EUREKA3D – EUROPEAN UNION'S REKONSTRUCTED CONTENT IN 3D

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ABSTRACT

EUreka3D aims to support Cultural Heritage Institutions (CHIs) in implementing high quality 3D digitisation for the purposes of reuse by a variety of stakeholders. The current scenario in Cultural Heritage sector is transforming with the advent of the new Data Space, to offer opportunities to all the users of digital cultural heritage. However, CHIs need support and technical solutions to enable their collections to transit to the digital realm and then be offered to users. This need will be fulfilled through the development of the EUreka3D data hub, a pilot e-infrastructure including various features for managing and sharing 3D assets.

INTRODUCTION

The EUreka3D project [1] began on 1 January 2023 as a data space supporting project funded by the European Commission's Digital Europe Programme. The project aims to support the digital transformation of the cultural heritage sector, with a specific focus on 3D. Its work is in line with the recent EC Recommendation 2021/1970 of 10 November 2021 on a common European data space for cultural heritage [2], that demands Member States and cultural institutions make an urgent effort to digitise heritage in 3D, and make it available online for reuse. However, cultural heritage institutions face various challenges concerning the creation, storage, visualisation and preservation of 3D models of cultural heritage, which are significantly more complex than 2D collections. In this light, the **EUreka3D proposal addresses the growing need of enabling the digital transformation of the Cultural Heritage sector**. The digital transformation comes from a decades-long process of basing museum (and also in general Galleries, Libraries, Archives and Museums-GLAMs) operations on solid information-sharing infrastructures, forcing an overall rethinking of the underlying work processes and business models. However, not all institutions have achieved the same level of maturity towards the new digital environment they need to embrace, and despite the Covid19 crisis, which acted as an accelerator of the process for nearly everyone in the sector, much work still needs to be done, especially for smaller Cultural Heritage Institutions (CHIs). Museums, galleries, libraries, archives and archaeological sites need to review and modernise, if not to create from scratch, their internal processes from digital capture to end-user access and re-use. They need to re-train their personnel to cope with the new digital responsibilities and roles; to review their infrastructure capacity, in particular with regard to the ability to process 3D contents; to generate a novel holistic documentation of the digital objects. The vision of a European Data Space for Cultural Heritage as a participatory playfield for all the actors involved (cultural institutions, technology partners,

multidisciplinary experts, creative industry, scientific researchers, end-users) moves in this direction, and requires CHIs of any size to enter the challenge of advanced digitisation (especially 3D digitisation in high-quality), holistic representation of CH information and re-use approaches. The existing services of the Europeana platform are a good starting point to support sharing and re-use, but integration with more advanced, powerful and secure services is needed to meet the demands of small institutions, as well as modern workflows and increased digital capacity on the part of CHIs.

From a technical viewpoint, CHIs need to move away from former ICT generations that focused on Web presence, specialised catalogue databases, isolated digitisation processes and virtual exhibitions, to a comprehensive, integrated, cloud-based IT infrastructure that extends beyond the boundaries of individual centres and focuses on network services and interoperability within the European Data Space for Cultural Heritage, crossing also with other Data Spaces that are under construction and evolution. In this sense, the EUreka3D project focuses on improving the digital capacity of the cultural sector by enriching the offer of services available on the data space, such as access to high quality and high value datasets, technological tools, technical know-how references, tools for knowledge sharing, consultancy and other services, to support digitisation, preservation and online sharing of digital cultural heritage assets.

