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Metadata Interoperability for Cultural Heritage Digital Repositories: A Case Study in Indonesian World Heritage Site Memory Institutions

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Abstract

This research aims to examine and evaluate the metadata interoperability of the cultural heritage digital repository known as "Pusako Ombilin" that developed using free open-source software. Over the last year, the Ombilin Coal Mining Heritage of Sawahlunto (OCMHS), which is one of the World Heritage Sites in the Republic of Indonesia, has been introduced as “Pusako Ombilin” and used in their memory institutions. This research employs a case study design with a qualitative methodology. The findings suggest that metadata interoperability may be achieved via the use of information crosswalks. The "Pusako Ombilin" fields are mapped to the Dublin Core using implementation metadata crosswalks. The researcher has used the open archives initiative protocol for metadata harvesting capabilities to achieve metadata interoperability in their prototype of the union catalog. The key elements that contribute to metadata interoperability are standardized metadata and protocol for interoperability. However, the lack of an established open-access policy and human resources for OCMHS memory institutions hinders this process. All OCMHS memory institutions should prioritize external interoperability with union catalogs to enhance access to heritage information and implement open access rules shortly, the information professionals in OCMHS memory institutions will play a crucial role in the development of "Pusako Ombilin."

Keywords: Metadata Interoperability, Metadata Crosswalks, Memory Institution, Digital Repositories, World Heritage Site

Introduction

The growth of digital repositories has prompted memory institutions, such as libraries, archives, and museums (LAMs), particularly those located at world heritage sites, to adjust to this circumstance. Developing digital repositories in memory institutions may promote convergence and enhance access to heritage information. The digital repository is a collection of services offered by memory institutions to maintain and improve information about their digital resources related to heritage. To facilitate the administration of digital resources and improve the preservation of cultural information, memory institutions need digital repository software, which may be achieved via the use of free open-source software (FOSS) like CollectiveAccess (CA).

Studying metadata interoperability for cultural heritage digital repositories is crucial for heritage information access and preservation. Memory institutions that use digital technologies must allow for data sharing and integration across multiple platforms. The development of a digital repository using FOSS presents a unique opportunity to study metadata interoperability within a World Heritage Site memory institution. This study will show how to achieve interoperability by mapping digital repository metadata fields to the international standard using metadata crosswalks and implementing the metadata exchange standard and framework. This study may benefit many parties. This study may help memory institutions adopt metadata interoperability to properly manage and exchange digital materials or collections. Multi-stakeholders may access more heritage information, enhancing their research and knowledge of the past. Additionally, the study promotes standardized metadata schemas and interoperability protocols to democratize cultural heritage information and make it more accessible to various groups and audiences.

The digital repository has a flexible framework and is capable of storing diverse types of data in several formats. Digital repositories sometimes do not have a strict data format and instead rely on metadata to organize the information. A digital repository is designed to efficiently store and retrieve data (Gaona-García et al., 2017; Martins et al., 2023). Although digital archives provide search and browsing capabilities, they lack the same level of data analysis provided by information systems. Digital repositories are well-suited for situations that need the extended preservation and collaborative use of data by many users (Hendrawan et al., 2024). Table 1 presents a thorough summary of the many types of digital repositories now in use. These digital repositories are essential for making informed decisions about the identification, categorization, administration, and preservation of cultural heritage materials. Moreover, they function as crucial instruments in the formation of shared remembrance and cultural distinctiveness.

Table 1
Types of Digital Repositories

Numb.	Types	Pro's	Con's
1	Physical (document and photographic inventories and catalogs)	+ Simple to setup + Low cost	- Typically linear or hard to cross-index - Hard to search or query - Physical storage requirements can become a challenge
2	Localized electronic databases	+ Highly customizable + Relatively easy to get started with + Simplifies indexing	- Interaction with other inventories is difficult - Non-standard, specialized query tools hard for novice users - Adding and managing data can be complex
3	Geographic Information Systems (GIS)	+ Strong data management potential + Highly customizable	- Requires considerable input of mapping info. - Steep learning curve. - Can be costly
4	3D Earth Viewers (online GIS with spatial imagery)	+ Combines advantages of GIS with an intuitive and easy-to-understand 'real' background	- Not as useful for non-spatial data - Nothing more than a nice visual interface (i.e. little data management and requires other tools to extend)
5	Hybrid, shared, 'Web 2.0' systems with relational data structures, XML, and other standards	+ Highly customizable, adaptable, and shared	- Emerging technology

