

Article

Good Practices for Web-Based Cultural Heritage Information Management for Europeana

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Abstract: This paper presents the digital tools, online platform and methodology created during the implementation of BYZART, a European co-funded project for the enrichment of Europeana collections with heritage objects for Byzantine art and archaeology provided by the partners of the project. The creation of the platform and its usability are thoroughly described as well as the importance of such tools for the preservation and promotion of world cultural heritage. Also, the paper discusses the adaptation of the methodology to other projects, for the engagement of communities in the field of heritage datafication, and we demonstrate how existing content can be re-used by “meta-creators” to develop new content, applications and presentation paradigms.

Keywords: cultural heritage; open linked data; Europeana; EDM; information management; World Wide Web; Byzantium; Byzantine art; BYZART project



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1. Introduction

During the last decade, the digitization of cultural heritage objects has been offering valuable contributions to the preservation and dissemination of cultural heritage. This digitization focuses not only on the use of physical media and the World Wide Web, but also towards making use of Web 3.0 platforms and the semantic Web [1]. Linked data representations of metadata about cultural heritage resources are now available in many digital libraries and online catalogs [2]. Several databases and platforms are in use for the enhancement of digitized intangible heritage objects [3], advancing knowledge, creating a sense of common heritage and engaging communities for the protection and promotion of cultural heritage. Furthermore, the creative industries can use the digitized content to create engaging storytelling experiences and further help with the dissemination of cultural heritage through increased audience engagement [4]. Despite the constant efforts and activities, the online community is still in need of further digitization as there is not enough e-documentation of digital cultural heritage objects to attract larger audiences [5]. This lack-of-information problem clearly affects all the connected creative industries as it introduces a non-use non-adoption effect. Additionally, the success of digitization and the cultural heritage content aggregation process is not always guaranteed and might fall short of meeting specific criteria [6].

One of the most important and large-scale databases that targets precisely this problem is Europeana, which aggregates metadata from many European institutions, creating a vast number of online digitized materials and promoting the idea of shared heritage to European citizens [7]. The intermediate aggregators play a significant role in accomplishing the goals of Europeana for simplification and distribution of data aggregation, allowing the unification of access to the objects [8]. In an effort to further facilitate the digitization and aggregation of art and cultural heritage-related material, Europeana has developed a specialized data model known as the Europeana Data Model (EDM). This model, which is

an extension of the Dublin Core model, is aiming to more comprehensively record metadata related specifically to objects of cultural heritage. In combination with its Guidelines, the EDM can alleviate to an extent many of the problems of metadata aggregation [9]. Hence, it can be used as a vehicle for other cultural or educational institutions or conglomerates to provide such digitized materials to Europeana.

In this article, we take a look at the implementation of a completed, multi-institutional, large-scale, cultural heritage aggregation and dissemination project focusing on collecting, digitizing and exhibiting its content as well as providing it to Europeana collections. Our goal is not only to identify the challenges faced by such an endeavor, but also to present a series of good practices that can facilitate its successful completion.

2. The Project

As mentioned above, an EU-funded project was implemented during the years 2017–2019 that created important integration and discoverability tools as well as a methodology for the enrichment of the online platform Europeana and the re-use of digital content. This project, named “BYZART: Byzantine Art and Archaeology on Europeana”, was co-financed by the European Commission in the framework of the Connecting Europe Facility (CEF) program. The project’s main goal was to enhance Europeana’s material regarding byzantine art and archaeology by publishing new online objects through Europeana collections.

During the implementation of the project, more than 75,000 items such as photos, videos, audio content, 3D surveys and reconstructions were digitized, appropriate metadata were embedded and their quality was validated, a process that created one of the largest digital collections in this subject area. These items were digital representations of objects of cultural heritage related to Byzantine art and culture. The objects originated from the wider geographic region of the Mediterranean and included both objects that are still on site, such as temples, wall paintings, architectural elements and archaeological sites, as well as items that are currently hosted in local or international museums, such as coins, ceremonial vessels, icons and more. From a temporal perspective, these objects are ranging from the late Roman Era, when the earliest items relating to the Byzantine Era started appearing and up to the post-Byzantine Era. Both the temporal and the geographical range of the digitized objects are embedded explicitly in the final digitized items thanks to the use of linked open data, as is further detailed in the Technical Implementation Section of this article.

