insightful information. In this light, the high rate and geographic spread of participants in webinars, the responses to post event surveys and other qualitative feedback received from the stakeholders

communities showed the interest in learning more and being guided in this new realm of 3D digitization of cultural heritage.

1.3 Role of this Deliverable in the project

The deliverable links to other important documents produced by the project, notably: D3.3 Final report on the EUreka3D services and resource hub: design and implementation, D2.2 Report on Training programme, D1.7 Integration report and D1.6 Final technical report. Relevant extracts from these documents are provided where useful, and appropriately quoted.

1.4 Structure of the document

The deliverable is composed of the following parts

- Executive Summary
- Chapter 1: Introduction
- Chapter 2: Methodology used and reflections
- Chapter 3: Findings
- Chapter 4: Continuing the work
- Chapter 5: Conclusions
- Annex

2. METHODOLOGY USED AND REFLECTIONS

2.1. Impact design

The EUreka3D project, from initial planning, decided it would follow a methodology that would make use of the Europeana Impact Assessment Playbook. To aid in the identification of Stakeholders and the Impact Measures, a workflow plan of the entire project was created and presented in the project plenary meeting in June 2023 in Rome. The workflow overview is presented as Annex 6, showcasing the many and complex connections of the various activities and their impacts can be seen.

In the course of the Impact Assessment workshops held in period July-November 2023, the effort was mainly focused at extrapolating the most relevant change pathways for the main stakeholders group addressed by the project, identifying the resources, activities and outputs that would determine a behavioural change in the stakeholders.

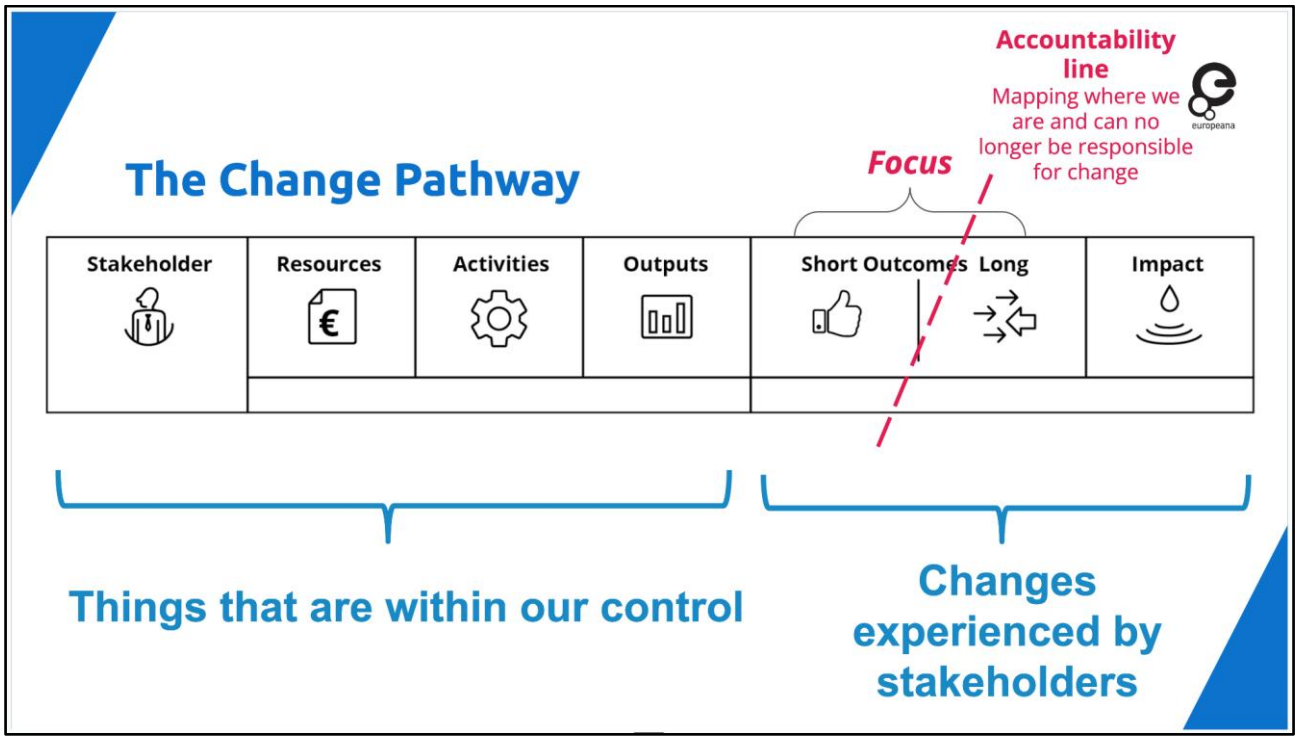


Fig. 2 Slide from Europeana Impact Playbook Training Session #3 - The Change Pathway

2.1.1 Stakeholder mapping

Several Stakeholders were identified in the EUreka3D project, starting from the project partners who could be grouped into 3 areas: content partners, innovation partners, dissemination and capacity building partners.

- **The content partners** (Bibracte, CRDI, CUT, Museo della Carta) were the CHI sample set that were assessing the workflow of 3D Digital Transformation, implementing the quality recommendations from the VIGIE 2020/654 Study in their digitization workflows, and participating in development and testing of the Pilot platform (i.e. the EUreka3D Data Hub) and its services.
- **The innovation partners** (EGI, Cyfronet, imec) were ensuring that the development and user needs of the Pilot e-infrastructure and services were properly planned and deployed. Europeana, and

Photoconsortium as accredited aggregator, were also deeply involved in this area, to enable integration of the workflow with Europeana and aggregation of the 3D assets.

- Finally, the **dissemination and capacity building partners** were mainly represented by CRDI, together with Photoconsortium, CUT and Europeana, but all the partners greatly contributed to the Capacity Building activities of the project by sharing their experiences and stories to other stakeholders communities via participation and presentations in conferences and events.

The **EU** is an invested stakeholder in the project, not only via financial contribution but also for the interest to aid Member States with 3D Digital Transformation and fulfil the recommendation to digitise relevant heritage by 2030.

External stakeholder groups included **European CHIs**, at any stage of their digital 3D transformation journey, and other **CH professionals** who want to improve their knowledge on high quality 3D digitization and reuse.

Another group of external stakeholders who benefit from the project's results are those who we anticipate will use the 3D models and collections for a variety of purposes, including sectors such as **education, academic research, archaeology, tourism**, and other reuse sectors such as the **creative and gaming industry** (e.g. XR-VR-AR related activities).

2.1.2 Stakeholder prioritisation

Stakeholder prioritization was based on the assessment of stakeholders' significance and level of involvement in the change process, determining the level of attention and resources devoted to assessing their feedback.

The content partners were the key priority for the impact assessment, as they were the sample group to monitor the process of digitisation and the viability of the Pilot (EUreka3D Data Hub) and workflows. As they were integral to the project, they were available to document a case study of their experiences producing a more detailed and accurate impact assessment.

The wider CHI sector, specifically smaller CHIs at the beginning of their 3D transformation journey, were the next priority stakeholder group. As a capacity building project, a key aim of EUreka3D was to provide knowledge and tools to CHIs to enable and innovate their digitisation workflows, also fostering an inclusive participation in the data space for cultural heritage.

The users of 3D assets were the third priority stakeholder group. This sector was deemed harder to assess for impact, as it demands a critical mass of 3D assets available to monitor the user behaviour in relation to use. Therefore, only a predicted assessment could be made, based on users' feedback, on the perceived benefits to a broad ranging 3D repository and the current limited use cases available. Additionally, it has been possible to identify uses for 3D models that had not initially been foreseen, such as in the field of arts and crafts and in the fight against the illicit trafficking of cultural goods.

Finally the EU, as the co-funding partner of the project, was a key stakeholder of EUreka3D that was taken into account in all communication, also in line with the requirements of publicity from the GA. In delivering the project objectives EUreka3D supported the EU mission, to foster digitisation of Cultural Heritage in 3D, and to provide knowledge and tools to contribute to the common European data space for cultural heritage.

2.1.3 The research questions

There were several questions that the project asked to assess stakeholder behaviour.

1: Armed with the VIGIE 2020/654 Study, could Content Partners follow the methodology and recommendations set out in the guide to produce quality 3D models with informed metadata and paradata? If they could, then we had a reasonable expectation that other CHIs would be able to also create standards and reliable infrastructure for 3D digital transformation.

2: Would the EUreka3D Data Hub be user friendly and fit the needs of the Content Partners to securely store and deliver the resulting 3D assets, metadata and paradata, to users, through integration to Europeana and potentially other platforms? If it could, then it would indicate that the Pilot would be a viable service for other CHIs to have the confidence that their digitised 3D assets could be disseminated to users and the wider world.

3: Would the Capacity Building and activities and learning resources create a knowledge transfer to CHIs? If it did, then there would be an indication that the project has helped enable CHIs to have the confidence to engage, or continue, in the 3D digital transformation of their 3D objects.

4: Do users have a need for high quality 3D models with metadata and paradata? Specifically in the areas of Education, Research and Tourism? If they do, then the push for 3D digital transformation and recommended workflows is creating a sustainable and beneficial ecosystem where the resulting 3D models are going to be used as much as, if not more than, existing digital resources (imagery, text, audio, video).

In addition, there were sustainability questions:

5: Is 3D digitisation affordable for CHIs? What is the minimum acceptable standard?

6: Would the EUreka3D Data Hub be affordable as an accessible product? Why would a CHI use it compared to the other solutions currently available?

2.1.4 Change pathway development

The Change Pathways of the project developed from a visual plan of the overall project which was described in the Grant Agreement. The figure is provided in full and more readable in the annex.

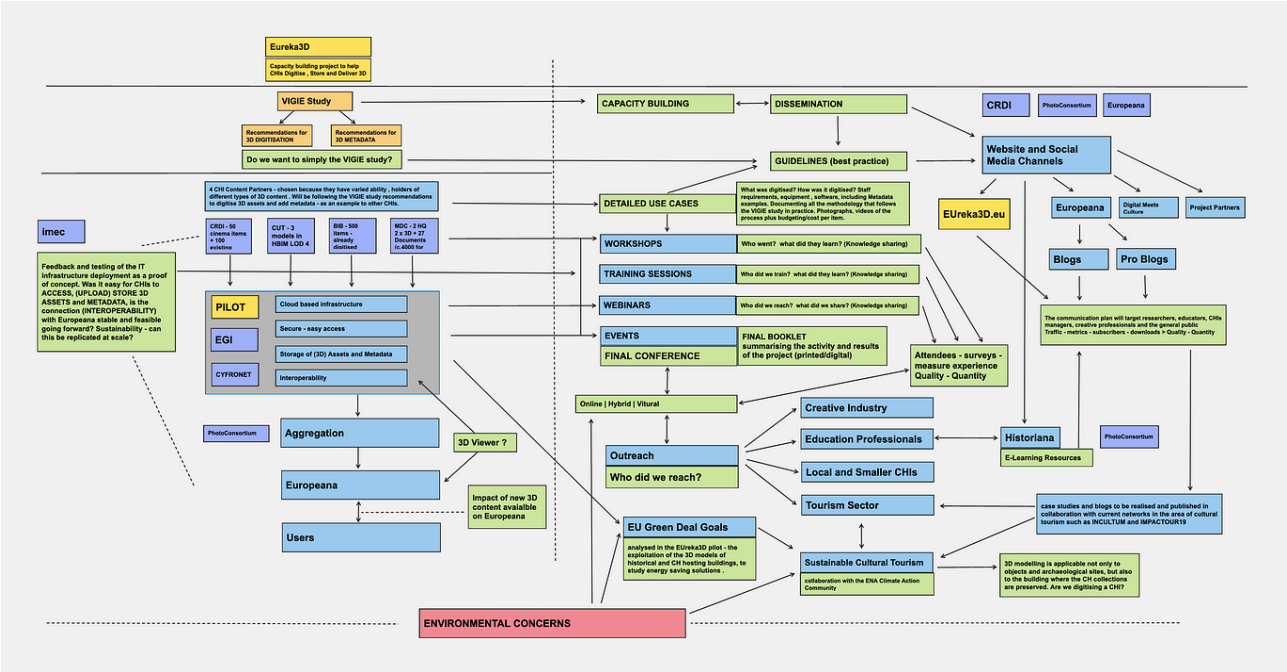


Fig. 3 The EUreka3D visual plan (please see the annex)

