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Abstract: Folklore culture is the summary and embodiment of a way of life, a normative form for people, covering local life in rural communities. A folklore museum typically displays historical objects used as part of people's everyday lives. The representation of information in the digital realm is an important aspect of cultural heritage institutions, with museums taking over a considerable proportion. Having taken into consideration requirements set by the existing literature and examining relevant research and approaches, the authors developed an analysis framework including 16 popular folklore museums around the world, in order to examine various aspects of their digital presence. More specifically, the authors followed a two-fold methodological approach conducting a functionality and semantic analysis of the chosen museums with the purpose of determining the current approaches and tendencies with respect to representation schemata for folklore museum artifacts and their digital representation.

Keywords: semantics; LOD; linked open data; vocabularies; interoperability; folklore museums; cultural heritage; semantic interoperability; metadata schema.

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1 Introduction

The emergence of new information technologies has caused a shift from conventional artifact representation towards different, innovative directions. Museums have undergone functional transformations, and, alongside those, there is a parallel transformation in the expectations of their visitors. These new expectations require agile integrations of the latest information technology into various everyday life operations of the museum.

The importance of digital museum resources was emphasised already back in 2008. Marty (2008) underscored the meaningfulness of adopting a visitor-centred approach and examination when working with the museum's digital resources, website and more, in order to identify the current user needs and their relationship to potential changes. The results of Marty's research and the descriptive and comparative statistics of the survey conducted demonstrated a variety of critical parameters, among which, the importance for museums to have official museum websites. Another observation which has considerable implications for researchers and professionals studying the role of information technologies in museums, is the visitors' delicate relationship with digital means. The museum visitors view websites as complementary, meaning that they would not intend to replace their physical visit experience, a parameter which brings other considerations in mind, such as creating a separation between the dynamics of the two, or taking the opportunity to create combinations which would attract visitors to the physical museum using digital facilities and experiences. The study of digital museum resources and the identification of visitors' needs and expectations is one of the many, sometimes challenging, tasks associated with the digitalisation of cultural heritage information. Digital museum content management and research on metadata standards remain essential to advance the state-of-the-art in digitisation techniques (Marty, 2008).

Digital technology and multimedia have already been utilised by museums for decades, however, museums need to monitor the everchanging visitors' expectations, as the learning experiences at museum websites will become less linear and more interactive (Jareontananan, 2016)]. For this reason, it is of great importance to try and align, to the extent this is possible, the future of museum websites with the evolution of all the relevant technologies in order to endorse their features to serve public interest. Some examples of this practice include the frequent update and modification of the websites, the engagement of visitor interaction, the promotion of online activities or community discussions related to exhibition topics (Walsh, 2010). Collaborative learning, visitors as co-creators or co-authors of content and the cultural exchange of ideas and collaboration among museums are also community enablers for the general public but also for the museum itself. Having conducted an analysis of museum websites throughout the times, the work presented by Brügger (2017), also demonstrates the transition of museums from top-down, authoritative knowledge entities to informative and multidirectional communication channels between them and the visitors. Marty (2008) emphasised that museum websites also serve as a means to justify the museum's mission, attract visitors and demonstrate its objectives, e.g., the preservation of cultural artifacts and more.

Kamariotou et al. (2021) analysed the principles of what the digitalisation of museums, as cultural heritage institutions, entails and examined the parameters of the transition from a conventional to a digital visitors' experience. Technology, as an enabler of digital advancements, paves the way towards its direct applications on the cultural heritage digital realm and the authors provide an overview of four forces which affect and interact with the concept of a digital museum: Technology push, Technology pull, Digital strategy and Innovation Management (Kamariotou et al., 2021). An integrated model of the digital museum is also developed, accompanied by the necessary explanations and directions which need to be followed by cultural institutions (more specifically, museums, in this context) in order to offer improved visitor experience, enhance interactive relationships between the museum and the visitor, and, where applicable, adapt or re-align the museum's mission based on the visitors' needs and requirements (Kamariotou et al., 2021).

This is the case for museums in general; however, one can understand the direct relation of this statement to folklore museums. Folklore museums showcase a diachronic reflection of the daily life activities, customs and traditions of a nation and, as folklore museums are a conceptual subset of general-purpose museums, the analyses conducted for museum websites can be inherited to folklore museums, however, always taking into account the special characteristics and traits of such an institution. The presented research aims to target this specific area of interest, which is the artifact presentation in folklore museums, the current status of their websites and possible future directions. The lack of studies of this nature specifically targeting folklore museums, indicates an area for more domain-specific research. The purpose of the presented study is to conduct the necessary steps in order to give a meaningful answer to the research question: 'Based on existing literature and on the functional and technical information retrieved from their websites; what are the current approaches and tendencies with respect to representation schemas for folklore museum artifacts?'

The following sections of this research include the Background, where the authors present how related and extended research sets the bedrock and rationale of the conducted work, the Methodology section, where the research method chosen is described, the Results, where the authors present the results of the applied method and finally, the Discussion section, where the results are being analysed and their contribution to this field's body of knowledge is explained and motivated. The presented work concludes with the section of Future Work, where the authors share future potential directions of this research and new desired approaches.

2 Background

At this point, should one wish to study similar research conducted in this area, a logical entry point is to have a glimpse at how museum websites are being evaluated and what are the key criteria used by experts and other stakeholders. After the evaluation metrics for a successful museum web presence, this Section proceeds with the presentation of current research on the deployment of Information and Communication Technologies (ICTs) aiming to improve visitor experience and enrich the museum's digital presence and artefact representation in the digital world, inevitably leading us to the importance of semantic technologies in this context, which is the concluding part of this Section.

