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D2.3 Digitisation and aggregation report

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EXECUTIVE SUMMARY

This report provides details of the aggregation process performed in the EUreka3D project and describes the collections prepared for publication by the content partners on the Europeana website.

The EUreka3D content providers committed to digitise and publish in Europeana a varied range of different cultural heritage objects:

- CUT: Three (3) high-quality models of Cypriot heritage: (a) the Byzantine monument the Church of the Holy Cross (Timios Stavros) in Pelendri village (UNESCO WH site), (b) the Chrysorrogiatissa Monastery in Paphos district (a monument under risk), and (c) the oldest fishing trawler of Cyprus, called "Lambousa", (also submitted to Europeana's TwinIt! campaign in May 2024). In addition to these three models, a selection of artefacts of Cypriot heritage, digitised in 3D in cooperation with the Museum of Mediterranean and Near Eastern Antiquities in Stockholm, Sweden, has been uploaded in the EUreka3D Data Hub for aggregation to Europeana.
- CRDI: Fifty (50) objects of pre-cinema and equipment. In addition, an existing collection of 3D digitised daguerreotypes has been uploaded into the EUreka3D Data Hub for aggregation to Europeana.
- BIBRACTE: Two hundred and fifty (250) records, including museum objects, cultural and everyday life artefacts, and typological 3D models of ceramic tableware. An additional 250 photogrammetric terrain models of the archaeological site (composed of 3D and 2D formats) and are also being prepared and documented for Europeana publication.
- MUSEO DELLA CARTA: Two (2) ancient paper moulds digitised in 3D with photogrammetry. In addition, a selection of ca. 5,000 documents (images and texts) from the Museum's archives has already been published on europeana.eu.

In addition to the technical verifications of the models, the requirements of the Europeana Publishing Framework (EPF) for content and metadata quality were addressed to produce collections for aggregation into the Europeana portal that match the tiers 2+ (for content) and A+ (for metadata).

1. INTRODUCTION

This report illustrates the details of the aggregation process performed in the EUreka3D project, describing its various phases and challenges relating to the aggregation of 3D cultural content, and outlines the various collections prepared for publication by the content partners on Europeana website.

Following the 3D digitisation of selected objects (widely described in the *D2.1 Digitisation report and pilot's best practice* delivered in August 2024, which captures the outcomes of the digitisation action done in the project, with details of the digitisation quality level provided), the work of the content providers continued with metadata and paradata preparation to accompany the 3D models. Quality and compliance checks were made on the aggregated datasets by Photoconsortium and the Europeana Foundation to ensure that the records comply with the EPF, specifically the contractual requirements of minimum tier 2 (content) and tier A (metadata).

The targets for new content to be aggregated in Europeana are expected to be completed according to the table indicated in the amended Grant Agreement p. 34 and reported below:

Europeana aggregation	New contents published in Europeana website	N. 3 HBIM LOD4 models from CUT N. 50 3D models of items from CRDI's collections N. 250 photogrammetric ground models, from Bibracte N. 250 economic (coins), cultural and everyday life artefacts from Bibracte N. 2 3D models of filigree paper moulds from Museum of Paper c 5,000 documents from Museum of Paper	WP2

Fig. 1 Target aggregation figures, from the EUreka3D Grant Agreement

The EUreka3D infrastructure (specifically, Check-in service and EUreka3D Data Hub) was used to manage the 3D collections and share them to Europeana safely. The EUreka3D Data Hub was expressly designed to be compatible with Europeana, with the implementation of a 3D visualisation library to view the objects, embeddable in the Europeana website, and an input form to describe metadata in the Europeana Data Model (EDM) format. Additionally, the EUreka3D Data Hub includes a service to obtain and assign Persistent Identifiers (PIDs) to the published objects and an overall approach for open data and open access in line with the ongoing developments of the common European data space for cultural heritage. The EUreka3D Data Hub communicates with Europeana systems via OAI-PMH to harvest the datasets for publication to the europeana.eu website. All the features of the EUreka3D infrastructure are described in

D3.2 "The EUreka3D AAI architecture", and *D3.3, "Final report on the EUreka3D services and resource hub: design and implementation".*

In addition to 3D objects, stored and aggregated via the EUreka3D Data Hub, the existing MINT mapping tool used by Photoconsortium as accredited aggregator for Europeana was adopted to aggregate the collection of ca. 5.000 2D records provided by Museo della Carta, and the 240 Geotifs of terrains from Bibracte, which are stored in the content providers' own repositories.

The document is composed of the following chapters:

1. Introduction
2. The EUreka3D pilot on digitisation, management and sharing of 3D collections
3. Aggregation to Europeana: a complex process
4. The EUreka3D Data Hub: making services compatible with Europeana
5. Description of the collections made available for publication in Europeana
6. Conclusions

2. THE EUREKA3D PILOT ON DIGITISATION, MANAGEMENT AND SHARING OF 3D COLLECTIONS

The EUreka3D project developed a piloting action, including four cases run by the content providers participating in the project (namely CUT, CRDI, BIBRACTE and MUSEO DELLA CARTA), to experiment with innovation in the workflow of Cultural Heritage Institutions (CHIs), especially to accommodate the needs and requirements connected to managing and sharing 3D collections.

In the EUreka3D piloting action, the four project partners undertook 3D digitisation of a diverse range of objects, from museum artefacts to archaeological sites, all following the technical specifications based on the relevant *VIGIE 2020/654 Study on Quality in 3D Digitisation of Tangible Cultural Heritage*. The 3D models were accompanied by relevant metadata and paradata to provide comprehensive documentation of the objects represented in 3D.

The datasets of the new 3D collections produced by EUreka3D content providers are available in the EUreka3D storage facility of the Data Hub and ready for harvesting via the Open Archives Initiative Protocol for Metadata Harvesting (OAI-PMH) by Europeana following the standard publishing protocol. The datasets will be then showcased on europeana.eu by the end of the project (M24 December 2024) following the calendar of ingestion of European Foundation. In some cases, publication to Europeana has already happened. The collections are illustrated in Chapter 5, with links to the OAI-PMH repository and, where available, to the records as they appear on europeana.eu.

These collections meet the EPF standards, aligning with EPF Tier 2+ for content and Tier A+ for metadata, ensuring high-quality data and metadata. Each object is assigned a Persistent Identifier (PID) to grant its long-term preservation on the Internet and made available as open data, thus enabling various types of reuse, particularly for educational and research purposes, thereby enriching the common European data space for cultural heritage with new content and data assets.

As a summary, the complex workflow covered in the EUreka3D project is graphically illustrated in Figure 2 below, which consists of three main phases:

- Capture: the actual digitisation process for the cultural objects and the creation of data, metadata, and paradata.
- Cloud Infrastructure: where produced files (data, metadata, and paradata) are uploaded to the cloud and are accessible with different levels of authorisation for access, with an Open Access policy preferred.
- Delivery: the models are visualised in a viewer compatible with Europeana, the metadata is entered and converted to the Europeana Data Model, and the paradata linked as open access files. At the end of this phase, aggregation to Europeana and publication on the europeana.eu website eventually happen.

