Controlled terminology for monuments, museum and gallery objects: preliminary research on vocabularies reconciliation

Križaj, Lana; Zlodi, Goran; Stublić, Helena; Majer, Ivana; Lucić Telišman, Ana

Filozofski fakultet
Sveučilišta u Zagrebu

dabar
DIGITALNI AKADEMSKI ARHIVI I REPOZITORIJI

Controlled Terminology for Monuments, Museum and Gallery Objects: Preliminary Research on Vocabularies Reconciliation

Lana Križaj*, Goran Zlodi**, Helena Stublić**, Ivana Majer**, Ana Lucić Telišman***

* City of Zagreb, City Institute for the Conservation of Cultural and Natural Heritage, Zagreb, Croatia
** University of Zagreb, Faculty of Humanities and Social Sciences / Department of Information and Communication Sciences, Zagreb, Croatia
*** Independent researcher, Zagreb, Croatia
gzlodi@ffzg.hr

Abstract - **The purpose of controlled vocabularies is to organize information and to provide terminology to catalogue and retrieve information in information systems. Vocabularies provide definitions and scope notes, which is especially important in the field of cultural heritage, capturing the richness of meanings and relationships between terms. Therefore, they are important tools for data integrity control and providing reliable search and retrieval, and also essential educational resources. Currently, there are only two controlled vocabularies in the Croatian language related to the field of cultural heritage, primarily museum collections and the protection of cultural monuments: 1) the *Classification of museum and gallery objects*, 2) the *Thesaurus of monument types*. They overlap to some extent, but also differ according to the levels of specificity, exhaustivity and structure. As an initial method of vocabulary reconciliation, mapping based on Simple Knowledge Organization System (SKOS) mapping properties is used. This paper aims to examine the possibilities and challenges of vocabulary reconciliation and to provide guidelines for the future use of these valuable terminological resources, to improve the users' access to cultural heritage. Additional mapping of both terminologies to the *Art & Architecture Thesaurus* will ensure interoperability in the global linked open data environment and provide a multilingual context.**

Keywords - controlled vocabularies; vocabulary reconciliation; thesaurus; classification; vocabulary mapping; museums; protection of cultural monuments; linked open data

I. INTRODUCTION

Each discipline is reflected in scientific language and the terms by which it describes the concepts it deals with. It is therefore essential to mention the term "controlled vocabulary", which can be simply defined as an organized system of words and phrases used for the naming of various concepts, objects etc. of a certain profession. The main purpose of these vocabularies is to unambiguously and consistently describe the content of an object/document, which will facilitate its subsequent retrieval. On the one hand, controlled vocabularies have a documentary role because they are used to describe an object, i.e. to create metadata in various information systems, and, on the other hand, they play an important role in users' access to the same object/document. These two aspects are equally important in a traditional, physical environment, but also in a modern, digital context.

The needs of the contemporary users of cultural heritage information require more accessible and more efficient access to information on the common heritage that is preserved, managed, processed, and researched in various institutions. This presumes stepping out of the information silos of individual institutions and enabling the wide availability of heritage information. In order to make information available to users, there are various systems and approaches: from online catalogues and institutional repositories to aggregation portals such as "Europeana" or federated search approaches based on SPARQL semantic queries. The effectiveness of such systems largely depends on the scope and quality of the controlled vocabularies used for the indexing and retrieval process. In this context, the interoperability and interconnectedness of different vocabularies are crucial. Therefore, this paper aims to examine the potentials and challenges of vocabulary reconciliation to enable interoperability in the global open linked data environment and provide preliminary guidelines for the mutual use of these valuable existing terminological resources, in order to improve the users' access to cultural heritage. In addition to the aforementioned application in the global information environment, structured terminology is extremely important for education in different fields – from heritage management and protection to cultural tourism and edutainment.

