GLAM metadata in museums and university collections: a state-of-the-art (Spain and other European countries)

Marina Salse, Javier Guallar-Delgado and Núria Jornet-Benito
Department of Library and Information Science and Audiovisual Communication, University of Barcelona, Barcelona, Spain, and

Maria Pilar Mateo Bretos and Josep Oriol Silvestre-Canut
Office of the Vice-Principal for Heritage and Cultural Activities, University of Barcelona, Barcelona, Spain

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Abstract

Purpose – The purpose of this study is to determine which metadata schemas are used in the museums and university collections of the main universities in Spain and other European countries. Although libraries and archives are also university memory institutions (according to a Galleries, Libraries, Archives and Museums perspective), their collections are not included in this study because their metadata systems are highly standardized and their inclusion would, therefore, skew our understanding of the diverse realities that the study aims to capture.

Design/methodology/approach – The analysis has three components. The first is a bibliographic review based on Web of Science. The second is a direct survey of the individuals responsible for university collections to understand their internal work and documentation systems. Finally, the results obtained are complemented by an analysis of collective university heritage portals in Europe.

Findings – The results of this study confirmed the hypothesis that isolation and a lack of resources are still major issues in many cases. Increasing digitalization and the desire to participate in content aggregation systems are forcing change, although the responsibility for that change at universities is still vague.

Originality/value – Universities, particularly those with a long history, have an important heritage whose parts are often scattered or hidden. Although many contemporary academic publications have focused on the dissemination of university collections, this study focuses on the representation of information based on the conviction that good metadata are essential for dissemination.

Keywords Cultural heritage, Metadata, University heritage, Data structure standards, Metadata schemas, Universities, Cataloguing, GLAM sector

Paper type Research paper

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Introduction and context

Universities are environments that generally contain different institutions that can be collectively referred to as GLAM (Galleries, Libraries, Archives and Museums) or LAM (Libraries, Archives and Museums). The extent to which these entities collaborate with each other within the parent institution is an unresolved question, although, as will be shown here, they have many points in common. The aim of this research has been to identify cases of collaboration at the level of information representation (specifically, at the level of metadata) and whether small university collections benefit from it. The potential is there, but is it used?

The acronym GLAM was coined by Zorich *et al.* (2008) in response to a trend that had been developing for years, with previous efforts to classify it including Dempsey's term "memory institutions" (Dempsey, 2000). Such terms reflect attempts to find points of contact between these different types of institutions, which unquestionably share functions such as documentation and preservation. Although their origins are diverse (Gilliland, 2016; Joudrey, 2018; Riley, 2017; Zeng and Qin, 2016) and the descriptive traditions and metadata schemas they use are very different, they nevertheless have numerous commonalities. Now more than ever, these similarities are evident in the major international repositories of cultural, artistic, natural and scientific heritage where items from different types of institutions are collected and exhibited.

There is debate in the literature about whether these institutions should move toward convergence or simply establish ways of collaborating (Hider and Kennan, 2020; Kennan and Lymn, 2019; Klimazewski, 2015; Rasmussen, 2019; Valentina Carriero *et al.*, 2019; Warren and Matthews, 2019). In fact, the development of metadata exchange schemes [e.g. Dublin Core, Darwin Core or Lightweight Information Describing Objects (LIDO)], the creation of digital repositories that collect content from different sources (i.e. Europeana, DPLA [1] or Global Biodiversity Information Facility (GBIF) [2]) and the presence of aggregation and transfer protocols (e.g. OAI-PMH and IIF) seem to support the idea that cooperation is now the preferred path. The boost to the technological development of digitalization resulting from the restrictions imposed by the COVID pandemic has reinforced this view (Kennedy, 2020). Added to this is the conviction that the end user cares most about being able to see all items from a single access point; the origin of the items becomes less relevant as long as they are all there (Bicknell, 2017). On the other hand, some authors (Alexiev, 2018; Freire *et al.*, 2019; Smith-Yoshimura, 2020) have identified linked open data and semantic data integration as key elements in this process. At the same time, it is important to consider the perspectives of authors such as Renshaw and Liew (2021), who suggest that convergence is increasingly being viewed as problematic because of the very different contexts of the various types of institutions involved.

In the case of universities, as Salse Rovira *et al.* (2021) point out, convergence or cooperation between GLAM entities of the same university tends to be rare because libraries, archives and collections often work within their own parameters.

Below is an overview of the four types of institutions covered by the GLAM acronym and their role within the university environment.

G-Galleries. Galleries are spaces for the exhibition and promotion of art that date back to the 16th century (Brigstocke, 2001), and most universities today have one. According to Gartnerová (Gartnerová, 2021), the first university galleries appeared in the 19th century in the USA (the Yale University Art Gallery was the first), where generous donations made their establishment possible, and the promotion of art was viewed as a means of enhancing the university's prestige. It is important to acknowledge that the line between galleries and museums is fuzzy, as many places that began life as galleries eventually became museums (e.g. Galleria degli Uffizi). At present, however, the concept of "museum" is associated more

with heritage, while galleries have a much more contemporary focus. Despite being included in the acronym at the metadata level, they usually fall outside the GLAM circle; publications aimed at training gallery managers (Díaz Amunarriz, 2016) do not usually mention metadata typical of the heritage sector, such as categories for the description of works of art (CDWA) or LIDO, and their management-oriented technical data sheets are usually created without any basis in the standards:

L – Libraries. University libraries have a consolidated position and follow their own standards and procedures in accordance with IFLA guidelines [3]. They have their own staff and operating system, often unfortunately isolated from the rest of the university's heritage collections, although the presence of bibliographic pieces of heritage value is unquestionable, especially in so-called historical universities. In fact, in many cases, their rich cultural heritage is contained in their own digital repositories available online and often aggregated in international portals such as Europeana.

A – Archives. Although essential for the management of documentation, university archives tend to suffer from a certain degree of invisibility, as the services they offer are not often used by the general public as libraries are. This translates into a lower online presence and less participation in the university heritage network (Salse Rovira *et al.*, 2021). There are three basic reasons for this:

(1) Their activity tends to be dominated by administrative functions.

(2) If they deal with historical documentation, then they are rather traditional and highly oriented toward users with a research profile.

(3) In many universities, they are "hidden" behind the library's website, on which they largely depend.