The workflow and features of EUreka3D technical infrastructure, composed of different components, are described in detail in various deliverables, most notably *D3.2 "The EUreka3D AAI architecture"* and *"D3.3 Final report on the EUreka3D services and resource hub: design and implementation".*

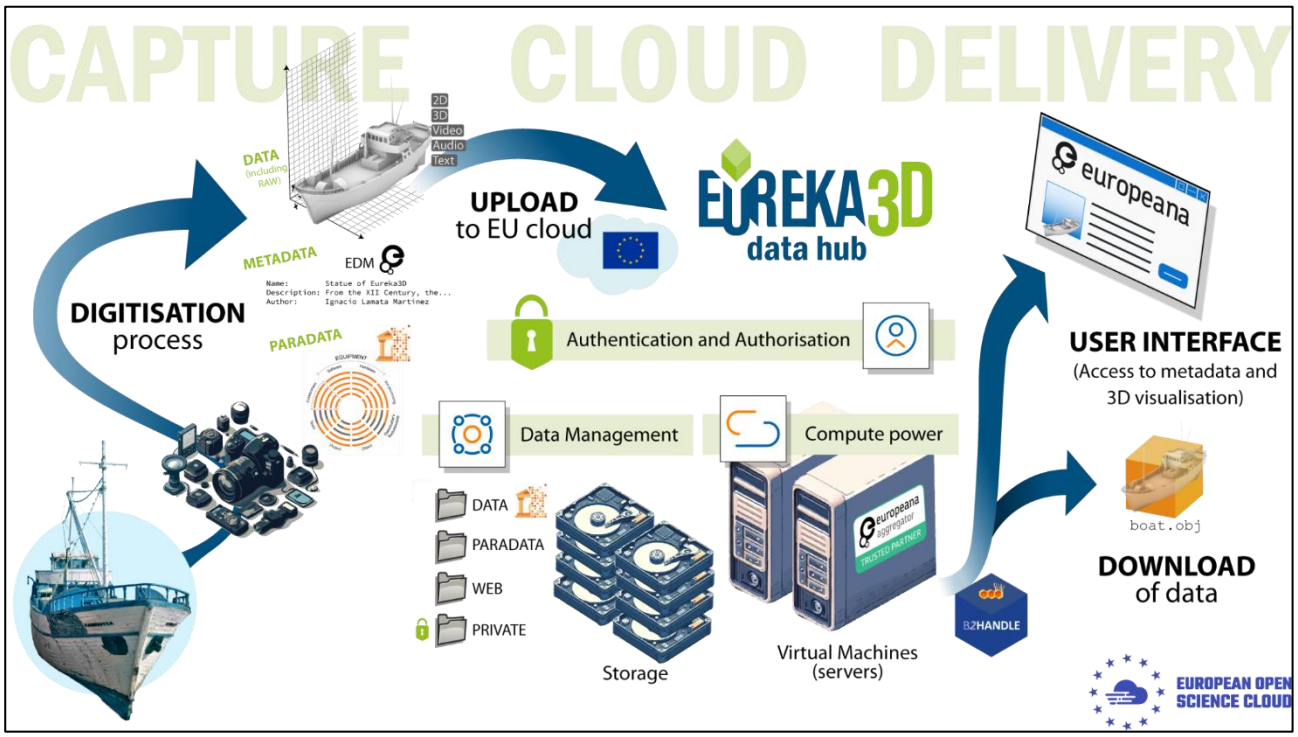

Fig. 2 The EUreka3D infrastructure workflow.

3. AGGREGATION TO EUROPEANA: A COMPLEX PROCESS

The aggregation of cultural datasets to Europeana happens with the intermediation of technical partners called “aggregators”. The aggregation landscape is varied, with different types of organisations, tools, and workflows, but the basic pipeline is similar. Aggregators work with CHIs to gather authentic, trustworthy, and robust data and make it accessible to Europeana for publication on the europeana.eu website. All Europeana aggregators are members of the Europeana Aggregators’ Forum (EAF), a network of national, regional, domain, and thematic aggregators who, among others, work to exchange the knowledge and best practices that support aggregation and data sharing with Europeana.

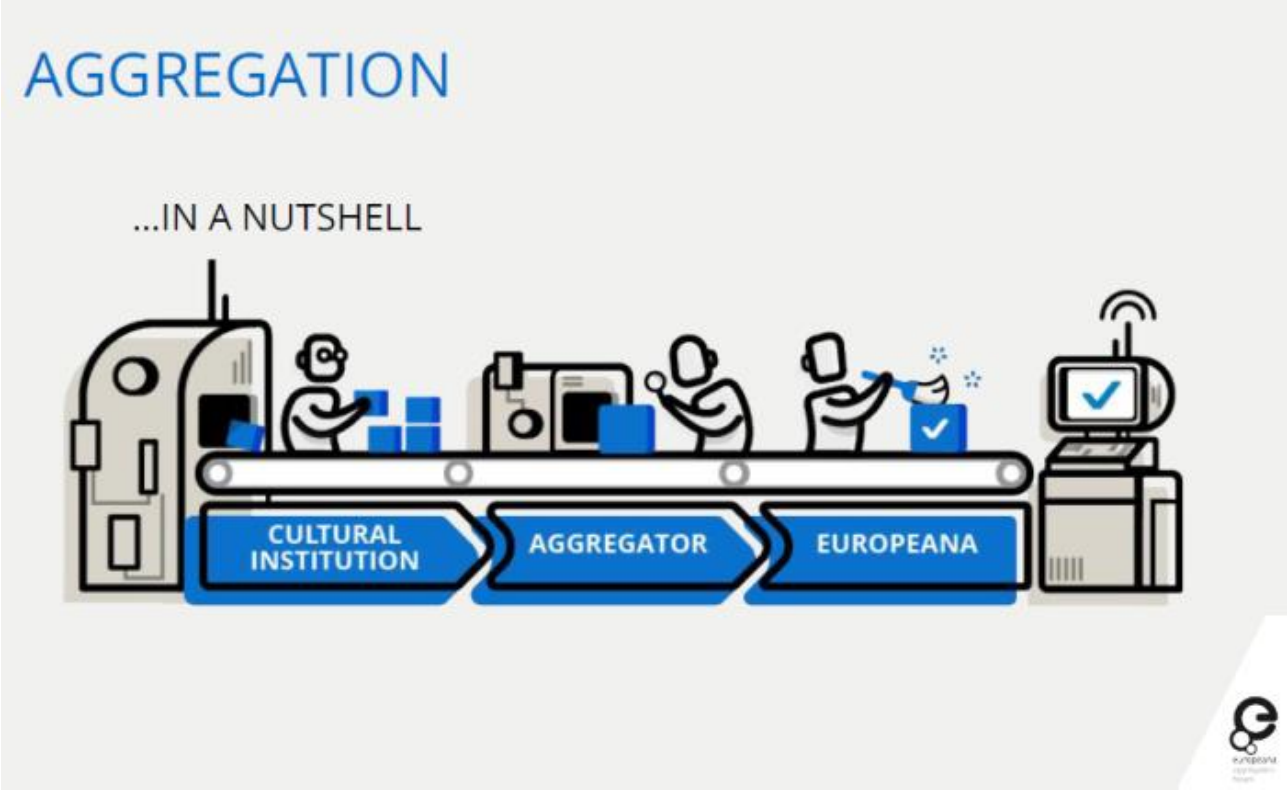

Fig. 3 Aggregation in a nutshell, image by Europeana Foundation

In this chapter, the aggregation process for Europeana is illustrated from the point of view of Photoconsortium’s workflow. Photoconsortium’s standard activities and services provided to CHIs include: providing support to institutions to learn about Europeana and the opportunities it offers; completing the paperwork that is necessary to join Europeana; enabling the technical work needed to map the source metadata EDM; providing assistance for publication at best quality according to the EPF; and implementing actions for dissemination and promotion of the published collections.

Since 2016, Photoconsortium has operated as an accredited aggregator for Europeana and is the thematic aggregator and expert hub on photography, in the treatment and aggregation of 2D collections. The aggregation workflow implemented for 2D collection uses the well-established MINT tool, widely used in the Europeana aggregation landscape, as described in Section 3.1.

In the context of EUreka3D, a new workflow and specialist tools were developed to enable the treatment and aggregation of 3D collections, specifically to address the various challenges that content providers face when treating 3D. This is explained in further detail in Section 3.2 and Chapter 4.

3.1 AGGREGATION WORKFLOW FOR 2D CONTENT

Photoconsortium enables the source metadata schema of the content holder to be properly mapped to EDM, via an aggregation infrastructure and mapping tool named MINT, which is created and maintained by NTUA National Technical University of Athens, one of Photoconsortium's founder members. This tool was used in the context of EUreka3D project in particular to aggregate the collection of images and documents from partner Museo della Carta and the Geotifs from Bibracte. This was done because this 2D content is stored on the content providers own infrastructure. Technical support was provided for the MINT mapping via the NTUA's spin off Datoptron.

Phase 1:

PREPARATION: The content provider prepares their data according to guidance and suggestions in compliance with the EPF requirements of data and metadata quality, and full support is delivered to the content provider according to their level of technical skill and experience with aggregation and metadata preparation. One-to-one tutoring is provided in all phases of dataset preparation, as well as guidance on image quality and IP advice. It is important to note that only metadata is transferred to Photoconsortium-MINT, both the storage and display of data is kept on the content provider's servers.

