

Article

Mexico's Tradition and Culture Entering the Digital Age: The Mexican Cultural Heritage Repository Project

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Abstract: Mexico is a country with a vast and extraordinary cultural heritage, which is the result of a rich history of cultural exchange, syncretism and transculturation. This rich culture has been materialized through the consolidation of a long and prestigious museum tradition, which at the same time is sadly characterized by an endemic lack of technological resources rather than professional skills. As a result, we have found that Mexican museums produce very heterogeneous forms of documentation, which are often not even managed using information technologies. Furthermore, most museums deploy ad hoc solutions that directly limit the usefulness and value of the documentation process itself. In response, the recently founded Mexican Ministry of Culture is undertaking the development of the Mexican cultural heritage data model (Modelo de Datos México), which is aimed at contributing to the cultural heritage domain of our country through the correct characterization and documentation of its cultural objects. It is the first documented experience in Mexico of a large-scale data model inspired by CIDOC-CRM, which is complemented by a set of terminological tools that attempt to capture the singularities and idiosyncrasies of the Mexican cultural sector. In the present paper, we will describe the motivations and decisions made so far to optimize the data model to the Mexican reality and the development of the project that will define a set of local terminologies built on the expertise of linguists, information architects, developers and especially, museum professionals.

Keywords: data model development; CIDOC-CRM; terminology; Mexican cultural heritage

1. Introduction

In recent years, Mexican institutions that are related to cultural heritage have engaged more frequently in digitalization projects and similar to other parts of the world, this activity has revealed how this information has been previously organized, the different ways to publish it and perhaps most importantly, the tradition of its documentation.

The Mexican Ministry of Culture (Secretaría de Cultura in Spanish) is a governmental entity that was recently established in December 2015. This ministry has started a project, which was coordinated by the Cultural Digital Agenda of the Information Technologies and Communication Directorate (Agenda Digital de Cultura de la Dirección General de Tecnologías de la Información y Comunicaciones), that has a direct impact on these cultural matters. During the short but fruitful period of September 2017 to date, it has promoted actions that tend towards the creation and implementation of the first Mexican cultural aggregator, sustaining its development in a semantic data model. This

became known as the Mexican Cultural Heritage Data Model (known as Modelo de Datos México in Spanish or MDM for short).

The strategy to achieve such a goal consisted of selecting some national museums and other institutions from the Mexican cultural sector and decidedly encouraging them to stick to data normalization in order to properly describe the cultural heritage objects they keep; implementing different actions aimed at training and professionalizing the personnel in charge of these tasks; and developing in a formal manner a set of lists for terminological control. In this paper, we introduce a short account of this experience.

2. The First Cultural-Information Aggregator in Mexico

Similar to others, the history of documenting and cataloguing the Mexican cultural heritage is a work in progress. After less than a century of constant efforts within the current institutional and legislative framework, it is still difficult to evaluate which are the most relevant contributions in this area. However, as a general hypothesis, we can affirm that even in recent times where information technologies are deeply bonded to the dissemination of cultural information in a digital environment, the methodological constant has been that it is extremely rare to find catalogues, databases or annotations properly described in order to ensure that they are widely interoperable.

The documentation of cultural heritage objects (CHOs) is mainly approached from a local scope and its impact is very limited since there is no specific strategy that could help to achieve this task in a holistic way. Therefore, the notion of “cultural sector” in Mexico applies best to a domain with a good material infrastructure (rather than technological) and where the information produced by the cultural institutions is not seen as an asset. Embracing concepts, such as Linked Open Data, would contribute to the integration of cultural information in a continuous data flow with other sectors of Mexico and promote its online dissemination and reutilization, which this sector is in dire need of.

The Mexican Ministry of Culture has managed to identify this problematic perspective and subsequently, have directed the attributes of the Information Technologies and Communication Directorate to strengthen the introduction of information technologies in the Ministry itself and to establish actions aimed at boosting the use of digital tools and resources. Thus, in accordance to the Internal Regulations of the Ministry (Article 25, section III), this Directorate is entrusted to “design, develop and establish an architecture of information and interoperability that facilitates the automation of processes, assimilation, use and exploitation in an electronic way of the information generated by the administrative units and decentralized administrative organs of the Ministry of Culture”¹ [1].