The University of Bologna acted as an intermediate aggregator to Europeana, while the rest of the partners contributed to the role of data providers. The Ionian University team designed the appropriate process and developed the software solutions that enabled effortless organization and linking of data with metadata, via the creation of a content management platform compatible with Europeana standards to assist the roles of the team members. The roles are categorized under the following four main categories [10]:

- **Content Contributors:** As contributors, users have been using the platform to upload/edit and submit content and metadata. Effortless and mass-uploading of vast data sizes was implemented using Cloud technologies and techniques which do not impose data-entry delays while uploading, enabling parallel processing to be implemented. New contributors can join the consortium and enrich the thematic channel by submitting their content. This process is very important for new researchers who wish to store and make their research available, as they will be located centrally, ensuring that they preserve their content ownership rights.
- **Content Validators:** The platform’s users are themselves content experts and as such they can act as validators for the submitted content. However, our external data validation experts are on hand during and before the final submission of a collection. This feature, combined with the creation of well-typed term vocabularies, enables metadata accessibility and uniformity, creating a solid data structure that can be effectively accessed both manually and automatically.

- **Developers:** We have been dealing with data and metadata issues, enabling existing content to be described appropriately, while new content can also be described and classified. New content involves data types including augmented reality, virtual reality and holographic content, new audio types involving locative information and latest minimum content-sampling requirements that enable this content to be used for the development of virtual-reality and holographic presentation environments.
- **Users:** Users are able to view the digital collection items and now the exhibition with a complete timeline. Users are presented with the options to browse generally through the collection, search for specific terms, identify the copyright terms and trace the copyright owner should they wish to use the content within their projects. They may also propose edits and corrections to the database.

However, as the research and the development progressed, we identified another important role, which is that of the “metacreator”, i.e., the person, interested party or algorithmic process that can re-use existing information for the creation of new content, often extending its originally intended use. For example, the content can be used to create a gamified course on byzantine archaeology that enables students to train while playing and accurately identifying the features of the artifacts. It is therefore important to set the foundation for future re-use of our content and for uses that we are unable today to foresee through the development of open systems and platforms and data schemes. In terms of innovation, this new content was examined in a pilot experiment implemented by the Ionian University Research Team with the Open University of Cyprus team. A holographic experimental video was created, presenting digitized archaeological features, showing an extent of meta-creation with the use of existing content. Furthermore, the use of existing content for further novel content-production tasks, such as the development of holographic representations, was introduced in our work [10], a process which introduces the importance of semantic technologies and their applications [11].

3. Technical Implementation

Designing and implementing the BYZART project’s platform was a multi-faceted challenge. The project had some specific requirements that made using an already existing commercial or non-commercial solution difficult at best, almost impossible. Since the project involved a multitude of partners and a huge amount of both content data and metadata, the use of a Cloud storage solution became a necessity. Additionally, the project’s end goal of integration of the content with Europeana dictated the use of the EDM. Since no content management system adequately met these needs, a heavy customization of the systems involved would be needed. Hence, the project’s technical supervisors in cooperation with the content providers proceeded to analyze and identify a series of challenges that posed requirements that the platform should meet. With these challenges in mind, the project’s team set out to create a highly custom solution based on well-established tools that fit the following requirements:

1. The platform needed to be available online through a Web interface. Since the project involved multiple partner institutions from multiple countries, an online collaborative solution was an absolute necessity. The amount of work required by each institution dictated the use of multiple staff members. This meant that the requirement of specific software tools on the side of the content providers would hinder the project’s chances of success. Thus, a Web interface was deemed necessary, since that would mean that a browser and an active internet connection would be sufficient for someone to work on the project.
2. The platform needed to be fast, reliable and secure. Online data management systems are often limited by performance issues caused either by network latency or lack of processing power [12]. The project’s scope meant that the platform had to be able to carry enough memory and processing power to run a big database server-side without causing delays, while at the same time providing a user interface that not only had low system requirements from each contributor’s device but also was fully

compatible with a variety of operating systems and browsers. Additionally, none of these requirements could be fulfilled at the cost of data security. This meant that a secure, robust and fast hardware and software combination was necessary for the Web server.