Phase 2:

MINT MAPPING: Once the dataset is prepared in the content provider's preferred format (e.g. MS Excel, .CSV, .XML etc.), the records are imported into Photoconsortium-MINT to provide the mapping of the source metadata to EDM. Quality checks and mapping refinements are provided to comply with EPF requirements, making the most appropriate mapping of the collection. Where applicable, LOD links (to authority files and established vocabularies' e.g., Getty AAT, Wikidata, Geonames, etc.) are also added to make the collection more easily retrievable and searchable. The mapped dataset in EDM format is then published on the OAI-PMH server.

Metis SANDBOX: From here, additional quality checks and compliance checks are provided by Photoconsortium via the Metis Sandbox, a test environment provided by Europeana Foundation, which clones the expected result of the records as if they were published in Europeana. This tool enables a reliable preview of the collection on the Europeana website and also offers a detailed report of the content and metadata quality and possible further improvements if applicable.

Metis INGESTION TOOL: At this point, it is time for Europeana Data Publishing Service to ingest the dataset from the OAI-PMH server into the Metis ingestion tool. Ideally, the result of ingestion in Metis should perfectly correspond to the one obtained in the Metis Sandbox, but possible additional adjustments can be required. Some back-and-forth between Europeana, Photoconsortium, and the content provider normally occurs, as the target is to achieve the best quality tiers of the EPF and the best user experience for those who visit the collection on the Europeana website.

Phase 3:

PUBLICATION ON THE EUROPEANA WEBSITE: The final step of the process is to have the collection appear on the europeana.eu website, ready for access, reuse, dissemination, and promotion.

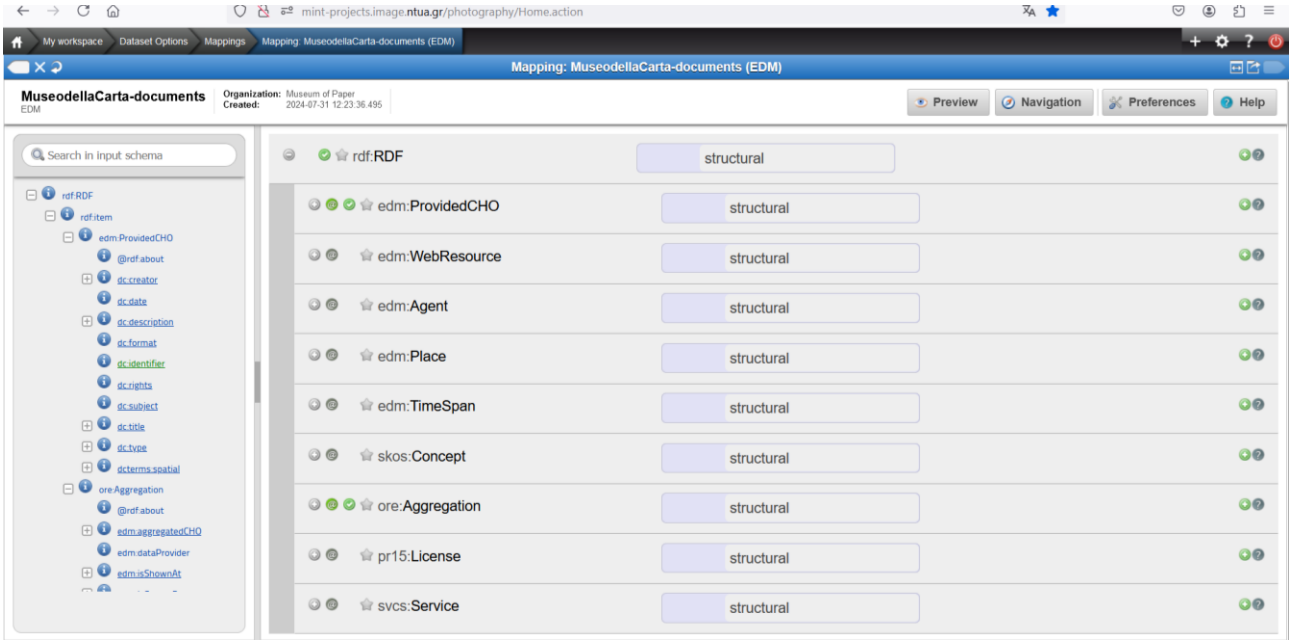

Fig. 4 Screenshot from the MINT mapping tool, on the left column the structure of source metadata, on the right column the EDM fields.

3.2 Challenges in aggregation for 3D content

CHIs who want to create online collections of 3D models, and share them in the Europeana environment to foster reuse and to enrich the common European data space for cultural heritage, need to solve various issues:

- Store files and provide access to the model in different formats to relevant categories of users.
- Enable visualisation of the model over the internet for online access and discovery in Europeana.
- In addition to provide regular metadata information, reconcile metadata to the current and evolving structure of the EDM.
- Provide access to the full set of paradata containing information about the 3D digitisation and modelling process.

All these points are currently addressed by CHIs in an often disorganized manner, relying on in-house or outsourced services by different service providers, thus often resulting in duplication of efforts, redundancies and complex workflow management and orchestration.

3.2.1 Providing access to different formats for different reuse cases

There are various challenges that CHIs face when it comes to sharing the models to users. The formats used for the storage of 3D data and raw data may not be the best choice for visualisation or delivery of the model online, due to the size of these files (often quite large and not suitable to be transferred online) and to the processing of 3D data that is done on the client side (and thus the actual device used by the user plays a key role in the user experience of the 3D model). These are not intrinsic problems for 3D, as 2D content also suffers from them, but they are more prominent in 3D because 3D is more complex in nature, and 3D content

requires extensively larger amounts of space than 2D content, which affects its storage, processing and transfer over a network. To partially cope with the challenges, different versions of the same model can be made available by the CHIs to the different categories of users they deem more appropriate, based on the CHIs digitisation use case reusability assessment, via controlled or open access on a cloud.

3.2.2 Visualization of models on the internet

Rendering 3D objects on a device for display typically happens client-side, so the actual device used by the user plays a key role in the user experience of the 3D model. This must be considered when designing 3D experiences, which are affected by network limitations, computer memory or processing capacity. The 3D industry has greatly evolved over the years but still lacks agreement and adoption of standards for use and display of 3D data. There is no complete open access solution that aligns the 3D software to process 3D data and the software to visualise or deliver 3D experiences to users.

To showcase a 3D model online, it is necessary to upload it in a viewer, that enables users to move freely around or inside the objects using a mouse, touchscreen or other navigation device. Various solutions are made available by cloud and service providers either for free or upon payment, however these are often from private companies, and often set outside Europe (one example is the United States based Sketchfab service, a popular choice for CHIs for showcasing their 3D models). This raises concerns about safe data management, storage and long term accessibility (at the time of writing Sketchfab has recently been acquired by Epic Games and announced the closure of its Cultural Heritage interests casting doubt over the status of CHI assets held). Using a separate service for the viewer may lead to duplication of storage of the 3D model, redundancies in workflows or different versioning of the model so to provide compatibility with alternative viewers (file formats, feature availability, etc). On top of this, whatever the choice of the viewer is, the URL of the external viewer needs to be integrated in the content provider's source metadata manually. Additionally, not many available viewers are currently embeddable and compatible with the Europeana website, thus making it impossible to visualise the 3D asset in the Europeana record's page even if the link is provided in the appropriate metadata field (i.e. edm:isshownby).

3.2.3 Work ongoing to extend the Europeana Data Model

In the context of the project leading the common European data space for cultural heritage, intensive work is currently ongoing to improve and extend the current features of EDM to evolve and better accommodate metadata representing the information associated with 3D models. This work is coordinated in the Europeana 3D Working Group, in which the EUreka3D project is represented by project coordinator Photoconsortium.