From that plan, three core Change pathways were developed:

- Digitization workflow (i.e. how the implementation of VIGIE 2020/654 Study recommendation impacts the 3D digitisation process)
- The Pilot action and EUreka3D Data Hub experience (i.e. proof of concept data hub, to store, display and integrate, the 3D models, metadata and paradata, created in the project)
- Capacity Building / Knowledge Transfer (i.e. how the information created in the project e.g. the resources, webinars, case studies, user feedback is impacting the external stakeholders who maybe be at any point in their journey with 3D digitisation or use)

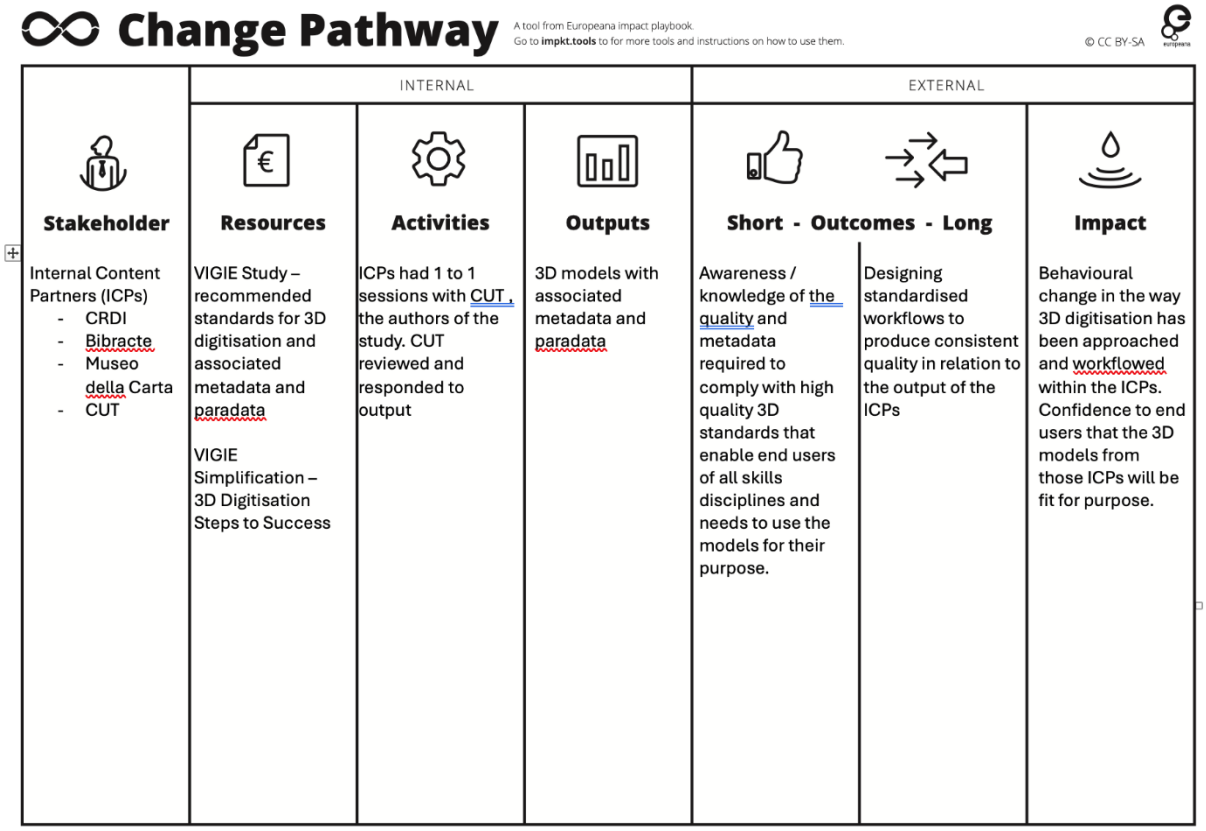
These areas are the key drivers of the impact assessment analysis and the basis for planning the sustainability actions, also in the light of the expected new project EUreka3D-XR starting 1/1/2025.

The change pathways were focusing on behavioural changes by the priority stakeholder groups, that happened because of the work done in the project. The reflections were driven by the research questions identified (cfr. sect. 2.1.3), reconsidered and reworded in terms of changing behaviours.

In the following charts, each Change Pathway is illustrated according to the templates of the Europeana Impact Assessment Playbook.

Change Pathway 1:

CP1: Would the Content Partners, and by extension CHIs involved in the 3D transformation, change their current workflows to integrate the standards and recommendations outlined in the VIGIE 2020/654 Study?



Change Pathway

A tool from Europeana impact playbook.
Go to **impkt.tools** to for more tools and instructions on how to use them.

	INTERNAL			EXTERNAL		
Stakeholder	**Resources**	**Activities**	**Outputs**	**Short - Outcomes - Long**		**Impact**
Internal Content Partners (ICPs) - CRDI - Bibracte - Museo della Carta - CUT	VIGIE Study – recommended standards for 3D digitisation and associated metadata and paradata VIGIE Simplification – 3D Digitisation Steps to Success	ICPs had 1 to 1 sessions with CUT , the authors of the study. CUT reviewed and responded to output	3D models with associated metadata and paradata	Awareness / knowledge of the quality and metadata required to comply with high quality 3D standards that enable end users of all skills disciplines and needs to use the models for their purpose.	Designing standardised workflows to produce consistent quality in relation to the output of the ICPs	Behavioural change in the way 3D digitisation has been approached and workflowed within the ICPs. Confidence to end users that the 3D models from those ICPs will be fit for purpose.

Fig 4.1 Change Pathway 1

Change Pathway 2:

CP2: In relation to the workflow in CP1, would the Pilot Data Hub be a viable platform for Content Partners, and by extension CHIs involved in the 3D transformation, to change their views about and reliance on local infrastructure and current 3D dissemination platforms? and could the EU Pilot Data Hub remove a barrier of entry to CHIs who are struggling to engage with the 3D transformation, thus resulting in more CHIs contributing their digitised assets to Europeana and the Europeana Common Data Space for Cultural Heritage?

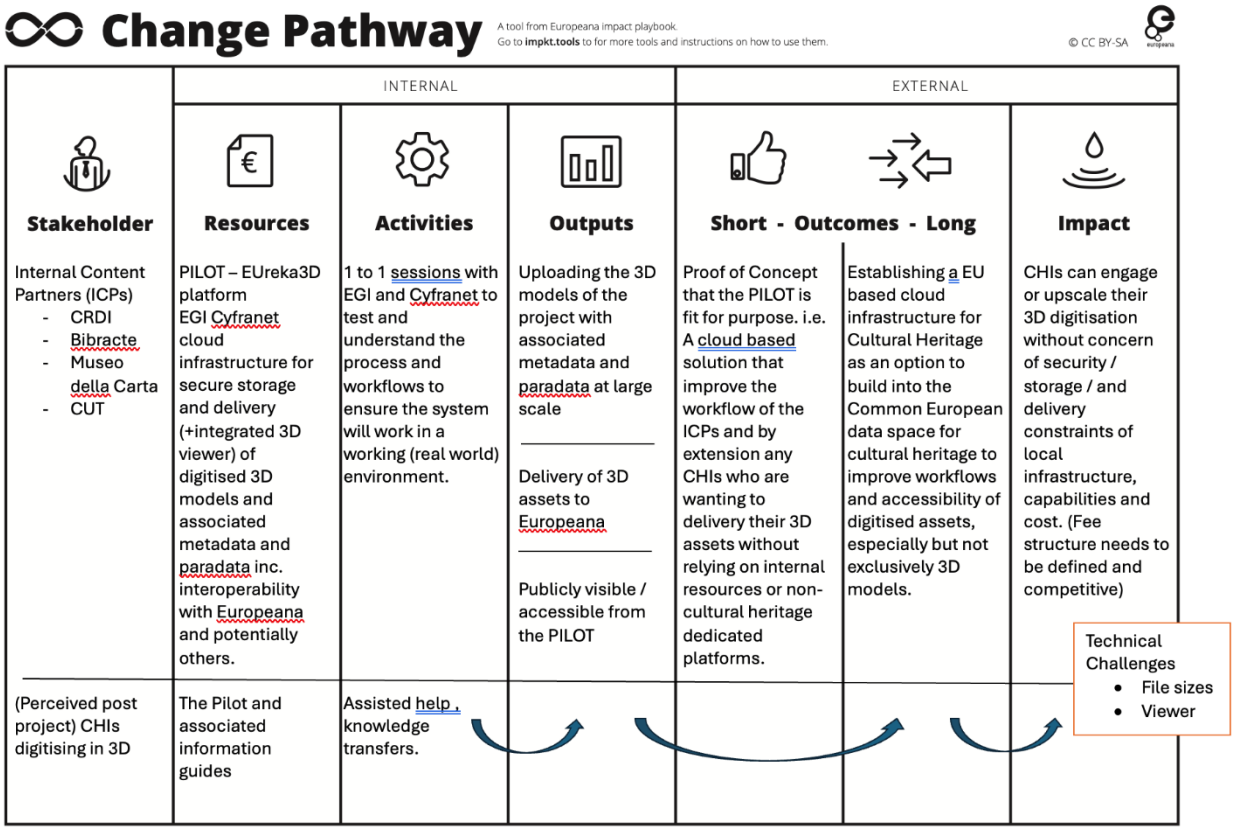


Fig 4.2 Change Pathway 2

Change Pathway 3:

CP3: Can the knowledge base, formed by the Capacity Building and Dissemination activities of EUreka3D, be adopted by CHIs to change their approach to 3D digitisation, and the workflows they use? Establishing standards for high quality 3D models. In turn, can the knowledge transfer to Users give them confidence to access and know that the 3D assets they want to use are reliable and fit for purpose with all of the relevant filedata, metadata, and paradata in place? Resulting in more 3D works being used.

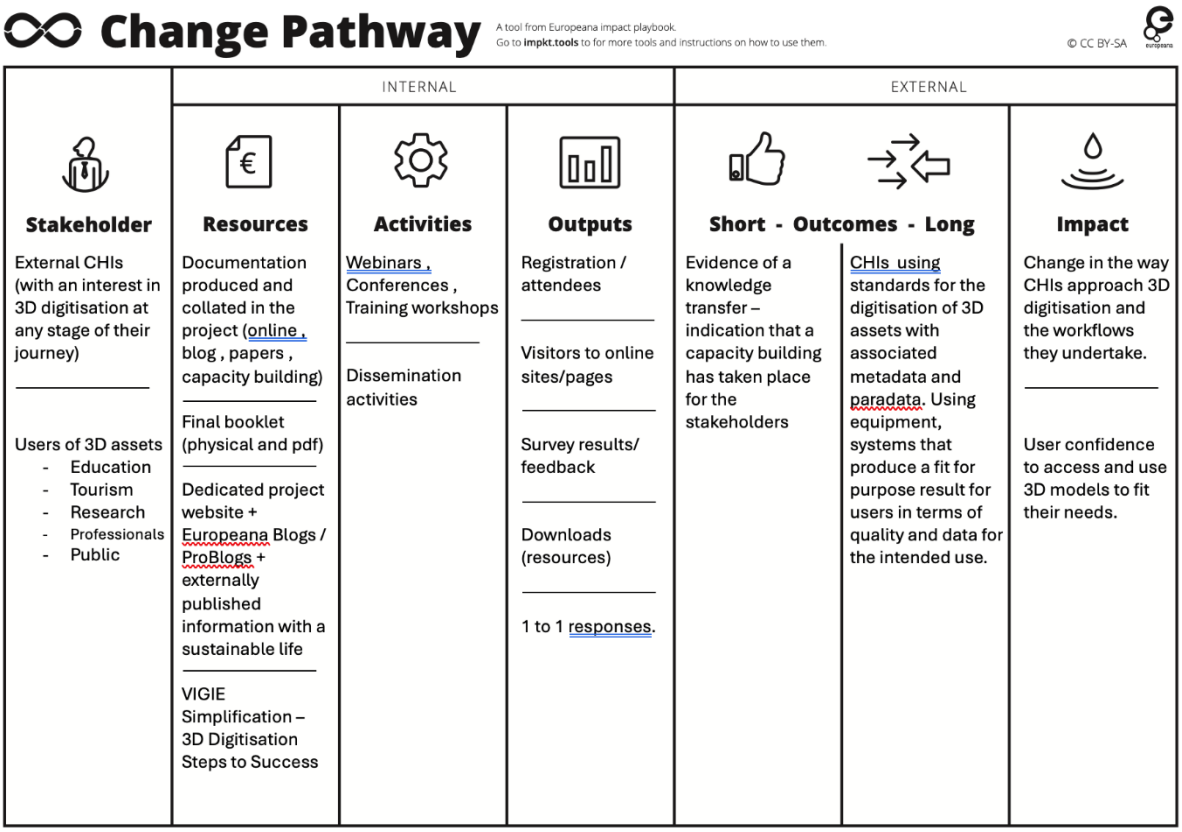


Fig 4.3 Change Pathway 3

2.2 Impact measurement

2.2.1 Data collection methodology

Data was collected using various methods and tailored to the stakeholder groups.