II. THE CONTROLLED VOCABULARIES INCLUDED IN THE RESEARCH

As there are currently only two structured controlled vocabularies in the Croatian language related to the field of cultural heritage (primarily museum collections and protection of cultural monuments), and *The Art & Architecture Thesaurus* is a *de facto* key international data value standard, the following vocabularies are included in the research and will be introduced in succeeding chapters.

A. The Classification of Museum and Gallery Objects by Types of Objects (CMGO)

The Classification of Museum and Gallery Objects by Type of Objects (further abbreviated as CMGO) was developed within the first systematic efforts in the direction of standardization of the documentation of museum and gallery objects in the year 1987 in the publication of a document entitled *Documentation and classification of museum and gallery objects* in the 25th volume of *Muzeologija* journal [1]. This is the first collection of the national guidelines for defining museum terminology in Croatian language and the setting up of framework and foundations for the organization of museum documentation.

Guided by current world trends at the time, CMGO was based on the *Classification of museum and gallery objects of the British Museum Documentation Association (MDA)* (MDA was re-launched as the Collections Trust in 2008). The British MDA classification system was characterized by three levels: "Major Categories", "Simple Names", and "Full Names" [1]. The system was redesigned and adapted in the national version in such a way that the first level was defined as "object type" (21 categories), the second level was marked as "purpose", and the third as "object name" (e.g. building – building element – roof). The system was supplemented and amended in 1990 by altering the 12th group of objects ("Art Objects") and the 13th group of objects ("Communication and Symbol") that was published in the second number of the *Bulletin o informatiziranju muzejske djelatnosti SR Hrvatske* journal [2]. It consists of more than 1200 terms. This classification system shows a clear hierarchy, but no definition of terms and objects is indicated.

B. The Thesaurus of Monument Types (TMT)

Croatian *Thesaurus of monument types* (further abbreviated as TMT) was developed in years 2002-2006 as an integral part of the information system of cultural heritage "Teuta", which had been established in the Ministry of Culture of the Republic of Croatia to serve as a tool for the efficient preservation of cultural heritage by ensuring the "base of knowledge" needed for any intervention in that field. Besides the cultural heritage service, targeted users of that information system were professionals from a wide variety of related disciplines, such as art historians, archaeologists, architects, urbanists, university teachers, etc., as well as the public.

The methodology for the compilation of the thesaurus was based on the thoroughly researched literature and praxis of other countries in that field. In accordance with the international standards for thesauri compilation, namely the ISO standards 2788 [3] and 5964 [4], to facilitate the work on the thesaurus and to enable the immediate construction of semantic networks, the sophisticated computer application was developed. As the terms had been compiled and integrated into the thesaurus, they were classified in the appropriate class or classes, ensuring the polyhierarchy (Fig. 1) as one of the desired qualities of thesaurus. At the same time, where necessary,

terms were linked with the various related and equivalent terms, creating the sort of network, which will support user processes in searching and retrieval of information. In that manner, 809 terms have been collected, processed, equipped by scope notes, classified and linked to related term(s), if there were any.

Figure 1. Example of polyhierarchy in hierarchical display of thesaurus terms, where the term *pool* (cro. *bazen*) is positioned in two different top classes of TMT (*Construction for sports* and *Gardens, parks and urban spaces*)

Furthermore, each term was mapped with the appropriate term from the Getty's *Art and Architecture Thesaurus* [5], French *Base de données Thésaurus* [6] and British *Thesaurus of Monument Types* [7] and the degree of equivalence was specified (if the term was not an exact match it was marked by +/- symbol).

The *Thesaurus* was published in 2017 in the form of the book [8] which comprises of two parts: the first one is dealing with the phenomenology and organization of knowledge as the general phenomenon as well as in the field of cultural heritage protection, legislation in the field of documentation and monument recording, Croatian experiences in the inventory creation and establishment of universal information system and the thesaurus compilation methodology, and the second part of the book is thesaurus itself, printed out as the hierarchically organized class list as well as the alphabetical list of concept entries that include scope notes, top classes, broader terms, synonyms, sources and already mentioned mappings (Fig. 2).