Source: Santana-Quintero et al. (2004)

The implementation of digital repository software involves managing resource description, metadata schema, and other types of data. Metadata refers to organized data that provides information about various kinds or formats of information resources. Metadata serves several functions, including identifying and describing resources, facilitating information retrieval, managing information resources, overseeing intellectual property rights, and promoting interoperability. According to Riley (2017), some examples of widely used metadata include Schema.org, Dublin Core (DC), Online Information Exchange (ONIX), and Exchangeable Image File (EXIF). In the memory institutions or cultural heritage sector, examples include Machine Readable Catalogue (MARC), Bibliographic Framework (BIBFRAME), Metadata Object Description Standard (MODS), Categories for the Description of Works of Art (CDWA), The Visual Resources Association (VRA) Core, and Encoded Archival Description (EAD). Other examples include The Data Documentation Initiative (DDI), Preservation Metadata Implementation Strategies (PREMIS), The Text Encoding Initiative (TEI), and The Music Encoding Initiative (MEI).

The disparities between software and metadata format may affect the ability of memory institutions to communicate and share data. Therefore, memory institutions must attain metadata interoperability. However, achieving consistency in the implementation of software and metadata schema is a tough task, especially when employing diverse standards like as DACS, CDWA, EAD, or MARC, each serving distinct goals. The memory institutions must modify the approach to enable metadata interoperability (Fresa et al., 2015). To accomplish metadata interoperability, many technologies may be used, including metadata frameworks, crosswalks, application profiles, and metadata registries (Haslhofer & Klas, 2010). Metadata crosswalks are often used to provide compatibility across various metadata standards. Metadata crosswalks are used to delineate the incorporation of metadata schemes in digital repository software, to contrast various metadata schemas, and to demonstrate the compatibility between the same or distinct software and metadata schema to exchange and share data (Alemu, 2016; Baca, 2016). Metadata crosswalks are cognitive processes that include comparing and analyzing two metadata schemas, resulting in crosswalks as the visual representation of the mapping (Gaitanou et al., 2024).

Several studies have attempted to investigate metadata interoperability by using metadata crosswalks such as Park and Tosaka (2010), Khan et al (2015), Pramudyo and Hendrawan (2020), Patrick-Burns et al (2022), and Liu et al (2023). However, some aspects have not been addressed in the context of metadata interoperability. For instance, the implementation of metadata interoperability in digital archives of memory institutions located at world heritage sites, and the variables that hinder or facilitate the interchange and sharing of data. The Ombilin Coal Mining Heritage of Sawahlunto OCMHS in the West Sumatra Province, Republic of Indonesia, used system design activities employing the "Pusako Ombilin" system. This system was developed using the FOSS known as CollectiveAccess (CA) and implemented a system analysis technique. The following material offers a comprehensive explanation of the main focus on design. CA serves as the foundation for the development of a digital repository for cultural heritage known as "Pusako Ombilin." This repository aims to effectively manage a wide range of digital materials and enhance the accessibility of historical information. This research seeks to comprehensively examine and evaluate the interoperability of metadata in the digital repository "Pusako Ombilin" of OCMHS memory institutions. The study intends to identify, explain, and analyze the inhibiting and supporting elements that affect the implementation of metadata interoperability. Therefore, metadata interoperability research for cultural heritage digital repositories is urgent and important. This study uses the "Pusako Ombilin" case study to provide practical advice for enhancing access to heritage information and preservation. Memory institutions, academics, and the public benefit from the discoveries that enhance knowledge and preserve cultural heritage.

Literatur review

Previous studies

Several studies have examined the issue of metadata interoperability. In their study, Weagley et al (2010) examined the methods of creating metadata in digital repositories. They specifically looked at the use of several information formats such as MARC, DC, and MODS. The lack of exposure to locally developed metadata and metadata principles outside local settings presents issues in metadata interoperability. Techawut et al (2014), examined an automated model for metadata interoperability. They tested this model using the Crosswalk approach to match information items across various schemas. The model's performance is

evaluated by using the Digital Thai Lanna archive as a case study. The outcome demonstrates that the accuracy of the suggested model surpasses the average accuracy at a significant degree of acceptability. Chen's (2015), study is on the use of metadata crosswalks to attain semantic interoperability specifically at the level of individual data elements. Enabling the generation of metadata in a format that can be easily understood by machines and shared and reused across many systems. The research highlights the significance of harmonizing metadata formats to enable the mapping and translation of data pieces across various systems, thereby promoting interoperability.