On the other hand, at the methodological level, the standardization of archival descriptions occurred much later than in the case of libraries [4] and has been oriented more toward the context than toward the item, which makes it more complex to harmonize the descriptions of other GLAM institutions with those of archives. The basic standards for archival institutions are issued by the International Council of Archives, although local standards also exist, such as the DACS in the USA, NEDA in Spain or RAD in Canada (Llanes Padrón, 2014).

M – Museums (and collections). Universities collect cultural and scientific heritage items typically resulting from teaching and research activities, as well as donations and testamentary legacies bequeathed by patrons (Lourenço, 2014; Marín Torres, 2018; Morón de Castro, 2018; Nykänen, 2018; San Andrés Moya, 2016), and even purchases. From a historical point of view, for example, natural heritage collections were especially valued in the 19th century, when they provided information on different parts of the world to students and researchers who were often unable to travel. Many universities created collections of scientific instruments used as teaching or research tools, which were essential in eras that were less technologically developed than the current one. Universities also collected objects that reflected the history of the institution, and to enhance their prestige, they often bought works of art. Over the centuries, this heritage came to be structured into collections, often organized by a professor or department, and in the most fortunate cases, it ended up taking the form of a museum. The Ashmolean Museum at Oxford University is considered the oldest example of such an institution (1683).

The museum sector is characterized by a general lack of international standards with universal applications like those of libraries and archives, despite the existence of very well-developed initiatives (e.g. the Getty Foundation). This lack of uniformity has led to the creation of different national standards (e.g. Spectrum in the UK, ICCD in Italy or

MuseumDat in Germany) and an exchange standard by the International Council of Museums (ICOM) to provide a forum for connecting these disparate schemes: LIDO, which adheres to ICOM's CIDOC Conceptual Reference Model and which has come to replace previous exchange initiatives such as VRA Core or CDWA Lite (Agenjo Bullón *et al.*, 2015; Ronzino *et al.*, 2011; CHIN, 2019 *Guide to Museum Standards*; Gilliland, 2016; Hu *et al.*, 2018; ICOM-CIDOC, 2012; Lo Turco *et al.*, 2019; Ronzino *et al.*, 2011).

Most universities also have biodiversity collections that apply standards unrelated to cultural heritage. Standards used in this context include ABDC and the Darwin Core Exchange Standard, which are used by most international biodiversity platforms, such as GBIF.

In general, however, most of the metadata schemas mentioned here are complex and far removed from the day-to-day reality of many university collections, which often have only one person in charge who has to juggle the work on the collection with teaching, research and management duties. In the best cases, the support of a few colleagues and the odd crowdsourcing initiative can sometimes give solitary managers the opportunity to catalog their collections. However, these conditions make it difficult to apply the elaborate standards of libraries, archives and museums and may even effectively perpetuate inventories based on manual systems, spreadsheets or home databases. Other solutions need to be found to facilitate the work of those responsible. However, to do this, it is first necessary to diagnose the situation, which is the objective of this study.

This analysis is founded on the conviction that quality metadata is essential for the development of quality dissemination products and should form the basis of any collection project (Alemu, 2021; *Digital Cultural Heritage/Edited by Horst Kremers*, 2020; Gutiérrez Usillos, 2010) (Gutiérrez Usillos, 2010).

This article focuses specifically on so-called Data Structure Standards, in accordance with the Society of American Archivists (SAA) definition: "A formal guideline specifying the elements into which information is to be organized". In this respect, it is important to acknowledge Gilliland's distinction between Data Structure Standards, Data Value Standards, Data Content Standards and Data Format/Technical Interchange Standards (Gilliland, 2016), because within their specifications data structure standards usually cover other standards as well. For example, LIDO indicates that the "Objects" facet of the *Art and Architecture Thesaurus* value standard should be applied to entries for the LIDO <WorkType> property [5] [6] [7].

Table 1 lists the most widely used standards in various environments. Although Gilliland's classification provides a perfectly valid framework to distinguish between different types of standards, in practice, some fall into more than one category. This is the case, for example, of CDWA and ISAD G, which provide structure, data and content indications. Table 1 prioritizes their role as data structure standards.

This analysis also takes into account that the different standards are underpinned by various conceptual models established in recent years, such as Library Reference Model for libraries, CIDOC-CRM for museums and Records In Contexts for archives. These models provide coherence to the entire set of rules and have served as references for updates. However, this article will not analyze these models, as the focus here is on understanding the day-to-day work of managers of university collections and museums.

Objectives

The aim of this study is to determine which metadata schemas are being used in museums and university collections at the main universities in Spain and other European countries. Libraries and archives were excluded from the study because their structures within universities and cataloging traditions are very different from those in other heritage collections. Libraries and archives already have staff and

Environment	Data structure standards	Data content standards	Data value standards	Date format/ technical interchange standards
Archives	EAD, ISAD G, ISAAR CPF, ISDF and ISDIAH	DACS Local standards, such as NODAC in Catalonia	Undefined	EAD XML RDF Interchange Standard
Libraries	MARC and Bibframe	RDA and AACR2	LCSH, LCA and local subject and authority headings	XML FRAME ISO 2709 RDF Interchange Standard
Museums	CDWA, SPECTRUM, ICCD, MuseumDat VRA and LIDO	BCC	ULAN TGN ICONCLAS AAT	XML
Biodiversity	Darwin Core and ABDC	Undefined, only for specific properties such as dates or coordinates	Undefined but taxonomical nomenclatures	HTML XML RDF Interchange Standards
Interoperability	Dublin Core, Darwin Core and LIDO	Different for every schema	Different for every schema	HTML XML RDF Interchange Standards
Internet	Schema.org	Undefined, only for specific properties such as dates	Any of them	Microdata JSON

Table 1. Metadata schemas used in different environments (GLAM included)

administrative infrastructures for their operations as well as standards that are followed everywhere, making for a much more uniform context than those of other categories of heritage collections.

The findings of this study will be used to establish a diagnosis of the context to offer a sustainable proposal for these collections, as experience shows that when time and resources are limited, metadata management is difficult.

The research questions to be answered are:

RQ1. What are the dominant metadata schemas and controlled vocabularies used in museum and university collections?

RQ2. What entities/people are responsible for maintaining the collections?

RQ3. Do collections/museums participate in collective digital repositories? If so, then what metadata schemas do these repositories use?

RQ4. Are there global metadata coordination projects between different collections in a university or a network of universities? If so, then do libraries and archives participate in them?

RQ5. Is the creation of virtual museums a reality? Which metadata schemas are they based on?