The different actions that have been considered to achieve data interoperability eventually led to the development of a project aimed to implement an information aggregator and structured data harvester, which is able to collect the information generated by the different cultural organizations managed by the Ministry of Culture. Nevertheless, given the heterogeneous nature and uneven quality of the data, it was necessary to extend the goals of the project and come up with a much more complex and ambitious proposal where the documentation process (and the professional practice itself) would be solidly grounded on international standards and guidelines. Otherwise, the project would have been doomed to failure from the beginning.

As a result, the implementation of the Digital Repository of the Mexican Cultural Heritage began on September 2017 and these are the main outcomes to date:

- The development of the MDM, a data model that is mainly based on CIDOC-CRM albeit with several modifications (see Section 2);
- A normalized set of CHO’s records (extracted from the databases of several cultural institutions managed by the Ministry of Culture), which has been used to develop the first prototype of the

¹ Translated by the authors.

website Museos de México (Museums of Mexico) [2,3]. To characterize these records, we have defined a set of minimum required metadata built by considering a number of local requirements and the set of minimum required metadata specified in several cultural metadata standards (such Object ID, VRA, CDWA, LIDO or SPECTRUM). The resulting set and its mapping to CIDOC-CRM and SKOS elements is shown in Table 1. In a future development stage, each participating institution will be able to generate MDM compliant records through a data entry platform to become active data providers;

- A set of concept lists for terminological control (developed as part of the data normalization process) that were incorporated into Museos de México and into the Digital Repository itself. These lists will be part of a wider project to look for an integral solution for terminological control in the Mexican cultural heritage sector;
- Finally, a project that seeks the professionalization of those who oversee the documentation process in cultural institutions in Mexico. Its first phase is comprised of different courses and workshops targeting the staff of the museums present in Museos de México (although new organizations will be considered soon) that cover topics, such as intellectual property; cataloguing and normalization of the cultural heritage; and vocabularies and terminological documentation.

Table 1. Required information elements to be provided about cultural heritage objects (CHO).

Element	Properties	Requirement	Mapping
CHO's identifier	ID value	Required	E42 Identifier. CIDOC-CRM
CHO's type	Preferential term	Required	Concept. SKOS
Rights about the digital object that represents the CHO	Permissions/Restrictions	At least, one of the properties required	E30 Right. CIDOC-CRM
Rights about the CHO	Permissions/Restrictions	At least, one of the properties required	E30 Right. CIDOC-CRM
Digital object that represents the CHO	Web identifier	Required	E73 Information Object. CIDOC-CRM
Institution that keeps the CHO	Entity name	Required	E40 Corporate body. CIDOC-CRM
CHO's title	Title Value	Required	E35 Title CIDOC-CRM
CHO's creator	Institution name (Institution)/Group name (Group)/Name (Person)	Properties corresponding to type of agent required	E39 Actor CIDOC-CRM
CHO's date of creation	Date value (Date)/Period value (Period)/Start; End (Range)	Properties corresponding to the type of temporal identifier required	E52 Time-Span CIDOC-CRM
CHO's identifier type	Preferential term	Recommended	Concept. SKOS

Other aspects we would like to highlight in this initial phase of the project is the organization of the first edition of the CIDOC Training in Mexico, which was delivered from the 23rd to the 27th of July 2018, and the reactivation of the Mexican board of the CIDOC that was initially created in 1997 by the remarkable museologist Felipe Lacouture Fornelli (1928–2003), which had ceased operations after his death. Additionally, several agreements have been consolidated with academic partners, such as the Institute of Aesthetics Research (Instituto de Investigaciones Estéticas) [4], which are intended to set up academic programs aimed at different environments and public related to the cultural heritage sector in Mexico.