The 3D Working Group delivered an in-depth analysis of EDM from the perspective of enhancing representation of 3D in Europeana, both in terms of accommodating a larger quantity of items and representations, and higher quality of information. At the time of writing (October 2024) this work is ongoing, and currently the main requirements for sharing 3D with Europeana are:

- The 3D models are published online and accessible in a viewer compatible with Europeana and embeddable using oEmbed
- Metadata records are available for export or harvesting in an XML format that is mapped to EDM, including information about both the cultural heritage object represented in the 3D model and the 3D model itself
- Content providers signed the Data Exchange Agreement with Europeana Foundation or via one of the Europeana aggregators

In addition, Europeana recommends enriching the metadata records by:

- Including language tags
- Supporting browse by subject or types; by place; by date or time-span; by agents
- Using LOD vocabularies supported by Europeana
- Offering access to additional information on the creation process of the 3D models (i.e. the paradata)

The first extension and refinement of EDM is expected in 2025, some more iterations and addition may be produced later. In the meantime, the discussions of the Europeana 3D Working Group are being followed closely. The compliance to EDM and to the requirements of EPF is therefore evolving and becoming more complex in the future, thus requiring cultural institutions to put more effort in creating EDM-based datasets that represent correctly and comprehensively the information about the 3D model.

Aggregators like Photoconsortium help CHIs to comply with all these requirements, however the absence of an EU-based, non-profit, integrated solution to all these challenges has created an evident need in the cultural heritage sector.

For this reason, the EUreka3D project developed a new and integrated suite of tools for CHIs exactly to cover all the phases of the process, from storing data, metadata and paradata, to visualising the object online, to creating the EDM-based dataset in compliance with its most recent developments, and finally to enabling publication on Europeana. The aggregation workflow for 3D established in the EUreka3D Data Hub is described in the following chapter.

4. THE EUREKA3D DATA HUB: AGGREGATING 3D COLLECTIONS TO EUROPEANA

The data management system and workflow developed specifically in EUreka3D is a comprehensive solution for CHIs to manage 3D assets and share them online. All the phases, from storage to visualisation to the addition of metadata and paradata are managed in the EUreka3D Data Hub, which also communicates with the Europeana Metis ingestion tool for harvesting via OAI-PMH. The intermediation of Photoconsortium as accredited aggregator to Europeana supports quality checks of the EDM-based metadata to comply with EPF.

The development of the EUreka3D Data Hub has followed an iterative process that saw participation of all project partners, including content providers (who represent the category of users of the EUreka3D infrastructure), and Photoconsortium and Europeana (who supported the development of the aggregation service in the EUreka3D Data Hub to be fully integrated and compliant with Europeana technical and procedural frameworks).

Content providers used the facilities of the EUreka3D Data Hub for storing the data in the cloud, both the raw data from the digitisation and the more refined models in different formats if applicable. The content providers had to register to the Check-in service and join the EUreka3D Community. This flexible system for granting different levels of access and editing rights to different communities is explained in detail in the *D3.2 The EUreka3D AAI architecture*.

Storage and data management facilities in the EUreka3D Data Hub are supported by servers, virtual machines and compute power based in the EU, hosted by the national providers of the European Grid Initiative (EGI) Federation and specifically by Affiliate Entity Cyfronet. The user can upload the files individually or via an API service for batch uploading. The EUreka3D Data Hub also integrates an open source 3D Viewer. The current version is a basic tool that enables visualisation of various formats of 3D models provided in a zip file. The viewer is fully compatible and embedded in Europeana.

All the files uploaded in the EUreka3D Data Hub can be shared on the internet via a shared, open data tool which also enables users to request a PID, provided by the service of EUDAT B2HANDLE, in partnership with the EUreka3D project.

The metadata for each object can be added either via XML or via a metadata input form, developed in close collaboration with Photoconsortium and Europeana to include all the mandatory and recommended fields to create a valid and rich EDM file. The metadata input form enables the user to add literal values and LOD links. Various elements and fields are automatically added in the metadata such as the PID, the link to the viewer (isshownby), the file size and others. In the metadata input form, it is possible to include a URL link that leads to the paradata report associated with the 3D model and a link to the raw data from the digitisation, available for downloading from the EUreka3D Data Hub.

The dataset in EDM format is then shared with Europeana through the harvesting of information via OAI-PMH, and after quality checks performed both manually and in the Metis Sandbox, eventually the record is published on Europeana.eu.

All the functionalities, services and architecture of the EUreka3D Data Hub are explained in detail in the *D3.3 Final report on the EUreka3D services and resource hub: design and Implementation.*

The metadata is accessible via the EUreka3D Data Hub as shown in Figure 5; the 3D viewer on the Europeana portal in Figure 6 and the metadata in the Europeana portal in Figure 7.

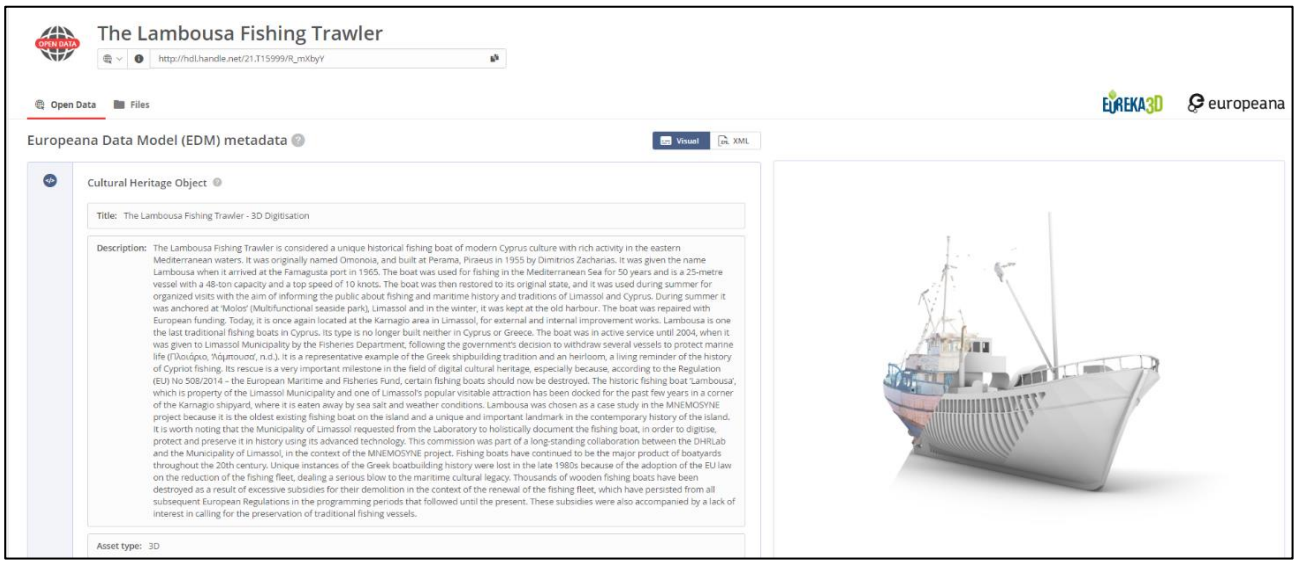

Fig. 5 Metadata as displayed in the EUreka3D Data Hub.