Gartner (2015), discussed an innovative XML architecture designed to enhance the semantic interoperability of archive descriptions. This is achieved by including more accurate metadata components within the conventional descriptive elements. The study proposes some first methods for using it to improve access to collection descriptions, its compatibility with standards like International Standard Archival Description (ISAD), and its potential usage in combination with EAD. Alemu and Garoufallou (2020), examine the prospective development of metadata, emphasizing the need for metadata that is interconnected, compatible, and capable of expansion. The authors contend that metadata should be specifically crafted to facilitate the amalgamation of heterogeneous datasets and the effortless interchange of information across disparate systems. In addition, Wu et al (2023), stress the need to use standardized metadata formats and standards to guarantee that data may be readily shared and reused.

This study employs a qualitative approach, specifically using a case-study methodology. The discovery discusses the compatibility of semantic metadata by examining how information is mapped between EAD and MODS. This study uses metadata crosswalks to achieve metadata interoperability at the scheme level. Metadata crosswalks aid in the process of mapping source metadata schemes to target metadata schemes as explained in this paper. This study also investigated the elements that facilitate or hinder the achievement of metadata interoperability in "Pusako Ombilin."

Digital Repository

The digital repository is a system that gathers, safeguards, and shares the intellectual work of an institution, making it accessible to everyone (Chapman et al., 2009). According to Benardou et al (2018), the digital repository is a process of gathering and safeguarding digital materials that represent the intellectual contributions of a community. It has the potential to become a costly and vital resource for memory institutions. Hence, it requires specialized expertise in programming, content management, metadata, publicity, and internal marketing for researchers. The digital repository facilitates memory institutions in the management, collection, and to enhance access the heritage information for their communities or users.

Metadata

Metadata is often defined as information about data (Baca, 2016). According to Riley (2017), metadata refers to organized and structured information about a resource, regardless of its media type or format. Metadata encompasses not only data about individual records, but also about groupings of records, persons and organizations, functions, and business processes (Caplan, 2003; Haynes, 2018). Metadata is a broad term that refers to the information about cultural heritage items stored in memory institutions. These objects might include artifacts,

ephemera, literature, archives, and both physical and intellectual materials. Metadata captures the content, context, and structure of these things.

In addition, a metadata scheme refers to a collection of metadata pieces that have been specifically created to serve certain objectives and provide descriptions for specific sorts of information sources (Greenberg, 2012). The digital repository metadata structure is revealed via semantic components, content rules, and syntax (Burke et al., 2020). Semantic elements pertain to metadata components that include names and meanings. Data content standards, also known as content rules, dictate the criteria for selecting and presenting metadata element values. Examples of such standards include Resource Description and Access (RDA) for libraries and digital resources, Cataloguing Cultural Objects (CCO) for museums, and International Standard Archival Description (ISAD) for archives. Syntax refers to how metadata items are encoded in a machine-readable format, such as Hyper Text Markup Language (HTML) or Extensible Markup Language (XML).

Metadata Interoperability

Interoperability facilitates universal accessibility, enhances the capacity of all parties to use online services, and improves efficiency (Hert et al., 2018; Noura et al., 2019). Interoperability refers to the integration of resources inside an organization, known as internal interoperability, as well as the integration across other institutions and domains, including the whole internet, known as external interoperability (Panetto et al., 2016). Interoperability refers to the capacity of several application systems to collaborate and exchange data seamlessly, without the need for previous contact. Interoperability is necessary since a standardized technique may not be suitable for many groups. Interoperability at the scheme level may be achieved by the use of derivation, application profiles, crosswalks, switching across, framework, and registry. Metadata crosswalks are a commonly used strategy for achieving metadata interoperability.

Metadata Crosswalks

A metadata crosswalk is a method used to establish connections or correlations between metadata words, such as items and refinements, that are identical or comparable (Chen, 2015; Ulrich et al., 2022). Crossings often use a chart or table to depict the semantic mapping of data components from one standard data or source to another standard or destination. This mapping is based on the similarity of functions or meanings of the pieces (Martins et al, 2023). A metadata crosswalk is a visual representation, often in the form of a table or chart, that illustrates the correlation and equivalence between two or more information types. Metadata crosswalks are used to compare metadata items between one or more schemes (Wu et al, 2023; Liu et al., 2023). Metadata crosswalks in reality often use two approaches: absolute crosswalks, which involve mapping the elements of the source scheme directly to those of the destination scheme. If there is no precise correspondence, there is no crossing. Secondly, relative crosswalks establish a mapping between all items in the source schema and at least one element in the destination schema, regardless of whether the two elements have the same meaning or not. The crosswalk strategy is effective in translating from intricate designs to more simple layouts.