Figure 2. Example of a concept entry record (*arcade*) in TMT

For a number of key concepts, a visual representation of the is provided, which is sometimes important for a understanding of the presented phenomenon (Fig. 3).

This thesaurus is just a model for the comprehensive thesaurus of monument types that should cover all types of cultural heritage, limited to the architectural heritage, be it single buildings or built complexes. During the establishment of the core structure of thesaurus, the possibility of subsequent extension of the thesaurus to the other categories of heritage, such as historical settlements, cultural landscapes, archaeological sites, intangible heritage etc., has been foreseen.

Figure 3. Example of a visual representation of the concept (*arcade*) in TMT: Zagreb, Arcades at the Mirogoj cemetery (photo: L. Križaj, 2016)

C. The Art & Architecture Thesaurus (AAT)

Since its beginnings in the 1970s and the start of the project by libraries and architectural experts Toni Petersen, Dora Crouch, and Pat Molholt, *The Art & Architecture Thesaurus* (further abbreviated as AAT) evolved significantly. It is a hierarchical and controlled vocabulary with the main purpose to describe works of art, architecture, decorative arts, material culture and archival materials [9]. AAT is currently managed by The Getty Research Institute through the Getty Vocabulary Program.

Main purposes of the AAT are: standardized framework for documentation and cataloguing through controlled vocabulary and structure and classification schemes, aid for research and information retrieval and especially allowing its use in linked data between different information systems. AAT is a living organism, being edited, expanded and improved every year, and today it contains around 72,225 records and 472,602 terms. The concept is the main focus for each AAT record (i.e. subject) identified by a unique numeric ID [10]. This thesaurus is following ISO 25964-1 standard [11].

The hierarchical structure of the AAT is constituted by facets arranged in such a scheme that it covers a large range of terms from abstract concepts to specific artefacts. There are 8 main facets: (1) "Associated Concepts": mainly abstract concepts and phenomena, e.g. Neoclassical, street art, etc., (2) "Physical Attributes": e.g. borders, cracks, etc., (3) "Styles and Periods": e.g. Neolithic, Aztec, etc., (4) "Agents": e.g. architects, barbers, etc., (5) "Activities": e.g. archaeology, meditation, etc., (6) "Materials": e.g. ivory, bleach, etc., (7) "Objects": e.g. paintings, gardens, etc., (8) "Brand Names": e.g. Araldite (TM), Google Earth, etc. [9]. AAT is open and available for users (in human readable form) on the Getty Research Institute website and also at the SPARQL endpoint in the linked open data formats (ready for machine reasoning processing).of data that defines a specific concept: definition (describes the meaning and how it is used in cataloguing), list of terms (with the indicated preferred term, and also the terms that could be synonyms), display of hierarchical position, unique ID number, etc.

III.   The Initial Review of Specifics, Incompatibilities and Limitations of Controlled Vocabularies Included in the Research

In this chapter, we would like to highlight results of some of the specifics, incompatibilities and limitations that we have identified in an initial review of the vocabularies included in this research. The study was performed through reviewing, reading and analysing hierarchical relationships and definitions of terms (where applicable).

A.   Differences between classification and thesaurus

First of all, it should be noted that both included vocabularies in the Croatian language differ in the formal sense of terminology control. CMGO is realised in the form of classification, and TMT as a thesaurus. As a type of controlled vocabulary, thesaurus represents a „semantic network of unique concepts, including relationships between synonyms, broader and narrower (parent/child) contexts, and other related concepts."[12]. In addition to the concept as the main type of record in the thesaurus, it also contains a list of synonyms, description of the (equivalence, hierarchical and associative) relationships between terms, definitions of concepts, i.e. a scope notes, etc. All the aforementioned features turn the thesaurus into a complex taxonomic network and ensure that it is not just a mere list of terms in the specific subject area. Thesaurus can be monolingual but also multilingual, thus contributing to interoperability and wide access to the content described.