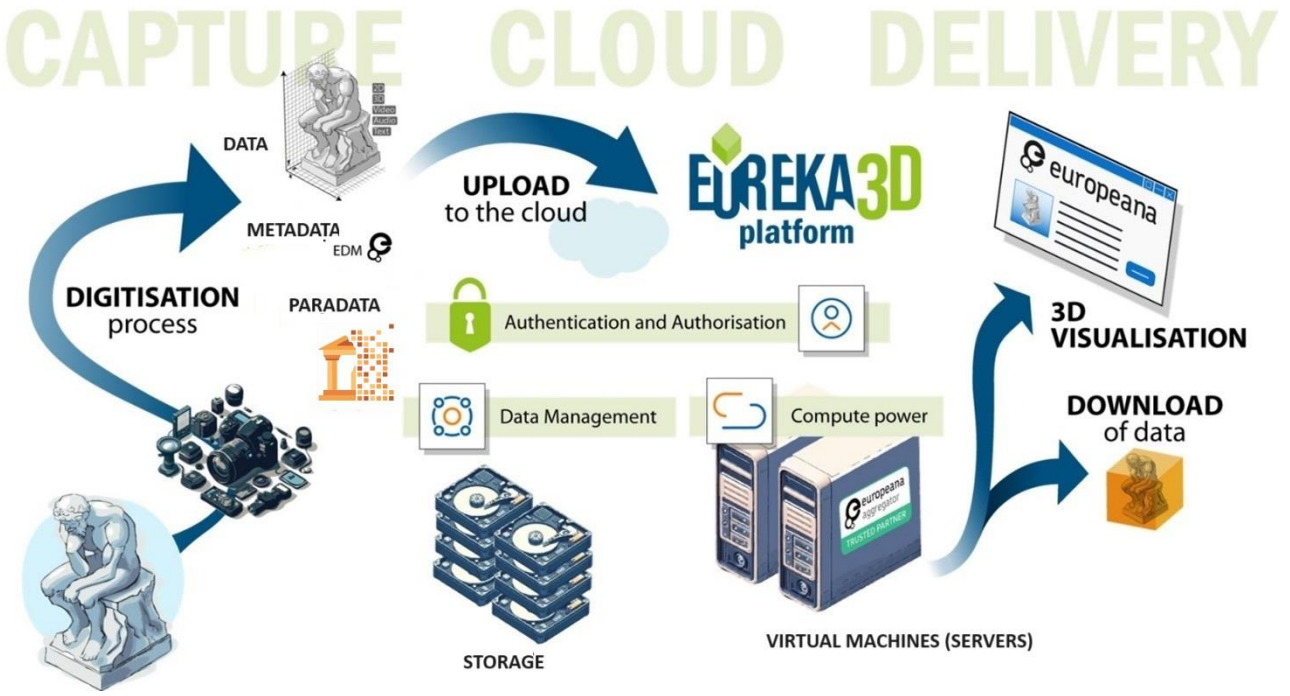

Fig. 1 EUreka3D data hub and workflow - general overview. CC BY-SA EUreka3D consortium.

THE EUREKA3D SOLUTION

The EUreka3D data hub offers solutions to cultural institutions for data, metadata and paradata management and for delivery of 3D collections to users, also providing interoperability with Europeana, the European initiative to share and promote digital heritage collections. The platform, currently under development, aims to include various features, such as:

- Secure authentication and authorisation mechanisms, to protect 3D objects from manipulation or unauthorised access;
- Storage of models in original formats (often with very large file sizes), and conversion/visualisation features that enable the object to be displayed online;
- Metadata model and paradata compatible with the Europeana Data Model;
- Interoperability with established tools and procedures;
- Harvesting functionality to provide the individual object or datasets to Europeana for publication.

A demo event organised in December 2023 [3] presented the progress of the development midway through the project timeframe, allowing for feedback, advice and recommendations to be collected. The image below depicts the **EUreka3D workflow, covering three big blocks: the digitisation process (capture), the upload and management of data in the platform (cloud) and the release of data and services to end users and external applications (delivery).** In the course of the next developments, the EUreka3D data hub will be integrated with Europeana and will also be available from the most noteworthy European cloud initiatives, such as the Data Space for Cultural Heritage and the upcoming ECCCH European Collaborative Cloud for Cultural Heritage.