2.1 Evaluating museum websites

The reason for this is that the evaluation of a museum website is an important part of its lifecycle and can help gain a deeper insight on what is to be prioritised next. Kabassi (2017) examined the state of the art for evaluation experiments on museum websites with special emphasis put on the use of ICTs, such as the use of mobile apps, Virtual Reality (VR) tours and more. The conducted research concludes on the most common criteria for evaluation. One can understand that the choice of the evaluation criteria is not a trivial procedure and can be rather complicated, however, some of the most common and rather important criteria appear to be usability and, in this context, content quality, accessibility, efficiency, user interface and metaphors, overall presentation/design.

More criteria which can be closely related to usability are: 'consistency, interactivity & feedback, navigation/orientation and multimedia usability', while more include: 'structure, completeness/richness, currency/clarity, learnability, role playing and text comprehension' (Kabassi, 2017). Apart from usability, various parameters of functionality are also included in the evaluation procedure, which is what makes 'functionality' another big category for evaluation after 'usability'. Some examples of functionality criteria include: 'multimedia features, services/mechanisms, online booking/event booking, email support, offers/announcements, offer of educational services, research and more' (Kabassi, 2017). In Figures 1 and 2, respectively, the evaluation criteria for inspection and empirical methods are shown, as presented by Kabassi, (2017).

Figure 1 Criteria used in inspection methods (Source: this table is taken from Kabassi, 2017)

	Monistrol et al. [65]	Di Blas et al. [52]	Van Welie and Klaasse [30]	Olsina Santos [53]	Garzotto et al. [54]	Harms and Schweibenz [75]	Lazarinis et al. [46]	Campbell and Wells [66]	Davoli et al. [39]	Dyson and Moran [28]	Fotakis and Economides [25]	Lin and Gregor [62]
Usability		x		x	x			x	x	x	x	
Currency/Clarity		x		x								
Consistency		x			x					x		
Accessibility	x	x		x	x				x	x		x
Complete-ness/Richness		x										
Quality Content	x	x			x	x		x	x	x	x	
User interface and metaphors				x	x	x			x	x		x
Structure		x							x			
Navigation/Orientation				x	x	x			x	x		
Interactivity & Feedback				x					x		x	x
Multimedia Usability		x			x				x	x		
Learnability					x					x		
Easy to use/simplicity												x
Efficiency		x		x	x				x	x		
Role Playing						x						
Text Comprehension						x				x		
Overall presentation-Design			x			x		x		x	x	
Functionality				x								
Multilingua-lism		x		x			x		x			
Multimedia features		x		x					x			
Educational services									x			
Services mechanisms			x				x		x	x	x	
Support of cultural tourism, Research									x			
Web communities							x		x			
Privacy, standards, regulations									x			
Mantainability - compliance - reliability				x					x is further			
Other												
Adaptivity/adaptability							x	x				
Technical	x						x				x	
Partnership												x

Figure 2 Criteria used in empirical methods (Source: this table is taken from Kabassi, 2017)

	Tasich and Villaespesa [73]	Chiang et al. [2]	Pallas and Economides [51]	Garzotto et al. [54]	Harms and Schweibenz [75]	Marty [74]	Streten [57]	Lin et al. [32]	Lopatovska [34]
Usability	x	x	x	x					x
Consistency				x					x
Accessibility				x				x	
Quality content		x	x	x	x				
User interface and metaphors		x		x	x		x	x	x
Navigation/orientation				x	x		x		
Interactivity & feedback			x					x	x
Multimedia usability				x					
Learnability				x				x	x
Efficiency		x		x					x
Role playing					x				
Text comprehension					x				
Overal presentation - design	x		x		x	x	x	x	x
services-mechanisms			x				x		
Mantainability - compliance - reliability		x							
Architecture	x								
Technical			x						
Engagement-positive affect								x	

Apart from the aforementioned criteria, offering VR environments is another important aspect for museums, as it can act as a means to promote and preserve cultural heritage artifacts in an interactive and more communicative manner than other conventional means. In this light, a set of criteria of evaluation for VR environments is also gathered and presented by Kabassi, (2017), according to the conducted research on the subject. Lopatovska (2015) conducted a comparative evaluation of four art museum websites in order to pinpoint their strong and weak sides with respect to navigation, design and content features, based on existing evaluation framework criteria. The most prominent predictor for the visitor's overall museum impression was found to be website aesthetics. Among the criteria covered, usability (e.g., navigation, contact info, text clarity) and interactive features (e.g., social media, gaming elements), image manipulation (e.g., image zoom, image saving, print) were also included.

In a similar context, Garcia-Madariaga et al. (2018) outlined the variables which website quality is defined by, by comparing two superstar museums. Their results offered important insights on the design of the websites and, among others, how to build trust and maintain a loyal and steady number of visitors. As the authors mentioned, there is little to none research regarding which elements of the museum websites attract loyal users, which is one of the reasons their work is of value, and they managed to showcase that website quality indeed has a significant positive effect on this matter.