3. The platform needed to be able to handle large data and files. The project's scope meant that the platform had to be able to work with vast data and metadata sizes on the server side, as dictated by the nature of the objects of cultural heritage that were its focus. Thousands of high-quality image, video and audio files had to be collected, organized and served, and for that reason, the use of Cloud services was employed.
4. The platform needed to allow users to provide content in a non-serial manner. The sheer number of cultural heritage objects involved would have made the process of manual input a daunting task. For that purpose, it was deemed necessary for processes to be created that were used to batch-import both metadata and actual content files.

Although the requirements mentioned above may seem somewhat universal in terms of online collaborative data management systems, some of them, such as the use of Cloud storage or batch-import of files, were found to be either absent or poorly implemented in existing CMS platforms. Additionally, other specifics of the project such as the EDM or the ability to present items from existing Europeana collections dictated an approach that allowed for the expansion of existing systems.

These clear requirements formed the basis for the creation of the platform. Each content-providing partner imported their metadata into BYZART's Content Management Component and uploaded their master files to the Cloud storage. The platform automatically used these master files to create their Web versions (including thumbnails where necessary). The completed items passed a quality assurance process and were then offered to the public both through the platform's Web interface and through an Open Archives Initiative (OAI) gateway. Through this gateway and a harvesting procedure, they were also integrated in Europeana collections. In Figure 1, a diagram displaying the platform's basic structure and the process of data collection is presented.

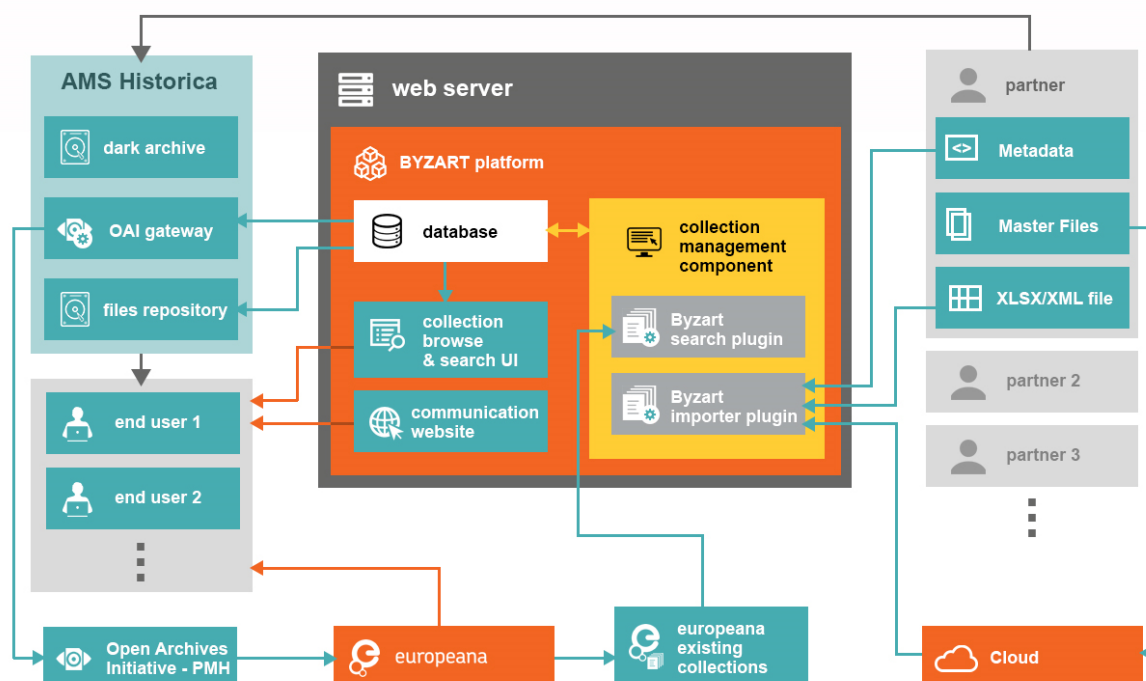


Figure 1. BYZART project data collection scheme.