Table 2
Example of a Metadata Crosswalk

Dublin Core	MARC	EAD	CDWA
Type	655 Genre/form	<controlaccess><genreform>	Object/ Work-Type
Title	24Xa Title and Title—Related Information	<unittitle>	Titles or Names
Date Created	260c Imprint—Date of Publication	<unitdate>	Creation–Date
Creator	1XX Main Entry 7XX Added Entry	<origination> <persname> <origination> <corpname> <origination> <famname> <controlaccess> <persname>	Creation-Creator-Identity
Subject	520 Summary. 6xx Subject Headings	<controlaccess> <corpname> <abstract> <scopecontent> <controlaccess> <subject>	Subject Matter
	852 Location	<repository> <physloc>	Current Location

Resource: (Baca, 2016).

Research Method

This research employs a single case study using a qualitative methodology. The data collection methods used in this research include observation, interviews, documentation, and the collection of data generated between 1 April and 30 June 2024. The data analysis method used is the qualitative data analysis model (Cresswell, 2016), including 1) Arranging and ready the data for analysis; 2) Review or examine all of the data; 3) Commence coding the whole of the data; 4) Produce a detailed account and identify recurring ideas or concepts; 5) Create a concise and focused summary together with the underlying ideas and concepts; and 6) Provide a concise analysis and explanation of the data. The data's authenticity was ensured by the triangulation of information from several sources, including holding question and answer sessions with colleagues and academics and requesting an auditor to assess the whole study endeavor. The reliability approach involves verifying the accuracy of the transcription findings, ensuring that there are no ambiguous definitions or interpretations of the codes throughout the coding process, and crosschecking the codes created by other researchers by comparing the independently acquired results (Gorman & Clayton, 2005).

Results and Discussion

Digital Repository

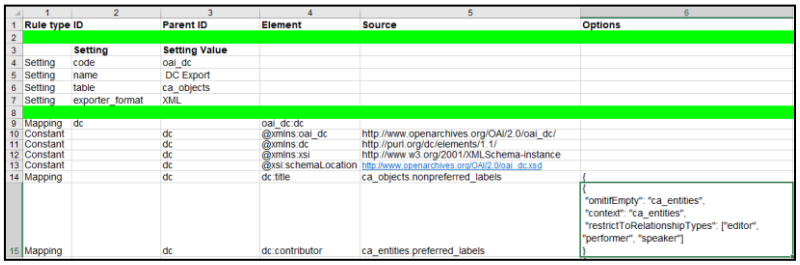
The OCMHS memory institutions recently introduced a digital repository called "Pusako Ombilin" to effectively handle their digital materials last year. The Public Library and Archives and Museums of OCMHS have established digital repositories following the following laws: Law Number 11 of 2010 on Cultural Conservation, Law Number 43 of 2009 on Archives, Government Regulation Number 66 of 2015 on Museums, and Law Number 43 of 2007 on Libraries (Government of West Sumatra Province and Ministry of Education and Culture of the Republic of Indonesia, 2017 & 2018). “Pusako Ombilin” is a software derived from free open-source software (FOSS), specifically designed for memory institutions, known as CollectiveAccess (CA). "Pusako Ombilin" is an ideal option for OCMHS memory institutions because it implements the metadata standard, the Open Archives Initiative Protocol for

Metadata Harvesting (OAI-PMH), which is a standard for metadata exchange and ensures compatibility and facilitates interoperability, it enables repositories to provide their contents in a well-organized, application-independent format that is designed to facilitate precise and efficient incremental harvesting (Nelson et al., 2005; Haslhofer & Klas, 2010). The "Pusako Ombilin" is regularly enhanced by information professionals from OCMHS memory institutions, including system librarians, museum curators, archivists, and software engineers. These enhancements include the addition of attributes such as Dublin Core (DC). "Pusako Ombilin" incorporates an OAI-PMH capability to enhance interoperability.