Classification schemes, on the other hand, are based on the distribution of knowledge within a certain area, according to predefined categories/classes. Unlike thesauri, classification schemes represent a (hierarchical) list of terms, but with no definitions given. Therefore, it is sometimes not possible to unambiguously identify a concept and describe the content.

Simply put: these are actually two different tools. The thesaurus is used for a description of subject content and information retrieval, and the classification scheme is used to organize objects into groups and their contextualization within a specific subject area. The methodology we will apply in our preliminary research will be based on the mentioned difference between these two tools. This will also help us to draw conclusions and suggest directions for

further development of subject vocabularies in the field of arts and related disciplines, especially in the local, Croatian language context.

B. Two domains of terminological control

Two key domains over which terminological control can be applied by TMT and CMGO have been identified, in terms of metadata elements and metadata groups: A) *Type of cultural heritage object* (semantically equivalent to following metadata elements: *Object/work type* element in CDWA and *Object name* element in SPECTRUM standard); B) *Content/Subject* (semantically equivalent to *Subject matter group* elements in CDWA or *Content and subject information subgroup* in SPECTRUM).

Metadata element *Type of cultural heritage object* (or any semantic equivalent elements) provides a fundamental way to refer to an object and therefore this information primarily supports the accountability, identification and access to objects – it identifies the kind of object being described.

Subject metadata elements provide access to content related information. Golub, Ziolkowski and Zlodi [13] summarize three key segments of the subject matter: "In subject analysis and indexing, it is important to identify and represent not only motives depicted in an object (*ofness*) or what an object/work is about (*aboutness*) but also what an object is *per se* (*isness*) and what its function is. [...] *Isness* denotes what a work is or which class of objects it belongs to; therefore, these kinds of subjects are based on the form or type of the object or its genre. Values for *isness* are ideally taken from controlled vocabularies such as the Art and Architecture Thesaurus. [...] *Ofness* and *aboutness*, on the other hand, are most often encountered in the field of fine arts. *Ofness* is about what a work depicts, what a non-expert viewer could see and recognize in the visual content of the object [...], and *aboutness* is related to narrative, thematic, iconographical or symbolic meaning" [13].

In the initial review we found out that in the museum context (Tab. I), CMGO is highly useful for vocabulary control for the *types of museum objects* (which is also its primary function), and also for *content/subject* indexing. While TMT is less usable for vocabulary control for *types of museum objects* (museums do not preserve architectural heritage (e.g. churches, mosques, etc.), but it is highly usable for *content/subject* indexing for all material that has visual content (e.g. photographs, paintings, drawings, etc.).

TABLE I.   USEFULNESS OF CMGO AND TMT VOCABULARIES FOR TERMINOLOGICAL CONTROL IN MUSEUMS

Metadata categories	Vocabularies	
	CMGO	*TMT*
Type of cultural heritage object	High	Low
Content/Subject	High	High

In the cultural heritage protection sector (Tab. II), CMGO is moderately useful for vocabulary control and for the *types of cultural heritage objects* (mostly for movable heritage) and also for *content/subject* indexing. While TMT is highly usable for vocabulary control for *types of cultural*

heritage objects (which is also its primary function), it is also highly usable for indexing of *content/subject* for all material that has visual content.

TABLE II.   USEFULNESS OF CMGO AND TMT VOCABULARIES FOR TERMINOLOGICAL CONTROL IN CULTURAL HERITAGE PROTECTION SECTOR

Metadata categories	Vocabularies	
	CMGO	*TMT*
Type of cultural heritage object	Medium	High
Content/Subject	Medium	High

C. Key specifics and limitations of applied vocabularies

We can highlight some of the specifics, incompatibilities and limitations that we have initially identified in the vocabularies included in research: 1) wide variety of cultural heritage types belonging to the movable heritage such as paintings, sculptures, liturgical equipment, utensils, vessels, vestments, fittings, books, archival materials etc., has not been tackled in TMT, since the large number of them has been already included in CMGO; 2) none of the three vocabularies included in the research defines terminology directly related to intangible cultural heritage; 3) local dialectal names for phenomena of tangible and intangible heritage are not included in either the TMT or the CMGO, which should be examined separately in new research. The lack of dialectal names in the AAT is understandable because it would greatly increase the number of terms, which would go beyond the scope and function of the AAT as an international data value standard.