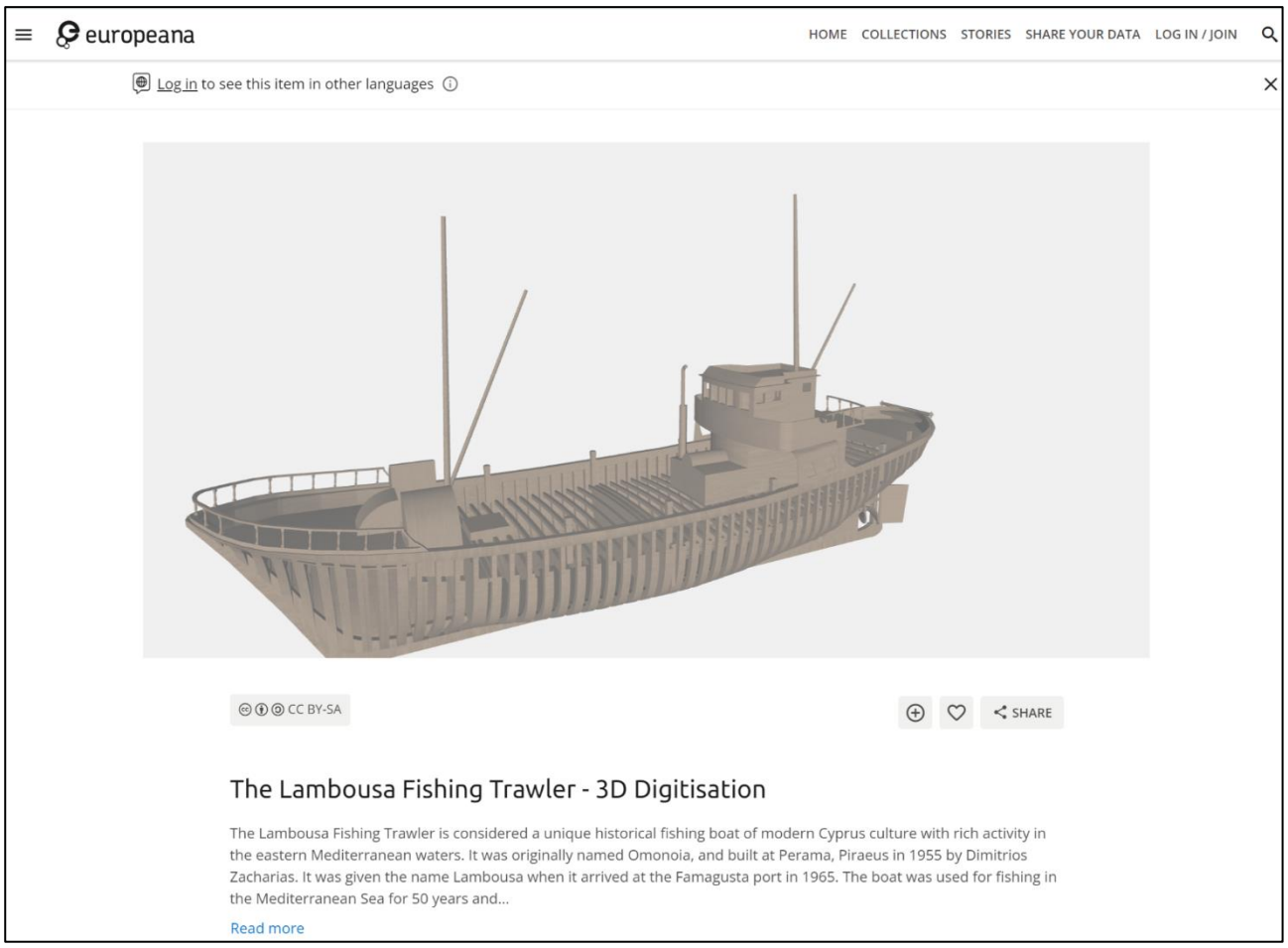

Fig. 6 The record as appearing on Europeana, with the object showcasing in the embedded 3D Viewer provided via the EUreka3D Data Hub.

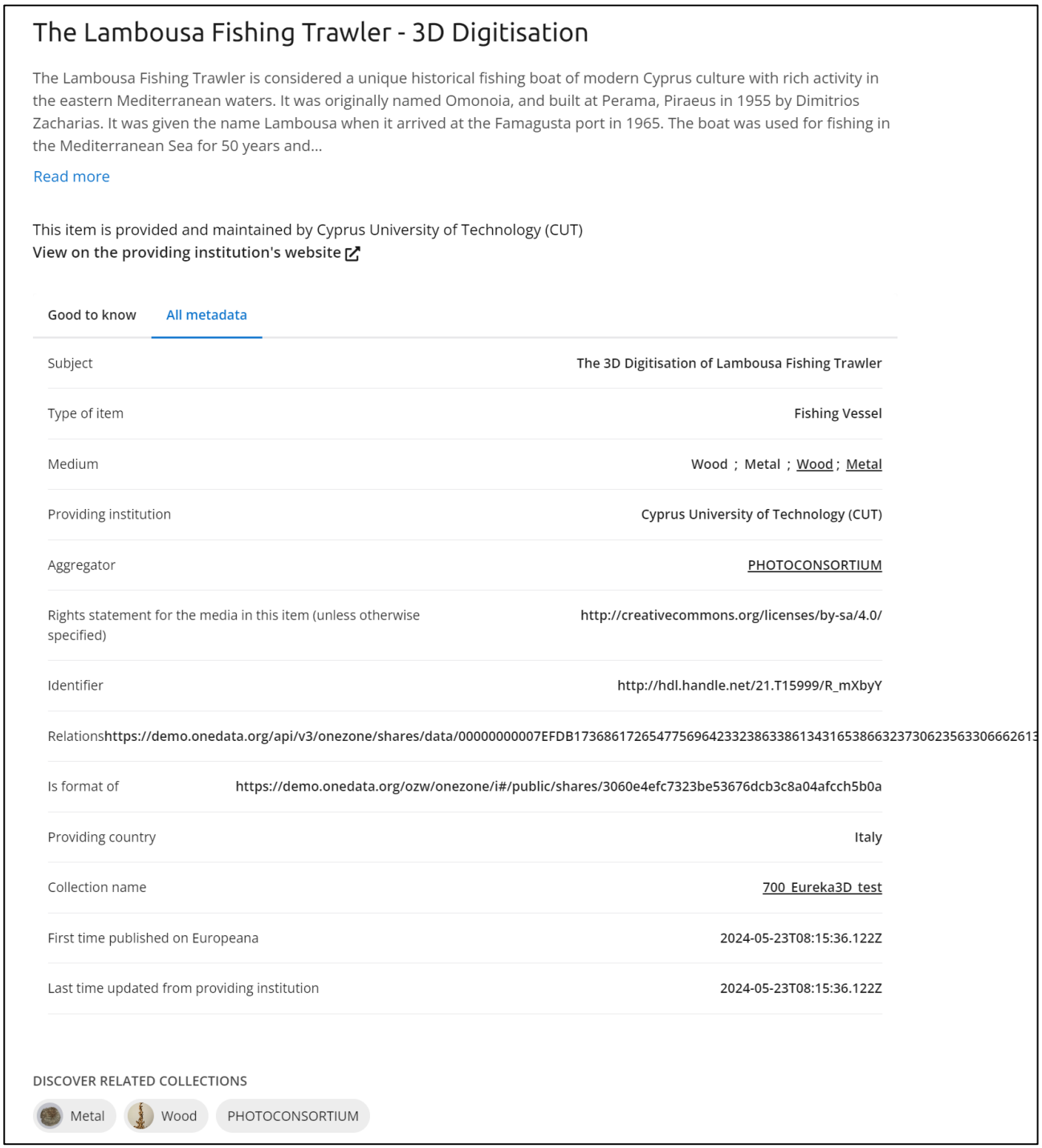

Fig. 7 Europeana record, showcasing all metadata.

5. DESCRIPTION OF THE COLLECTIONS MADE AVAILABLE FOR PUBLICATION IN EUROPEANA

This chapter reports on the collections selected for publication by the content providers in the project, also explaining scopes, challenges and added value that creating these collections implied. The experience of the content providers is a core part of the project's Final Booklet, currently under finalisation and which will be distributed as online publication and in print at the Final Conference of the project in Girona on 13th December 2024.

5.1 CUT CYPRUS UNIVERSITY OF TECHNOLOGY (CY)

CUT digitised and shared in the EUreka3D project three important monuments in Cyprus: the oldest fishing trawler of Cyprus, called "Lambousa"; the Holy Cross / Timios Stavros in Pelendri village (UNESCO WH site), and the Monastery of Panagia Chrysorrogiatissa in Paphos district (a monument under risk). Particularly, the work on the Lambousa Fishing Trawler digitisation was exceptionally complex and was used as a best practice and case study in the EUreka3D project.

The **Lambousa Fishing Trawler**, a significant vessel for Cypriot Fishery tradition, was built in 1955 at Perama, Piraeus by Dimitrios Zacharias, and in 1965 it arrived in Famagusta, Cyprus. The boat was in a decayed condition and the Municipality had to proceed with refurbishment works. The coordinator of the Lambousa Fishing Trawler's digitisation is Limassol Municipality which is also the stakeholder. Upon request of the stakeholder, CUT digitised the boat before restoration, during the restoration and after the boat was refurbished. During the digitisation, CUT was in a close collaboration with the team which undertook the refurbishment works, such as the Underwater Archaeologist, Naval engineers, and the Marine contractor. This collaboration was crucial in order to understand the overall components of this vessel, to have access to the site, and receive feedback from the results of our work and how we can further proceed with the detailed digitisation. A photogrammetric survey was held by a team of two members of CUT and an external contractor which is a topographer. The Terrestrial Laser Scanning (TLS) survey was made by CUT staff and other experts specialised in Laser Scanning. The post-processing of the point cloud results was made by a member of the CUT team, with the creation of 3D NURBS models, and naval architectural drawings with a Level of Detail (LOD) 400. Further detail for this case study will be described in detail in the following section.