Methodology

To collect as much information as possible on the metadata schemas used in museums and university collections, three methods were adopted:

(1) A bibliographic review of articles published on cataloging in university museum environments was carried out based on the theoretical framework (to contrast the results of the survey described below). To this end, the following sources were used, covering the years 2016–2021:

- Web of Science; and
- *University Museums and Collection Journal* (published by UMAC).

In Web of Science and Google Scholar, the search terms used were:

- cataloging university museums;
- cataloging university collections;
- metadata university museums;
- metadata university collections;
- cataloging GLAM university; and
- metadata GLAM university.

A total of 423 articles were identified, 111 of which were deemed to be relevant. Different filters were applied to these articles, including the country of origin, metadata schemas used, existence of digitalization projects and issuing institution of the article within the GLAM context. Articles referring to libraries and archives cataloging their collections were removed, except in cases where the library or archive was working with special collections, such as dresses, photographs or three-dimensional objects.

(2) A direct survey was conducted on individuals responsible for university collections and museums in Spain and with heads of European museums and university collections at the 100 top universities in the academic ranking of world universities (ARWU) ranking. As in the case of the bibliographic review, the survey did not include individuals responsible for libraries or archives because their standards are widely implemented (Salse Rovira *et al.*, 2021) and their responses would have skewed the study results.

(3) An analysis of community university heritage portals in Europe was carried out, followed by the analysis and characterization of metadata schemas used as long as there were associated digital repositories/virtual catalogs.

Results

As mentioned in the previous section, for the bibliographic review, this study involved the analysis of a total of 111 documents found on Web of Science.

For the survey, a total of 23 Spanish museums/collections responded of 125 contacted, representing 18.4% of the total. From other European countries, there were 43 respondents of 183 (23.5%).

The results are divided into two columns. The left column shows the top-ranked European universities in the ARWU, while the right column shows all Spanish universities present in the same ranking. These two groups were separated because their characteristics were very different and placing them all in a single group would have skewed the results. European universities in the ARWU are very powerful and generally have long histories behind them, as well as a theoretically more consolidated heritage infrastructure. In the specific case of Spain, although there are universities with very good rankings in the ARWU, these are often small centers (such as the Polytechnic University of Valencia or the University of the Basque Country) that cannot compete in terms of resources or history with large universities in other European countries.

Finally, 15 community portals were analyzed. This list was not intended to be exhaustive, as the analysis was limited to the repositories to which collection managers reported uploading their collections.

1. What are the dominant metadata schemas and controlled vocabularies used in museums and university collections?

The survey conducted on Spanish and other European collection managers provides a clear picture of the situation of metadata outside the library sphere, where uniformity predominates, as the biggest difference between individual libraries or archives lies in the degree of implementation of new metadata standards or in the development of linked data projects or digital documentary heritage libraries. Museums and collections have a wide range of characteristics that are often associated with the diversity of their origins and subsequent evolution. The data shown in Table 2 reflect these very different situations, from museums with large infrastructures to precarious collections operating with minimal resources. In any case, the prevalence of proprietary metadata schemas is significant [8] both in Spain (68% of schemes) and in other European countries (36.84%), as is the lack of penetration of GLAM standards used in non-university environments or even within university environments, as the normative experiences of archives and libraries are rarely transferred to other museums and collections.

In the survey, some centers reported the use of combinations of standards. This is usually the result of centers using more complex or proprietary standards for cataloging but then developing or adapting crosswalks that allow their records to be added to external

Metadata schema used for cataloguing	Europe		Spain	
We use our own metadata schema	21	36.84%	17	68.00%
Do not know	12	21.05%	1	4.00%
Data interchange structure standards + other data structure standards	5	8.77%	1	4.00%
DARWIN CORE	4	7.02%	1	4.00%
DUBLIN CORE	4	7.02%	1	4.00%
LIDO	2	3.51%	–	–
ICCD (National Heritage Standard, Italy)	1	1.75%	–	–
ISAD G	1	1.75%	–	–
Spectrum	1	1.75%	–	–
CDWA	1	1.75%	–	–
FRAME	1	1.75%	1	4.00%
GDR	1	1.75%	2	8.00%
Joconde (National Heritage Standard, France)	1	1.75%	–	–
ABCD	1	1.75%	–	–
None	1	1.75%	–	–
Do not know/Did not answer	–	–	1	4.00%

Table 2. Metadata schemas in university museums and collections (libraries not included)

digital repositories. For example, CDWA is associated with LIDO, Darwin Core with access to biological collection data and Dublin Core with Spectrum (specific to English museums).

This lack of applicability of the recommended standards is even more apparent in the case of Data Value Standards. Table 3 shows that the predominant trend is for centers to use their own proprietary controlled vocabularies, although, in many cases, those responsible are unaware of which one they are using. Only a few collection managers were able to identify specific vocabulary items. This situation is aggravated by the fact that some centers use more than one vocabulary; for example, Geonames, Index Fungarium and IPNI all belong to a single center.

Complementary bibliographic research only confirms the objective data provided by the collection managers themselves, although it also reveals some interesting trends that have an impact on the use of certain metadata schemas and confirms the associations between some of the schemas mentioned above. Tables 4 and 5 present the following findings:

- Of the 111 articles analyzed, most focused on the most historical or scientifically relevant aspects of the collections and did not mention the metadata schemas used. At the very least, they indicate that they are being "catalogued" or "documented." This confirms the hypothesis that metadata are not generally a priority.
- The professional library community displays greater concern for matters related to metadata schemas, as of the 24 articles analyzed in which libraries have participated, only 5 do not indicate the schema used. The most commonly used were proprietary standards of the libraries themselves (in 12 cases) or exchange schemes developed in this context (e.g. Dublin Core or MODS).
- There is still a strong presence of proprietary metadata schemas, probably in many cases because of ignorance and in others because of insufficient resources to make a change of scheme possible.