IV. RECONCILIATION OF THE VOCABULARIES METHODOLOGY

Aitchison, Gilchrist, and Bawden have noted that "over the last 30 or more years many controlled languages, whether thesauri, classification schemes or subject heading lists, have been published, entirely independent of one another and, even within the same subject field, differing in structure, viewpoint and specialization" and identified that "reconciliation or integration of thesauri is a means of overcoming this incompatibility barrier" [14]. There are several approaches or methods to the reconciliation of incompatible controlled languages: mapping, switching, merging and integration.

For this preliminary research, a mapping approach of reconciliation of different controlled languages was chosen and applied. Mapping refers to a "process of establishing relationships between the concepts of one vocabulary and those of another" [15]. The mapping was based on the Simple Knowledge Organization System (SKOS), i.e. "a common data model for knowledge organization systems such as thesauri, classification schemes, subject heading systems and taxonomies" [16]. We used six mapping properties categories from the SKOS data model: exact match, close match, related match, broad match, narrow match, and no match. The SKOS mapping property *skos:exactMatch* links two concepts that are the same, both in semantic meaning and spelling (that also

includes the subject terms that differ in singular/plural form). Exact match indicates "a high degree of confidence that the concepts can be used interchangeably across a wide range of information retrieval applications"[16]. The SKOS mapping property *skos:closeMatch* links "two concepts that are sufficiently similar that they can be used interchangeably in some information retrieval applications"[16]. However, finding exact matches in different knowledge organization systems is rare, so the *skos:closeMatch* is more common and appropriate in majority of situations [15]. As for the SKOS mapping properties *skos:broadMatch* and *skos:narrowMatch*, they "are used to state a hierarchical mapping link between two concepts" [16]. Following the similar methodology [17], we added the *no match* category to explicitly indicate the terms from one system that do not have a matching pair in the other system.

V. MAPPING RESULTS AND INTERPRETATION

Mapping was performed in only one direction (from source to target vocabulary), and was implemented in two phases: (1) mapping of TMT index terms against the CMGO index terms, and (2) mapping of TMT index terms against the AAT concepts. In this preliminary research, we decided that, in order to gain an initial insight into the subject, it is sufficient that TMT is the only source vocabulary, and CMGO and AAT the target vocabularies, and in further research we will need to perform vice versa mappings.

In the first mapping phase, we used the sample of 116 terms from the main class (facet) of TMT called "Components (elements) of buildings". Preliminarily, by reviewing the hierarchical view of TMT thesaurus, we identified this facet as the one that has the most overlap with CMGO (other facets contain only sporadic terms from CMGO). We found out that only 12 terms have matching terms in CMGO, all with *skos:exactMatch* matching level property (Tab. III). The remaining 104 terms from this class do not exist in CMGO.

TABLE III. MAPPING PHASE 1: SEGMENT OF TERMS FROM TMT FACET "COMPONENTS (ELEMENTS) OF BUILDINGS" WITH MATCHING TERMS IN CMGO

Source vocabulary: TMT	Matching level (SKOS)→	Target vocabulary: CMGO
krov	skos:exactMatch	krov
pod	skos:exactMatch	pod
prozor	skos:exactMatch	prozor
stup	skos:exactMatch	stup
vrata	skos:exactMatch	vrata
dovratnik	skos:exactMatch	dovratnik
nadvratnik	skos:exactMatch	nadvratnik
zabat	skos:exactMatch	zabat
oltar	skos:exactMatch	oltar
propovjedaonica	skos:exactMatch	propovjedaonica
trijem	skos:exactMatch	trijem
ambon	skos:exactMatch	ambon

In the second mapping phase, we used the TMT terms from the results of the first mapping and provided mapping to AAT. We found out that all terms except one have

matching terms in AAT, 9 with *skos:exactMatch* and 2 with *skos:closeMatch* matching level properties (Tab. IV).