3.1. Building the Platform

The cornerstone of any robust data management platform is its hardware and software base [12]. The BYZART project was hosted in a Web server provided by the University of Bologna that runs on Ubuntu 16.04. It included a full LAMP stack with Apache handling Web serving, MySQL 5.7 as the database and running on PHP 7.2. The server had 2 CPUs and 8GB of RAM and made use of 100 GB of local storage. The server displayed immense bandwidth capabilities and exceptional stability throughout the long process of the project. The server's maintenance and updates were handled through the use of the Webmin system configuration tool. Access to the server's non-public content was achieved through a secure VPN and all public Web content was served through the Secure HTTP protocol, making use of TLSv1.2 encryption and the appropriate SSL certificates.

The platform's Content Management Component was implemented through the use of a heavily customized installation of Omeka Classic CMS, a "leading open-source Web publishing platform for digital collections" [13]. The Omeka system was selected for its focus on the display of the digital collections and its customization capabilities. It also comes with a built-in user management system offering a variety of permissions and the ability to have multiple item collections for each user. The multi-institutional nature of the project was well-served by this. A user was created for each partner institution and each user's access was thoroughly limited to their own added items and collections, in order to achieve the best data security. The system's functionality was expanded by multiple plugins, some taken from Omeka's library of plugins and others specifically developed by the researchers for the BYZART project. In Table 1, you can see a list of all the developed plug-ins and a short description of their utility.

Table 1. Omeka classic plugins implemented for use in the BYZART project.

Plugin Name	Utility
ByzartBatch	Enabled the batch editing of item status concerning the QA process.
ByzartDocumentation	A series of documentation and user help pages in the Omeka administration area.
ByzartElements	Implemented EDM in the Omeka classic environment.
ByzartExporter	Used for exporting metadata in EDM xml format files
ByzartGalleries	Interface for creating multi-item themed galleries available to the public
ByzartImporter	Used for importing items from spreadsheets or xml files as well as content files from the Cloud
ByzartOutput	Used to implement the ability for Omeka to display the EDM schema in XML format online.
ByzartSearch	Interface for searching Europeana collections and seamlessly importing items to be displayed as external collection items.
ByzartStatistics	Interface for displaying statistics regarding the content provided by every partner
ByzartValidate	Implementing the validation of the EDM schema in Omeka's content form.

One of the first and most major enhancements to Omeka was the implementation of Europeana's metadata schema known as the Europeana Data Model (EDM). Although, based on the Dublin Core schema, the EDM has diverged into a very thorough and well-structured metadata schema specializing in objects of cultural heritage and their representation on the Web. Its implementation served not only with better structuring and delivering the content provided by the project's partners, but also with the ingestion of the bulk of the project's items into the Europeana collections. In addition to implementing the schema, specific vocabularies were created through which the content providers could provide information regarding aspects of their items using URIs instead of free text, thus making the most of open-linked data. The vocabularies used the Getty Art and Architecture Thesaurus® Online for materials, item types and techniques. Additionally, URIs could be provided by the Iconclass Classification system for item subjects and the GeoNames geographical database for locations and other sources, but without being part of a closed vocabulary list.

3.2. Facilitating the Data Entry Process

Equally important for the project's content providers was the ability introduced to the CMC to import metadata using xlsx and xml files. Some of the partners already had some

of their collections' metadata digitized so an automatic mechanism was created that parsed that information either in xlsx or xml format and imported it into the CMC. This enabled content providers to avoid repeating work that had already been concluded and focus on the digitization of even more objects of cultural heritage. Additionally, a spreadsheet template in xlsx format was designed specifically for this project. This template could be used by partners instead of the CMC's item addition form to provide metadata. That was especially helpful for content providers that had multiple staff members working on different collections and were more familiar with the use of spreadsheets. An example of data from such a spreadsheet can be seen in Figure 2. The columns are color-coded to help data providers adhere to the data structure model's strict guidelines.