Metadata Interoperability

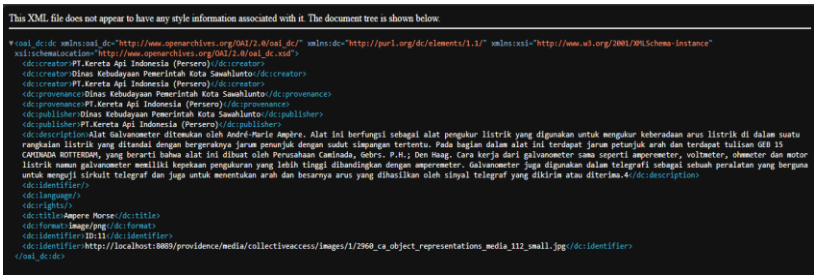
The OCMHS memory institutes used the resource "Pusako Ombilin" to fulfill their requirements and facilitate their operations. Their preference is to build "Pusako Ombilin" as software for institutional development digital repository. In addition, each OCMHS memory institution was striving to achieve external metadata compatibility. Additionally, "Pusako Ombilin" has other functionalities that facilitate the sharing of data between various systems. This enables the utilization of collection information across different platforms and plays a crucial role in enhancing the visibility, accessibility, and usability of resources and services in the digital age. This feature enables users to implement and align international standard metadata schemas, like as DC, MARC21, or CDWA, which are specifically designed for memory institutions. These schemas ensure compatibility with other systems that use comparable schemas.

Metadata interoperability enables the transfer of collected data from "Pusako Ombilin" in various forms such as XML, MARC21, and CSV, while maintaining the appropriate metadata schema variation model. Figure 1 demonstrates the interoperability of CDWA information for museum collection items into DC format. This may be achieved by mapping the metadata using a spreadsheet format file (.xlsx). The resulting output is shown in Figure 2.



	1	2	3	4	5	6
1	**Rule type**	**ID**	**Parent ID**	**Element**	**Source**	**Options**
2						
3		**Setting**	**Setting Value**			
4	Setting	code	oai_dc			
5	Setting	name	DC Export			
6	Setting	table	ca_objects			
7	Setting	exporter_format	XML			
8						
9	Mapping	dc		oai_dc:dc		
10	Constant		dc	@xmlns:oai_dc	http://www.openarchives.org/OAI/2.0/oai_dc/	
11	Constant		dc	@xmlns:dc	http://purl.org/dc/elements/1.1/	
12	Constant		dc	@xmlns:xsi	http://www.w3.org/2001/XMLSchema-instance	
13	Constant		dc	@xsi:schemaLocation	http://www.openarchives.org/OAI/2.0/oai_dc.xsd	
14	Mapping		dc	dc:title	ca_objects.nonpreferred_labels	{ "omitIfEmpty": "ca_entities", "context": "ca_entities", "restrictToRelationshipTypes": ["editor", "performer", "speaker"] }
15	Mapping		dc	dc:contributor	ca_entities.preferred_labels	

Figure 1. Metadata Schema Interoperability Configuration



This XML file does not appear to have any style information associated with it. The document tree is shown below.

<oai_dc:dc xmlns:oai_dc="http://www.openarchives.org/OAI/2.0/oai_dc/" xmlns:dc="http://purl.org/dc/elements/1.1/" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xsi:schemaLocation="http://www.openarchives.org/OAI/2.0/oai_dc.xsd">
<dc:creator>PT.Kereta Api Indonesia (Persero)</dc:creator>
<dc:creator>Dinas Kebudayaan Pemerintah Kota Sawahlunto</dc:creator>
<dc:creator>PT.Kereta Api Indonesia (Persero)</dc:creator>
<dc:provenance>Dinas Kebudayaan Pemerintah Kota Sawahlunto</dc:provenance>
<dc:provenance>PT.Kereta Api Indonesia (Persero)</dc:provenance>
<dc:publisher>Dinas Kebudayaan Pemerintah Kota Sawahlunto</dc:publisher>
<dc:publisher>PT.Kereta Api Indonesia (Persero)</dc:publisher>
<dc:description>Alat Galvanometer ditemukan oleh André-Marie Ampère. Alat ini berfungsi sebagai alat pengukur listrik yang digunakan untuk mengukur keberadaan arus listrik di dalam suatu rangkaian listrik yang ditandai dengan bergeraknya jarum penunjuk dengan sudut simpangan tertentu. Pada bagian dalam alat ini terdapat jarum petunjuk arah dan terdapat tulisan GEB 15 CAMINADA ROTTERDAM, yang berarti bahwa alat ini dibuat oleh Perusahaan Caminada, Gebrs. P.H.; Den Haag. Cara kerja dari galvanometer sama seperti amperemeter, voltmeter, ohmmeter dan motor listrik namun galvanometer memiliki kepekaan pengukuran yang lebih tinggi dibandingkan dengan amperemeter. Galvanometer juga digunakan dalam telegrafi sebagai sebuah peralatan yang berguna untuk mengaji sirkuit telegraf dan juga untuk menentukan arah dan besarnya arus yang dihasilkan oleh sinyal telegraf yang dikirim atau diterima.</dc:description>
<dc:identifier/>
<dc:language/>
<dc:rights/>
<dc:title>Ampere Morse</dc:title>
<dc:format>image/png</dc:format>
<dc:identifier>ID:11</dc:identifier>
<dc:identifier>http://localhost:8889/providence/media/collectiveaccess/images/1/2960_ca_object_representations_media_112_small.jpg</dc:identifier>
</oai_dc:dc>