For the workflow and Pilot analysis, data was produced directly from the Content Partners. This data was gathered during the regular project discussions and via one to one guidance by the lead partners, i.e. the 3D digitisation (CUT), and the Pilot EUreka3D platform (EGI, Photoconsortium). Content Partners were also asked to produce case studies of their experience, which were disseminated in blogs and shared in open access, including the publication in the Final Booklet.

The external stakeholder data was gathered by the Partner in charge of the webinar / workshop / event etc., either via Zoom and on spreadsheets. For external stakeholders, the project was interested in the global reach, the audience skill level (for 3D digitisation), and the numbers reached. The metrics were gathered in advance of the webinars and workshops via registration and attendance recording. The project also wanted to have evidence of the knowledge sharing, as an indicator of impact i.e. that the capacity building was qualitative not simply quantitative: for this aspect, post-webinar surveys were sent to attendees and targeted stakeholders were asked directly for feedback. Additionally, a survey about expected use of 3D models of European heritage was submitted to heritage, education and cultural tourism professionals across the summer 2024, collecting a sample of 24 in depth responses. Details and analysis of the survey is provided in section 3.2.

The project's Capacity Building programme also published blogs, pro-blogs on Europeana, newsletters as well as other online and social media activities. Data metrics were gathered for these to assess reach and the target was stakeholder groups but the qualitative impact was harder to allow for.

2.2.2 Data analysis

The Content Partner data was all direct word of mouth qualitative data shared in project discussions and monthly / thematic meetings, that also served in the iterative process of the EUreka3D tools and services development. For the project objectives, this narrative data, which eventually converged in the *EUreka3D Final Booklet*, could be analysed and used almost immediately to change project goals and to re-assess the workflows and key information that was being disseminated via the Capacity Building events. Also, from these conversations and the work to develop the EUreka3D Data Hub, it was clear that more investigation was needed on formats and 3D viewers to provide a good user experience while visualising 3D models online, which led to the organization of a dedicated webinar by an expert professor and convenor of the JPEG committee, and various collaborations with institutions working on viewers such as Archeovision, CNR-ISTI and University of Cologne for Kompakkt viewer.

External stakeholder data was quantitative in terms of numbers attended. The global reach was also recorded and analysed. As a result, it showed the importance of affiliation with world-wide associations like the ICA (International Council of Archives) who had a readily interested network stretching as far as, and as isolated, as Nepal, Indonesia, Philippines, Mozambique, Lebanon, South Africa, US, Japan, Mexico, Guatemala, Brazil, Chile, who would have been impossible to reach without such a partnership.

The webinars also gathered some qualitative data from the chat which was often in the form of informed questions which could be used to develop the Capacity Building programme. In person workshops conducted

by Partners were generally smaller groups which provided in depth feedback which was also recorded and analysed to develop Capacity Building activities.

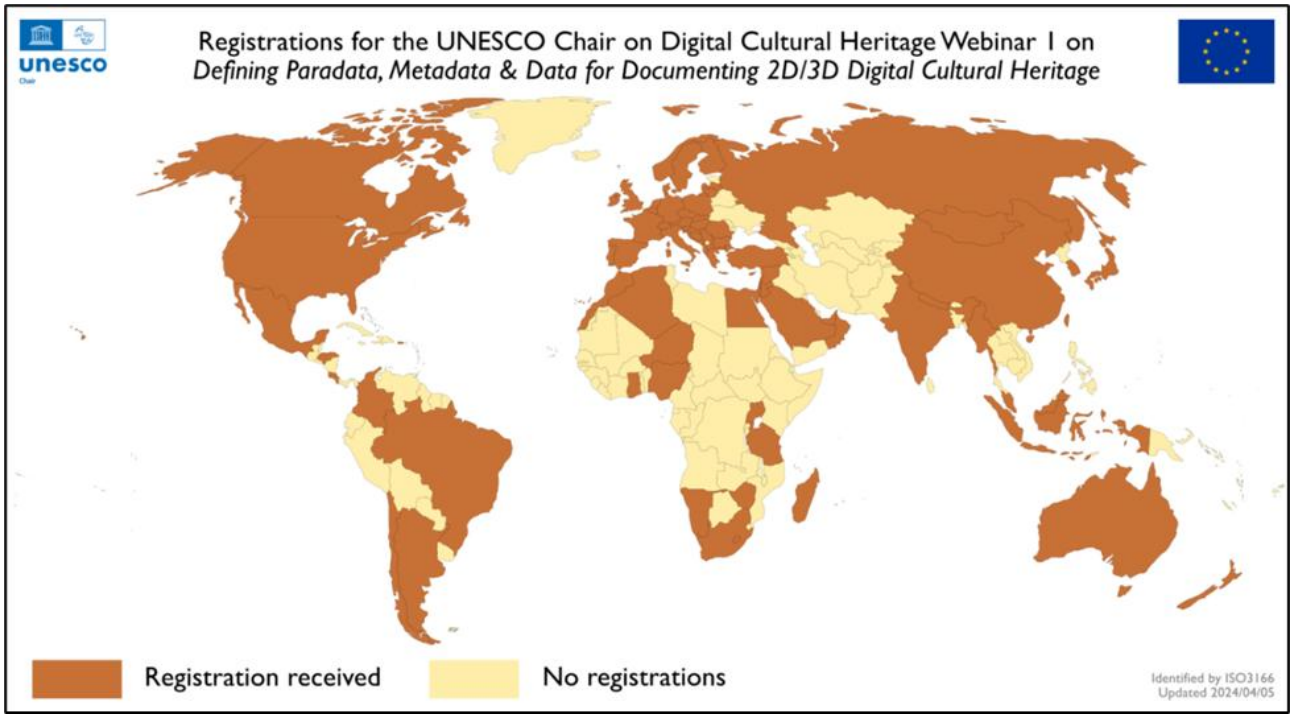


Fig 5 Geographic distribution of registrants to webinar “Paradata, Metadata and Data for 3D acquisition in cultural heritage”

2.2.3 Response rate, challenges, limitations

Detailed information about the attendance to the training and capacity building programme is provided in the *D2.2 Report on Training Programme*, from which the following table is derived to summarize the outreach and also verify the (over)achievement of the project target KPIs.

TABLE REPORTED FROM D2.2 REPORT ON TRAINING PROGRAMME, SECT. 3.2.1		
Target KPI from GA	**Achievement**	**Commentary**
Participants in pilot (project CHI partners, their staff and their networks): overall 50	Participants in onsite events and hands-on training: 729	Data of onsite events from the table in sect. 2.3 Additional events were hybrid, as indicated in the table on sect. 2.2
Participants in the online capacity building sessions: overall 200 EUreka3D training programme: min. 150 participants from CHIs from all over the EU	Webinar series Fall 2023: 330 Webinar series Fall 2024: 368 Participants in other online events: 746	Data of online events from the table in sect. 2.2
Workshops at the Euromed 2024 Conference: min. 200 participants from the GLAM sector, policy and scholars	Participants in workshops: • Paradata Webinars: 539 • Onsite Euromed: 202 • Video Presenters: 18	This activity included an articulated programme of thematic interventions, with online and onsite actions culminating in Euromed 2024 conference in Cyprus. Overall, the number of participants went beyond expectations, engaging DCH experts and learners. An open access publication with Springer was derived from this activity.

Workshop/demo at ENA: min. 50 participants from the CH sector	Outreach in Europeana events: 383	The data includes the participation in Europeana Projects week day 2 and day 3, and in the Digital Storytelling Festival.
Technical workshops at EGI annual conference: min. 25 scientists from the e-infrastructure community	EGI 2023 attendees: +120 EGI 2024: AAI workshop: +80 attendees; data spaces session: +40 participants; Interactions at the booth: +100	The project participated in both annual events from EGI. In 2023, the participation was mainly about announcing the preliminary development of the project, while in 2024 it was possible to actually demonstrate the project's results.
Workshop/demo at I&R Image & Research: min. 25 professionals from the archival community	Participants at I&R: 139	The EUreka3D session was included in the plenary programme of day 1 of the conference, thus being delivered to all attendees of the conference
Participation in third parties' events attended by the partners: min. 10 key events	Events attended: 18	The participation in third party's events has the double scope of providing communication and dissemination of project's outcomes and promoting learning resources and training activities.

Additionally, a survey prepared in the summer 2024 about the reuse of 3D models of European heritage was distributed via the project newsletter and partners channels, and led to insightful responses, especially to open questions with free text, as it is shown in the example below. Details of the responses to the survey are presented and commented on section 3.2.