creator	description	lang	current_own	subject	title	type	chron	mate	chron	current_location	technique	euro	original_coll	content	europa
Local workshop	Impost capital with acanthus leaves	zxx	Archeological Museum of Rimini		Rimini, Museo Civico, facciata laterale lunga di capitello imposta	capital (column component)		marble (rock)	5 th -6 th c. AD	sws.geonames.org/3169	carving (processes)	IMAGE	Giuseppe Bovini Archive (cliché 4087)	University of Bologna	BY-ND
Local workshop	Impost capital with acanthus leaves and, on the short side, a central cross	zxx	Archeological Museum of Rimini		Rimini, Museo Civico, facciata laterale lunga di capitello imposta	capital (column component)		marble (rock)	5 th -6 th c. AD	sws.geonames.org/3169	carving (processes)	IMAGE	Giuseppe Bovini Archive (cliché 4040)	University of Bologna	BY-ND
Local workshop	Relief with a female figure in the centre (the Saint), between two sort of walls decorated with opus pavonaceum	zxx	Pontifical committee of Sacred Archaeology	http://iconclass.org/rkd/11HH%28AGNES%29/	Roma: catacombe di Sant'Agnese, immagine della santa del IV secolo	sculpture (visual work)		marble (rock)	4 th c. AD	sws.geonames.org/3169	carving (processes)	IMAGE	Giuseppe Bovini Archive	University of Bologna	BY-ND
Local workshop	Funeral or celebratory stele with a man riding a horse and an inscription	zxx	Oliveriano Museum of Pesaro		Pesaro: Museo Oliveriano, stele di S?maragudis Dio	stele		marble (rock)	Late Roman	sws.geonames.org/317	carving (processes)	IMAGE	Giuseppe Bovini Archive (cliché 4303)	University of Bologna	BY-ND
	Two male figures stand in front of an architecture	zxx	Vatican Library		Roma. Biblioteca Vaticana-Menologio di Basilio	book	975-1025 A.D.	parchment		sws.geonames.org/3169	drawing (image-making)	IMAGE	Giuseppe Bovini Archive (cliché Istituto 4885)	University of Bologna	BY-ND
	Male figure praying, sitting in a sarcophagus	zxx	Vatican Library		Roma. Biblioteca Vaticana-Menologio di Basilio	book	975-1025 A.D.	parchment		sws.geonames.org/3169	drawing (image-making)	IMAGE	Giuseppe Bovini Archive (cliché Istituto 4886)	University of Bologna	BY-ND
	Male figure praying, sitting on the top of a column	zxx	Vatican Library		Roma. Biblioteca Vaticana-Menologio di Basilio	book	975-1025 A.D.	parchment		sws.geonames.org/3169	drawing (image-making)	IMAGE	Giuseppe Bovini Archive (cliché Istituto 4476)	University of Bologna	BY-ND
	Two male figures; one is standing and is going to kill the man who is sitting	zxx	Vatican Library		Roma. Biblioteca Vaticana-Menologio di Basilio II Simeone: il	book	975-1025 A.D.	parchment		sws.geonames.org/3169	drawing (image-making)	IMAGE	Giuseppe Bovini Archive (cliché Istituto 4475)	University of Bologna	BY-ND
	Male figure.	zxx	Church of Saint Decenzio, Pesaro		Pesaro: S. Decenzio, cripta, busto di	fresco		paint (coatin AD)	6 th -7 th c. AD	sws.geonames.org/317	fresco	IMAGE	Giuseppe Bovini Archive (cliché 5119)	University of Bologna	BY-ND
	Ornamental pattern	zxx	Church of Saint Decenzio, Pesaro		Pesaro: S. Decenzio, cripta, motivo	fresco		paint (coatin AD)	6 th -7 th c. AD	sws.geonames.org/317	fresco	IMAGE	Giuseppe Bovini Archive (cliché 5119)	University of Bologna	BY-ND
Local workshop	A man riding a horse between two pillars	zxx			Rimini: viale Tiberio, fianco di	sarcophagus		marble (rock)	Late Roman		carving (processes)	IMAGE	Giuseppe Bovini Archive (cliché)		BY-ND

Figure 2. Sample data for xlsx importing.