3. Model Overview

The MDM is an attempt to tackle the problem of cultural heritage documentation in Mexico from a technological perspective, which is a complex task considering the socioeconomic, geopolitical, technological and cultural context of the country. Despite these difficulties, the purpose of the MDM is to raise the Mexican cultural sector in the short term to the level of other countries that have a

much longer tradition in the documentation of cultural objects and the application of information technologies to museums.

The model is based on the principles of the semantic Web and Linked Open Data, which are namely interoperability and reutilization of open information in different platforms and applications [5]. In such a way, it is possible to develop enriched information services for a wide range of external users in addition to fulfilling the information needs of the users within the institution itself. That was one of the priorities of this project due to the endemic lack of efficient information management systems in Mexican museums. Thus, it was necessary to focus on the development of a user-friendly model, which was based on new information technologies that could be used to preserve the museographical tradition and professional practices of local museographers. Furthermore, we wished to help museographers to exploit the information that they are producing.

As a first step, we had to decide which data model in the cultural heritage sector would best fit our needs and could be used as a basis for the development of the MDM. The ideal model should be able to provide the means to describe cultural objects with high accuracy, exhaustiveness and quality standards. We finally opted for CIDOC-CRM [6] as a guide to build the MDM because of the coverage and extension possibilities that it offers in comparison to other data models. It is robust and stable, which makes it suitable as a basis for data modeling harmonization in the cultural heritage sector. This provides a common language for heterogeneous information niches (i.e., archives, libraries and museums), making it possible to share and retrieve information without losing specificity or accuracy. Therefore, using CIDOC-CRM as a reference model allowed us to create a basic framework and enrich it with elements that are both locally defined and extracted from other semantic vocabularies (see Figure 1). In the following section, we describe the structure and main features of the MDM in more detail.

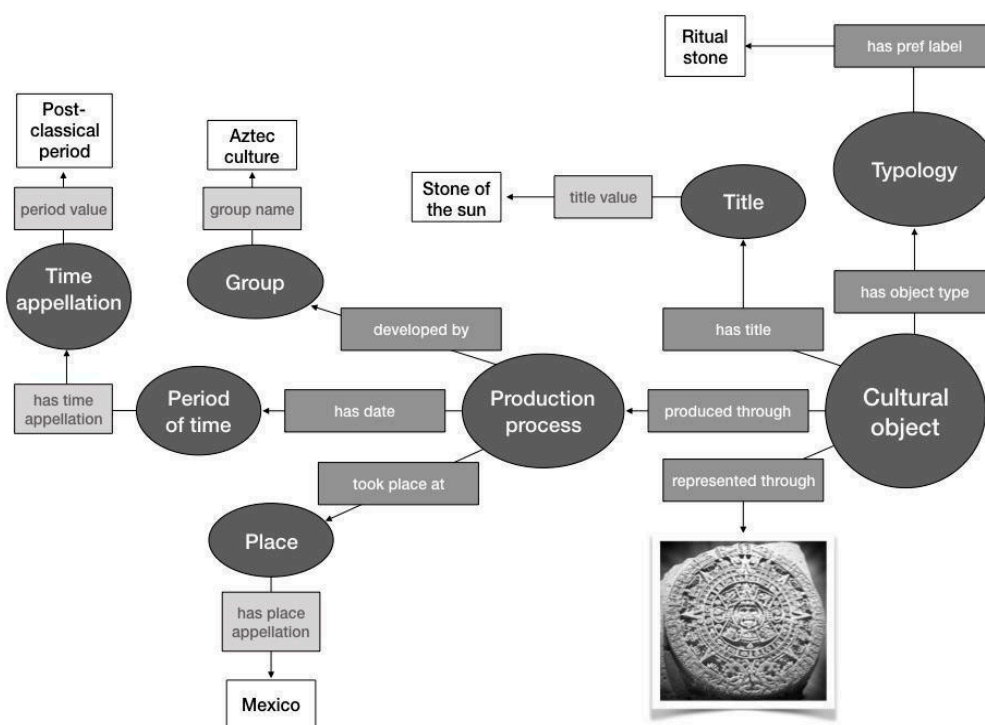


Figure 1. Example of a cultural object description using the MDM.