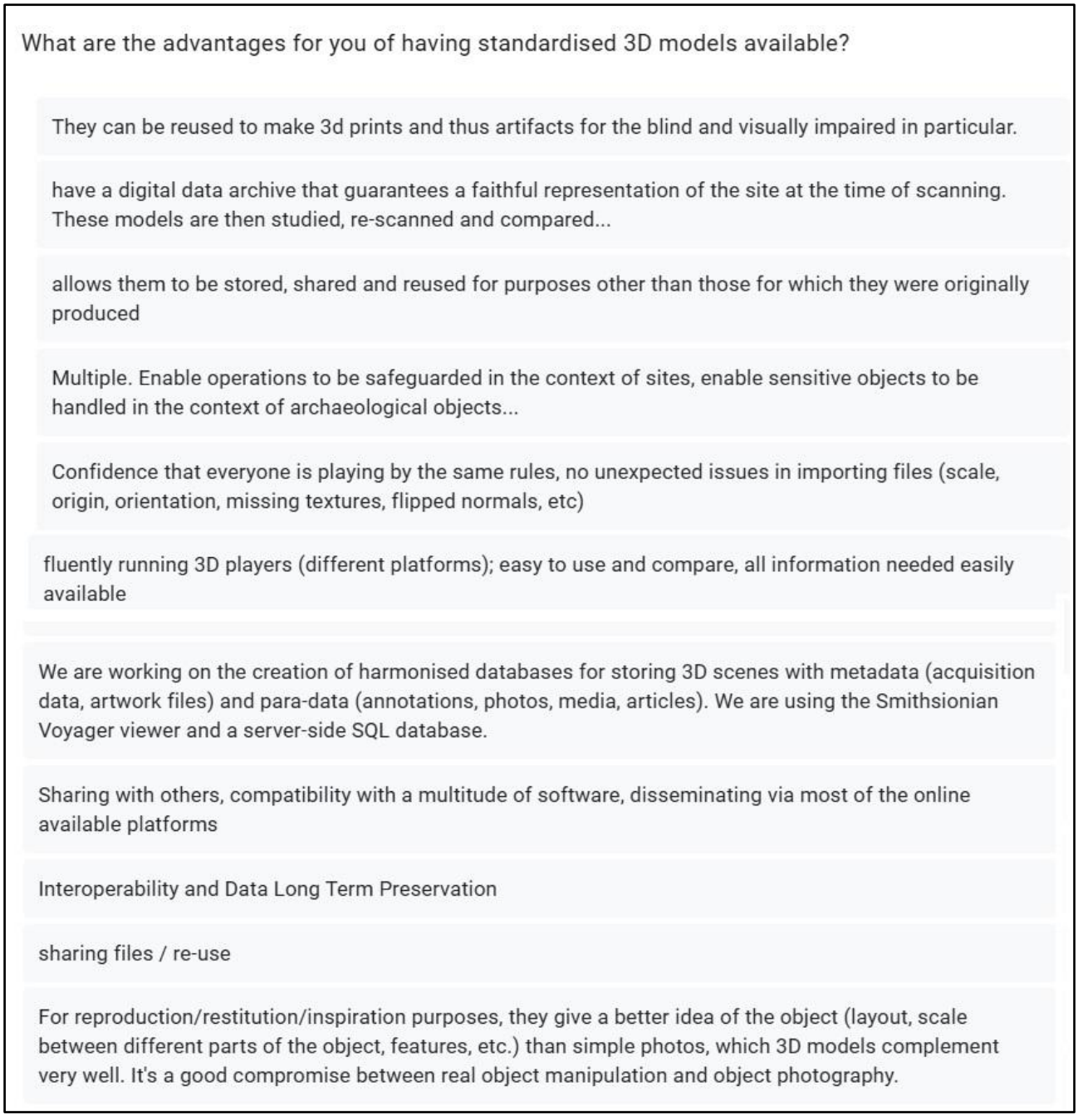


Fig. 6 An example of the quality of responses received to the survey about reuse of 3D models

Besides collecting responses in written form, one of the aims was receiving informed engagement from the attendees. Although online surveying tools are available, these often distract the flow of information of the presenter for the sake of quantitative data which is only representative to a slightly increased subset of participants. In this light, we found that the live questions in the chat, or made by the attendees directly, proved the most valuable responses which could then be answered in the ears of all those present.

Unfortunately, there is also a trade-off between the timeframe of the event and the time available for Q&A and discussion. As a strategy for the project Capacity Building programme, we chose to keep the majority of the webinars compact, in the range of ca. one hour, so as to be more appetible to potential attendees who can easily include a one-hour webinar in their agendas. However, the knowledge-sharing nature of the webinars inevitably leads to many questions from the attendees, with the challenge of fully accommodating them in the timeframe available. The quality and relevance of these "live" questions and the feedback from attendees resulted in some of the most important data we received. Also, inviting attendees to contact us afterwards for any further question or information led us to enlarging the network of stakeholders, and the registrants to the project's newsletter.

2.2.4 IMPACT NARRATION AND EVALUATION

EUreka3D was aware of the primary research questions which developed from the change pathways when interpreting the data to validate the findings. The perspective of the Content Partners as representative CHIs was key when performing the 3D digitisation process and the Pilot EUreka3D Data Hub. The project was also mindful that internal focus could produce a siloed and biased response and therefore was conscious to include narratives from external stakeholders and the Advisory Board, collected and shared in the form of quotes used in the final booklet, which validated the projects methodology and strengthened the sustainability of the published dissemination of the project.

When evaluating the impact of the project, a main consideration was how EUreka3D contributed to the 3D Digital Transformation and if the Pilot EUreka3D Data Hub was viable to develop and assist with the common European data space for cultural heritage. These are initial steps in the 3D digital ecosystem, to equip CHIs with the knowledge to effectively digitise their 3D assets and to provide a platform that allows them to store and disseminate the resulting models to users. The future steps that were considered, but beyond the scope of this project, were the applications that leverage the resulting 3D models to engage and enhance the users' experience. This is the main core of the continuation project EUreka3D-XR starting in February 2025.

3. FINDINGS

It would be fair to say that 3D Digital Transformation of the cultural heritage sector is in a nascent phase of development. As such, the EUreka3D project was formed in a 3D landscape which did not adhere to formal standards, with multiple formats and technical solutions, and a variety of hosting platforms that appeal to generic 3D modelling, with a network of systems that were not interoperable. For the CH sector the importance of the 3D Digital Transformation has become urgent, as stated in the EU recommendation to digitise in 3D all CH at risk by 2030.

With this as a starting point, the EUreka3D project set out to help CHIs of all levels, but particularly smaller CHIs and also SMEs working on 3D digitization, with their 3D Digitisation journey, and covered 3 impact points corresponding to the behavioural changes in CHIs and CH professionals that were fostered by the project.

1. **High Quality Digitization Workflows:** Using the VIGIE 2020/654 Study 2020/654 as the EU recommended best practice for the entire workflow of 3D Digitisation Transformation, we guided the project's content partners and shared the knowledge of this standard to the wider CHI community to produce and promote a consistent output of high quality 3D digital assets with correctly annotated metadata and paradata in order for users of 3D models, present and future, to be able to use reliable records of cultural memory.

2. **EUreka3D Data Hub Experience:** The project created pilot cloud resources, services and tools, referred to as the EUreka3D Data Hub, to serve as a secure and dedicated repository for CH with the capacity to handle, display and disseminate high resolution digitised 3D models, with quality metadata and paradata, to act as a proof of concept system supporting the European data space for cultural heritage.

3. **Capacity Building / Knowledge Transfer:** The Capacity Building webinars, workshops and blogs all served as a knowledge centre for all aspects of the 3D digital transformation of CH, to be discussed, shared and recorded as an information resource.

Above this, the EUreka3D project formed an Advisory Board of experts in the field of 3D digitisation to ensure that the right questions were being asked and the resulting methodology was being adhered to maximise the impact of the project.

3.1 The three Change Pathways

3.1.1 High Quality Digitization Workflows

When investigating the 3D digitisation process with the Content Partners we discovered some important aspects: firstly, that there was a general lack of awareness of the VIGIE 2020/654 Study as an EU recommendation for standards and quality in 3D digitization. This was evident from the initial response from the content providers and also more broadly in the Europeana ecosystem, following discussions with Europeana, as a partner of EUreka3D. This consideration naturally excludes partner CUT, who prepared the Study in 2020: in this light, CUT was appointed as the lead partner for the digitisation work package and for capacity building. The feedback regarding the VIGIE 2020/654 Study became a catalyst for the initial capacity building efforts, i.e. pushing this recommendation document (including dissemination via Europeana) to promote high quality and standards in 3D digitisation amongst CHIs, and making it one pillar of the Training and Capacity Building programme.

As the content partners looked at the VIGIE Study, it was found that the VIGIE 2020/654 Study was a complex document to follow, particularly for smaller CHIs whose typical digitization scenario would be with moveable objects in controlled conditions (while situations of large sites in uncontrolled outdoor, even underwater, conditions are less common). It was also found that many CHIs are likely to contract an external 3D digitisation company rather than invest in costly equipment and professional in-house staff which may only be needed for a limited period of a defined project.

As a result from assessing this feedback received from the content providers, the EUreka3D project decided to create a simplification to the VIGIE 2020/654 Study, an open access publication entitled **3D Digitisation: Steps to Success**[3], with explanation, guidance and a checklist. The scope of this hands-on document is to help CHIs follow the recommendations set in the VIGIE 2020/654 Study for quality digitisation and therefore change workflow behaviours to produce consistent high-quality models with informed metadata and paradata. As the content partners had access to one to one expertise from CUT throughout the digitisation phase the need and resulting simplification guide came late for the content partners to follow directly, but positive feedback was received from both the content partners and selected external target stakeholders who validated the usefulness of the guide to aid CHIs with their 3D digital transformation and as a result it remains a valuable contribution to the sustainability of the project.

When looking at the VIGIE 2020/654 Study in more detail, the Content Partners were also unaware of the importance of paradata. This was also reflected in the Europeana frameworks, particularly in the Europeana Data Model, which showed limitations in the way paradata information can be accommodated. This steered many conversations and activities to teach CH professionals, surrounding the differences between metadata and paradata, the relevance of paradata, the uses of paradata, the recording of paradata. This theme became a prominent topic in many webinars of the Training and Capacity Building programme and also a focus in the Springer open access publication **3D Research Challenges in Cultural Heritage V: Paradata, Metadata and Data in Digitisation**[4]. The focus on the key relevance of paradata in the 3D representation of cultural heritage and the contribution of EUreka3D in this ambit have been acknowledged also in the context of the 3D Working Group of the Data Space project, as illustrated below.

All the feedback from content partners, and the stories, lessons learnt and challenges encountered in the digitization of heritage collections were collected in the **EUreka3D Final Booklet**[5], which includes four detailed case studies from the direct experience of the four content providers. The four case studies were also presented in the final conference of the project in Girona, in a dedicated session on 13 December 2024.

[3] https://eureka3d.eu/3d-digitisation-guidelines/
[4] https://link.springer.com/content/pdf/10.1007/978-3-031-78590-0.pdf
[5] https://eureka3d.eu/wp-content/uploads/2024/12/EUreka3D-FinalBooklet.pdf

Fig 7 The three main training and learning resources produced in EUreka3D from assessing the needs of stakeholders: Digitisation Guidelines, Final Booklet, and Springer open access publication

As mentioned above, it was also found that Europeana user interface does not display metadata and paradata information in full, particularly the properties included in the edm:WebResource class, that in principle is the optimal class for including paradata. Although the information aggregated by a content provider is fully stored and available via the Europeana API, a typical user of the Europeana interface only sees the information displayed on the record's page. This is a known challenge that is becoming more prominent as long as more 3D content with richer metadata is aggregated in Europeana, and the issue is being addressed in the context of the 3D Working Group of the Data Space project, which is appointed for a revision and expansion of the Europeana Data Model. In this context, the project recommended key paradata fields to be incorporated in the Europeana Data Model and in the visualization interface, for the benefit of both producers and users of 3D models, and each content provider included a direct link to the full paradata report for each object in the dc:relation field. Until the implementation of the EDM expansion is finalized, the consequence is that the metadata of an object as visible on EUreka3D Data Hub is richer than what is visible for the same object in Europeana. This shows the importance of interoperability between systems which is a pillar in the future developments of the data space and other initiatives such as the European Collaborative Cloud for Cultural Heritage.

3.1.2 EUreka3D Data Hub Experience

The EUreka3D Data Hub was successfully developed and deployed as a pilot action, and the content partners successfully uploaded their models which were then harvested directly to Europeana. As a proof of concept, the Pilot ticked the following impact objectives: the EUreka3D Data Hub is an EU funded and based system dedicated to CH which proved important, often essential, for CHIs from EU Member States. It incorporated secure single sign on (SSO) with organisation credentials, reducing the chances of system violations by bad actors. The system was developed to not only handle the files of the 3D models but integrated metadata and

more importantly (and uniquely) paradata compliant, with the VIGIE 2020/654 Study and interoperable with Europeana. Additional time was spent investigating 3D viewers/visualisers that would allow users to display and embed 3D models directly from the platform. The EUreka3D project identified and incorporated the most versatile viewer available but the varying standards and formats currently available for 3D can be challenging, particularly for ultra high resolution models to be displayed accurately, in the same level of detail, for users.

The project can only anticipate if the EUreka3D Data Hub will impact the behaviour of CHIs to favour a dedicated a EU Cultural Heritage Data Hub, which is interoperable to Europeana, to store and publish their 3D Models, Metadata, Paradata, over the current systems which are predominantly Commercial US based services (e.g. Sketchfab). Initial feedback from the community was positive as a number of CHIs, who were not partners in the project, came on board to test and successfully use the platform. In some cases these external stakeholders finalized their entire workflow by publishing the collections in Europeana via the EUreka3D Data Hub. Operations and business planning for the EUreka3D Data Hub was provided in the *D3.3 Final report on the EUreka3D services and resource hub: design and implementation,* which will also be part of the continuation project EUreka3D-XR. Extracts about continuing the work are provided in the next section 4.1.