Figure 2. Export Results per Record with Dublin Core Schema Metadata

Experiments were also undertaken by researchers for each of them to be included in the digital repository aggregator, from a free open-source software basis called VuFind. The digital repository aggregator is a centralized database that can collect information and combine online catalogs, digital repositories, and e-resources from different institutions.

Metadata Crosswalks

Metadata interoperability challenges arise due to the presence of different software systems and diverse metadata standards. These issues arise to attain metadata compatibility for digital repositories. Hodge (2005), states that institutions may achieve interoperability by creating metadata crosswalks, allowing them to search, share, transfer, utilize, and understand variations across digital repository software and metadata systems for various purposes. An illustration of metadata crosswalks that rely on metadata compatibility among OCMHS memory institutions. Table 3 illustrates the presence of three metadata systems and data content standards in "Pusako Ombilin." The presence of information resources in "Pusako Ombilin" is a key factor in the widespread adoption of DC as a universal metadata scheme. This is due to its straightforward method of obtaining essential data on various sorts of collections.

Table 3
Metadata Schemes and Data Content Standard in "Pusako Ombilin"

Memory Institution Name	The OCMHS Public Library	The OCMHS Public Archives	The OCMHS Museum
Metadata Schema	Machine-Readable Cataloging (MARC)	Dublin Core (DC)	Dublin Core (DC)
		Rules for Archival Description (RAD)	Categories for the Description of Works of Art (CDWA)
Data Content Standard	Resource Description and Access (RDA)	International Standard Archival Description (ISAD)	Cataloging Cultural Objects (CCO)

Metadata crosswalks involve establishing connections between different standards. Table 4 demonstrates how the DC schema utilizes content data from ISAD and CCO. Additionally, it demonstrates the interconnectedness of several content standards, enabling the organization of diverse collection kinds inside a single system. For instance, an institution may choose to categorize its museum objects under the same system as its archives collection. This implies that information from the archives and museum may be collected and disseminated into a discovery system or other application gateway that facilitates data interchange and encompasses many sorts of collections.

Table 4
Crosswalk Data Schema and Data Content on "Pusako Ombilin" in Dublin Core Metadata Schema Fields

Dublin Core Fields	**ISAD**	**CCO**
Identifier	--	--
Title	Title Note	Title
Description	Scope and Content Element	Subject Matter
Type	Extent Element	Work Type
Subject	Access points	Subject, Classification
Date	Date Element	Creation Date

Metadata crosswalks for implementation According to Baca (2016), metadata crosswalks refer to a structured representation, such as a table or graphic, that illustrates the connection and equivalence between two or more metadata types. Metadata crosswalks are used to compare metadata items from one scheme to others, or even many schemes simultaneously. The mapping system involves linking each memory institution in "Pusako Ombilin" to the DC metadata scheme, which serves as the goal. The mapping technique utilizes relative crosswalks. The relative crosswalks are used to establish mappings between all components in the source schema and at least one element in the destination schema, regardless of their semantic similarity or dissimilarity. The process of metadata crosswalks, as described by Baca (2016) and Riley (2017), is shown via several instances of "Pusako Ombilin" field components converted to DC and represented in XML or HTML format. These examples are presented in Table 5. The table presents an example of a metadata mapping scheme taken from one of the "description" sections of RAD, MARC21, CDWA, and ISAD information in "Pusako Ombilin" that has been converted using the DC Metadata Scheme.