The model is made up of five main classes that follow the structure of CIDOC-CRM's class hierarchy:

- **Date:** Class used to describe periods of time.

- **Dimension:** Class that defines physical dimensions of things.
- **Place:** Class that includes entities related to the description of physical locations.
- **Temporal entity:** Class comprising entities with a limited existence in time (such as events and activities).
- **Persistent entity:** Class that includes entities with a persistent identity through time.

Although the first three classes define physical and contextual limits of things (dimensions, time and places), the latter are classes that describe events and objects (both material and immaterial). Thus, essentially, the MDM harnesses the hierarchical infrastructure and semantics defined by CIDOC-CRM but there are several differences:

- **Class hierarchy:** It is common to find CIDOC-CRM classes that have more than one superclass, thus giving the museographer the chance to decide which one has the most appropriate semantics to carry out a specific documentation task. However, this type of complex hierarchical structure is disadvantageous in contexts where simplicity is required. In our case, the main goal of the project is to make Mexican cultural institutions capable of providing quality data to the repository by themselves so it was a priority for us to simplify the class hierarchy of the MDM as much as possible in order to make it more comprehensible to the average museum professional. Thus, we opted for keeping just one superclass per each MDM class with multiple possible instantiations in CIDOC-CRM. As a result, we produced a lightweight mode, which is less expressive but still semantically coherent. For example, for the “E12 Production” class, which is a subclass of “E63 Beginning of Existence” and “E11 Modification”, we decided to exclusively maintain the relation with “E11 Modification” for the sake of simplicity.
- **Definition of local elements:** Most of the classes and properties defined in the MDM have an equivalent element in CIDOC-CRM but it is hard to find a one-size-fits-all standard capable of meeting all the requirements to describe a specific knowledge domain. Therefore, in order to capture the singularities of Mexican Museography, we have incorporated different elements from other data models (such as Creative commons, DBpedia, DCterms, W3C Time, Schema.org and SKOS²) and a set of local classes and properties. For example, CIDOC-CRM lacks a specific event to describe the process of exhibiting cultural objects so we decided to create an “Exhibition” element as a local subclass of “E7 Activity”. Similarly, we have defined local time appellations, new subclasses of “E73 Information object” (such as the “Digital cultural object” class) or the class “Typology”, which is semantically equivalent to “E55 Type”. This class deals with controlled vocabularies using a similar solution to the one proposed by Pedro Szekely for the Smithsonian American Art Museum [7], which considers “E55 Type” instances as SKOS concepts [8]. That implies that any controlled term can be inserted into a hierarchical structure (i.e., a thesaurus), which relates it to broader, narrower and semantically related terms (even from different knowledge schemata) (see Figure 2). In other words, the use of SKOS clears the path to linked data and helps in dealing with semantic ambiguity through the interconnection of multiple controlled and specialized vocabularies.
- **Discursive logic of description:** Similar to CIDOC-CRM, the MDM considers events and activities as the central descriptive elements of the model to understand the processes carried out in a cultural heritage institution that affect the cultural objects’ life cycle (i.e., the period between the creation of an object and the eventual end of its existence). This approach allows us to describe cultural objects as the result of a specific process or activity and represents a dramatic change regarding the object-centric traditional description. Defining the discursive logic of descriptions in this manner was a significant challenge because one of the main requirements of the project was

² Vocabularies respectively available at: <http://creativecommons.org/ns#>; <http://dbpedia.org/ontology/>; <http://purl.org/dc/terms/>; <http://www.w3.org/2006/time#>; <http://schema.org/>; <http://www.w3.org/2004/02/skos/core#>.

to be as much faithful as possible to the Mexican museographical traditions to make it easier for museum professionals during the methodological and technological transition to the MDM, which requires moving from barely automated work environments to dealing with semantic information systems. The solution that we found was to limit CIDOC-CRM expressiveness and take cultural objects as the starting point of any descriptive or documentation process (see Figure 2), thus providing local museographers with a non-disruptive discursive logic while introducing them to a new technological paradigm at the same time.