Another modification aimed at making the data entry process faster and more robust was the addition of the ability to import the master files of an item from Cloud storage. Due to the nature of the items, their media files which involved images, video and audio could reach up to hundreds of megabytes for each file (i.e., high-resolution tiff images). Uploading each file individually through the CMC would interfere with the metadata entry workload (when it was done through the CMC's form) and create delays. Instead, through the use of a unique file identifier, the metadata could be linked to files that the partners uploaded on the project's Amazon AWS S3 storage and then automatically imported into the system. This process involved the system automatically downloading the appropriate master files, creating versions that were suitable for the Web as defined in the project's specifications and also thumbnails when appropriate, as well as updating the database accordingly. Thus, with a single click, partners could import their files from the Cloud into the platform.

3.3. Ensuring Adherence to Standards

An essential process of any data-collection system is the proper validation of the information it handles in order to ensure that it adheres to the strict standards dictated by

the data structure schema. In the case of the BYZART project, since the EDM schema was implemented, additional validation functionality needed to be added to the CMC to ensure that the requirements of the schema were met for every item. The first step to achieve that goal was to add validation rules to Omeka's existing item-adding form. This was implemented with the ByzartValidation plugin. This validation included but was not limited to checking whether an object always contained the edm:type, edm:rights, edm:dataProvider and edm:provider fields, as well as at least one of the dc:title or dc:description fields and at least one of the dc:subject, dc:type, dcterms:created or dcterms:temporal fields. Additionally, as seen in Figure 3, the form was color-coded to help data providers adhere to the validation rules. Similar to the xlsx sample data from Figure 2, the color yellow was used to signify that at least one of the fields "Title" and "Description" must be filled in as a requirement of the EDM schema. Moreover, the color green was used on the fields "Subject", "Type", "Chronology Specific" and "Chronology Period", which also needed at least one value present in any of the four. Finally, the color red was used for the fields that must absolutely have a value, which were the fields "Europeana Type" that signified the type of resource, "Content Provider" that signified the provider of the Cultural Heritage Object and "Europeana Rights" which contained information about the copyright and rights of use of each presented object. Distinctive shades of yellow, green and red were used to ensure that people with color blindness could also somewhat benefit from this assistance. It should be mentioned that validation requirements were explicitly stated in both the platform's documentation and in the interface when a validation error occurred. Visual aids such as color coding were used in addition to that and were not in any way detrimental to the way people with cultural differences regarding color or accessibility issues could use the platform.

The EDM requirements were also strictly enforced during the process of importing metadata using xlsx or xml files. Any item that did not meet them was omitted but could be easily imported later when any data-related omissions were fixed. In addition to the form and import validation enhancements, the ByzartValidation Plugin included a process of automatically correcting common mistakes made in URIs that data providers used to provide information about the subject and location of an item through the Iconclass and GeoNames websites (for example using the www.geonames.org (accessed on 16 April 2021) domain instead of the proper one which is sws.geonames.org (accessed on 16 April 2021)). The correction process saved an immense amount of time that manual corrections would have required and ensured that the data provider's work achieved its goals despite these types of minor human errors.

In addition to the validation and correction measures detailed above, a manual quality assurance process was also implemented. The National Hellenic Research Foundation oversaw the rigorous process of reviewing the items provided by the project's data providing partners and gave the final OK for each item's publication and dissemination. In order to accommodate this functionality, an account with permissions was created for the NRHF and a status system was implemented in Omeka's forms that enabled partners to notify the NHRF when an item was considered ready for its final quality check. The NHRF could then review the item and either make it public or return to the original provider with requests about the item's amendment.

The screenshot shows a web form for adding items to an Omeka collection. The form is divided into three main sections, each with a label on the left, a description on the right, and an 'Add Input' button below the label. The 'Creator' section is highlighted with a brown border, the 'Description' section with a yellow border, and the 'Subject' section with a green border. The 'Subject' section is currently selected, and its description reads: 'Subject of the CHO as full text and where appropriate as a link from <http://iconclass.org>'. Each section has a large text input field to the right of the description.