Particularly interesting for further exploration is the possibility offered by the EUreka3D Data Hub of sharing collaboratively 3D files with trusted users and members of EUreka3D groups, as authenticated in the EUreka3D Data Hub. The potential of this service lies in the possibility of supporting collaboration and co-creation projects between different CHIs, who may share their 3D files for the production and use of exhibitions and other interactive contents for visitors and user communities.

3.1.3 Capacity Building / Knowledge Transfer and Dissemination

The EUreka3D project is heavily focused on Capacity Building. This Change Pathway is measuring the impact of the knowledge transfer between the information, resource gathering, and dissemination of the project and how that is creating a behavioural change to the CHIs who are digitising and the stakeholder users of 3D assets.

The project has collated data which quantifies the reach of external stakeholders who attended webinars and the numerous dissemination activities within the life of the project. The information and reflections about the data collected and analysed is fully provided in the *D2.2 Report on Training programme*, which also compares the data with project's KPIs, and summarized in sect. 2.2.3 of the present document. To more accurately measure the impact, EUreka3D obtained qualitative feedback and testimonies by stakeholders about various key concepts such as: the need for digitising in 3D; the importance of 3D digitisation standards (VIGIE 2020/654 Study); the importance of Paradata (in addition to metadata); the need of a dedicated EU Cultural Heritage Data Hub; user needs and expectations for 3D assets (particularly in relation to education and tourism); environmental impacts; the future of 3D and Cross Reality (XR).

As such the project engaged broadly, not only with European stakeholders but with global networks, such as the International Council of Archives and the Europeana Aggregators Forum and ENA. It achieved this dissemination in a number of different formats including webinars, workshops, blogs and Europeana pro-blogs as well as social media channels, a dedicated e-newsletter and the project website. The quantitative data validated that the reach of the project surpassed the anticipated goal set at its inception.

Topics of training were driven by the Advisory Board comments, internal project findings, expertise of the partners, and feedback from external partners. This all helped to deliver a programme to target the stakeholder needs for the 3D Digital Transformation. The impact of this knowledge sharing is more predictive, only time will tell how well the standards and recommendations have been followed and whether the 3D ecosystem for CH is consistently producing high quality digitisation that is proving to be, not only fit for purpose, but also used by the external stakeholder groups that have been identified. What we do have is evidential feedback that the various activities of the project have been valuable as a resource and will indeed assist the digitisation journey of CHIs. In addition we have also received some evidence of use as a direct result of the CH digitised within the project. Together with the tangible material produced by EUreka3D the knowledge resources stored on the project website and via Europeana will provide a sustainable resource and lasting impact for a number of different stakeholders interested in 3D.

Additionally, it must be noted that the Capacity Building resources will remain online at the project website. Editorial galleries, blogs and pro-blogs are available at Europeana, a number of partners have published information on their sites and the news published on the EUreka3D showcase on digitalmeetsculture have complemented the effort of dissemination. Tangible resources created in the project such as the 3D Digitisation Guidelines: Steps to Success and the Final Booklet will be available as online resources and in print form. Additionally, an open access publication with Springer was created in December 2024 collecting papers from the webinar "Paradata Metadata and Data in cultural heritage" and Euromed conference, and will be widely disseminated in the next months especially in the context of EUreka3D-XR. in this light, it is worth to highlight that the KPIs on outreach and the performance of Europeana editorials are presented in the *D1.6 Final technical report*, showcasing how the project overachieved. The following table presents a summary:

KPI according to the GA	**Performance**
200 newsletters receivers	573 newsletters receivers - *Data collected on 10/12/2024*
300 followers on social media	748 followers on social media - *Data collected on 10/12/2024*
20,000 page visits during project's lifetime	20,275 website pages visits (M6-M24) + 8,847 visits to Europeana editorials + project's blog on Digitalmeetsculture.net *Data stats collected on 10/12/2024*
Editorials: • min. n. 4 Europeana blogs about the collections of the four content providers; • min. n. 3 Pro blogs on high-quality 3D digitisation, capacity building and new services and tools; • min. n. 10 Europeana galleries; • min. n. 24 blogs, published monthly on project's blog and other dissemination channels.	All editorials published in Europeana during the project are collected in this dedicated page: https://www.europeana.eu/eureka3d n. 6 Europeana blogs in different languages n. 6 Pro blogs published and two additional, ready to publish n. 14 Europeana galleries n. 80 news items published on Digitalmeetsculture project's blog and disseminated in partners' websites, social media, newsletter and others. n. 5 source collections in Historiana, on Photoconsortium partner page

3.2 Analysis of the results of the online survey of 3D model producers and users

In late Spring-Summer 2024 a survey was circulated to collect in depth information by stakeholders who produce, use and reuse 3D models. Of the 24 responses were collected, the geographic origin of respondents spans several European countries (France, Cyprus, Spain, Italy, Greece, Finland, and Austria), and their profiles align with and go beyond the initially identified categories. Four main groups stand out:

- Producers of 3D models (9 people);
- Producers and users of 3D models (2 people);
- Users of 3D models (7 people);
- Potential users (6 people).

In addition, among the 7 people already using 3D models, one photographer also expressed interest in becoming a producer.

Producers of 3D Models

The producer group includes professionals from companies specializing in 3D modeling (3D model makers and graphic designers, digital cultural researcher, and scientific project manager) and engineers working at technology universities. They model the four types of heritage addressed in the survey (archaeological objects and sites, works of art and historical artifacts, monuments) as well as other (whole cities, underwater sites and shipwrecks, characters in period costumes, and natural heritage such as landscapes or paleontological assets).

Their work meets the wide variety of user needs in the field of cultural heritage:

- Scientific research and dissemination (6 responses),
- Documentation (2 responses),
- Conservation, site memory preservation, and restoration (3 responses),
- Public engagement and mediation (2 responses), with diverse approaches (exhibitions, immersive experiences, films, etc.).

This work covers all 3D applications (modeling, including 3D printing, reality capture, web construction, and visualization), as demonstrated by the variety of file formats used (OBJ, STL, 3DM, FBX, BLEND, LAS, PLY, Geotiff, RVT, BIM, HBIM Model, GLTF, GLB, PSX), as well as resolutions that vary depending on the applications and intended uses:

- Precision applications: Extremely high needs, ranging from microns for conservation to coarser resolutions for terrain scans.
- 3D printing: Focus on models with several million polygons for maximum geometric resolution, without textures.
- Modeling and web display: Resolutions range from 50K to 1M polygons, with textures from 4K to 8K, depending on object complexity and display requirements.

Highly skilled in the technical aspects of 3D digitization, these producers are also keen on delivering standardized 3D models, recognizing their advantages: interoperability, compatibility, reliability, integration of metadata and para-data, and durability, allowing storage, sharing, and reuse for purposes beyond their original creation. However, they identify several limitations with 3D models:

- Poor quality of some scans, requiring extensive optimization to make them usable.
- Lack of comprehensive standards for metadata and para-data.
- Insufficient solutions for storage, annotation, and reading of models, hindering the long-term sustainability of 3D acquisitions (some models are lost or underutilized due to a lack of appropriate tools).
- No guarantees on the long-term preservation of data.
- Users remain largely unaware of the benefits of using detailed and standardized 3D models.

They express a need to better share experiences among producers and gain a deeper understanding of user needs.

The distinction between producers and users does not entirely reflect the difference between suppliers and clients because several producers work closely with users, either within European projects (see: link) or within companies like ICONEM. The scientific project manager from ICONEM who responded to the survey is both an architect and a heritage conservator. This company is also a user of its own models through its Exploration platform, which makes over 200 heritage site models accessible to the public and facilitates exploration and analysis via integrated browser tools.

This group includes an archaeologist specializing in 3D and an engineer from a French public organization dedicated to the conservation and promotion of monumental heritage, engaged in a national digitization program. Their uses largely mirror those mentioned by producers (research, preventive conservation, and mediation) as well as applications: 3D modeling (OBJ and FBX files), reality capture (E57 and ASII), and interactive visualization (GLB).

They recognize the same advantages of standardized models as producers but highlight different limitations: challenges related to institutional infrastructure (PCs, screens, storage, networks, and expertise) and the need to balance quality and time constraints, as illustrated by this observation:

> *"The type of equipment affects the texture of the final result. Limited time requires the specialist to make certain choices to deliver the best result in the shortest time, which often means compromises. 3D models must be viewed as replicas, not the actual object; this is a common misconception."*

Users of 3D Models

Their profiles align partly with those initially identified: archaeologists (2), cultural mediators (2), teachers (1), and a photographer (1). Additionally, a new profile emerged: craftsmen, represented by a bow maker.

Their interests focus more on objects than on archaeological sites and monuments. Their uses are diverse: research (2), conservation (1), restoration, reproduction, inspiration (1), education (1), and mediation (2). For instance, 3D printing enables tactile discovery for visually impaired individuals and facilitates the study of sensitive objects that cannot be handled. Other applications include conservation, studying models in OBJ, E57, and LAS formats, and visualization via online platforms.

Regarding standardized models, only one respondent mentions compatibility, ease of use, and availability of information. The other six did not fully understand the question and focused instead on the advantages of 3D models over real objects or photographs.

Their responses remain insightful, as they reflect general user perceptions. All emphasize that 3D models are an excellent alternative when access to real objects, archaeological sites, or monuments is impossible (e.g., due to fragility, distance, or disappearance, as in excavation stages). For example, a teacher highlights students' enthusiasm for handling 3D models themselves to better understand site organization or machine operation but notes that models do not replace real objects or sites. The craftsman points out the advantages of 3D models over photographs: better identification of the object, ability to see its different faces, the relationships between its different parts... but points out as a limitation that many models lack detail and above all an indication of its dimensions or a ruler integrated into the viewer to measure its different parts.

Potential Users of 3D Models

Among the 6 potential users, 4 fit the identified profiles (2 cultural mediators, 1 tourism professional, 1 teacher), while 2 others are specialists in fighting illicit trafficking of cultural goods (following Bibracte's dissemination of this survey as part of an Erasmus+ project on this topic).

Their intended uses include mediation activities like guided tours, as well as promoting tourist sites at fairs, educational workshops, school and university courses, and conferences. A notable innovation is the fight against illicit trafficking of cultural goods, where 3D models in stolen object databases offer significant advantages over photographs by enabling customs and law enforcement to identify suspicious objects more quickly and accurately.

Other mentioned advantages include:

- Mediation**:** Controlling the production chain, from selecting objects to their visualization, while making transportation easier compared to wooden replicas, such as Roman bows.
- Education**:** "Having 3D objects would facilitate classroom study (especially for Sixth Grade students): seeing the object in all its dimensions for better understanding of its fabrication and uses, conducting a more detailed, interactive, and precise study than with a simple photo. Applications would include history, art history, and technology."

About limitations of 3D models, key concerns include:

- **Download times:** Issues arise if a school's internet speed is insufficient, at tourist fairs where Wi-Fi is costly (offline tablet access may address this issue), or for customs officers where speed is crucial.
- **Technical devices:** Questions arise about portable solutions for projecting 3D models on heritage sites to showcase artifacts preserved in distant museums.

Two-thirds express the need for training to use 3D models effectively. This also applies to the photographer already using 3D models who now wishes to become a producer to share cultural heritage with others.

This analysis enhances the understanding of practices and expectations among stakeholders involved in the digitization and use of 3D heritage models, while identifying pathways for improvement to better meet their needs.

3.3 Reflections on economic impact and sustainability of high quality 3D digitisation and documentation of collections

As an additional reflection, the economic impact of digitising in 3D was considered by the content providers and reflections were included in the D1.5 Technical Report and in a more narrative form in the Case Studies published as part of the Final Booklet.