Table 5
Example of Metadata Crosswalk Mapping

Rule type	**Parent ID**	**Element**	**Source**	**Options**
Mapping	dc	dc:description	ca_objects.MARC_summary	{"omitIfEmpty": "ca_objects.MARC_summary"}
Mapping	dc	dc:description	ca_objects.RAD_admin_hist	{"omitIfEmpty": "ca_objects.RAD_admin_hist"}
Mapping	dc	dc:description	ca_objects.ISADG_scope	{"omitIfEmpty": "ca_objects.ISADG_scope"}
Mapping	dc	dc:description	ca_objects.dc_description	{"omitIfEmpty": "ca_objects.dc_description"}
Mapping	dc	dc:description	ca_objects.CDWA_description	{"omitIfEmpty": "ca_objects.CDWA_description"}

The process of mapping the metadata scheme involves finding the properties of the "Pusako Ombilin" fields and matching them with the attributes of DC. Consult Table 5 to see that the variables labeled "Pusako Ombilin" can be mapped to DC. Metadata crosswalks serve as the first stage in achieving interoperability across different digital repositories. Metadata crosswalks strive to preserve and manage metadata pieces to achieve metadata interoperability. Metadata crosswalks are used to examine and evaluate metadata schemes,

make comparisons between various metadata schemes, and establish connections between disparate metadata schemes. This enables institutions with varying metadata schemes to effectively communicate and exchange data. Metadata crosswalks are valuable tools for examining metadata systems and demonstrating the potential for metadata interoperability to others.

OAI-PMH Provider

The "Pusako Ombilin" has an OAI-PMH implementation feature that allows for metadata harvesting. This function provides database records in an XML-based format that may be customized to meet specific requirements. Furthermore, DC serves as a framework and benchmark for facilitating OAI-PMH. The capacity to transfer data sets into a shared repository. In this scenario, it can accommodate all demands specified in the protocol and is configured using the Data_Exporter feature framework that is available. To enable data accessibility via OAI-PMH, users are required to first generate a minimum of one XML mapping in the data exporter. Figure 3 represents the metadata configuration prefix "oai dc" on Pusako Ombilin. This configuration includes many predefined format definitions, which are shown in Table 6.

Table 6
Format Definition Configuration

Setting	Description	Example value
mapping	Export mapping code to be used for the provided format	oai_dc
schema	Has a function to be used in describing the format in the List-MetadataFormats verb.	http://www.openarchives.org/OAI/2.0/oai_dc.xsd
metadataNamespace	Only used to describe the format for the ListMetadataFormats verb.	http://www.openarchives.org/OAI/2.0/oai_dc/

In Figure 3, the metadataPrefix format configuration for the oai_dc format is implemented. The mapping is derived from the records in the Pusako Ombilin database table. The schema refers to the XML Schema Definition (XSD) file for the OAI-PMH Dublin Core metadata format, and the metadataNamespace refers to the specification for the DC metadata schema format used by OAI-PMH.

```
formats = {
oai_dc = {
    mapping = ca_objects_oai_dc,
    schema = http://www.openarchives.org/OAI/2.0/oai_dc.xsd,
    metadataNamespace = http://www.openarchives.org/OAI/2.0/oai_dc/,
  }
},
```

Figure 3. Metadata configuration prefix:oai_dc on “Pusako Ombilin”

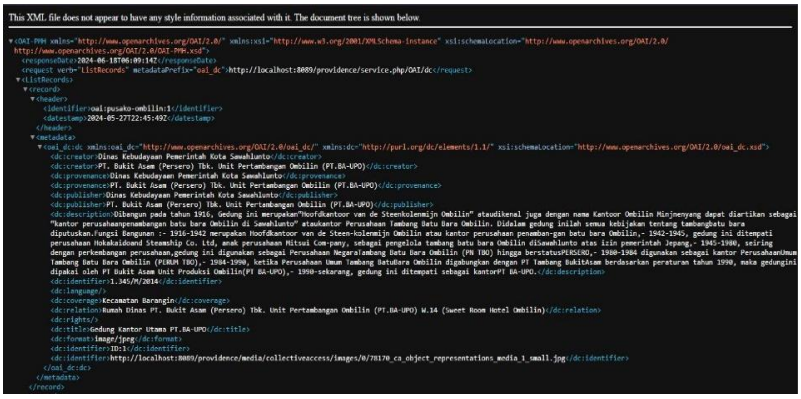


Figure 4. ListRecords and metadata Prefix by schema oai_dc

The results may be seen in Figure 4, which illustrates the use of OAI-PMH with DC metadata format to retrieve metadata records. This service enables users to access a standardized list of records from the digital repository "Pusako Ombilin" and simplifies the sharing and compatibility of information.