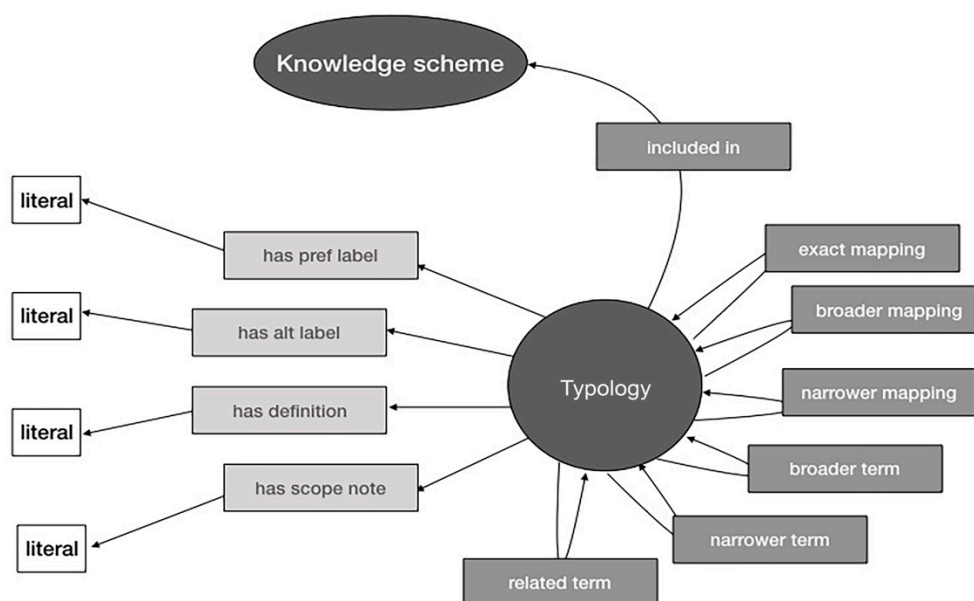


Figure 2. Detailed caption of the element “Typology” and its main attributes.

4. The Terminological Catalogues of the Mexican Repository³

Developing a terminological control for the project is questionable, given that there are already several terminological control projects in Spanish. Nevertheless, contrary to what one might think, the abundance of technical dictionaries and terminological controls does not necessarily lead to the vocabulary normalization of a given knowledge domain [9]. If this was the case, the terminological variability problem would have been solved many years ago. For instance, the term “bacín” as documented in the Thesaurus of Art & Architecture (Tesauro de Arte & Arquitectura in Spanish) [10] is defined in three different ways: (1) a pot that can contain solids and liquids, (2) a type of shallow bowl and (3) a bowl.

With this example, we can confirm that the reference work itself is not enough to normalize the concept if we consider the following elements: a) three meanings that are associated to a single term (i.e., the term is polysemic, which leads to conceptual ambiguity) [11]; and b) the limited scope of the definition.

In addition, in the Thesaurus of Art & Architecture, not all the required terms were available. For example, the term “mojigango” is not registered (giant human-like figures used in popular festivals, whose origin can be traced to the Mexican state of Colima and has resulted in it transcending as an inherited object in regional and national museums of popular cultures in the entire country) so this

³ For further information about requirements, elicitation and collaboration with different Mexican cultural institutions, see: Molina Salinas, C. and Franco Trujillo, E. D. Una metodología para la construcción de un sistema conceptual para un tesauro de las artes espaciales en México, *Terminalia* 2018; num. 18, pp. 25–36. Available online: <http://revistes.iec.cat/index.php/Terminalia/article/view/144213> (accessed on 15 December 2018).

can be considered as an indicator that the thesaurus does not have a local normalizing scope in Mexico and as a consequence, it lacks coverage of local vocabularies.