The challenge here is that estimates cannot be stated in terms of a fixed cost per 3D model, but instead can vary significantly, related to the complexity of the project, the measuring of which is the cornerstone of the VIGIE 2020/654 Study. Also the cost of creating high quality metadata and paradata is very variable.

Extract from D1.5:

1/ COST OF 3D DIGITIZATION

The providers in the project adopted different strategies according to their requirements and needs and according to the specificities of the objects to be digitised. The 3D digitisation of tangible CH can be an exceptionally complex process. Various factors condition the production effort and have a direct impact on the quality of the final output (e.g. the characteristics of the object, the type of equipment to be used, the level of accuracy expected for the 3D model..), and the complexity refers both to data capture and data post-processing.

Partners CRDI and Museo della Carta, committed to digitise museal objects but missing internal capacity and technologies, outsourced the entire process to specialised companies. In this case, guidance was given to the service provider about the quality requirements indicated in the VIGIE 2020/654 Study. The cost of the digitization, performed with the widely used photogrammetry technique, is therefore expressed in a fixed price all inclusive.

Partner CUT, in charge of digitising highly complex monuments and outdoor sites on behalf of local municipalities and authorities, leveraged internal capacity and technology to perform the digitisation so to meet the highest quality standards, with the aim to derive 3D models that fully correspond to a digital twin of the real monument. The cost of the digitization is mainly composed of the hourly cost of specialised personnel who spent their time onsite for the digitization and in the post-processing of the 3D models.

Partner Bibracte adopted a mixed approach including photogrammetry digitization of museal objects and 3D reconstruction of theoretical models of artefacts based on research and software restitution of metric, statistical, typo-chronological, and stylistic data. In addition to this, Bibracte is delivering a collection of orthophotographic terrain surveys, digitised by photogrammetry as commonly used in archaeology to document and study the physical features of a site or landscape. The terrain collection is currently in the process of being documented. The work is conducted by Bibracte leveraging internal resources.

In summary, it is very difficult to estimate the cost of digitising in 3D, because each object is different. Often, CHIs perform digitization projects to create 3D models under national or EC funded projects, and in such cases the most part of the cost of digitization, if not the entire cost, is not sustained by the CHIs directly.

2/ COST OF DOCUMENTATION (METADATA AND PARADATA)

There is significant work employed to create meaningful metadata for cultural heritage resources, and also multidisciplinary expertise is often needed by metadata experts, technical experts and subject-matter experts alike. All of this contributes to the total cost of metadata creation and annotation, which mainly remains a human-based activity. Even if methods for automated metadata creation exist, the result of machine-generated information may not be optimal and needs in any case a human intervention to validate and ensure trustworthiness of the information.

Also, depending on the type and depth of research that is needed for the creation of appropriate documentation that accompanies the cultural heritage object, the creation time might highly vary. (…).

In the case of paradata, the level of information to be collected also varies, depending on the data acquisition process itself (more or less complex), equipment used, conditions indoor/outdoor, involved personnel. As with metadata, the paradata collection's effort is based on the content provider requirements and constraints. While advocating for the highest accuracy and quality possible, such constraints for information collection and preservation must be considered.

In summary, similarly to the cost of digitization, it is very difficult to estimate a one-size-fits-all average cost for metadata and paradata creation, as these activities largely depend on the content providers requirement, available documentation and desired level of background research to be implemented. In this light, the project embraces the Europeana's recommendation to content providers to "determine the minimum quality needed but aim for the highest affordable".

3.4 Environmental sustainability and contribution to European Green Deal goals

EUreka3D also took into account aspects related to Environmental sustainability and contribution to European Green Deal goals, and particularly the project supported and collaborated with the ENA Climate Action Community, which is active in the identification of initiatives for change and for impactful, cooperative and sustainable action. In this context, EUreka3D followed and supported the Community's initiatives, such as the workshop "How to create more climate-friendly communications" that reflected on how in the everyday work of any cultural professionals small actions can be taken to make a difference in terms of climate impact, and supporting other initiatives such as the Europeana-Ki Culture sustainability workshop series, and Environmental Sustainability practice survey launched in September 2023.

Larger reflections and mindfulness of climate impact delivered by storage and data management and sharing were also an element of technical requirements for the services developed in the project, as part of the activities of the EUreka3D Data Hub development.

Finally, the project explored the trade-off in the organization of online events opposed to physical ones which require travelling. Even if it is acknowledged that both the production of online events with video streaming, and the storage of videos from events for rewatching do have an impact on carbon footprint, the scale and geographical coverage of the global audience the project was able to reach in the webinars programme would have had a highly negative environmental impact. In fact, if all those attendees would have travelled to the project conferences to hear information and build capacity on 3D workflows, the negative impact would have been massive.

In a side note, an interesting insight into the unforeseen environmental consequences as a result of the immersive access of 3D Digitisation is described below by the experience following the 3D digitisation of the village of Fikardou. Without doubt there is a success story in recording the memory, at the point of digitisation, to provide very engaging 3D immersive experiences to promote cultural heritage and tourism. As a result, however, the preservation of a priority area, as described in the Commission Recommendation (EU) 2021/1970 6.b the most physically visited cultural and heritage monuments, buildings and sites, could see an increase in physical tourism and the negative impacts of mass visits on these heritage sites could be accelerated as a result, without alternative preventative measures in place to protect them.

This and other interesting "side stories" emerged from partners during the work done in the project, that represent a clear indicator of impact. They are briefly presented in the next section.

3.5 Stories of impact

3.5.1 A Swedish museum and its Cypriot heritage: digital repatriation

Partner CUT collaborated with the Medelhavsmuseet Museum of Mediterranean and Near Eastern Antiquities in Stockholm. This museum hosts a collection of artefacts coming from Cyprus, that are of interest for Cypriot cultural heritage. In a collaborative project between CUT and the Museum, a selection of these artefacts was digitized and modelled. Two of them eventually became part of EUreka3D's project, and were aggregated by CUT via the EUreka3D Data Hub on behalf of the Museum, also publishing both of them in Europeana.

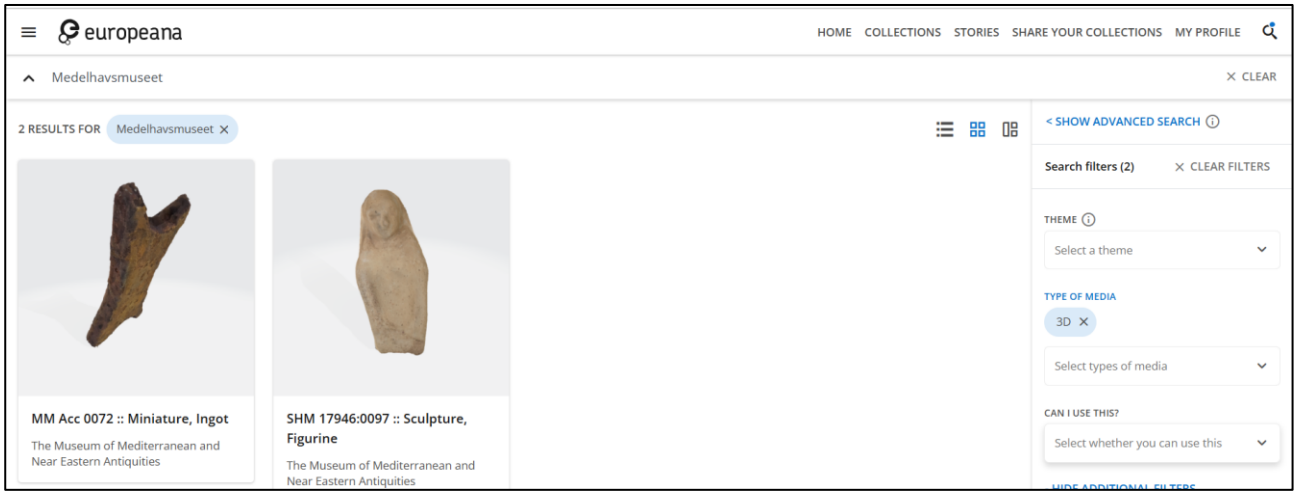


Fig. 8 The objects aggregated from Medelhavsmuseet in Europeana

3.5.2 Digitizing a village to preserve it: unpredictable outcomes

The village of Fikardou, which was in danger of disappearing, was digitised in 3D by CUT, and also provided by the Ministry of Culture in the Twin It! 3D for Europe's culture campaign, which invited EU Ministries of Culture to submit at least one 3D digitised heritage asset to the common European data space for cultural heritage.

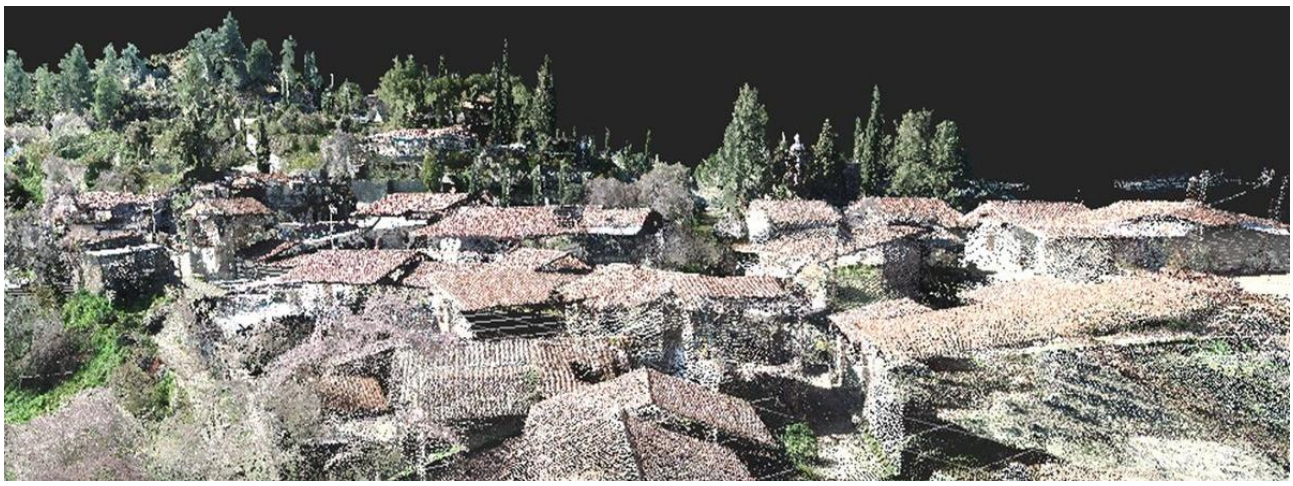


Fig. 9 A 3D point cloud mesh created from drone photography of the village.

The village was also promoted with an online platform, dedicated to the rediscovery of this ancient monument, recording 62,037 online visits in December 2023 alone, 89.5% originating from Cyprus. It emerged how this work in digitization and promotion stimulated economic growth in the local community, by revitalising heritage tourism. Since the inception of the preservation project, there has been a remarkable surge in visitors to Fikardou, with over 100,000 exploring the village by the end of the year 2023. Such unexpected flooding of visitors in this fragile site poses challenges and worries about the balance that is needed between site promotion and its preservation. Apparently, online visits to 3D models do not replace the desire of visiting the sites, on the contrary this case shows how promotion stimulates people to discover their local heritage. This interesting story is told in the Europeana Pro blog published by EUreka3D[6].

3.5.3 From digitization to exhibition: a new story for Museo della Carta

One of the two items digitized in 3D by partner Museo della Carta from their exceptional collections is a paper mould produced in 1923. It features the watermark with a stylized anchor, flanked at the bottom by the letters "E" and "S". These are the initials of Ettore Serra (1890-1980), poet, critic, antiquarian, multifaceted and cosmopolitan intellectual, and most of all founder of the publishing house Stamperia Apuana, which published the second and expanded edition of Giuseppe Ungaretti's collection of poems Il Porto Sepolto printed on a high quality paper specially manufactured by the Magnani Paper Mill in Pescia, using the paper mould currently preserved at the Museo della Carta, and digitized in 3D or EUreka3D project[7].