Table 3. Controlled vocabularies in university museums and collections

Which metadata value standards do you use?	Europe	Spain
We use our own vocabularies	23	13
I do not know	11	6
AAT	2	0
ABCD	1	0
AKL ONLINE	1	0
BNZ (Beni Naturalistici Zoologici) of the Italian ICCD (Istituto Centrale per il Catalogo e la Documentazione)	1	0
Geonames	1	0
Index fungarium	1	0
IPNI (International Plant Name Index)	1	0
Joconde - norme DMF	1	0
LCAuthorities	0	1
LCSH	0	1
LEMAC	0	1
LENOTI	0	1
ULAN	1	0
None	1	2
n/a	1	0

Notes: Combinations of vocabularies at a single center. LCSH, LEMAC, LENOTI and Library of Congress Authorities. ULAN; AAT; We use our own vocabularies. AAT; We use our own vocabularies. We use our own vocabularies, Geonames, GND (Gemeinsame Normdatei), Index Fungarium, IPNI (International Plant Name Index)

Metadata schema	No. of articles
Undefined	49
Library standards	14
Proprietary	14
Darwin Core	13
Dublin Core	4
Archival standards	3
National regulations (ICCD, Joconde)	3
MODS	2
TEI	2
ArcCatalog	1
IAWA List	1
VRA Core	1
Europeana Data Model	1
UMIS	1
UNITE	1

Table 4.
Metadata standards according to the bibliographic review

Institutions involved	No. of articles	Undefined	Proprietary	Archival standards	Library standards	Interchange standards	Museum standards	National regulations	Other
Archives	2	1	0	1	–	–	–	–	–
Libraries	19	4	0	2	8	5	0	0	1
Libraries/ Universities	4	1	1	–	2	–	–	–	–
Libraries/ Universities/ Museums	1	–	–	–	1	–	–	–	–
Museums	19	14	1	–	0	2	–	2	
Museums/ Universities	17	9	4	–	1	2	–		1
Universities	49	23	8	–	1	13	–	2	2

Note: Bibliographic review

Table 5.
Metadata standards according to issuing institution

- Digitalization and the creation of digital repositories are important issues in the literature (43% of the articles deal with these aspects). The bibliographic review revealed recurring references to certain metadata schemas that are scarcely mentioned in the survey but that are necessary in a digitalization environment because they have been accepted as interchange standards by communities that use different repositories (such as Darwin Core or Dublin Core).
- However, there is still a lack of uniformity at the level of metadata schemas and management entities.

2. What entities/individuals are responsible for maintaining the collections?

The survey incorporated two questions intended to obtain a general idea of who was responsible for cataloging/documentation of the collections. In general, as can be seen in Table 6, the entity in charge of management is usually the museum/collection (in more than 43% of cases both in Spain and in the rest of Europe) in cases where it is large enough to

constitute a separate entity from the department or faculty of which it forms a part. In small collections, a department generally assumes this task.

A surprising aspect of the results is the degree of decentralization evident in these museums and collections, as well as the very small role in the management of metadata played by the university's central area of cultural and scientific heritage, which is responsible for management in only two cases in Spain and one case in the rest of Europe.

The role of full-time cataloguers in a collection is usually very low. Normally, this task is carried out directly as part of the duties of those responsible for managing the collections/museums.

However, it is worrying that more than 43% of university collections in Spain and more than 34% in the rest of Europe have no one dedicated to this task, as shown in Table 7. What may be needed is an institutional policy that could help centers to construct their catalog, especially considering that a significant proportion of collections still have very low levels of automation, as reflected in Table 8.

3. Do collections/museums participate in collective digital repositories? If so, then what metadata schemas do these repositories use?

As Table 9 shows, the survey found that many museums and collections are still isolated from one another, although there are some cases of data transmission to other institutions or

Table 6. Cataloguing responsibilities (survey)

Who is in charge of the documentation and cataloguing of your collection?	Europe		Spain	
The department or faculty that owns the collection	9	15.00%	4	12.90%
The cataloguing department of the museum/collection	11	18.33%	6	19.35%
The archive	7	11.67%	0	0.00%
The library	6	10.00%	2	6.45%
The curation department of the museum/collection curators (individual)	15	25.00%	7	22.58%
The Cultural Heritage Department of your university/collection	1	1.67%	2	6.45%
Other	3	5.00%	5	16.13%
More than one organization in charge	8	13.33%	5	16.13%

Table 7. Employees dedicated to cataloguing (survey)

How many people work full-time as cataloguers in your museum/university?	Europe		Spain	
None	15	34.88%	10	43,48%
Part time/occasional	17	39.53%	7	30,43%
1–2 people	6	13.95%	5	21,74%
More than 2 people	2	4.65%	1	4,35%
Do not know/NA	3	6.98%	0	0.00%

Table 8. Percentage of automation (survey)

What is the % of automation in your collection?	Europe		Spain	
0	8	18.60%	2	8.70%
0–25	3	6.98%	1	4.35%
26–50	6	13.95%	2	8.70%
51–75	4	9.30%	1	4.35%
76–99	1	2.33%	2	8.70%
100	13	30.23%	9	39.13%
Undefined/NA	8	18.60%	6	26.09%

repository aggregation. It would be interesting to trace the evolution of this data over time to see whether the situation improves, although the trend toward digitalization identified in the bibliographic review (43% of articles deal with some aspect of this issue) suggests that this is happening.

Centers that combine their records often upload them to specialized portals for their subject area and usually to more than one. The repositories mentioned by the universities that responded are:

- *archives*: Archives Hub (two), Discovery (two) and Cheshire Archives (one);
- *museums and humanities collections*: ArtUK (one), MIMO (Musical Instruments Museum On-line) (one), CER. ES (one) Musit Arkeology (one), Atalaya 3D (two), NUMiD Verbund (one) and Kenom (one);
- *photography*: Deutsche Fotothek (one) and Foto Marburg (one);
- *geology*: GeoCase (one);
- *biodiversity*: General Biodiversity Information Facility (GBIF) (five), Biodiversity Heritage Library (BHL) (one), Plant Search (one) and ReColNat (one); and
- *culture in general*: Europeana.

In summary, in view of the objective data, it is not possible to identify the main aggregation systems or specific metadata schemas used. In this sense, however, the bibliographic review reveals some trends in terms of digitalization projects and clarifies that the contribution to national or international platforms/repositories has led to the growth in the use of three main schemes: Dublin Core for university heritage collections, especially documentaries; Darwin Core for collections related to biodiversity; and LIDO for collections with a more conventional museum orientation. Table 10 shows the metadata schema used for the repositories cited by respondents when provided.

The growth in the use of certain metadata schemas resulting from digitalization has led to two ways of working:

(1) *Mapping*: Centers that have more complex proprietary schemes (such as libraries) have been mapped toward these simpler schemes to make their data sets exportable. In this sense, one of the most "mapped" schemes in the field of cultural heritage is Dublin Core, which is the basis of the EDM model used by Europeana and the OAI – PMH protocol. Although criticized today for its obsolescence (Freire *et al.*, 2020), this protocol has been the basis on which numerous digital repositories have been built. On the other hand, in the field of natural heritage and biodiversity, the most mapped scheme is Darwin Core, since GBIF, a repository to which almost 1,800 institutions upload data and where there are about 2 trillion records, "versions" this scheme.