Figure 3. Color coding in the Omeka item-adding form.

3.4. Diffusion of the Collected Data

The data collected from content providers and aggregated on the BYZART project's platform is readily available through the CMC's customized Web interface available at <https://cmc.byzart.eu/> (accessed on 16 April 2021). A pillar of the BYZART project was the use of linked open-data and the EDM standard to make all collected information a part of the semantic Web. In that spirit, providing the data only through a Web interface would defeat the purpose of the project. So, an Open-Access Initiative Protocol for Metadata Harvesting (OAI-PMH) endpoint was created and is available at <https://cmc.byzart.eu/oai-pmh-repository/request> (accessed on 24 March 2021) using a modified version of Omeka's OaiPmhRepository plugin. This endpoint provides the bulk of the metadata collected by the platform alongside information concerning the Web resources (images, video, audio, etc.) for each object of cultural heritage, using the EDM data structure, through the use of the "metadataPrefix=EDM" parameter.

Using this OAI-PMH endpoint and in collaboration with Europeana and AMSHistorica, all the data collected by the BYZART project were ingested into Europeana collections. This was made possible by strict adherence to the EDM data structure and meticulous compliance with all of the Europeana guidelines throughout the course of the project, starting from the design stages and up to the final ingestion procedure. As part of this procedure, in order to make the ingestion of video and audio Web resources possible, an oEmbed interface was implemented on the CMC. Through this interface, all audio and video files that were part of the data collected were made publicly available through Europeana. After the ingestion process, which included more than 75,000 items, was completed, over 97% of content was placed on Content Tier 2 or above, while the rest was in Content Tier 1, with no items in Content Tier 0. Regarding the items' metadata, 28.44% was placed in Metadata Tier A, 55.76% on Metadata Tier B and 15.78% on Metadata Tier C, while none

of the items were placed on Metadata Tier 0. This combination of quantity and quality is a testament to the huge endeavor that was the BYZART project.

3.5. Enriching the Final Project

The project's goals did not end with the collection and dissemination of data, but expanded to other fields such as generating interest, creating a more user-friendly introduction to the material and gathering and presenting other related material that was available.

For the purpose of finding such material, a special search mechanism was implemented and integrated with the CMC. This search would take user-provided keywords and present results from existing Europeana collections based on the relevance. These results could then be added to a special collection in the platform which was comprised by external items. This collection was presented through the platform's Web interface, fully attributing the original content providers and providing links to both Europeana and the original versions of such items. These items were not further disseminated through OAI since they were not original content, but their inclusion in the project helped expand this already huge repository of Byzantine-related objects of cultural heritage even further. The total items currently displayed in the BYZART database reach more than 115,000 pieces, of which more than 41,000 are from other Europeana collections, while over 75,000 are part of the BYZART project's contributions.

In order to make this vast amount of data more accessible, a special mechanism was implemented through the ByzartGalleries plugin, which allowed content providers to select a series of item images and combine them into galleries centered around a specific theme or relating to a particular subject. These galleries are now available through the platform's Web interface. In addition to this, an informational website that introduced the BYZART project was created and is available at "<https://byzart.eu>" (accessed on 24 March 2021). This website provides detailed information about the project and its partners, links to the collections both in Europeana and the CMC's interface, announcements and news about the project's ongoing progress and a help desk for people who are interested in contacting the project's management.

Finally, a digital exhibition regarding the project was created that was titled "*The Silk and the Blood. Images of Authority in Byzantine Art and Archaeology*" and is available at "<https://byzart.eu/exhibition/>" (accessed on 24 March 2021). This exhibition made use of Esri's ArcGIS platform to present the places where many of the items presented by the BYZART project were located, including both immovable cultural heritage objects such as churches and archaeological sites and objects that are being held in museums around the globe. Figure 4 contains a snapshot of the interactive map that was generated using the location information provided by the content providers in the form of GeoNames URIs. The exhibition also presented a timeline of the Byzantine empire's history and cultural-related content from various places of great historical importance. Its main goal was to generate the interest of both researchers and the general public and act as a gateway towards the vast amount of cultural data presented by the BYZART project.