Fig. 8 UAV Photogrammetric Point Cloud and Longitudinal Section of the Lambousa Fishing Trawler

The **Church of the Holy Cross at Pelendri** is a three-aisled basilica with a dome and a UNESCO world heritage site, with Byzantine wall paintings created from the 12th century up to the 14th century by 4 different painters. This church was built in three phases. Firstly, it was a single-aisle dome chapel built in 1178, which also included wall paintings. The church was then destroyed and only the apse remained, which was included within the new church that was built at the start of the 14th century. In the second half of the century, the north chapel was constructed, and in the 16th century the south chapel. The Church was digitised with the aim of digitally preserving the history of this monument through a holistic approach which includes both its internal and external survey. The HBIM model created includes material and structural details of all the components of this heritage building. Furthermore, architectural drawings are also created that can be used for research by architects, civil engineers, archaeologists, and historians. The textures mesh model of the exterior includes also a topographic survey which provides details regarding the building and its surrounding mountainous landscape. The interior textured mesh model is also important because it indicates all the wall paintings in high-resolution. The main stakeholder of the Holy Cross Church is the Metropolis of Limassol, and the coordinator for the digitisation is CUT. The topographic and external photogrammetric survey was done by a team of three people, one of whom is an external contractor. TLS and internal photogrammetry was undertaken by three members of the Digital Cultural Heritage Research Lab at CUT. The results from the survey were processed for the creation of an HBIM LOD 400 model as well as a photogrammetric mesh model by two members of the CUT heritage lab.

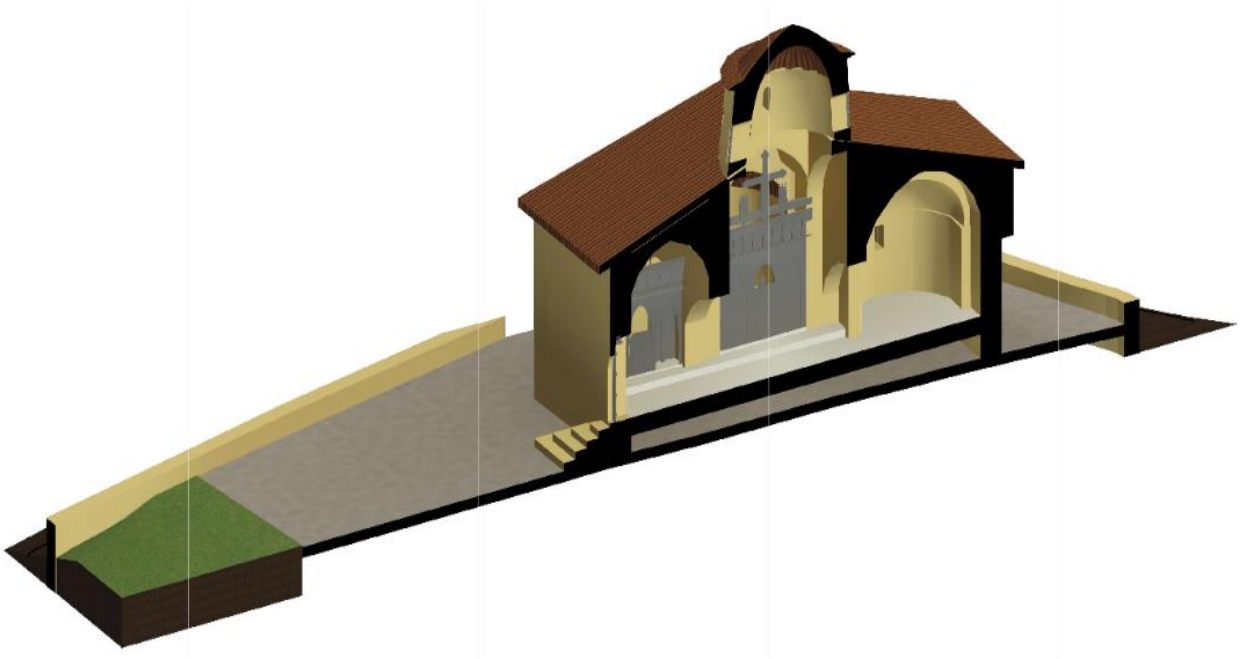

Fig. 9 Axonometric section of the HBIM result of the Holy Cross Church.

The **Monastery of Panagia Chrysorrogiatissa** in Paphos, was established in 1152. The Katholikon (main Church), and surrounding complex of buildings were constructed at the end of the 18th century. The major stakeholder of the Monastery of Panagia Chrysorrogiatissa is the Metropolis of Paphos, and the coordinator for the digitisation is CUT.

The digitisation was undertaken by CUT members as well as other specialists. The Cyprus Department of Antiquities was also involved and present during digitisation. Two photographers participated and documented the procedure. In addition, representatives of the Bishop of Paphos and the District of Paphos, attended. A group of CUT undergraduate students followed the process and attended the digitisation.

The Monastery comprises several buildings such as the church, museum, library, dormitories, dining rooms, conference centre, kitchens, old winery, and cellars which are spread along four levels. Overall, there are 180 spaces and rooms, as well as the surrounding area. For the purpose of digitising the entire Monastery, both the interior and exterior of each space had to be scanned, with a total of 276 scanning positions. This was a time-consuming procedure where each position was selected carefully so that no space was overlooked by the survey. Furthermore, the registration and alignment of the point clouds was a laborious procedure due to the vast amount of data of 88 GB which had to be processed.