Do you belong to any collective catalogs/repositories?	Europe	Spain
Yes	15	7
No	13	16
Not Yet	2	
Do not know	2	
NA	11	

Table 9. Participation in collective catalogs

Table 10.
Repositories cited in the survey

Repository	Specialty and country	Scheme used
Art UK	Art, the UK	Custom made
CER.ES	Museums, Spain	Custom made (Domus software)
Europeana	Europe	Dublin Core – EDM
Deutsche Fotothek	Photography, Germany	Dublin Core – IIIF
Photo Marburg	Photography, Germany	LIDO
GeoCase	Earth Sciences, worldwide	ABCDEFG-XML-Scheme
GBIF	Biodiversity, worldwide	Darwin Core Archive
Kenom	Nusimatics	LIDO
MIMO	Musical Instruments – Public Museums, worldwide	LIDO based
Musit Archaeology	University Museums, Norway	Dublin Core application profile (ABM SEN)
NUMiD Verbund	University collections of Numismatics, Germany	Custom made with download to LIDO and IKMK
Plant Search	Botany – Members of Botanic Gardens Conservation, International	Custom made
ReColNat	Natural Heritage, France	Darwin Core
BHL: Biodiversity Heritage Library	Natural History Literature	Dublin Core
Cheshire Archives	History	EAD/ISAD and Dublin Core

A third major scheme for metadata mapping is LIDO, created by ICOM as a way of exchanging museum data. It is used by repositories such as Kenom and Foto Marburg.

To make these schemes compatible, numerous crosswalks have emerged in an effort to align them, such as the Getty Foundation's CDWA Metadata Crosswalk.

(2) *Working directly from exchange schemes*: This solution probably leaves out management tasks such as loaning parts of the collections, the management of acquisitions or events associated with the pieces. All of these tasks are contained in the conceptual model of the CIDOC (CRM) and are recommended by ICOM for museums, but they often do not appear in metadata exchange schemas, which usually focus on the most descriptive aspects and minimize elements related to administration. However, they constitute simple schemes for collection managers (who are often unable to engage in complex piece management), allow metadata with a minimum of quality (if applied properly) and prepare collections for sharing. In addition, it is possible to add fields that allow simple management, resulting in an application profile that is acceptable to staff responsible for collections who do not work full-time.

These methods of working are not mutually exclusive. For example, Figure 1 shows the solution adopted by The University of Barcelona in its virtual museum, although it has not yet been implemented for all collections.

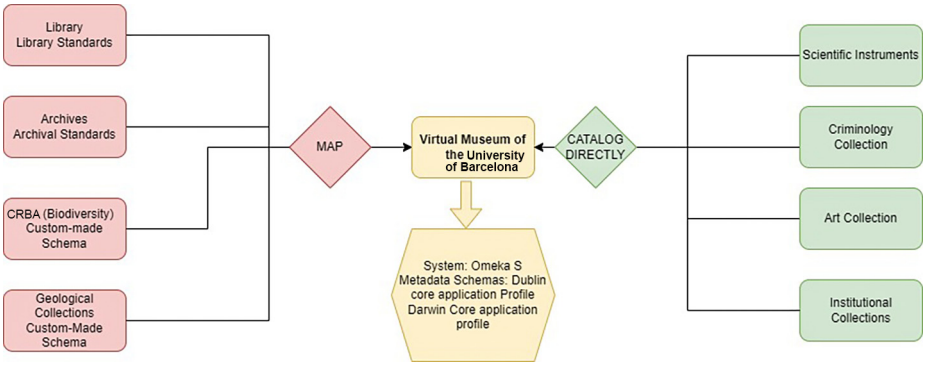

Figure 1. University of Barcelona: cultural heritage working structure

4. Are there global metadata coordination projects between the various collections of a university or a network of universities? If so, then do the library and archives participate?

According to the survey results, isolation is the norm at the university level. As shown in Table 11, more than half of the respondents in other European countries did not have a centralized structure, which reinforces the sense of isolation mentioned above. In Spain, the percentage is lower, but this may also be because this survey collected data from all Spanish universities listed in the ARWU, including smaller universities that have a more centralized structure than large European universities with an ARWU ranking.

In cases where there is centralized cataloging, we wanted to know whether the library and archives participated, as in a previous study (Salse Rovira *et al.*, 2021), the analysis of the Web showed that libraries and archives were institutions that were often independent of museums and collections.

The results contained in Table 12 reveal that in Spain, archives and libraries are still considered in isolation, while in other European countries, they tend to be viewed as part of this centralized structure. However, the number of results was too low to reach a reliable conclusion on this point.

Do you have a centralized cataloguing and management structure at your university for all the university collections?	Europe		Spain	
No	24	55.81%	8	34.78%
Yes	11	25.58%	5	21.74%
Only for some	7	16.28%	6	26.09%
Do not know	1	2.33%	3	13.04%

Table 11. Cataloguing structure (survey)

If yes, then are the library and historical archives included in this structure?	Europe	Spain
Do not know	1	3
Not at the moment, but in progress	1	1
Yes	5	2
No	3	6
News, butterfly memories	2	1
NA	1	0

Table 12. Participation of library and archives in the structure (survey)

In cases where there is no centralized cataloging, we wanted to know whether records were shared between the different collections of the same university. As shown in Table 13, most centers did not share their records.

Despite this state of affairs, which is certainly discouraging, university institutions themselves have launched joint initiatives to solve collection management issues, although many such initiatives have yet to affect the day-to-day activities of collection managers. For example, there are initiatives clearly aimed at heritage preservation, such as those of UMAC [9] and Universeum, which articulate their activity through publications and conferences. In the area of the promotion of university heritage, the Coimbra Group [10] maintains a heritage working group, and the Xarxa Vives (Vives Network) [11] [12] has signed a university cultural policy document that includes the aim of promoting the preservation and cataloging of the university assets of network members (Xarxa Vives d'Universitats, 2021). This network periodically organizes cultural debate forums (Xarxa Vives d'Universitats, 2021).

5. Is the creation of virtual university museums a reality? Which metadata schemas are they based on?

Apart from online collective catalogs, which were already mentioned in Question 3, we wanted to consider initiatives implemented independently by centers to disseminate their collections at an individual level. As shown in Table 14, while, in Spain, there are still many centers that have not launched initiatives of this kind, at the European level, there appears to be an increasing awareness that establishing a presence in a space where their heritage can be visited everywhere, even if that space is virtual, is essential for survival.