Lastly and quite unfortunately, the facets of this thesaurus could be unclear for Spanish speakers because the Spanish version is a translation from English, which results in the arrangement and hierarchical structure of the terminology behind the thesaurus' facets reflecting an Anglocentric conception and interpretation of knowledge.

As an alternative to the *Thesaurus of Art & Architecture*, we could adopt any of the *Thesauri-Dictionaries of the Spanish Cultural Heritage* (*Tesauros-Diccionarios del patrimonio cultural de España* in Spanish) [12] as a terminological control tool. However, one of the first limitations that we discovered is the low availability of thesauri as we only have a *Dictionary of Materials*, a *Dictionary of Cultural Heritage Object Appellations*, a *Dictionary of Geographic Names* and a *Dictionary of Techniques*, which are considered as part of a set called "general thesauri". On the other hand, there are another three dictionaries or specific thesauri, which are namely *Dictionary of Ceramics*, *Dictionary of Numismatics* and *Dictionary of Furniture*. With regards to the possibility of adopting another online finding aid as a terminological control tool, such as the *UNESCO Thesaurus* [13], it has been previously reported that some of them reuse meanings taken from general language dictionaries, which implies an implicit defective description of concepts [14], and therefore, many of the specialized meanings of terms are missed.

Naturally, printed thesauri and reference works are not exempt from all the observations already mentioned and additionally, are incompatible with the current cataloguing systems because they lack essential data, such as the author or the name of the vocabulary that the terms derive from, a unique ID for each term or a unique URL linking to the online description of any concept taken from another vocabulary and so on [14].

Considering all the above-mentioned points, we decided to develop 27 terminological control lists to fulfill the requirements of the digital repository. We had to face several problems, including the integration of measurement units, names of institutions and geographic locations that are not exclusive terms to the discipline. After this, to justify the control of these necessary lexical units, we relied on the assumption of the existence of *sensu lato* terms and *sensu stricto* terms. *Sensu lato* terms are designations of common language that specialize their meaning and are common to several knowledge domains while a term is described as an exclusive denomination of a technical or scientific area [15].

The existence of these differences between term hierarchies, applied to the typology of terminological control for the project, has represented a first categorization of the terminological lists. On the one hand, we have a set of terminologies related to Art and Archeology in Mexico and on the other hand, we would have *sensu lato* terminologies that Art and Archeology share, such as with Law, Mathematics, Humanities, Informatics and information technologies.

With regards to the *sensu stricto* terminological control lists, we found terms that refer to types of objects (photography or frieze), materials (wax or jute), techniques (polishing or marbling), documental typology (letter or flyer) and physical characteristics of the CHO (delamination or patination). All these terminologies combine the documented terms from the *Dictionary of Cultural Heritage Object Appellations* [16], the *Dictionary of Topics* [17] and the *Dictionary of Techniques* [18] of the Spanish Ministry of Culture and the database of names of institutions that are participating in the project. At the moment, there are a total of 7,103 terms but as these terminologies are extremely dynamic, they are expected to grow in the short term.

Sensu lato terminologies are more numerous than the former and in turn, they can be classified into more specific types. Essentially, this will create terminologies that refer to the intrinsic conditions of the CHO (those directly related to the object) and terminologies that refer to the administrative aspects or extrinsic conditions of objects.

The intrinsic conditions of CHOs are described using terms referring to the preservation conditions (good condition or requires intervention); the physical carrier (for instance, acetate or microSD); length, mass and time units (gram or second); type of physical marks (autograph signature or sign); type of

file format (zip or m3u); type of production process (manufacture or ornamentation) and type of agent (colorist or xylographer). These terminologies are based on the International System of Units [19], the Dictionary of the Spanish Language [20] and the CHO's records of participant institutions. As a result, 389 lexical units were added to the overall set of terms.