Figure 4. Section of the map of locations of the BYZART project's items.

4. Implementation Importance and Future Uses

The implementation of the BYZART project has been very important for the field of digital heritage documentation and metadata re-use as the metadata included in the platform contextualize the objects of the collections for better understanding of the historical and artistic heritage involved [14].

Although oftentimes reformation of a structure model is deemed necessary in order to better accommodate the needs of the aggregated information [15], the BYZART project used existing standards such as the EDM to aggregate newly digitized content and focused primarily on maximizing the content's diffusion and longevity. An important goal of the project was documenting and implementing the full procedure, starting from an object of cultural heritage and achieving a digital representation that not only follows the principles of linked open-data, but is also easily available to the public for reuse. During this implementation, a series of issues that had to do with the practical aspect of such an endeavor arose and were solved. This article presented an example for other institutions or parties interested in cultural heritage data digitization, aggregation and dissemination. Some good practices that became apparent during the course of this project and have been detailed in the Technical Implementation Section include:

- The use of Cloud storage in order to facilitate the transmission of data between content providers and the system as well as maintain high-quality master files of the digitized items.
- The focus on facilitating the end user through means of batch metadata importing, using external formats such as xlsx or xml while simultaneously converting that information into a popular standardized data structure. This can be especially helpful

for ingesting collections with existing digital information as long as the process focuses on preserving the richness of the original metadata [16].

- The definition of URI vocabularies and a system that allows the end user to provide information in text form that will be converted into URIs by the system as well as a system that validates user-provided URIs from specific sources.
- The focus on supporting already dominant dissemination technologies such as OAI-PMH and using internationally acknowledged standards like the EDM. This can help promote the content and ensure its longevity in the ever-changing World Wide Web. The promotion and focus on the diffusion of the digitized content should be considered an integral part of the digitization process.

The created methodology allowed the partners of the consortium to experiment on data aggregation based on linked data, obtaining practical experience and expertise on the semantics of digital heritage. That same methodology could be very useful, with minimum adaptation, for many other cultural heritage assets, monuments or sites, tangible or intangible, as the usability of such a platform promotes digital heritage management in a simple and participatory way for end users that wish to generate further content. Such an example is the case of another European co-funded project, called “Hologrammatic Corfu” [17], which is currently being implemented by the Ionian University research team. In this project, which aims at the digital documentation of the world heritage monument of the “Old Town of Corfu” in Greece, an adaptation of the platform is being used to store and link data regarding the monument. The data collected are originally produced by the research team and consist, among others, of 360° photographs and videos as well as 3D holographic representations of important points of interest of the monument. The transmedia content created for this project, apart from being used for the implementation of an interactive tourist guide, is also being stored in the platform with the appropriate metadata, rendering it ready to automatically be submitted as a thematic collection following the appropriate standards that will allow it to be published within SearchCulture.gr, the Greek National Aggregator for Cultural Content and National Provider for Europeana. Another relevant case study is the application of the content management methodology to the European co-funded project named “Brenda: Digital Gastronomy Tours” [18], in the framework of which gamified applications are being designed, in order to create personalized gastronomical tours for the locals and visitors of the area of Kilkis in Greece. There is a plurality of the content gathered in terms of kinds and multimedia, such as photos, videos, maps, recipes and local industry online presentations. The above presented content management interface has been adapted in order to cover the project’s usability requirements, which mostly lies on the promoted interaction of users with the content.

The use of these kind of methodologies faces successfully the problem that lies in the extreme amount of content that is usually available for cultural heritage objects and the challenges created for search and exploration. People engage themselves with online digital platforms for several reasons, usually personal or societal, many of which are the need to exploit the platforms’ content for personal matters or to participate in the protection and promotion of their own heritage [19]. Thus, the BYZART project served a double goal: on one hand to facilitate the procedures regarding digital content management and aggregation, and on the other hand to support Europeana’s mission for facilitating people in using cultural heritage for education, research and creation. In terms of content openness and re-use, both the website and the thematic Europeana channel act as a window that allows access and experimentation with content, enabling full access to those interested to try out their designs, while the copyright rights are clearly stated and communicated.

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