THE PLATFORM

The EUreka3D platform is an essential component of the EUreka3D project, which aims to contribute to the digital transformation of the cultural heritage sector. One of its practical objectives is to enable data, metadata and paradata to be delivered to users via platforms like *europeana.eu*.
The EUreka3D platform is technically supported by different components, among which the following stand out:

- The **EGI Check-in** service [4] , an Identity and Access Management system that supports the processes of **authentication** (verifying who the user is) and **authorisation** (reporting what a user can do in a system). EGI Check-in allows users to authenticate with their home organisation (typically, a research institute participating in eduGAIN [5]) as well as with an academic account (e.g. ORCID), a social account (e.g. GitHub, Google, LinkedIn, etc.) and others. EGI Check-in provides a simple and integrated method to ensure that EOSC users use EUreka3D services per their defined access policies.
- **EGI Cloud Compute** [6], which provides **virtual servers** in the cloud, on-demand. The virtual allocation of servers is done through Virtual Machines (VM), which are software components that run over physical hardware and emulate and provide the functionality of a physical computer system. One of the advantages of cloud technology is that the virtual infrastructure can be created directly through software instructions, without the need to physically access the servers. Moreover, this virtualisation greatly facilitates elasticity, a term used to describe the ability of a system to increase or decrease its resources to adapt to the current workload.
- The **EGI DataHub** [7], which provides a federated distributed system for **data management and data publication**. DataHub relies heavily on the cloud storage available for EUreka3D, which is one of the core components of the project. It is directly used by EUreka3D end users and is therefore accessible through a user-friendly Web interface. Users can easily upload any type of data file, associate metadata to it in different formats, assign permanent identifiers to it and many other tasks. DataHub is also able to communicate with the Europeana platform to perform the required content aggregation.

These three components form the core of the EUreka3D technical platform. There are many challenges associated with the ingestion, processing, aggregation and delivery of 3D content. These challenges stem from the nature of 3D content, current hardware limitations and the quality target set by the VIGIE Study 2020/654 on quality in 3D digitisation of tangible cultural heritage [8], followed in EUreka3D, as it promotes guidelines to ensure the highest level of quality and the best possible outcome. The current capabilities of consumer computers and networks impose limitations and challenges in the design of the EUreka3D platform. Quite often, processing of 3D data online is done on the client side, so the actual device used by the user plays a key role and 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 the standardisation level** that 2D content has. This lack of standards for the use of 3D data makes it a challenge to decide on a universal 3D format. There is no complete alignment between the 3D software to process 3D data and the software to visualise or deliver 3D experiences to users. Herein, some content providers may use a format for the archival of 3D data, but this may not be the best

choice for visualisation or delivery to end users. For example, OBJ is a widely known format, commonly accepted by 3D software and 3D visualisation libraries, but it is less space-efficient for data, making it a poor choice if the data to be sent over a network are too large. Such cases can benefit from a binary format such as PLY. The Nexus multi-resolution format [9], created by CNR, delivers 3D data more efficiently over the network, but it is not supported by common software and current technical challenges make it unsuitable for 3D CAD data. Some algorithms and 3D formats focus on compression ratio, while others focus on performance. It is usually a trade-off: compression makes more efficient use of space (benefiting, for example, the storage or transfer of a file) but increases processing effort (both for compressing and decompressing the data). 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. Therefore, the design of the EUreka3D platform is not limited to providing a technically capable infrastructure but also has to address the challenges of the management of these three categories of assets: the **data** (3D models, raw data, audiovisual content, etc), the **metadata** (information about the models) and the **paradata** (information about the digitisation process). Many of the challenges associated with data have already been mentioned above. **3D metadata information** has been studied for a long time, and many of the challenges involved have been minimised with the help of the EDM Europeana Data Model [10], which provides a common framework for the understanding of systems that exchange Cultural Heritage metadata. However, the situation is not so favourable as far as the paradata are concerned. **Paradata information processing** is a necessary yet not widespread practice amongst 3D content providers and is not currently addressed by EDM. Delivering the paradata information associated with some data provides key insights into how the digitisation process was carried out to obtain the data. Although there are different initiatives and efforts focused on the description of paradata, Cultural Heritage lacks a formal data model to express them, and this is one of the future enhancements planned for the Europeana Data Model.