2.2 Information and communication technology (ICT) in the service of the digital museum concept

Information and Communication Technologies (ICTs) are critical for the realisation of conceptual ideas regarding advancements in the cultural heritage context. Ioannakis et al. (2020) used machine learning (supervised learning) to describe cultural objects and digitally enrich visits for the museums with minimum technical specifications required from the museum's infrastructure. The developed approach started as a case study of the Folklore Museum of Xanthi, Greece, where the initial benchmark data set originated from, and, currently, Ioannakis et al. (2021) proposed museum visit enrichment can be incorporated on demand by the interested (folklore) institutions]. Sperlí (2021) developed a cultural experience framework, including a Chatbot based on a deep learning approach and a micro-services architecture, to allow the visitors/tourists to interact with this conversational interface and be provided with answers to their questions, suggestions regarding their visit path and other recommendations which can improve their cultural experience. Another conversational agent in the cultural heritage context was proposed by Machidon et al. (2020). The agent, named CulturalERICA, supports speech recognition techniques, Text-to-Speech (TTS), dialogue management, multilingualism and advanced identification and ranking of results retrieved from Europeana; a major European digital library, museum and archive of digital cultural objects. This digital library is based on the Semantic Web principles, however, due to the vastness of information, searching for and accessing the digital artifacts can be very challenging Machidon et al. (2020). CulturalERICA improves the accessibility to the digital library by offering interactive, virtual assistance to the user, and enabling them to better navigate through the plethora of information available in the Europeana digital library of cultural objects. Machine learning has also been used by Puspasari et al. (2022) to proposed a virtual museum conceptual model for learning purposes, supporting AR/VR games, virtual tours and other gamified and interactive means, enabling museums to offer alternative ways of access to their collections in times where physical visits are limited (e.g., COVID-19). The inability to access tangible objects in a museum is not only introduced by the limitation of physical presence, but also by the restriction of haptic prohibition that many museums enforce. Although a logical restriction, it can be a game-changer for visually impaired visitors who depend on the haptic sense to experience the exhibited artifact. To help alleviate this situation, Pistofidis et al. (2021) collected user preferences, to develop the specifications and functionalities of a smart exhibit, which will allow for a morphological, topological, and dimensional design of an object to be 3D digitised and printed for haptic interaction, something currently under development.

2.3 Semantic technologies and the cultural heritage domain

On a different but pivotal note, when one is to talk about new ICTs in the area of artifact representation, the notion of a semantic website cannot be excluded. The innovations of the Industry Revolution 4.0 and the ability of the Semantic Web to change information representation in a more linked and effective manner, are aspects that need to be taken into

consideration. Lourdi et al. (2007), as early as in 2007, created an extensive multi-layer metadata schema for digital folklore collections, its purpose being the organisation of the museum exhibits and artifacts in a semantically valuable manner. This metadata model suggests an efficient way to make cultural heritage collections accessible by improving their findability and interoperability among heterogeneous systems. The developed model includes 7 metadata categories (collection, notebook, chapter, sub-section, page, photograph and objects) and 3 types of data (descriptive, structural and administrative), and it denotes the metadata standard followed (e.g., Dublin Core or other), but also makes sure the inheritance property of the described elements is being followed (Lourdi et al., 2007). The metadata schema is described and presented, allowing for each described object to be properly organised in terms of adequate metadata, and thus become more easily discoverable by the interested user.

In general, information retrieval, user-generated context, linking the data and allowing it to be accessible by machines (not only humans) are only some of the valuable aspects of the Semantic Web in our research context. Rahmania et al. (2022) put this into practice by building a museum website using the Semantic Web principles to make the content machine understandable but also help the museum reach a wider share of visitors and increase its visibility and credibility, on which note, Rahmania et al. (2022) also mentioned a clear correlation between usability and credibility. The website the authors dealt with, was initially not based on any Semantic Web principles and a new set of requirements to transform the initial static websites were necessary. In addition, Monistrol et al. (2007), already back in 2007 had underscored the importance of search engines being able to identify the museum resources' related information such as title, author, contents, keywords and more. This is where the role of metadata becomes primary and comes to the foreground. The research conducted by Monistrol et al. (2007) involved the analysis and evaluation of 68 Catalonian Museum websites and aimed to monitor various defined quality levels based on parameters such as: accessibility, metadata, visibility, source code and others. The metadata tags of the websites, the presence of Resource Description Framework (RDF) schemas, as well as the way in which metadata presence is spread in each website were examined. Another parameter the Catalonian Museum websites were analysed by was the source code quality, incorporation of XML language and more. Finally, the results of the conducted research were presented in order to provide measures for a museum website's general quality and public awareness. The essentiality of metadata standards research on museum content management was also emphasised by Marty (2008), as mentioned previously.

When it comes to official representation schemas in the cultural heritage field, one of the most prominent conceptual models is the International Council for Documentation (CIDOC) Conceptual Reference Model (CRM). This model acts as an ontology within the context of cultural heritage. CIDOC CRM provides a common-ground semantic framework for the representation of cultural heritage information integration, and it has by now been recognised as an ISO standard. Conducting a search with the keyword 'museum' in the Linked Open Data Vocabularies (LOV), one directly runs into Erlangen CRM/OWL which is an implementation of CIDOC CRM in Web Ontology Language (OWL) and acts as an interpretation of the conceptual reference model in a logical framework. Erlangen CRM/OWL (ECRM) is expressed in RDF and RDF Schema, and it consists of 84 classes. The metadata of ECRM is expressed in RDF and it follows the representation of classification schemes, taxonomies and controlled vocabularies as it is defined in the Simple Knowledge Organisation System (SKOS). 'The primary role of the CRM is to serve as a basis for mediation of cultural heritage information and thereby provide the semantic 'glue' needed to transform today's disparate, localised information sources into a coherent and valuable global resource.' CIDOC-CRM (2014) is often used with standards for Linked Data as the Resource Description Framework (RDF) can act as the technical infrastructure to present CRM data on the web.