Conclusions

Based on the results obtained in this study, the following five main conclusions can be drawn:

- University collections are predominantly isolated and mostly use proprietary metadata schemas. This is the legacy of an era largely dependent on voluntary work, which in itself is certainly praiseworthy, as without it, many of these collections would never have existed. However, although there are excellent open-source tools for managing collections based on standardized metadata schemas, many collection managers are unaware of them or are unable to implement them because of a lack of resources.
- The survey revealed a surprising lack of centralization of the scientific-historical heritage services of universities. Clearly, a common policy is needed that could

Table 13. Record sharing (survey)

If not, then do you share records with other collections in your university?	Europe	Spain
Yes	6	2
No	19	9

Table 14. Online catalogs (survey)

Do you have an online catalog on your website?	Europe		Spain	
Yes	23	53.49%	8	34.78%
No	20	46.51%	15	65.22%

facilitate the enhancement of collections. The bibliographic review and our own experiences suggest that important efforts are being made in this regard. Institutions need to remember that metadata are the basis of many of the most effective dissemination services and that the creation of quality metadata based on standardized schemas should be promoted. The schemas are there, and the collections are there too, but the two need to be brought together by a governing institution that can establish common policies. This governing institution could be a university or even a government, as is the case in Italy, France and Denmark [2].

- Libraries and archives are good metadata producers and universities must take advantage of this. The greater uniformity at the metadata level, as reflected in the bibliographic review and in some of the survey responses, is the product of the influence of libraries and archives. Librarians and archivists need to be freed from the minority status that some authors argue (Anglada, 2021) has been assigned to their professions, so that we can take advantage of their expertise in the representation of information. All universities, as GLAM institutions, have this expertise in their staff and should make the most of it. Committees should be created with professionals to cover all necessary tasks: technologists for technology, curators for preservation, researchers for research, heritage institutions for policies and librarians and archivists for metadata.
- University collections need to start creating good digital metadata. As the bibliographic review confirms, digitalization is growing and the COVID pandemic has given it a boost (RLI, 2020; Kennedy, 2020; Simpson, 2021; Smith-Yoshimura, 2020). Institutions that had once ignored technology have been forced by circumstances to embrace it. We believe that it is time for collections that still maintain their inventories on spreadsheets or even in manual files to consider a change – of course, with the support of institutions with expertise in this field.
- For most institutions, limited personal, material and economic resources are a day-to-day reality. Therefore, a sustainable metadata strategy needs to be developed that does not preclude volunteerism. It would not be sustainable or realistic to expect small centers to use complex systems, such as CDWA (cultural heritage), ABDC (natural heritage) or RDA/MARC21/ISADG (documentary heritage). In this sense, under the direction of metadata experts, such as librarians or archivists, exchange standards should be proposed in conjunction with their own fields of work (i.e. an application profile) that facilitates the description and management of the collections. In fact, this research has shown that the most widely used standards are exchange standards, specifically LIDO, Darwin Core and Dublin Core, which facilitate quality work and the preparation of collection pieces for migration to other environments. Thus, if one day an institution obtains more resources, then it can transfer its records to these schemas using relatively simple mapping processes.

The approach of bringing professionals from different fields into contact with each other should be accompanied by a modification of university curricula referring metadata specialists to make them less stratified and more interprofessional (Renshaw and Liew, 2021), so that metadata experts are able to adapt to a biodiversity collection, to a human heritage catalog and even to working in a library or archive.

Future research

Future research by the team of authors of this study will include the creation of a sustainable proposal of work guidelines for small heritage collections in universities. We are concerned

about the persistence of outdated schemas and the isolation identified in this study, which is why we believe that we need to consider how this can be addressed to win the metadata battle. If the battle is lost, then the possibility of visually positioning heritage collections in an increasingly digital world will likewise be lost, consigning them to the fate of Yerbury's "Cinderella Collections" (Yerbury, 2001) or de Clerq's "Orphan Collections" (de Clercq, 2001).

Notes

1. Digital Public Library of America.
2. Global Biodiversity Information Facility.
3. International Federation of Library Associations.
4. The first edition of the former description standard used by libraries, ISBD (M), dates from 1971, while the first edition of ISAD G, its equivalent for archives, dates from 1994.
5. Data Value Standards: "these are the terms, names, and other values that are used to populate data structure standards or metadata element sets" (Gilliland, 2016).
6. Data Content Standards: "these are guidelines for the format and syntax of the data values that are used to populate metadata elements" (Gilliland, 2016).
7. Data Format/Technical Interchange Standards: "This type of standard is often a manifestation of a particular data structure standard [. . .] encoded or marked up for machine processing" (Gilliland, 2016).
8. Proprietary metadata schemas are schemas that have been developed according to the needs of the collection but do not conform to the standards recommended by the GLAM sector, as specified in the introduction to this article.
9. The UMAC is an International Council of Museums (ICOM) committee for promotion, preservation and cataloging worldwide. At the European level, this is also the function of UNIVERSEUM Academic Heritage Network.
10. The group of Coimbra is a network made up of 41 European universities.
11. The Vives Network brings together 22 universities in the Catalan-speaking regions of Spain.
12. For example, in Italy, the Ministry of Culture coordinated its rich heritage with the creation of the Istituto Centrale by Il Catalogo e la Documentazione, which is responsible for issuing rules governing the cataloging of the country's enormous wealth of cultural assets (ICCD). These rules are observed by Italian university museums and collections, which upload their data to Catalogo Generale dei Beni Culturali (Tucci, 2018).

References

Agenjo Bullón, X., Hernández Carrascal, F. and Hernández Rubio, S. (2015), "El formato LIDO, puente Para la integración de bibliotecas y museos en el entorno Linked Open Data y Europeana", *Terceras Jornadas de Bibliotecas de Museos: hacia Una Integración de Colecciones y Servicios*, Ministerio de Educación, Cultura y Deporte, Madrid, pp. 29-46, available at: https://es.calameo.com/read/0000753351819b34168b2 (accessed 3 June 2022).

Alemu, G. (2021), "La función de los metadatos Para galerías, bibliotecas, repositorios y museos", in Machín-Mastromateo, J.D., Tarango, J. and Romo-González, J.R. (Eds), *Tendencias en Estudios de la Información, Comunicación e Investigación*, Metadatos y gestión de la información, Alfagrama Vol. 2, pp. 65-102.