The 3D digitization of this paper mould supported in the Museum additional research about the story of the object itself and of this publication of Il Porto Sepolto. As a direct outcome of this research, an exhibition and catalogue was derived that will open in Museo della Carta in February 2025, showcasing the original model, the various documents and stories that surrounded it and the book published by Ettore Serra, and of course the 33D model itself digited in the EUreka3D project.

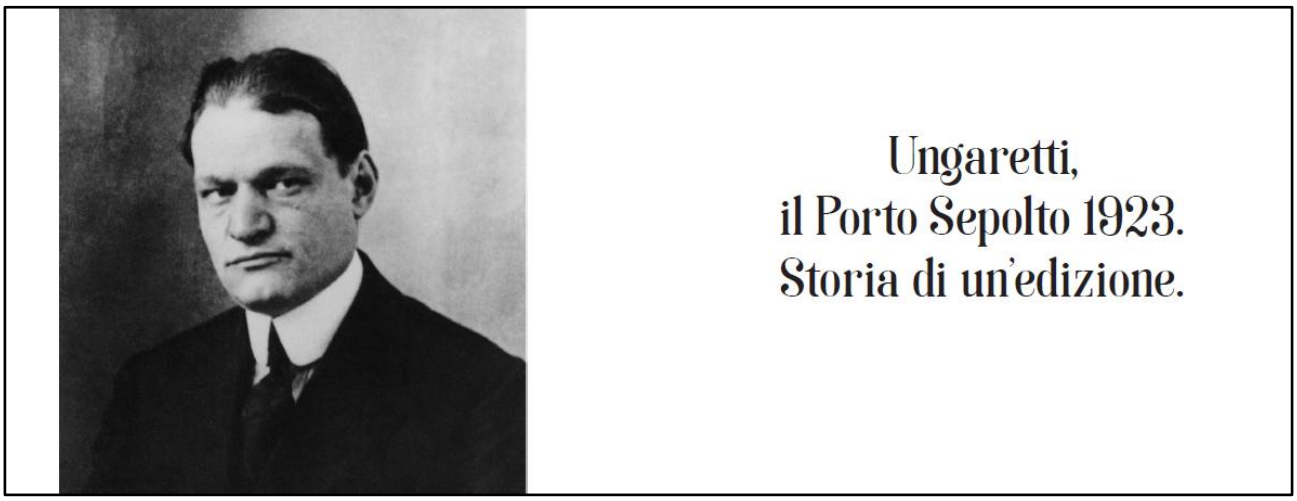


Fig. 10 The cover of the exhibition catalogue from Museo della Carta

[6] https://pro.europeana.eu/post/3d-scanning-preserves-a-cypriot-village-for-the-future
[7] https://www.europeana.eu/en/item/1226/21_15123_XFZYETI

3.5.4 Montsoriu Castle: continuing the work of EUreka3D as a competence center for 3D

As a side activity of the EUreka3D final event in Girona, a collaboration was established with the Museu Etnològic del Montseny about the digitization project of the important archaeological site of the Montsoriu Castle. A presentation of this work was part of the EUreka3D final conference in the morning of 13 December 2024, and a dedicated workshop took place in the afternoon addressing local cultural institutions, to present the work done by the Museum and their partner Digivision for virtual reconstruction of the castle of Montosiu. Additionally, a guided visit of EUreka3D project partners was organized on 14 December to the Castle, also discussing the possibilities offered by 3D digitization for the future of this site, especially in enabling virtual access to the castle, also with publication in Europeana, and virtual reconstructions of the different structures of the castle across centuries. An agreement was established for a next survey of the location, in the light of providing a laser scanner digitisation of the castle. This agreement paves the way for the continuation of work in supporting stakeholders with 3D digitization, leveraging and sharing the knowledge and competence established and collected in the EUreka3D project.

Fig. 11 The EUreka3D group of partners visiting Montsoriu Castle, 14th December 2024

4. CONTINUING THE WORK

4.1 The EUreka3D Data Hub as a resource

In the previous D3.3 deliverable describing the development and final features of the EUreka3D Data Hub, a section was dedicated to offering a comprehensive presentation of the services, tools, value proposition and cost/revenues profile, together with a tentative structure of the pay-per-use mechanisms that users of EUreka3D could be subject to, consisting in three levels of service, corresponding to three incremental plans with possibility to switch plans at any moment.

Extract from D3.3

> The value proposition identified in the project is to offer to CHIs an EU-based comprehensive solution for 3D data management and a direct entry-gate to the common European data space for cultural heritage. This clearly differentiates the EUreka3D platform from similar services for 3D data management, and showcases the competitive advantage of this solution, focusing more specifically on the needs of the "customers" (i.e. the European CHIs), in particular by making use of non-for profit cloud providers based in Europe, federated to the EGI European Grid Initiative, and offering safe data management mechanisms and integrated tools. All these features make the EUreka3D platform not only specialised and competitive, but also more resilient in terms of scalability, adaptability and flexibility to future developments of the digital transformation of the cultural sector. In terms of costs, initial investigations have been done as part of the project's impact assessment task, to estimate the running cost of the platform in its current shape, and a tentative cost of €1,000 per TB per year, that is in line with the price applied by other players like Sketchfab, has been considered. The comparison with Sketchfab is unavoidable given the fact that so far various CHIs relied so far on Sketchfab for visualising and sharing their 3D collections. However, as mentioned, the EUreka3D platform is not comparable to Sketchfab, being a much more specialised infrastructure addressing the needs of the specific community of the CH sector. In this light, EUreka3D Data Hub aims at offering a tailor made service to the target customers, with integrated tools, that CHIs would find much more suitable to their needs than Sketchfab. For this reason, the competition of EUreka3D with Sketchfab is between two different products, one addressing specifically CHIs requirements, the other offering a generic platform for 3D contents, whatever is the target sector. Also from a user perspective in the domain of cultural heritage, the EUreka3D infrastructure is much more efficient being directly integrated with Europeana and the Data Space for Cultural Heritage.
>
> In terms of revenue and sustainability systems, the mechanisms to develop a marketing model for the EUreka3D platform could be based on user profiling and the user's need for storage and services, similarly to the general *pay-per-use* approach of cloud and other service providers. An entry level with minimum services and functionalities can be established, and additional services can be available to the user upon payment.

In the light of granting future reuse of the platform and expansions of its services, two paths are identified

- the continuation project EUreka3D-XR, which will serve not only to expand the functionalities according to the project planning, but also to capitalise the lessons learnt in the EUreka3D project for improvements of the existing services and tools;
- a Joint Ownership Agreement between the EUreka3D project partners, with clear identification of exploitable outcomes and rules for parties, in consideration that each of them is entitled to exploit and reuse the project's results, provided the other partners are informed and agree.

Additionally, to reflect the current scenario of change for the EOSC European Open Science Cloud, a Memorandum of Understanding with project EOSC Beyond, aimed at creating a structured framework for a long-term collaboration between EOSC Beyond, EUreka3D and EUreka3D-XR continuation project. This MoU serves as a foundation for collaborative efforts that will test technical interoperability and data sharing with EOSC, next to a commitment to foster cross-dissemination and knowledge exchange to the diverse stakeholder communities. Thanks to this agreement, we expect to be able to continue to work for integration of EUreka3D in one node of EOSC.

4.2 Activity with Data Space project, and course on 3D digitization on Europeana Learning Platform

As partner of the data space project implementation plans, Photoconsortium includes actions in 2025 that have a relevance also as elements of sustainability and continuation for EUreka3D, by taking part in various groups, task forces and activities of the data space project, including participation in the task about Policy for PIDs, the tasks for use cases and requirements to support models for content reuse, participation in the Europeana 3D Working Group and Data Quality Committee meetings. Additionally, Photoconsortium participates in the task appointed to define criteria and use cases for integration of services and tools in the data space, reusing the case of the EUreka3D Data Hub to help define general criteria and requirements for accepting enabling services to users of the data space.

Finally but importantly, Photoconsortium has an active participation in the Capacity Building Working Group, that already in 2024 has led to the creation of one course on 3D digitization to be published on the Europeana Training Platform, directly derived from the 3D digitization guidelines, expanded with exercises, case studies and other resources. The course will be ready in the early months of 2025, after a first release of a beta version and collection of feedback for iterative review and improvements. The course will then be presented at one or more Europeana Academy events organized by Europeana in 2025.

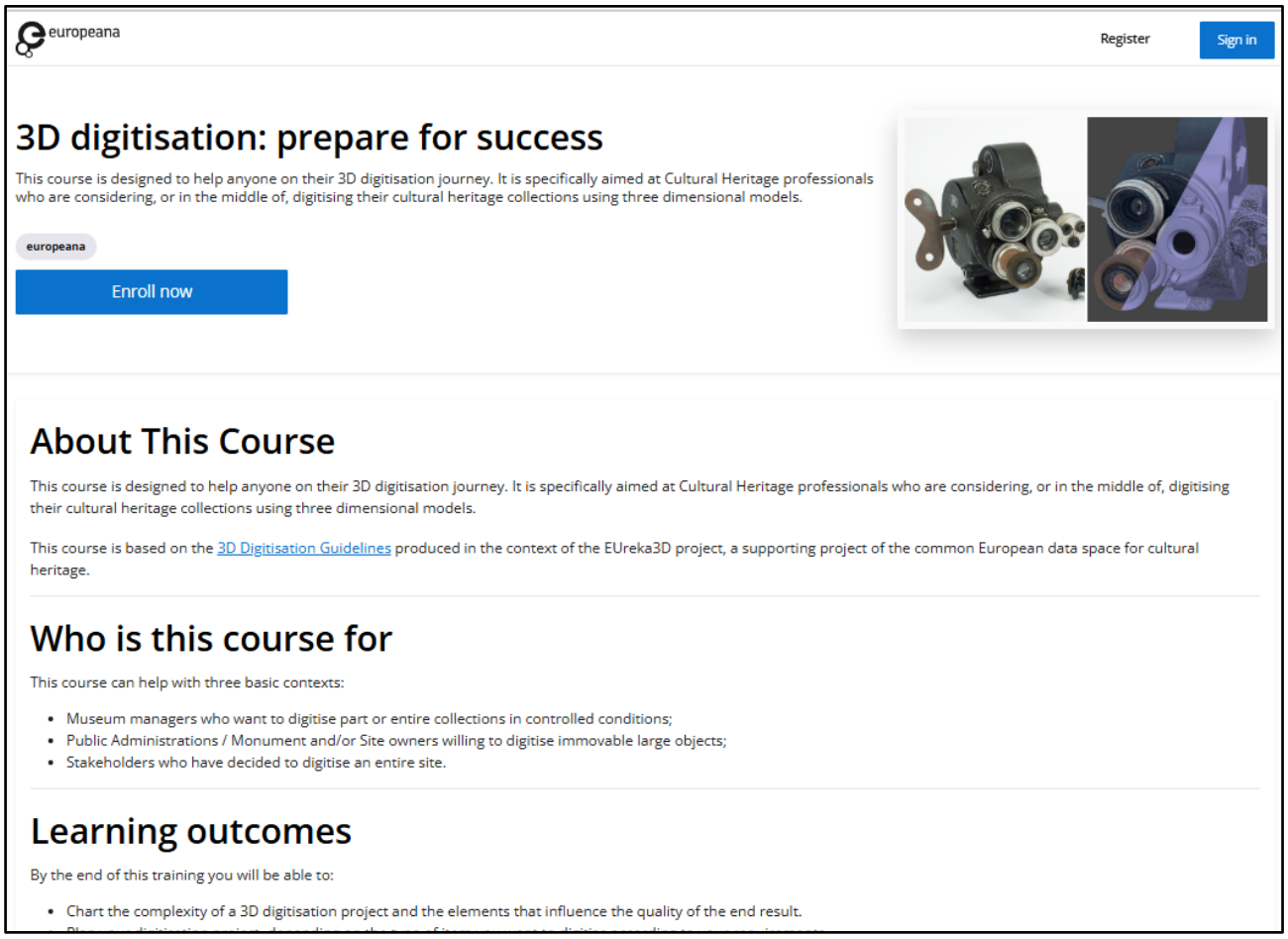


Fig. 12 Preview of the course on 3D digitization in the Europeana Training Platform

4.3 EUreka3D-XR

The new project *EUreka3D-XR – European Union's REKonstructed content in 3D to produce XR experiences* is the continuation project of EUreka3D, funded by the Digital Europe Programme of the European Union, to develop innovative re-use scenarios and tools that enable the creation of extended reality (XR) applications, building upon and expanding the features and services offered to cultural heritage institutions already developed and tested in the field of EUreka3D project. The consortium of the new initiative stems from the group of partners of EUreka3D but expands to other partners who will support technologies and capacity building.