IMPACT OF 3D COLLECTIONS, AND INSPIRING EXAMPLES

As part of EUreka3D's capacity building activities, the project is developing use cases to show how 3D digitisation offers new ways to stimulate interest in cultural heritage, by enabling the creation of more advanced collections to represent not only cultural objects but also the story and memories associated with them. This enhances **storytelling and knowledge sharing**, also breaking borders related to age, social status or cultural background of the public (especially digital natives), to support the mission of heritage institutions. Four project partners undertake 3D digitisation of a wide range of objects, to develop case studies of **reuse for the collections in different domains and for different purposes**. The best showcase for these digital collections is *europeana.eu*, the European gateway to digital cultural heritage. The Europeana website provides cultural heritage enthusiasts, professionals, teachers, and researchers with access to Europe's digital cultural heritage, to inspire and inform fresh perspectives and open conversations about our history and culture; to share and enjoy our rich cultural heritage and to reuse for various purposes and in different domains. Europeana gives access to millions of items from cultural institutions across Europe, including artworks, books, music, photographs, and videos on art, newspapers, archaeology, fashion, science, sport, and much more. As mentioned above, in the context of the EUreka3D project, there are four cultural institutions involved in a piloting action that starts from high quality digitisation of heritage collections of different kinds and will follow the full journey of collections management, storage, aggregation and sharing to Europeana:

CRDI/Ajuntament de Girona is providing a 3D collection of pre-cinema heritage equipment and objects precursors of film that are on display at the Cinema Museum in Girona, but cannot be touched or interacted with. Having detailed 3D models will support the Museum in boosting visitors' engagement, for example by creating 3D printed replicas of the objects, to be used by visually impaired visitors or to view internal parts and fragile mechanisms; by creating new virtual scenarios

onsite and enriched experiences for online visitors; and by giving access to a complete and realistic vision of the cultural object with all the knowledge associated with it.

Cyprus University of Technology is currently working on reproducing the advanced 3D model for an historical boat in Limassol, a unique part of Cypriot fishing tradition and industrial heritage. Through meticulous digitisation efforts, detailed modelling, and collaborative initiatives, this fascinating piece of history is being brought to life in the digital realm. The upcoming e-platform for Lambousa is set to be a comprehensive hub, housing all materials and insights related to the case study. From historical documentation to 3D models, the platform will provide an immersive experience, allowing enthusiasts and researchers alike to delve into the intricate details of the Lambousa Fishing Boat. The model, accompanied with informative metadata and paradata, will be published soon on Europeana, the European website showcasing heritage collections, openly available for education and research purposes. In addition to the Lambousa boat, other historical monuments such as the Holy Cross Church at Pelendri, a symbol of rich cultural heritage, and other objects relating to Cyprus heritage are being digitised and will be shared on Europeana.

Bibracte is an archaeological site in the French region, Burgundy. Located on Mont Beuvray, it was the capital of the Aedui, a Gallic tribe that lived during the late Iron Age and the beginning of Roman period. In the context of EUreka3D, Bibracte is creating a 3D collection for a selection of artefacts as exhibited in their museum, for online publication as open access resources in *europeana.eu*. The entire collections comprised nearly 2,000 objects providing irreplaceable evidence of life in the oppidum, including coins, fibulae (brooches for fastening garments), wine amphorae (two-handled storage jars), writing tools, weapons and luxury items, religious dedications and ex-votos. In addition to museum objects, Bibracte provides Europeana with a selection of terrain models of the archaeological site.