Alexiev, V. (2018), "Museum linked open data: ontologies, datasets, projects", *Digital Presentation and Preservation of Cultural and Scientific Heritage, Conference proceedings, Sofia, Bulgaria,*

Institute of Mathematics and Informatics,Vol. 8 pp. 19-50, available at: https://dipp.math.bas.bg/images/2018/019-050_32_11-iDiPP2018-34.pdf (accessed 3 June 2022).

Anglada, L.M. (2021), "Letter: reflections on possible reasons for excessive undervaluing of some professions and proposals for its reversal", *El Profesional de la Información*, Vol. 30 No. 6, p. 1, available at: https://doi.org/10.3145/epi.2021.nov.04 (accessed 03 June 2022).

Bicknell, K. (2017), "The future looks GLAMorous: from resource sharing to collaboration and convergence", *Online Searcher*, Vol. 41 No. 4, pp. 11-14.

Brigstocke, H. (2001), *The Oxford Companion to Western Art*, Oxford University Press, Oxford, available at: www.oxfordreference.com/view/10.1093/acref/9780198662037.001.0001/acref-9780198662037 (accessed 3 June 2022).

Canadian Heritage Information Network (CHIN) (2019), "Chin guide to museum standards, department of canadian heritage;canadian heritage information network", [s.l.], available at: www.canada.ca/en/heritage-information-network/services/collections-documentation-standards/chin-guide-museum-standards.html (accessed 03 June 2022).

de Clercq, S.W.G. (2001), "Uniting forces: the european network and national collaborative projects", in Kelly, M. (Ed.), *Managing University Collections*, OCDE, Paris, pp. 85-103.

Dempsey, L. (2000), "Scientific, industrial, and cultural heritage: a shared approach: a research framework for digital libraries, museums and archives", Ariadne: Web Magazine for Information Professionals, No. 22, available at: www.ariadne.ac.uk/issue/22/dempsey/ (accessed 3 June 2022).

Díaz Amunarriz, C. (2016), "La gestión de las galerías de arte", AECID, Madrid, available at: https://bibliotecadigital.aecid.es/bibliodig/es/catalogo_imagenes/grupo.do?path=1012627 (accessed 3 June 2022).

Freire, N., Voorburg, R., Cornelissen, R., de Valk, S., Meijers, E. and Isaac, A. (2019), "Aggregation of linked data in the cultural heritage domain: a case study in the europeana network", *Information*, Vol. 10 No. 8, p. 252, available at: https://doi.org/10.3390/info10080252 (accessed 3 June 2022).

Freire, N., Robson, G., Howard, J.B., Manguinhas, H. and Isaac, A. (2020), "Cultural heritage metadata aggregation using web technologies: IIIF, sitemaps and schema.org", *International Journal on Digital Libraries*, Vol. 21 No. 1, pp. 19-30, available at: https://doi.org/10.1007/s00799-018-0259-5 (accessed 3 June 2022).

Gartnerová, E. (2021), "Typology and audience engagement of university galleries", *Muzeológia a Kultúrne Dedičstvo*, Vol. 9 No. 1, pp. 119-134, available at: https://doi.org/10.46284/mkd.2021.9.1.7 (accessed 3 June 2022)

Gilliland, A.J. (2016), "Setting the stage", in Baca, M. (Ed.), *Introduction to Metadata*, Getty Research Institute, Los Angeles, CA, available at: www.getty.edu/publications/intrometadata/setting-the-stage/(accessed 3 June 2022).

Gutiérrez Usillos, A. (2010), *Museología y Documentación: Criterios Para la Definición de un Proyecto de Documentación en Museos*, Trea, Gijon.

Hider, P. and Kennan, M.A. (2020), "How far Apart are L and M? The institutional and publishing disconnects between LIS and museum studies", *Journal of Education for Library and Information Science*, Vol. 61 No. 1, pp. 48-63, available at: https://doi.org/10.3138/jelis.61.1.2018-0047 (accessed 3 June 2022).

Hu, X., Jeremy, N. and Shengping, X. (2018), "User-centered evaluation of metadata schema for nonmovable cultural heritage: murals and stone cave temples" *Journal of the Association for Information Science and Technology*, Vol. 69 No. 12, pp. 1476-1487, available at: https://doi.org/10.1002/ASI.24065

ICOM-CIDOC (2012), "Statement of principles of museum documentation", available at: https://cidoc.mini.icom.museum/wp-content/uploads/sites/6/2018/12/principles6_2.pdf (accessed 3 June 2022).

Joudrey, D.N., Taylor, A.G. and Wisser, K.M. (2018), *The Organization of Information*, 4th ed., Libraries Unlimited, Santa Barbara CA.

Kennan, M.A. and Lymn, J. (2019), "Where is the I(nformation) in GLAM? Education, knowledge and skill requirements of professionals working in GLAM sector institutions", *Journal of the Australian Library and Information Association*, Vol. 68 No. 3, pp. 236-253, available at: https://doi.org/10.1080/24750158.2019.1613708 (accessed 3 June 2022).

Kennedy, M.L. (2020), "GLAM collaborations under COVID-19 conditions and Beyond (RLI 300, 2020)", *Research Library Issues*, No. 300, pp. 32-38, available at: https://doi.org/10.29242/RLI.300.4 (accessed 3 June 2022).

Klimazewski, C. (2015), "Lumping (and splitting) LAMs: the story of grouping libraries, archives, and museums", *Canadian Journal of Information and Library Science*, Vol. 39 No. 3, pp. 350-367.

Kremers, H. (Ed.) (2020), *Digital Cultural Heritage*, Springer International Publishing, Cham (Switzerland), available at: https://doi.org/10.1007/978-3-030-15200-0 (accessed 3 June 2022).

Llanes Padrón, D. (2014), "La normalización de la descripción archivística en gran bretaña, EE.UU., Canadá, Portugal, Brasil y españa después de ISAD", *RICI. Revista Iberoamericana de Ciencias de La Información*, Vol. 7 No. 2, pp. 1-23.

Lo Turco, M., Calvano, M. and Giovannini, E.C. (2019), "Data modeling for museum collections", *The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences*, Vol. 42 No. 2/W9, pp. 433-440, available at: https://doi.org/10.5194/isprs-archives-XLII-2-W9-433-2019 (accessed 3 June 2022).