Specifically for folklore museums, some adaptations and research based on CIDOC-CRM have been conducted in order to approach artifact representation in this context. Martini et al. (2016) developed an ontology, namely OntoMP, which targets the Museum of the Person. '*Museum of the Person aims at gathering testimonials from every human being, famous or anonymous, to perpetuate their history*' (Almeida et al., 2001). The objective of the Museum of the Person (MP) is to allow the visitor to extract information and knowledge from various life stories presented to them in a virtual manner. The virtual navigation of the Portuguese Museum of the Person is based on the OntoMP ontology, which was built based on the Digital Humanities Thesaurus (DTD) and an exhaustive concept extraction the authors conducted in order to include all the relations and information needed to describe the life stories in the virtual tour. In the list of the ontology concepts, among others, were the following: *'ancestry, offspring, house, job, education, episode, dating, accident, migration, festivity, political event, catastrophic event, marriage'* and more. In addition, some of the identified relations included, among others, the following: *'performs, depicted, visits, lives, occurs, has-type, refers to'* and more. The OntoMP ontology is specified and described so as to follow the CIDOC-CRM standard to ensure its compatibility with the standard museum ontology and future interoperability in the same domain. Similarly, as a continuation of the aforementioned study, Araújo et al. (2018) expanded the CIDOC-CRM ontology in order to manage an automatic extraction of information from their annotated repository (which in this case is a collection of XML documents) with the purpose of providing museum visitors with the ability to visit virtual exhibition rooms. The authors refined the designed ontology with FOAF (Friend of a Friend) and DBpedia and they built a text filter which converts the useful information from peoples' interviews into RDF triples in order to capture the concepts described by the ontology (Araújo et al., 2018). In other words, Araújo et al. (2018) proposed a general architecture to create the museum's virtual exhibition rooms by extracting information from the document repository.

Luchev et al. (2008) also attempted to preserve and present the Bulgarian folklore heritage by using knowledge technologies for its semantic presentation. For this purpose, the Folklore Ontology Concept, which served as the main ontological concept, was used. The authors related the folklore object to three levels of knowledge (also referred to as 'thematic entities'), which are enriched with sub-levels of

data classification. This ontology represents the semantics of Bulgarian folklore context. Another example of knowledge representation is the research conducted by Tan et al. (2010). In this research, the authors designed and then evaluated a knowledge representation approach based on CIDOC-CRM semantic architecture in order to capture the information of a folklore dance from various perspectives. Making use of the main concepts and annotations of CIDOC-CRM, this piece of work attempts to assist the user in identifying and reusing relationships in the knowledge domain of ethnic dances.

Some more recent studies are focused on the utilisation of Linked Open Data technologies to connect and improve the linkability of cultural heritage information. Marcondes (2021) proposed and developed classification schemata, a Culturally Relevant Relationships (CRR) vocabulary and a classification schema of types of heritage objects, in order to provide context and integrate cultural artifacts in other heritage collections available. The interlinking of resources and correct classification of information is a pivotal aspect of data discoverability and interoperability for each domain. Another Linked Open Data approach for cultural collections is presented by Kotis et al. (2021) and it aims to transform a children's art museum collection into HTML-embedded structured data using the Europeana and Schema.org data models, showing that the Linked Open Data (LOD) paradigm is gaining more and more traction in the cultural heritage domain as well.

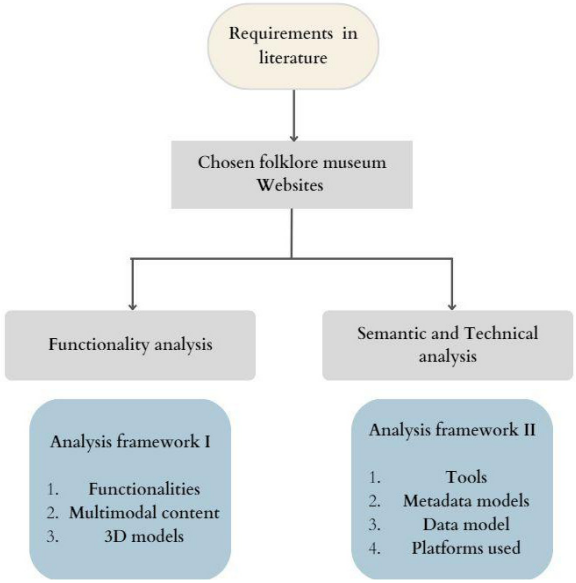
From what one can observe, it becomes obvious that there have been attempts to include semantic technologies in the cultural domain of museums, however, there is yet to exist a standardised approach for folklore museums in specific. Having considered the related research on the topic, the contribution of semantic technologies on museum artifact representation, as well as all the important characteristics of museum websites, it is time to move on to the Methodology section, where the proposed analysis frameworks will help gain more insight on the examined situation.

3 Methodology

This section describes the chosen methodology for the presented study. For this piece of research, sixteen (16) folklore museums around the world were selected for the analysis and this list of museums was chosen based on some selection criteria. To begin with, the authors tried to involve a variety of countries and not limit the study to European institutions, for the sake of expanding the range of different practices, which could differ from one continent to another, or for future reference. Secondly, for a folklore museum to be included in the list, it needed to have an official and organised website. Thirdly, the museum needed to either entirely focus on folkloric art or tradition, or have a distinct division dedicated to folklore. The vast majority of the selected museums have a clear and targeted focus on the folkloric tradition of the country of their origin. Folklore museums with no online presence or an official website were out of the scope of this research, so they were not included in the analysis. After having taken into consideration the information gained through related literature sources, the authors conducted a two-folded analysis on the chosen folklore museum websites. The rationale behind the selection of aspects included in the analysis framework is mainly predicated on the evaluation criteria for museum websites, as well as the facilitations introduced by semantic technologies, as presented and discussed under the Section 'Background'. The existing related research on the subject, especially (Kabassi, 2017), in combination with the current status in information presentation for cultural heritage artifacts, acted as the central point of guidance towards the development of this analysis framework.