TABLE IV. MAPPING PHASE 2: MAPPING OF TMT TERMS FROM THE RESULT OF FIRST MAPPING PHASE TO AAT

Source vocabulary: TMT	Matching level (SKOS)→	Target vocabulary: AAT
krov (eng. *roof*)	skos:exactMatch	roofs
pod (eng. *flor*)	skos:closeMatch	floors (surface elements)
prozor (eng. *window*)	skos:exactMatch	windows
stup (eng. *column*)	skos:exactMatch	columns (architectural elements)
vrata (eng. *door*)	skos:exactMatch	doors
dovratnik (eng. *doorjamb*)	noMatch	
nadvratnik (eng. *lintel*)	skos:closeMatch	lintels (spanning elements)
zabat (eng. *gable*)	skos:exactMatch	pediments
oltar (eng. *altar*)	skos:exactMatch	altars (religious fixtures)
propovjedaonica (eng. *pulpit*)	skos:exactMatch	pulpits
trijem (eng. *portico*)	skos:exactMatch	porticoes
ambon	skos:exactMatch	ambos (pulpits)

The process of contributing Croatian terms to the AAT involves precise mapping according to the AAT concepts, translation of existing scope notes from the AAT into Croatian language and recording of references of at least three sources in which a particular Croatian term is used. Already defined scope notes of terms from TMT will greatly help to accurately understand the concepts and consequently contribute to the quality of translation of AAT scope notes. Thus, by mapping the CMGO to the AAT, the CMGO can be enriched with scope notes and references to relevant sources, and adding scope notes to the CMGO would allow the transformation of this terminological tool from a classification scheme to a thesaurus.

VI. CONCLUSION

The initial review of controlled vocabularies included in the research revealed that in the museum context TMT is highly usable for content/subject indexing of all material that has visual content, while in the cultural heritage protection sector CMGO is highly useful for vocabulary control for the types of cultural heritage objects, especially for movable heritage, and also for content/subject indexing. Initial study also detected the following limitations: none of the three vocabularies defines terminology directly related to intangible cultural heritage or include local dialectal names for phenomena of tangible and intangible heritage, which requires future research.

Initial reconciliation of the vocabularies by mapping method showed small overlapping of terms between TMT and CMGO and high overlapping of TMT and AAT. Nevertheless, by mapping CMGO to the AAT, the CMGO can be enriched with scope notes and references to relevant sources, which would allow the transformation of this

terminological tool from a classification scheme to a thesaurus. Existing scope notes from TMT will greatly help to accurately understand the concepts and consequently contribute to the quality of translation of AAT scope notes, which is a mandatory part of contributing Croatian terms to the AAT.

Mapping to AAT and contributing to AAT will indirectly ensure data openness in two ways: 1) human readable data on the AAT thesaurus website, 2) machine readable data on the SPARQL linked open data (LOD) endpoint. Mapping terms to AAT concepts can greatly accelerate the implementation of multilingualism which enables greater visibility and accessibility of Croatian cultural heritage, as already identified in paper by Zlodi, Ivanjko, Štefičar, and Marochini [18].

At the practical level, there are two main different options for developing both Croatian vocabularies – TMT and CMGO. They can be developed separately and periodically exchange information and enrich one terminology with another. And they can be developed within a common framework (for example as one of the projects within "STRUNA" database of Croatian special field terminology [19]. Further research is needed to pinpoint the challenges and opportunities for development and application, to identify best practices that will improve both vocabularies and provide optimal solutions for heritage and educational institutions and users.

REFERENCES

[1] "Dokumentacija i klasifikacija muzejskih i galerijskih predmeta," Muzeologija. Zagreb, vol. 25, pp. 3–117, May 1987.