The main work in the project will be focused on transforming existing and new cultural contents in various formats such 2D, 3D, video, texts, maps, stories into extended reality (XR) scenarios, and to deliver said scenarios to the common European data space for cultural heritage. EUreka3D-XR will deliver 5 open source digital tools that include online services and mobile apps to support innovative reuse and exploitation of cultural 3D resources in various settings, including various cultural heritage institutions. The tools will be integrated in the EUreka3D Data Hub and connected to the data space for cultural heritage.

EUreka3D-XR will also promote the re-use of digitalised cultural heritage in different domains such as education, tourism research and preservation.

As a proof of concept and pathfinder for replicability, EUreka3D-XR will handle three showcase scenarios, to be made available in the Data Space as contents and documentation:

- The virtual visualisation of the middle-ages walls of the city of Girona
- The XR narrative of excavations in process in the Bibracte archaeological site
- The creation of a new life of Saint Neophytos Englystra in Cyprus in the virtual space

In the context of EUreka3D-XR, the work done in EUreka3D will be leveraged and expanded. The current pipeline for aggregation will be used to offer new datasets to Europeana. The new project will also give us the possibility to improve features of the EUreka3D Data Hub, especially investigating improvements of the current basic 3D viewer.

EUreka3D-XR kickoff event will take place on 26-27 February at Museo della Grafica, Pisa (Italy).

5. CONCLUSIONS

The success of the EUreka3D project was thanks to careful planning, execution, and a genuine need from Stakeholders for the knowledge and tools developed in the project. As a result, EUreka3D has been able to deliver and produce a methodology that will be continued by the consortium as a competence centre for 3D digital transformation and its use.

This methodology has been firstly crafted via a Change Pathway which provides a best practice guide that CHIs can follow to produce consistent high quality 3D digitisation, with relevant metadata and paradata. This workflow has been documented into a tangible step by step guide (3D Digitisation Guidelines: Steps to Success) and backed up via a number of workshops, webinars and blog posts. Case Study evidence, detailed by all the content partners who followed this digitisation best practice during the project, was recorded in the final booklet EUreka3D - Good practices for the 3D digitisation of Cultural Heritage.

Secondly the pilot EUreka3D Data Hub has proved to be a viable proof of concept for the secure cloud storage and delivery of 3D models (and other digitised assets). As an affordable non-commercial EU based platform it is interoperable with Europeana and supports the common data space for EU Cultural Heritage. This has been proven in the storage and delivery of nearly 350 3D models of Cultural Heritage assets which, at the time of writing, forms 30% of all of the openly re-usable 3D content served on Europeana. This not only is from the 4 Content Partners of the project but also includes 3D models from 4 external Cultural Heritage stakeholders (RAMS, INSPAI, Medelhavsmuseet, Giravolt) who collaborated to make use of the EUreka3D Data Hub. With interest expressed from a number of external stakeholders and a guaranteed 3 year funding of the infrastructure, the project firmly believes that the EUreka3D Data Hub will gain enough traction to be a self-sustainable solution for many Cultural Heritage Institutions who are currently blocked by the complexities of in-house infrastructures or dissemination to corporate based platforms based outside the EU.

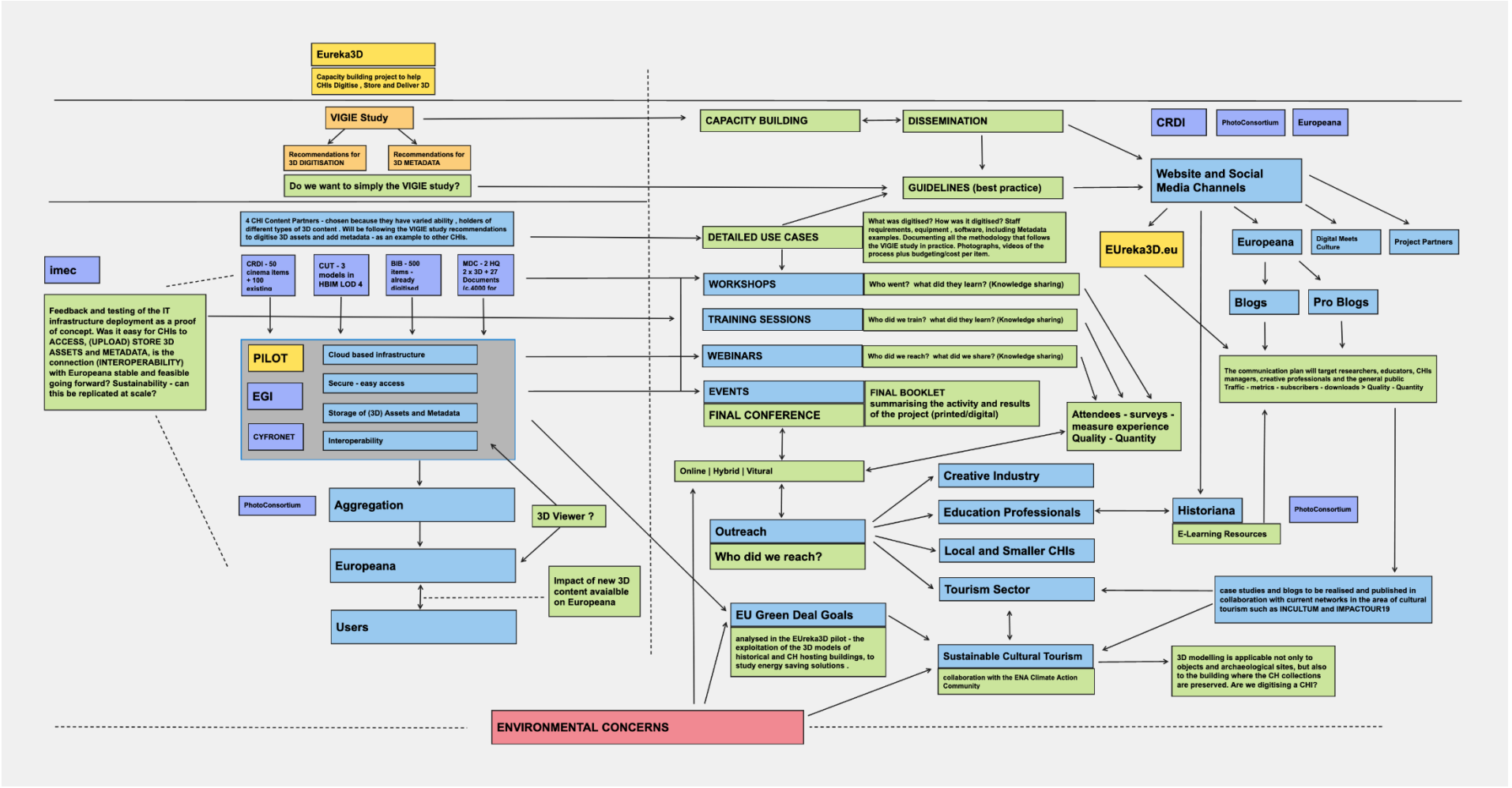
Fig. 13 Outstanding results in sharing 3D reusable content in Europeana, from the EUreka3D Final Conference in Girona, 13 December 2024

Finally, the EUreka3D project and ongoing competence centre is also addressing the users of 3D content. This will be explored further in the 18 month continuation of the project, EUreka3D-XR, where stakeholders will be engaged in the development of XR scenarios based on 3D and other cultural contents. Already in the course of the project, we have evidence of the use of the 3D models, not only in blogs and editorials in Europeana as planned, but also by partners in their own channels and activities, for example Photoconsortium in their Historiana partner page, Museo della Carta with the upcoming exhibition in February 2025, and CUT's with the model of the Lambousa fishing vessel that has its own dedicated e-learning hub[8] including puzzles and other engagement tools which are being used in schools.

In summary EUreka3D has gone beyond its objectives by developing a best practice workflow, data hub and cloud resources, and the delivery of high quality 3D models. In its capacity building activities the project has reached interested stakeholders from multiple countries in every continent of the world (with the exception of Antarctica). And the legacy of the project not only survives in the documented knowledge base but also continues via the ongoing EUreka3D-XR project, the future planned EUreka3D Competence Centre, and the 3 year guarantee to further the EUreka3D Data Hub as an affordable and viable EU based platform contributing to the EU common data space for Cultural Heritage.

[8] https://elambousa.eu/

6. ANNEX


Eureka3D
Capacity building project to help CHIs Digitise , Store and Deliver 3D
VIGIE Study
Recommendations for 3D DIGITISATION
Recommendations for 3D METADATA
Do we want to simply the VIGIE study?
CAPACITY BUILDING
DISSEMINATION
GUIDELINES (best practice)
CRDI
PhotoConsortium
Europeana
Website and Social Media Channels
EUreka3D.eu
Europeana
Digital Meets Culture
Project Partners
Blogs
Pro Blogs
4 CHI Content Partners - chosen because they have varied ability , holders of different types of 3D content . Will be following the VIGIE study recommendations to digitise 3D assets and add metadata - as an example to other CHIs.
imec
CRDI - 50 cinema items + 100 existing
CUT - 3 models in HBIM LOD 4
BIB - 500 items - already digitised
MDC - 2 HQ 2 x 3D + 27 Documents ie 4000 for
Feedback and testing of the IT infrastructure deployment as a proof of concept. Was it easy for CHIs to ACCESS, (UPLOAD) STORE 3D ASSETS and METADATA, is the connection (INTEROPERABILITY) with Europeana stable and feasible going forward? Sustainability - can this be replicated at scale?
DETAILED USE CASES
What was digitised? How was it digitised? Staff requirements, equipment , software, including Metadata examples. Documenting all the methodology that follows the VIGIE study in practice. Photographs, videos of the process plus budgeting/cost per item.
WORKSHOPS
Who went? what did they learn? (Knowledge sharing)
TRAINING SESSIONS
Who did we train? what did they learn? (Knowledge sharing)
WEBINARS
Who did we reach? what did we share? (Knowledge sharing)
EVENTS
FINAL CONFERENCE
FINAL BOOKLET summarising the activity and results of the project (printed/digital)
Attendees - surveys - measure experience Quality - Quantity
The communication plan will target researchers, educators, CHIs managers, creative professionals and the general public Traffic - metrics - subscribers - downloads > Quality - Quantity
PILOT
EGI
CYFRONET
Cloud based infrastructure
Secure - easy access
Storage of (3D) Assets and Metadata
Interoperability
Online | Hybrid | Vitural
PhotoConsortium
Aggregation
3D Viewer ?
Europeana
Users
Impact of new 3D content avaialble on Europeana
Outreach
Who did we reach?
Creative Industry
Education Professionals
Local and Smaller CHIs
Tourism Sector
Historiana
E-Learning Resources
PhotoConsortium
case studies and blogs to be realised and published in collaboration with current networks in the area of cultural tourism such as INCULTUM and IMPACTOUR19
EU Green Deal Goals
analysed in the EUreka3D pilot - the exploitation of the 3D models of historical and CH hosting buildings, to study energy saving solutions .
Sustainable Cultural Tourism
collaboration with the ENA Climate Action Community
3D modelling is applicable not only to objects and archaeological sites, but also to the building where the CH collections are preserved. Are we digitising a CHI?
ENVIRONMENTAL CONCERNS