An overview of the methodological approach for this research is summarised in the chart of Figure 3. The study begins with the examination of relevant literature and elicitation of requirements set for museum Websites and digital presence, then the selection of the 16 folklore museums takes place (the selection criteria is described earlier). To continue, the two-fold approach of (i) a functional analysis framework and (ii) a semantic and technical analysis framework is followed.

Figure 3 The proposed methodological approach



3.1 Functionality analysis

The first part of the analysis framework includes a functionality analysis of the folklore museum websites. Kabassi (2017) and Lopatovska (2015) both mention usability and interactive means as important evaluation criteria for museum websites, while functionality is analysed further by Kabassi (2017). The authors of this study decided to include both aspects in the analysis framework and add the binary aspect '3D content' in order to note down which folklore museums have developed this so far and examine whether there appears to be a tendency to include this aspect in the future.

3.2 Semantic and technical analysis

The second part of the analysis framework focuses on the semantic and technical aspects of the folklore museum websites. The rationale behind this part is based on the need for information to contribute to the Semantic Web in order to align with the new ICTs and benefit from their advantages but also on the research conducted by Rahmania et al. (2022). In general, in the following table (see Table 1), a brief motivation for the chosen methodological approach for this research is presented.

Table 1 Purposes for using a semantic and functionality analysis of folklore museum websites and respective means of achievement

Purpose	*Means*
Understand the common practices for information presentation in folklore museum websites	Functional analysis of the websites, literature & desktop study
Examine the presence of metadata, enable the web of data (Semantic Web)	Semantic and technical analysis of the websites
Envision possible ways to improve visibility and the preservation of artifacts	Semantic and functional analysis of the websites
Benchmark the results against existing best practices and standards for cultural heritage institutions	Functional analysis of the websites & literature study

In the following Section, the results of the two-fold analysis framework approach are presented under each segment respectively.

4 Results

The Analysis Framework for Folklore Museums is presented in this section. The functionality analysis, availability of multimodal content and 3D representations of exhibits on the websites of the selected folklore museums under analysis, are presented in Table 2.

Similarly, the findings of the semantic and technical analysis of the folklore museums under examination, their use of tools, metadata models and platforms on their websites are presented in Table 3.

Table 2 The folklore museums functional analysis

Museum name /Country	*Functionalities*	*Multimodal content*	*3D Models*
Norsk Folkemuseum, Oslo/Norway	Language: Norwegian & English, Museum location, info & history, Contact details, Main & temporary exhibitions (photos & videos), Guided tours booking and planning, Museum shop, Knowledge resources, Research & documentation activity (research for folklorists, ethnologists, historians, etc.), social media (Facebook, Twitter, Instagram, YouTube, Tripadvisor)	Flickr account for photos archive- free of charge to use for museum journalism, Pictures & videos of exhibitions, Knowledge resources (library & archive) available to public after arrangement	No
The Museum of English Rural Life/England	Language: English, Museum location, info, mission & history, Contact details, Museum Collections, Museum shop, Donations function for the collections, Community projects & Volunteering, Newsletter function, Museum Database search function, Social media (Facebook, Twitter, Pinterest, Instagram, University of Reading Museums & Collections)	Online content: Text & images, Archives & library	No
National Folk Museum of Korea/South Korea	Languages: Korean & English, Museum location, info & history, Contact details, Museum Exhibitions, Artifact and Archive Donation service, Annual Museum Report, Search for a Collection function, social media (Facebook, Twitter, Instagram, YouTube, Blog (in Korean))	Special Exhibitions online content: Text & images	No
National Crafts Museum & Hastkala Academy/India	Languages: Hindi & English, Museum location, info & history, Museum Shop & Café, Contact details, Museum Collections (Exhibitions, Galleries, Wall Murals and more), Craftsperson Workshops (for kids and professionals), Booking for cultural events function, Careers and working positions, social media (Instagram, YouTube)	Museum TV (Videos), Virtual Galleries	No
Hida Minzoku Mura Folk Village/Japan	Languages: Japanese & English, Museum location, info & history, Hida Takayama Craft Experience Centre, Annual Events Information	Text & images	No
Skansen/Sweden	Languages: Swedish & English, Museum Shop, Newsletter function, Calendar of upcoming events and highlights, Contact details, Companies & events organisation, Museum Thematic Areas (Village, Zoo, Aquarium, etc.), School Workshops, social media (Facebook, Instagram, YouTube, DigitaltMuseum), Work opportunities, Support/Sponsorship/Donation	Virtual galleries, Text & images	No

Table 2 The folklore museums functional analysis (continued)