[2] M. Fruk, "Informacija o radu Radne grupe za klasifikaciju muzejskih i galerijskih predmeta," Bulletin o informatizaciji muzejske djelatnosti SR Hrvatske. Zagreb, no. 2, pp. 22–34, 1990.

[3] ISO 2788: Documentation – Guidelines for the establishment and development of monolingual thesauri. Geneva, 1986.

[4] ISO 5964: Documentation – Guidelines for the establishment and development of multilingual thesauri. Geneva, 1985.

[5] The Getty Research Institute, "Art & Architecture Thesaurus® Online". [Online]. Available: https://www.getty.edu/research/tools/vocabularies/aat/ [Accessed: 16-Feb-2022].

[6] Ministère de la Culture et de la Communication – Direction générale des patrimoines, "Base de données Thésaurus". [Online].

[7] RCHME & English Heritage, Thesaurus of monument types: a data standard for use in archaeological and architectural records. Swindon, 1998. [Online]. Available: http://www.heritage-standards.org.uk/fish-vocabularies/ [Accessed: 16-Feb-2022].

[8] L. Križaj, Tezaurus spomeničkih vrsta: podatkovni standard u inventarima graditeljske baštine. Zagreb: Ministarstvo kulture RH, Uprava za zaštitu kulturne baštine, 2017.

[9] Getty, "About the AAT". [Online]. Available: https://www.getty.edu/research/tools/vocabularies/aat/about.html [Accessed: 17-Feb-2022].

[10] Getty, "AAT: Frequently Asked Questions". [Online]. Available: https://www.getty.edu/research/tools/vocabularies/aat/aat_faq.html [Accessed: 17-Feb-2022].

[11] ISO 25964 – the international standard for thesauri and interoperability with other vocabularies. [Online]. Available: https://www.iso.org/obp/ui/#iso:std:iso:25964:-1:ed-1:v1:en [Accessed: 17-Feb-2022].

[12] P. Harpring, Introduction to controlled vocabularies: terminology for art, architecture, and other cultural rorks. Los Angeles: Getty Research Institute, 2010.

[13] K. Golub, P. M. Ziolkowski, and G. Zlodi, "Organizing subject access to cultural heritage in Swedish online museums," Journal of Documentation. [London], vol. 78, no. 7, pp. 211–247, 2022.

[14] J. Aitchison, A. Gilchrist, and D. Bawden, Thesaurus construction and use: a practical manual. 4th ed. London: Routledge, 2000.

[15] M. L. Zeng, "Interoperability," Knowledge Organization. Würzburg, vol. 46, no. 2, pp. 122–146, 2019.

[16] A. Miles and S. Bechhofer, eds., SKOS Simple Knowledge Organization System Reference. W3C recommendation, 18 August 2009. [Online]. Available: http://www.w3.org/TR/2009/REC-skos-reference-20090818/ [Accessed: 11-Jan-2022].

[17] G. Zlodi, I. Majer, and L. Biličić, "User interfaces for browsing the online catalogues of museums and cultural heritage institutions: preliminary research on mapping of subject access points," in The 44th international convention on information, communication and electronic technology – MIPRO 2021: proceedings, K. Skala, ed. Rijeka: Croatian Society for Information, Communication and Electronic Technology, 2021, pp. 724–729.

[18] G. Zlodi, T. Ivanjko, P. Štefičar, and M. Marochini, "The model of collaborative terminology contribution to the Art & Architecture Thesaurus: application and improvement of crowdsourcing methods in an educational context," in The 43rd international convention on information, communication and electronic technology – MIPRO 2020, K. Skala, ed. Rijeka: Croatian Society for Information, Communication and Electronic Technology, 2020, pp. 722–726.

[19] Institut za hrvatski jezik i jezikoslovlje, "Struna – Hrvatsko strukovno nazivlje". [Online]. Available: http://struna.ihjj.hr/ [Accessed: 18-Feb-2022].