Lourenço, M.C. (2014), "University collections, museums and heritage in Europe: notes on significance and contemporary role", *Congreso Internacional de Museos Universitarios: Tradición y Futuro. Madrid*, 3,4,5 Diciembre 2014, pp. 58-66, available at: https://eprints.ucm.es/37851/(accessed 03 June 2022).

Marín Torres, M.T. (2018), "Los museos universitarios en españa. Hacia una mayor visualización y difusión", *Cuadernos de Arte de la Universidad de Granada*, Vol. 49, pp. 89-108, available at: https://doi.org/10.30827/caug.v49i0.7754 (accessed 3 June 2022).

Morón de Castro, M.F. (2018), "Las colecciones artísticas como recurso educativo y de investigación", *Cabás: Revista Del Centro de Recursos, Interpretación y Estudios En Materia Educativa (CRIEME) de La Consejería de Educación, Cultura y Deporte Del Gobierno de Cantabria (España*, Vol. 20, pp. 104-124, (December 2018), available at: https://doi.org/10.35072/CABAS.2018.85.62.008 (accessed 3 June 2022).

Nykänen, P. (2018), "First steps in global advocacy: some perspectives on the formation of UMAC, an international committee of ICOM", *University Museums and Collections Journal*, Vol. 10, pp. 10-21, available at: http://umac.icom.museum/wp-content/uploads/2018/12/UMACJ10-Final.pdf (accessed 3 June 2022).

Rasmussen, C.H. (2019), "Is digitalization the only driver of convergence? Theorizing relations between libraries, archives, and museums", *Journal of Documentation*, Vol. 75 No. 6, pp. 1258-1273, available at: https://doi.org/10.1108/JD-02-2019-0025 (accessed 3 June 2022).

Renshaw, C. and Liew, C.L. (2021), "Descriptive standards and collection management software for documentary heritage management: attitudes and experiences of information professionals", *Global Knowledge, Memory and Communication*, Vol. 70 Nos 8/9, pp. 697-713, available at: https://doi.org/10.1108/GKMC-08-2020-0129/FULL/PDF (accessed 3 June 2022).

Research Library Issues (2020), "GLAM collaboration opportunities and challenges", No. 300, available at: https://doi.org/10.29242/rli.300 (accessed 3 June 2022)

Riley, J. (2017), *Understanding Metadata What is Metadata, and What is it for? About the NISO Primer Series*, NISO, Baltimore, available at: https://doi.org/10.1080/01639374.2017.1358232 (accessed 3 June 2022).

Ronzino, P., Amico, N. and Niccolucci, F. (2011), "Assessment and comparison of metadata schemas for architectural heritage", *XXIII CIPA Symposium*, *Prague*, 12-16 September, 2011, proceedings, CIPA Heritage Documentation, [s.l.], pp. 12-16.

Salse Rovira, M., Jornet-Benito, N. and Guallar, J. (2021), "El patrimonio universitario desde una perspectiva GLAM. Análisis de los sitios web de las universidades europeas", *Revista General de Información y Documentación*, Vol. 31 No. 2, pp. 521-543, available at: https://doi.org/10.5209/RGID.77215 (accessed 3 June 2022).

San Andrés Moya, M. (2016), "Los museos y colecciones de la universidad complutense de Madrid: origen, peculiaridades y situación actual", *Los Museos y Colecciones Universitarias: tradición y Futuro*, Universidad Complutense de Madrid, Madrid, pp. 15-39.

Simpson, A. (2021), "Australian university museums and collections interfacing with COVID-19", *Australian Museums and Galleries Collection*, Vol. 29 No. 1, pp. 29-35, available at: www.researchgate.net/publication/350133114 (accessed 3 June 2022).

Smith-Yoshimura, K. (2020), *Transitioning to the Next Generation of Metadata*, OCLC, Dublin, OH, available at: https://doi.org/10.25333/rqgd-b343 (accessed 3 June 2022).

Tucci, R. (2018), *Le Voci, le Opere e le Cose: la Catalogazione Dei Beni Culturali Demoetnoantropologici*, Ministero dei beni e delle attività culturali e del turismo; Istituto centrale per il catalogo e la documentazione (ICCD), Roma.

Valentina Carriero, A., Dakino, M. and Tomasi, F. (2019), "Semantic convergences between museums, archives and libraries. Ontologies for interpersonal relationships | convergenze semantiche tra musei, archivi e biblioteche. Ontologie per le relazioni interpersonali", *JLIS.It*, Vol. 10 No. 1, pp. 72-91, available at: https://doi.org/10.4403/jlis.it-12499 (accessed 3 June 2022).

Warren, E. and Matthews, G. (2019), "Public libraries, museums and physical convergence: context, issues, opportunities: a literature review part 1", *Journal of Librarianship and Information Science*, Vol. 51 No. 4, pp. 1120-1133, available at: https://doi.org/10.1177/0961000618769720 (accessed 3 June 2022).

Xarxa Vives d'Universitats (2021), *Carta D'Universitats i Cultura: el Compromís de la Xarxa Vives Amb la Dimensió Cultural de Les Universitats*, in Montaña Matosas, J. and Ariño Villarroya, A. (Eds), Xarxa Vives d'Universitats, Castellò de la Plana, available at: www3.vives.org/publicacions/arxius/cuc.pdf (accessed 3 June 2022).

Yerbury, D. (2001), "The cinderella collections: an Australian fairy story", *Managing University Museums: Education and Skills*, OECD, Paris, pp. 55-68, available at: https://researchers.mq.edu.au/en/publications/the-cinderella-collections-an-australian-fairy-story (accessed 03 June 2022).

Zeng, M.L. and Qin, J. (2016), *Metadata*, 2nd ed., Neal-Schuman, Chicago.

Zorich, D., Waibel, G. and Erway, R. (2008), *Beyond the Silos of the LAMs Collaboration Among Libraries, Archives and Museums*, OCLC Research, Dublin OH, available at: https://doi.org/10.25333/x187-3w53 (accessed 3 June 2022).

Further reading

Nasosdrosopoulos, A., Tzouvaras, V., Simou, N., Christaki, A., Stabenau, A., Pardalis, K., Xenikoudakis, F., Tsalapati, E. and Kollias, S. (2011), "An aggregation system for cultural heritage content", *CIDOC Conference*, September 2011, *Sibiu*, available at: https://cidoc.mini.icom.museum/wp-content/uploads/sites/6/2018/12/NasosDrosopoulos_full_paper.pdf (accessed 3 June 2022).

Corresponding author

Marina Salse can be contacted at: salse@ub.edu