Finally, **Museo della Carta di Pescia** is preparing 3D models from the collection of ancient paper moulds, a type of heritage almost unknown relating to the traditional paper manufacturing industry. This institution in Tuscany preserves complete and original tools related to all the working phases and set up of paper production, as a witness of a traditional economic activity in the area, which continues nowadays. The collection of tools, paper moulds and historical archival documentation of the paper mill are not only a specific example of tangible heritage, but also bring the intangible values and history of the local community which for centuries worked in the paper mills of the area. In particular, the 3D digitisation of paper moulds enables users to virtually handle and examine in detail very fragile heritage items which cannot be accessed otherwise.

CONCLUSIONS

In the third millennium, CHIs are called to create, preserve and make available for re-use new and high-value datasets, and in particular 3D records of museum objects, monuments and archaeological sites, with an urgency, especially, to digitise those CH items that are at risk of decay due to various reasons (physical deterioration of supports, impact of climate change, damage by human attacks, natural disasters, etc.). These new digitisation actions will serve not only for preserving documental, movable and built heritage, but will also boost opportunities for scientific research, for supporting preservation and restoration purposes, for planning new environmental sustainable solutions for the premises that host CH, and for enabling re-use by the cultural and creative sector in the light of audience engagement, education, tourism empowering, and more in general to support the process of identity building in Europe.

Also, **high quality and digitally advanced dataset are directly beneficial to CHIs, as they provide digital opportunities for promoting their collections and sharing knowledge**, creating virtual visits to the collections and the sites, and offering valuable building blocks for history reconstructions, cultural tourism, education and learning. Unfortunately, many museums, especially the smaller ones that often lack resources and specialist capacity, are afraid of moving towards 3D digitisation, and only dare to share their collections online by the means of basic photographic content published on their website or social media. Similarly, it is easier, and apparently cheaper, to just get

a professional photographic shooting on their collections than to embark on a high-quality 3D digitisation campaign. Also, once the 3D model is created, the issues on how to store it, how to visualize it online and how to preserve and share associated information are big challenges for CHIs. Hence, despite the benefits of high-quality digitisation being understood or acknowledged by the CHIs, often these technologies and competence can be considered too difficult to achieve or too expensive. The digital transformation of the sector at large, including a substantial push towards 3D digitisation, needs to penetrate all levels, as many CHIs/GLAMs still suffer from barriers (e.g. lack of financial support, lack of professional human resources in 3D data acquisition and processing, lack of digital capacity, lack of ICT infrastructures) and challenges (e.g. access to sustainable tools and technologies, knowledge about use & re-use potential).

These key issues are addressed in an inclusive and very innovative way with the EUreka3D project, through the development of a safe and secure environment, that provides CHIs of any size with strong support, advanced ICT services, knowledge about 3D digitisation, and novel participatory services for users. The project engages a variety of CHIs in a piloting action that is currently achieving various objectives: Set-up dedicated cloud-based services for the management and preservation of cultural contents in a secure and IP-mindful environment; Generate high-quality 3D digitisation of selected items and their related para-/metadata ready to be harvested by Europeana; Perform aggregation of the new contents to the Europeana platform and exemplification of few cases for use and re-use in unique areas such as Education; Four different CHIs with various levels of engagement and in different stages of their digital transformation process participate in the piloting action, with their varied collections, providing user requirements, testing and iterative feedback.

On top of that, the project focuses on the capacity building of the human resources of the museums and CHIs and develop unique training material for the 3D digitisation, processing, preserving on the cloud and harvesting in Europeana, as part of a network effort, and by offering dedicated consultancy, webinars and training. Impact assessment and mindful sustainability planning complement the effort of the project in enabling a long-lasting contribution to the digital transformation of the sector. By accessing the EUreka3D solution, it will be possible from a single access point to cover the entire workflow of data, metadata and paradata management in sight of enabling online sharing of 3D collections. The improved capacity of CHIs in the production of 3D contents and their ability to give access in a secure way to their valuable assets will enable other public and private sectors to gain benefits too. In particular, we can envisage new applications adopted by the research and academic sectors and new business opportunities created for Cultural and Creative Industries (CCIs), education, cultural tourism and awareness.

References

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