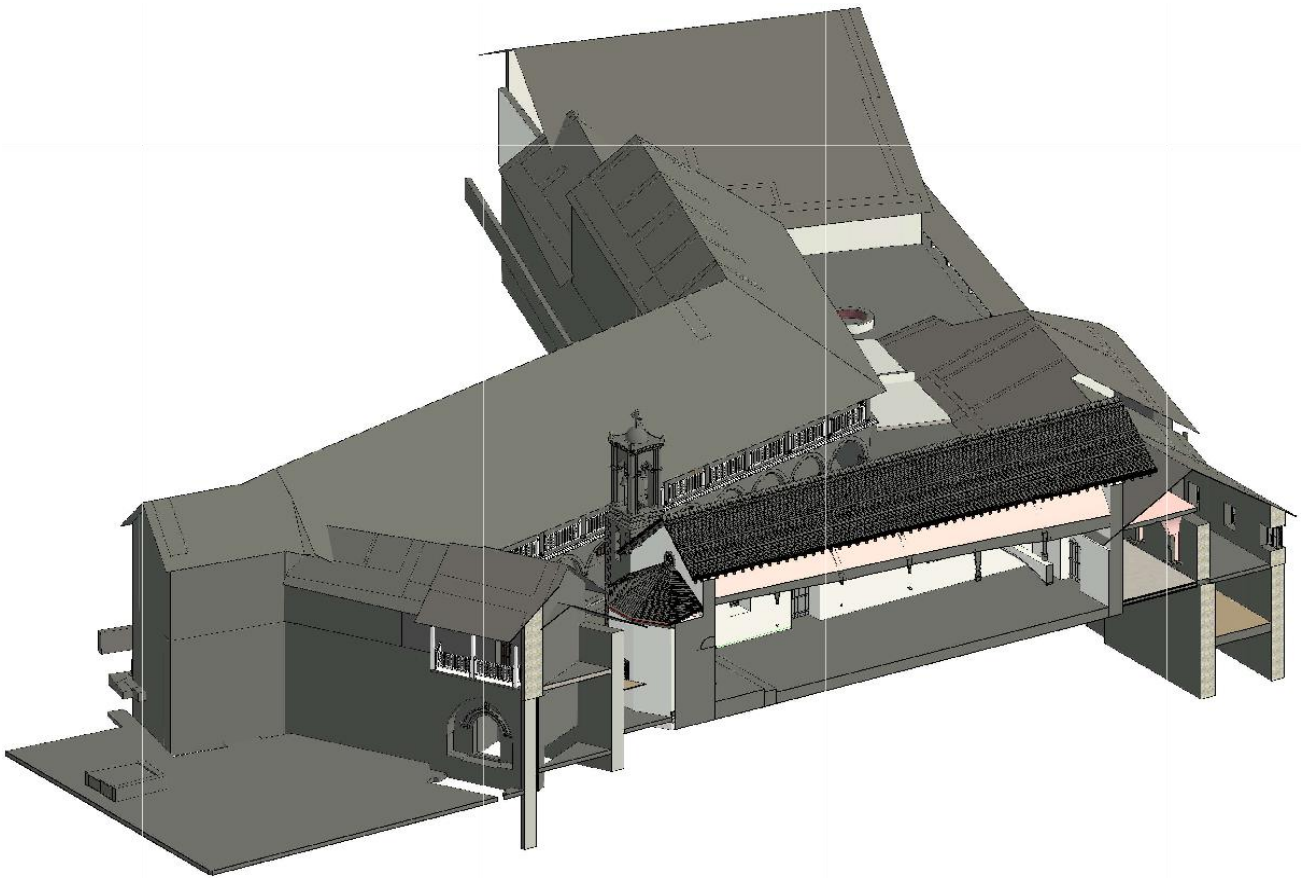

Fig. 10 HBIM Model result of the Monastery of Panagia Chrysorrogiatissa.

- EUreka3D Data Hub OAI setspec: https://datahub.egi.eu/oai_pmh?verb=ListRecords&metadataPrefix=edm&set=cb7fd2af32cc8258ce38b224538440d8ch9367

5.2 CRDI – AJUNTAMENT DE GIRONA (ES)

The digital transformation of the Girona city archive has been a lengthy process that has provided significant professional learning while also representing a substantial change in the organisation's workflows. The archive is primarily a space for preservation and physical storage, but it is also a space for discovery, knowledge, experimentation, and creation. The amplification of these values is closely associated with the technological possibilities of the moment, increasingly well-used by a sector that has also learned how to transform itself.

The digitisation in 3D of 99 daguerreotypes from the collection in 2022 was CRDI's first experience in this regard. This endeavour served to explore the benefits of 3D digitisation in the heritage field but also to identify the challenges posed by such an initiative. The collection of 99 daguerreotypes has been moved to the EUreka3D Data Hub to be republished in Europeana, and offered an interesting case of testing the viewer, in the light of improving its performance. In facts, due to the characteristics of the models, the current version of the EUreka3D viewer poses various challenges to obtain a good visualization of the daguerreotypes. Testing and investigations are currently ongoing.

The new objects digitised in the EUreka3D project comprise of 50 items from the heritage elements preserved at the Girona Cinema Museum, showcasing the diversity, quality, and uniqueness of an extensive cinematographic heritage. The objects belong to the following categories: image projection, capturing and viewing still images of the real world, image animation, optical illusions and visual tricks, and amateur cinema.

Fig. 11 Cinematographic camera. Bell & Howell, 1940. Museu del Cinema – Col·lecció Tomàs Mallol Digitised model by CRDI Ajuntament de Girona, in collaboration with La Tempesta Media.

- EUreka3D Data Hub OAI setspec: https://datahub.egi.eu/oai_pmh?verb=ListRecords&metadataPrefix=edm&set=94318854ea0727ebb9bb20a3268e8ec0chfc85

5.2 BIBRACTE (FR)

Bibracte provided to the EUreka3D project 500 scans of furniture, structures, and terrain from the archaeological site of Mont Beuvray (Burgundy, France). Originally, the digitisation plan also included a collection of coins, but during the selection phase of the objects to be digitised it was considered preferrable and more interesting to expand the collection of artefacts, that would better depict and illustrate the everyday life of the site inhabitants. These scans cover various periods, ranging from the Gallic oppidum (fortified settlement) seat of the Aedui tribe, active from the end of the 2nd to the late 1st century BC, to more recent occupations, such as the Cordeliers convent. The latter, established in the 14th century in the Pâture du Couvent district, was frequented by Franciscans until the end of the 17th century. The scientific partners of the establishment have been involved in all stages of the production, use, and dissemination of these scans, which are divided into three distinct collections aimed at supporting archaeological research and enriching the visitor experience on the site and in the museum.

3D Digitisation of Collection Objects: This collection includes 3D models of 130 artefacts representative of the material culture of the oppidum of Bibracte, a fortified city from the 1st century BC located on Mont Beuvray. These objects illustrate various aspects of Gallic life, ranging from agriculture to weaponry, including art, hygiene, building materials, and means of transport.

Fig. 12 Spout in the shape of a boar's head. The object and its 3D model.

Documenting an archaeological site: Collection Terrain: This collection includes 250 terrain models from the archaeological site, documenting the history of archaeological research on Mont Beuvray. These models, comprising 3D files and orthophotographs in TIF format, provide an overview of the different excavation phases and discoveries made over the years. The Collection Terrain reflects the continuous adaptation of archaeological methods to advances in digital technologies. Ortho-images, also known as orthomosaics or orthophotographs, derived from photogrammetry, have gradually replaced traditional paper millimetre-scale drawings of archaeological remains in plan, section, and elevation. This technique allows for the measurement of 3D scenes from 2D photographic data. However, the proper practice of this process involves mastering a set of knowledge and techniques during the acquisition and processing phases. The base image is recomposed pixel by pixel as a result of mathematical processing: optical distortions of the lens are corrected, all pixels respect a perfectly vertical viewing axis, each pixel is associated with coordinates, and the ground relief and the curvature of the earth are taken into account. The principles of photogrammetry

also allow for the production of point clouds describing the captured scene in a three-dimensional form, as in the example of the masonry cellar of the domus PC2. The collection brings together 250 models that document the history of archaeological research on Mont Beuvray and the technological evolution of the practice of photogrammetry applied to archaeology. The methodological process for the production of an orthomosaic from several digital photographs is an outstanding research outcome of Bibracte, also published in open access[1] in collaboration with the UMR 6249 Chrono-environment (Besançon, France) and as part of the doctoral thesis of Quentin Verriez (2023, University of Burgundy, UMR 6298 ArTeHis).

Fig. 13 Masonry cellar of the domus PC2. The archaeological site and its 3D terrain model.

3D Reconstruction: Collection Morphométrie: This collection includes 120 theoretical 3D models of ceramic vessel shapes. These models allow for the visualisation and calculation of reference morphometric parameters, thus facilitating the identification of sherds found on the site by archaeologists. Designed specifically to serve as a morphometric comparison reference, the collection assists archaeologists in the typological identification of newly scanned 3D sherds. Thanks to this reference, newly scanned ceramic fragments can be systematically compared to existing models, facilitating their identification and classification.

Over time, these new sherds will enrich the reference collection, making it increasingly relevant and comprehensive. In other words, each newly identified and integrated sherd increases the quality and reliability of this tool, thereby refining future archaeological research.

Fig. 14 Bottle, tall, closed shape, with a height greater than 1.5 times the maximum diameter. Narrow opening (usually less than 10 cm) and generally developed neck. Annular base, sometimes raised (pedestal).

[1] https://books.openedition.org/pufc/5078

Challenges encountered

API batch upload

As described above, Bibracte's collection of objects is relatively large: a total of 500 models to be uploaded, described with EDM-metadata, associated with individual PIDs, and then published on OAI-PMH server for Europeana to harvest. Although EUreka3D Data Hub's Web interface is user friendly, doing this process manually is very tedious, long and error prone.

After conducting some tests, it was decided to automate the process as much as possible. To do so, Bibracte is benefiting from the API (Application Programming Interface) provided by Data Hub. The API offers a way for programs to interact with Data Hub, so that they can make requests to Data Hub programmatically: a program or script created in any programming language (Python, Java, Go, etc) can automate the task and upload 3D models and its associated metadata, obtain PIDs and publish them for Europeana.

Testing this possibility and option was very beneficial to the project, providing another use case for the EUreka3D Data Hub that follows user requirements: the case where the user needs to do batch uploads of a high number of objects. To test and implement the programming for Bibracte's objects required additional efforts and collaboration between Bibracte's team, EGI and Photoconsortium.