Museum name /Country	*Functionalities*	*Multimodal content*	*3D Models*
Museum Europäischer Kulturen/Germany	Languages: German & English, Museum Shop, Events calendar, Newsletter function, Museum info & history, Contact details, Companies & events organisation, Separate menu for Exhibitions and Collections in detail, Guided tours, visits and workshops, Opening hours, location and contact info, social media (Facebook, Instagram, Google Arts & Culture, Blog, Research and scholar contact info point, Library, Network and partners	Google Arts & Culture page, Text & images	Yes
Metsovo Folk Art Museum/Greece	Language: Greek & English, Museum info & history, opening hours & contact info, Online collections, 'Upload your own story' function	Timeline image gallery, 'Memories' images in thematic groups, Videos, Game	Yes
Museum of International Folk Art/Mexico	Languages: English, Museum location, info & history, Special Needs Accessibility, Newsletter function, Museum Shop & Café, Contact details, Online Exhibitions, Current exhibitions and collections, Possibility for Online tours via zoom, Events calendar, DIY Folk Art projects for home, Library & Archives, Lesson Plans on various cultural subjects, Museum Book Publications, Donations & Volunteering, Job opportunities, social media (Instagram, Facebook, YouTube, Twitter, Pinterest, Blog)	Images & videos, Live Streaming tours	Yes
Volkskunde Museum Salzburg/Austria	Languages: German & English, Museum location, info & history, Special Needs Accessibility, Newsletter function, Museum Shop & Café, Contact details, Online Collections, Museum Publications, Library, social media (Instagram, Facebook, Youtube, Twitter)	Image gallery, photographs of paintings organised in collections	No
Poble Espanyol - Spanish Village Barcelona/Spain	Languages: Spanish, French & English, Museum location, info & history, Newsletter function, Contact details, Agenda of Activities/ Calendar with filtering options for the user, Permanent Workshops, Handicraft Workshops, Exhibitions in thematics, Hiring venues for events, Family activities, Social media (Instagram, Facebook, Linkedin, Twitter)	Images & text	No
'ASTRA' National Museum Complex/ Romania	Languages: Romanian & English, Museum location, info & history Museum App, Newsletter function, Contact details, Events Calendar, Activities for Children, Museum conservation and restoration department, Museum publishing house (publications), social media (Instagram, Facebook, Tripadvisor, Twitter, Google Arts & Culture, Blog)	Images & videos	No
The Glenview Folk Museum/Ireland	Languages: English, Museum location, info & history, Museum shop & restaurant, Contact details, Tour guide arrangement, Online collections	Text & some images	No
Volkskundemuseum/ Belgium	Languages: German, Dutch, Spanish, French & English, Museum location, info & history, Museum shop, Newsletter function, Contact details, Job opportunities, Events & Exhibitions calendar, Donations & Volunteering, Online collections, social media (Instagram, Facebook, Linkedin, Twitter, YouTube)	Browsing exhibitions, text & images, Live Streams, social media	Yes
The American Folk Art Museum/USA	Languages: English, Museum location, info & history, Museum shop, Newsletter function, Membership function, Exhibitions, Thematic collections (paintings, photographs, toys, works on paper and more), Events calendar, Contact details, Library, archives and publications, Donations, social media (Facebook, Twitter, YouTube, Pinterest, Vimeo)	Text, images, video, Vimeo, Exhibitions: images & text	No
Bowraville Folk Museum/Australia	Languages: English, Museum location, info & history, Events calendar, Exhibitions, Programs the museum is involved in, Contact details, Publications & research, Consultants register, Job opportunities, Artist's opportunities, Social media (Facebook, Twitter, Instagram)	Images & text, Podcasts, Forum	No

Table 3 The folklore museums semantic and technical analysis

Museum name /Country	*Tools*	*Metadata models*	*Data model (*)*	*Platforms used*
Norsk Folkemuseum, Oslo /Norway	Analytics: Google Analytics	No standardised metadata found[2], Metadata: Title, Description, Copyright, Keywords	Custom data model	Web Server /Reverse Proxy: Nginx, Platform as a Service (PaaS): Amazon Web Services, JavaScript Frameworks: AngularJS, Content Delivery Network (CDN): Cloudfare, jsDelivr, cdnjs, Security: SSL/TLS enabled, Protocol: TLS 1.2
The Museum of English Rural Life /England	Video Players: YouTube, Wordpress Plugins: Breadcrumb NavXT, The Events Calendar, Yoast SEO, Cookie Notice, wpBakery, Search Engine Optimisation (SEO): Yoast SEO, Analytics: Google Analytics	No standardised metadata found	No data model or standard mentioned	Content Management System (CMS): Wordpress, Blogs: Wordpress, Page Builders: wpBakery, Databases: MySQL, Web Servers: Apache, Platform as a Service (PaaS): Amazon Web Services, Content Delivery Network (CDN): Amazon S3, Security: SSL/TLS enabled
National Folk Museum of Korea /South Korea	SWFObject opensource JavaScript library to embed Adobe Flash content on web pages	No standardised metadata found	No data model or standard mentioned	Web Servers: Apache, JavaScript Frameworks: GSAP, Content Delivery Network (CDN): jsDelivr, Security: SSL/TLS enabled, Protocol: TLS 1.3
National Crafts Museum & Hastkala Academy /India	Wordpress Plugins: SiteOrigin Page Builder	No standardised metadata found	No data model or standard mentioned	Content Management System (CMS): Wordpress, Blogs: Wordpress, Page Builders: SiteOrigin Page Builde, Databases: MySQL, Web Servers:Apache, JavaScript Frameworks: GSAP, 11 Security: SSL/TLS enabled
Hida Minzoku Mura Folk Village /Japan	Analytics: Google Analytics, Advertising: Twitter Ads, Widgets: Twitter	No standardised metadata found	No data model or standard mentioned	No more info found
Skansen /Sweden	Search Engine Optimisation (SEO): SEOmatic, Widgets: AddThis, Analytics: Google Analytics, Hotjar, Facebook Pixel, Pinterest Conversion Tag, Moat, Advertising: Adform	No standardised metadata found	No data model or standard mentioned	Web Server /Reverse Proxy: Nginx, Content Management System (CMS): Craft CMS, Web Frameworks: Yii, Content Delivery Network (CDN): Cloudfare, cdnjs, Security: SSL/TLS enabled
Museum Europäischer Kulturen /Germany	Video Players: VideoJS, Analytics: Matomo Analytics, Google Analytics, Facebook Pixel	No standardised metadata found	No data model or standard mentioned	Content Management System (CMS): TYPO3 CMS, Web Servers: Apache, Security: SSL/TLS enabled
Metsovo Folk Art Museum /Greece	Video Players: MediaElement.js, Wordpress Plugins: Contact Form 7, Analytics: Google Analytics	No standardised metadata found, Metadata: Title, Copyright, Keywords	Custom data model	Web Server /Reverse Proxy: Nginx, Content Management System (CMS):Wordpress, Blogs: Wordpress, Databases: MySQL, JavaScript Frameworks: GSAP, Content Delivery Network (CDN): Cloudfare, cdnjs, jsDelivr, jQuery CDN