For their part, extrinsic conditions include names of keeping institutions (San Carlos Museum or Anthropology National Museum); countries and locations of these institutions (Spain or Coahuila de Zaragoza); names of languages in Spanish (Nahuatl or Popolocan); the intended use of the CHO (ceremonial or medicinal); and a set of typologies such as type of title (descriptive or popular); type of note (generic note or maintenance recommendations); type of descriptor (topic or temporal term); type of magnitude (length or time); type of acquisition (allocation or rescue); type of dimension (diameter or volume); type of place (country or municipality) and type of identifier (ISBN or registry number).

The sources used to document these lexical units (which total up to a total of 14,733 descriptors) were the Mexican Cultural Information System [21], the catalog of Mexican Indigenous Languages [22] and the institutional databases of the participant museums. To summarize, the whole terminological control lists now contain a total of 22,165 terms.

5. Conclusions

The development of the MDM represents the first effort of the Mexican cultural sector in creating a technological and methodological infrastructure capable of facing new challenges in the documentation of cultural heritage objects in the short and long term.

Such a necessary change of perspective implies a transformation of extraordinary proportions since it needs to be accompanied by a modification in the documentation practice, incorporating norms and international standards, with the objective of turning the data sets managed by cultural heritage institutions into the main information source of a harvesting and aggregation system.

We have opted to use semantic web technologies not only to allow the definition of the data model necessary to conduct a proper documentation of the cultural heritage (using the standard CIDOC-CRM as a basis), or the terminological control through knowledge schemata as expressed with the SKOS vocabulary, but also to open the path for the development of new services and the interconnection of the Mexican cultural heritage repository with datasets from different international libraries, archives and museums for mutual enrichment.

Our project has placed an emphasis on the fact that the best information will always have its origin in specialists, cataloguers or curators who directly work with the CHOs. The MDM leverages data integration in a framework of information providers (the cultural heritage institutions) and a data aggregator (the digital repository of Mexican cultural heritage). Furthermore, it proposes an academic approach to documentation, which opens a window of opportunity to provide access to high-quality CHOs' descriptions through the Web. It is evident that the top-to-bottom approach of the MDM definitions should be balanced with a bottom-up approach of the data from the cultural institutions so this will be considered as one of the main research lines to be developed in the near future.

We admit that this extremely relevant effort may be too daring. In addition to offering radical solutions, our work looks to expose common difficulties in Latin America. As shown, we have worked on a very uneven context in where large-scale technological projects have to face a series of atavistic shortcomings. For instance, there is a generalized lack of standardization culture and technological resources, thus making easy to find national museums that do not even have access to broadband Internet connection. However, the problem of documenting CHOs in this new technological context is not new to the academic community in Mexico and there are several ongoing projects to develop specific subjects to postgraduate students of Art History at the UNAM (Autonomous National University of Mexico).

Regarding the development of vocabularies, the terminological documentation that has been conducted in this project is just the beginning of a much more complex process. We found very valuable initiatives in projects, such as the Spanish Cultural Heritage thesauri and dictionaries, but

unfortunately a) they do not consider the local use of Art terminology and therefore, do not include common terms used in Mexico; b) they do not take into account all the subdomains of the knowledge area, which impacts on its coverage; and c) they present definitions that contribute to conceptual ambiguity or ignore specialized aspects of the meaning of a concept that are exclusive to the discipline.

We have applied a methodology based on the terminological normalization of the vocabularies used in the context of Mexico's cultural sector in order to develop a specialized thesaurus in the mid-term. The creation of this thesaurus will be based on the ISO 25964 norm and its elements (hierarchical relations and semantics) will be defined after linguistic and ethnographic local analysis.

In summary, this project is under development and there are still many goals to be achieved, such as the implementation of the conceptual taxonomy of the Mexican Cultural Heritage thesauri, the evaluation of the MDM and the consolidation of a training program to allow high-level cataloguers to provide high-quality metadata for the aggregator.

Even though there are still many challenges to be faced, the project we describe in this work represents a firm declaration of intentions on behalf of the cultural sector of Mexico to claim its space and to place the rich Mexican cultural heritage at the level of other countries with better economic resources and technological infrastructure.

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