Visualizing and sharing Geotifs

In addition to the API batch upload, another interesting case come out from the analysis of the BIbracte's collection of Terrains. The 250 terrain models come in two different formats: PLY and TIF. The case of PLY, amounting to 10 models in 3D, can be treated as any other format for 3D models in EUreka3D Data Hub, and the 10 objects are documented and exposed in EUreka3D OAI. The remaining 240 orthophotographs are in TIF format. The orthophotographs are rectified and georeferenced 2D images. These are complex image files of big size, and this poses challenges for their visualization online by users with standard devices and connection speed. The Geotifs are published in EUreka3D Data Hub, with a public share link that allows user to download each file.

However, to enable visualization online for these files and to provide the appropriate URL that Europeana can expose in the europeana.eu website, Bibracte has created jpg files and uses the French national repository NAKALA to expose a direct link to the object. The reconstruction of the metadata schema for publication in Europeana of these 240 items will include both links: the direct URL to jpg file (to be mapped to edm:isshownby) and the download link to Geotif (to be mapped to dc:relation). The mapping to EDM for these 240 items makes use of the MINT mapping tool by Photoconsortium and its workflow for aggregation of 2D content as described in section 3.1.

- EUreka3D Data Hub OAI setspec: https://datahub.egi.eu/oai_pmh?verb=ListRecords&metadataPrefix=edm&set=f5f5e13338851b6866b085fee019276ech038f

5.3 MUSEO DELLA CARTA (IT)

Museo della Carta di Pescia (Pescia Paper Museum) holds a rich heritage of paper goods consisting of watermarked paper moulds, watermark waxes, punches, watermarked metal sheets, about 7,000 pieces, witnessing the history of paper manufacturing in Tuscany. These goods, which became part of the Museum's collections thanks to a private donation, document the relationships that the local paper factory named 'Antiche Cartiere Magnani di Pescia' had with companies, famous people, banks, insurance companies and, foreign states over three centuries of activity from the mid-eighteenth century to the 2000s.

Fig. 15 A paper mould, 2D image and its 3D digitisation

3D digitisation: paper moulds

The watermarked paper moulds are very special objects and were used in the past to produce handmade watermarked paper, as we still do today in the Museo della Carta di Pescia, which is located in a completely intact and original eighteenth-century paper mill. The moulds are made of a wooden frame and a metal sheet on which the watermark was sewn with silvered copper wire.

Museo della Carta di Pescia was the first institution in Italy to have inventoried and catalogued these assets, also digitising in 2D a selection of the most relevant ones, but had not previously created 3D models of its collections and therefore had no previous experience in this area. The EUreka3D project was an experimental path for this institution that allowed them to create two 3D models of watermarked paper moulds, and gave the Museo della Carta di Pescia the opportunity to acquire skills and evaluate the positive aspects of digital models.

The 3D digitisation of objects followed the entire EUreka3D workflow and were made available to Europeana via the EUreka3D Data Hub and services.

Documents

In addition to the tools and machinery for paper production, the Museo della Carta di Pescia also received the Historical Archive of the Magnani Paper Mills of Pescia as a donation. The documents from the archive are now located inside a wing of the Le Carte Paper Mill built specifically for this purpose. It is one of the most important archives of Italian companies and is made up of approximately 700 linear metres of documentation. A 2D digitisation action on these assets was initiated already before the EUreka3D project and continued with the final aim to offer over 5,000 documents for publication online and in Europeana.

Paper oeuvres and 2D digitised objects

As mentioned above, in 2008 the Museum started a pilot project (the first in Italy) for the inventory and cataloguing of paper machinery and goods, followed by several in-depth research projects on a selection of historical items, in particular the watermark paper moulds, and also other artworks on paper, which today constitute the first part of the Museum's online catalogue.

The collection of 2D assets was uploaded onto a pre-existing platform created by Museo della Carta, and published in Europeana using the aggregation route via the MINT mapping tool from partner Photoconsortium, as described in section 3.1.

- EUreka3D Data Hub OAI setspec: https://datahub.egi.eu/oai_pmh?verb=ListRecords&metadataPrefix=edm&set=cc582e6bfd891abbfa0283121f499c73ch819a
- Europeana website: the two 3D models of paper moulds
- Europeana website: the collection of 5.247 documents
- Europeana website: the collections of 2D imagery (digitised paper moulds and other paper items from the Museum's collections)

5.5 Additional collections of 3D cultural items

Next to the beneficiaries who are partners in the project, work is ongoing with external organisations as associate partners interested in using the EUreka3D Data Hub for the storage, management, and sharing of their data. In some cases, the 3D collections were finalized in the EUreka3D OAI and published in Europeana.

Contents already uploaded on the EUreka3D Data Hub:

- RAMS Regionaal Archeologisch Museum a/d Schelde (Belgium): 13 models of archaeological artefacts
    - EUreka3D Data Hub OAI setspec: https://datahub.egi.eu/oai_pmh?verb=ListRecords&metadataPrefix=edm&set=750c901f220a7978e43cf3ce6d4bd53ech64f0

- INSPAI Centre de la Imatge Diputació de Girona (Spain): 5 models of heritage photocameras
    - EUreka3D Data Hub OAI set spec: https://datahub.egi.eu/oai_pmh?verb=ListRecords&metadataPrefix=edm&set=4aeeaa532b2ddd90b10f6e317ee9458ach6358
    - Europeana website: the collection of 5 models in 3D of video and photographic equipment

- Medelhavsmuseet Museum of Mediterranean and Near Eastern Antiquities (Sweden): a selection of 5 models of Cypriot heritage from the museum's collection, aggregated by CUT as intermediate provider, the records are available on CUT's OAI:
    - EUreka3D Data Hub OAI set spec: https://datahub.egi.eu/oai_pmh?verb=ListRecords&metadataPrefix=edm&set=cb7fd2af32cc8258ce38b224538440d8ch9367

Contents that are currently testing the use of the EUreka3D Data Hub:

- Basilica del Pi (Spain): aiming to upload and publish in Europeana one or more models of the statues adorning the Basilica

- Giravolt project from Generalitat of Catalunya (Spain): aiming to upload and publish in Europeana one or more models from the church of Saint Climents in Taull

- Department of Architecture of KU Leuven (KU Leuven): currently developing a case study about sharing in Europeana reconstructed 3D models of lost buildings from the XIII century.

6. CONCLUSIONS

This deliverable illustrates the different collections made available by the EUreka3D content providers and some associate partners.

All the contents from the EUreka3D partners are ready for publication to europeana.eu. This document corresponds to the timely and successful achievement of MS7 “The collections are available for harvesting in (MINT) OAI-PMH server”.

While for the 2D collections foreseen in the project, the existing MINT mapping tool operated by partner Photoconsortium was indeed used, the collections composed of 3D models, most of them digitised in the course of the project, were aggregated via the EUreka3D Data Hub. The Data Hub is a specialised and dedicated solution for the storage, management and sharing of 3D data, metadata and paradata, including an OAI-PMH server for harvesting by Europeana systems.

Quality and compliance checks were performed on the datasets to ensure that the contractual requirement of minimum tier 2 (content) and tier A (metadata) of the EPF is fully met.

The table below summarises the exact amounts of items prepared for Europeana. The actual harvesting by Europeana and full publication of all collections on europeana.eu is expected to be completed by M24 (December 2024) following the publication programme of Europeana Foundation. In some cases, the records already appear on europeana.eu at the time of writing.

CONTENT PROVIDER	**COLLECTIONS**
CRDI	n. 50 models in 3D (newly digitised items)
Bibracte	n. 260 models in 3D (newly digitised items and already existing items) n. 240 models in Geotif (already existing items)
Museo della Carta	n. 2 models in 3D (newly digitised items) n. 39 images in 2D (already existing items) n. 5.247 documents in 2D (newly digitised items and already existing items)
CUT	n. 3 models in 3D (newly digitised items)
RAMS	n. 13 models in 3D
INSPAI	n. 5 models in 3D
Medelhavsmuseet	n. 5 models in 3D
Total items	n. 5.864 items

In addition to these collection, work is ongoing with the testing of the visualization for CRDI of the 99 models in 3D of daguerreotypes (already existing models, to be republished on Europeana in the coming period).

The digitisation journey of the four content providers, with lessons learnt and experience gained for others to be inspired, will be shared publicly as case studies, and also published in the Final Booklet due M24 and presented at the Final conference in Girona on 13 December 2024.