Table 3 The folklore museums semantic and technical analysis (continued)

Museum name /Country	*Tools*	*Metadata models*	*Data model (*)*	*Platforms used*
Museum of International Folk Art /Mexico	Analytics: Google Analytics, Facebook Pixel	No standardised metadata found, Metadata: Title, Keywords exist	Custom data model	UI Frameworks: ZURB Foundation, Web Servers:Apache, Security: SSL/TLS enabled, Protocol: TLS 1.2
Volkskunde Museum Salzburg /Austria	No more info found	No standardised metadata found, No model or standard mentioned -1 keyword	Custom data model	Web Servers: Apache, Security: SSL/TLS enabled, Protocol: TLS 1.3
Poble Espanyol - Spanish Village Barcelona /Spain	Video Players: YouTube, MediaElement.js, Wordpress Plugins: Contact Form 7, WP Rocket, Yoast No model or standard mentioned, Metadata: Title, Description, Copyright, Keywords Content Management System (CMS): Wordpress, Blogs: Wordpress, Web Servers: Apache, Databases: SEO, Moove GDPR Consent, Search Engine Optimisation (SEO): Yoast SEO, Yoast SEO Premium, Analytics: Google Analytics, Facebook Pixel, Microsoft Clarity, Google Ads Conversion Tracking, Advertising: Microsoft Advertising	No standardised metadata found, Metadata: Title, Description, Copyright, Keywords	Custom data model	Content Management System (CMS): Wordpress, Blogs: Wordpress, Web Servers: Apache, Databases: MySQL, JavaScript Frameworks: GSAP, Security: SSL/TLS enabled, Protocol: TLS 1.2
'ASTRA' National Museum Complex /Romania	Video Players: YouTube, Ecommerce: Cart Functionality, Search Engine Optimisation (SEO): Yoast SEO, Analytics: Google Analytics, Wordpress Plugins: The Events Calendar, Tablepress, Yoast SEO, Breadcrumb NavXT	No standardised metadata found, Metadata: Title, Keywords exist	Custom data model	Content Management System (CMS): Wordpress, Blogs: Wordpress, Security: SSL/TLS enabled, Protocol: TLS 1.3, Web Servers: Apache, Databases: MySQL
The Glenview Folk Museum /Ireland	Wordpress Plugins: Divi, Analytics: Google Analytics	No standardised metadata found, Metadata: Title, Keywords	Custom data model	Content Management System (CMS): Wordpress, Blogs: Wordpress, Page Builders: Divi, Web Servers: Apache, Databases: MySQL
Volkskundemuseum /Belgium	Analytics: Google Analytics, Hotjar, Facebook Pixel, Surveys: Getsitecontrol, Widgets: Getsitecontrol, Wisepops, Shopify Apps: Shopify Buy Button	No standardised metadata found	No data model or standard mentioned	Web Server /Reverse Proxy: Nginx, Security: SSL/TLS enabled, JavaScript Frameworks: Alpine.js

Table 3 The folklore museums semantic and technical analysis (continued)

Museum name /Country	*Tools*	*Metadata models*	*Data model (*)*	*Platforms used*
The American Folk Art Museum /USA	Analytics: Google Analytics	No standardised metadata found, Metadata: Title, Keywords exist	Custom data model	Content Management System (CMS): Wordpress, Blogs: Wordpress, Security: SSL/TLS enabled, Protocol: TLS 1.2, Web Servers: Apache, Databases: MySQL, Web Server /Reverse Proxy: Nginx, JavaScript Frameworks: Handlebars
Bowraville Folk Museum /Australia	Analytics: Google Analytics, MonsterInsights, PDF.js, Wordpress Plugins: Tablepress, Yoast SEO, Gravity Forms, MonsterInsights, Smash Balloon Instagram Feed, Search Engine Optimisation (SEO): Yoast SEO	No standardised metadata found, Metadata: Title, Description, Copyright, Keywords exist	Custom data model	Content Management System (CMS): Wordpress, Blogs: Wordpress, Security: SSL/TLS enabled, Protocol: TLS 1.2, Web Servers: Apache, Databases: MySQL, UI Frameworks: Bootstrap, JavaScript Frameworks: React

The adoption of ICTs in folklore museums from all over the world is a strong indicator of the current trend advocating the utilisation of their key capabilities in the respective services. Furthermore, a folklore museum based on augmented reality technology and artificial intelligence gives easier access, more attractive and more interesting than maintaining the model of traditional museums and helps to learn about cultural heritage in younger generations. For instance, a virtual folklore museum can enable the teachers to enrich the traditional way of learning because of the attractiveness it causes at younger ages. On the other hand, a museum can use ICT to spread to a wider audience, and more swiftly, even to identify assistants for its maintenance that embraces the history of a culture. The majority of folklore museums, which we examine in this research, do not offer a virtual tour to the public and other critical functionalities, such as the location of the museum, are offered in an unstructured manner. The functionality analysis of the examined folklore museums results in the following observations:

- All folklore museums websites are offered in at least two languages, the native language of the country and the English language.
- Almost all of the examined museums present in their websites some general information and their history. Less of them also include information regarding their location. In addition, almost all of them provide their contact details.
- A considerable percentage of the examined folklore museums (almost 45%) use ICTs with the sole purpose of information provision, without them including information regarding their exhibitions and collections or making use of the latest technological advances in that regard.
- About 31% of the museums offer the online visitor the ability to search through their databases and exhibition material using search functions, e.g., searching by keyword or category. However, no SPARQL endpoint to allow for semantic search was identified for any of the examined folklore museums to allow for other search alternatives by more experienced users, should there be this need.
- 45% of the examined museums provide archives & publications as well as a library digital section.
- The majority of the museums have a social media presence but only 6 out of 16 allow users to donate while only 3 out of 16 have a special form asking for volunteers. Less than half of the museums allow for the possibility of user contribution to enrich museum exhibits or material.
- About half of the museums have an event calendar, as well as a newsletter function.
- 37% provide job opportunities through their website.
- The lower rates bring together two very important services: accessibility for disabled people (2 out of 16) and a mobile application (1 out of 16) so that the citizen can find more information about the museum even in special circumstances, such as while they are on the road.

From a technical perspective, at most one folklore museum does not use Google Analytics and only 5 out of 16 are using Search Engine Optimisation (SEO). As a result, they are not fully aware of the usability of the websites, the attendance of their websites, and many other important indicators. In addition, they do not gain traffic from the organic results of search engines. 70% (approximately) of the examined museums use a CMS platform for the websites and a 50% use

the bundle of WordPress CMS and MySQL database. 10% of the websites are not using SSL/TLS in order to provide a safer internet experience for the users, which is negative with respect to user trust and visibility of the website. None of the examined museums is using standardised metadata and no reference of a data model or standard to describe their data is mentioned. Almost half of them have some metadata in the HTML code of the websites. Another critical conclusion is that none of the examined museums offers standardised metadata and there is no clear reference to data models or standards used widely among them, which understandably, implies that there is currently no advanced utilisation of the benefits of semantic technology in this domain, as also discussed in the Background section of this work. As mentioned earlier, none of the examined museums were providing a SPARQL query endpoint, instead, 5 out of the 16 folklore museums offered the ability for database search or search through their collections using keywords and thematic areas. Perhaps this is something expected, considering the fact that none of the museums offered metadata in a standardised form. However, in order to further examine this matter and include insightful parameters to target it, more research needs to be conducted.

5 Conclusion and further research

The conducted piece of research intends to contribute to the domain of museum and folklore museum website content management, website quality, perceived credibility and visibility by the general public, as well as information and artefact presentation in a cultural heritage context. Furthermore, this research is an attempt to form a best practice guide and connect it to the latest ICTs, enabling the web of data and utilising these new technologies to shift towards a new vision for folklore museum websites, but also, at a second phase, towards a standardised approach for representation.

As a next step within the field of cultural heritage and artefact representation schemas, a suggested track is a systematic, scientific review of conceptual modelling principles with a special focus on folklore museums. The central aim of this research would be to investigate the existing conceptual models for information presentation and potentially develop a data model tailored specifically to match the needs of folklore museums, a subset of cultural heritage institutions which currently appears to be underrepresented but is an important source of cultural knowledge, which needs to be preserved for the generations to come, with the utilisation of new ICTs being on the epicentre as a means of assistance for this purpose.

At this point, some folklore museums already offer virtual tours by using augmented reality and artificial intelligence but the majority of them offer a description or photos of what visitors can find on them. The aforementioned problem opens a new pathway to a next generation folklore museum by transforming it to the digital realm. For this purpose, a new data model or a standard can offer the opportunity to develop a European Folklore Portal, which will represent all European folks in one single entry point. This folklore interoperability means can facilitate the finding of common elements between the various European cultures in order to compare them. This movement can potentially expand the research to other areas of culture.

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Notes

1 The examined websites of the selected folklore museums can be found in Appendix A.

2 **(*)** No further information found.

Appendix A – List of the Examined Folklore Museum Websites

Norsk Folkemuseum

https://norskfolkemuseum.no/en

The Museum of English Rural Life

https://merl.reading.ac.uk/

National Folk Museum of Korea

https://www.nfm.go.kr/english

National Crafts Museum & Hastkala Academy

http://nationalcraftsmuseum.nic.in/

Hida Minzoku Mura Folk Village

https://www.hida.jp/english/

Skansen

https://www.skansen.se/en/

Museum Europäischer Kulturen

https://www.smb.museum/en/museums-institutions/museum-europaeischer-kulturen/home/

Metsovo Folk Art Museum

http://metsovomuseum.gr/en/

Museum of International Folk Art

https://www.internationalfolkart.org/

Volkskundemuseum Salzburg

https://www.salzburgmuseum.at/volkskundemuseum/

Poble Espanyol – Spanish Village Barcelona

https://poble-espanyol.com/en/

'ASTRA' National Museum Complex

https://muzeulastra.ro/en/

The Glenview Folk Museum

http://glenviewmuseum.ie/

Volkskundemuseum

https://www.museabrugge.be/en/

The American Folk Art Museum

https://folkartmuseum.org/

Bowraville Folk Museum

https://mgnsw.org.au/organisations/bowraville-folk-museum/