Implementation Metadata Crosswalks

Crosswalks are mostly used as fundamental specifications for transforming records from one metadata scheme to another, enabling record interchange, contributing to union catalogs, or metadata harvesting (Haynes, 2018). Metadata crosswalks serve as technical requirements for identifying the metadata schemes used by digital repository software to exchange material in union catalogs.

Metadata Crosswalks from "Pusako Ombilin" may be implemented in several ways, with the simplest approach being the use of a discovery system and aggregator software like VuFind, which was specifically built and developed by Villanova University. Researchers conducted an experiment utilizing VuFind to examine the effectiveness of "Pusako Ombilin" in improving access to resources for OCMHS institutions. This trial aimed to simulate the experience of OCMHS memory institution users by enabling them to search and browse all resources via a user-friendly interface.

Researchers chose to utilize VuFind because of its versatility in creating a search interface for many sorts of material or resources outside the scope of memory institutions. The inclusion of "Pusako Ombilin" material in VuFind involves modifying the metadata to include catalog entries and digital repository resources. Figure 5 demonstrates the effective indexing of the "Pusako Ombilin" resources into the VuFind discovery system, as seen in Figure 6.

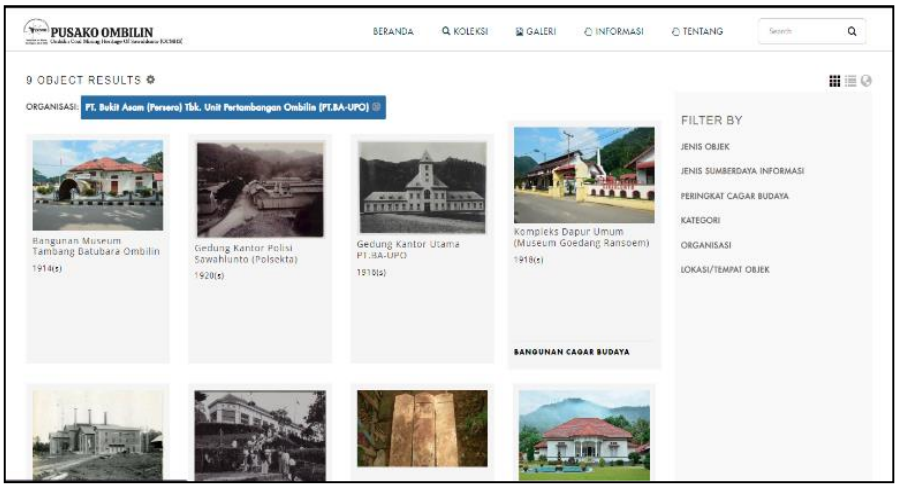


Figure 5. Pusako Ombilin Collection with entities of each memory institution

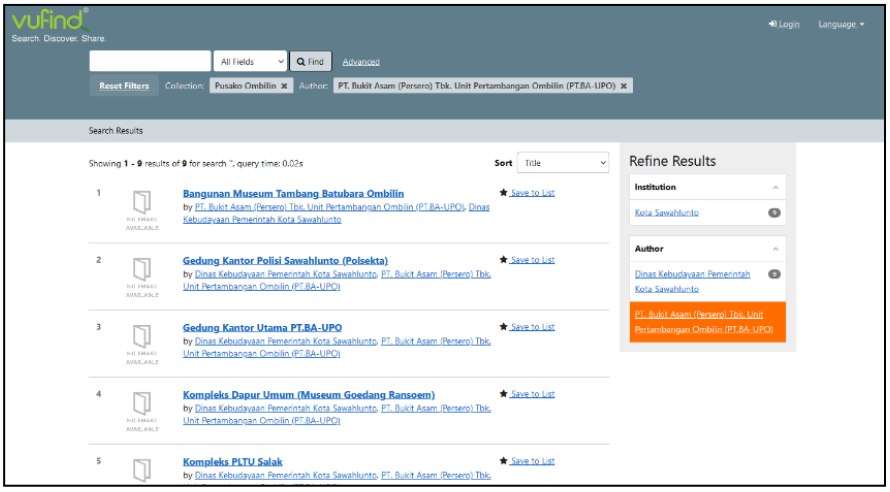


Figure 6**.** Resources of "Pusako Ombilin" successfully indexed on the VuFind discovery system

Figure 7 displays the outcomes of the records shown by the VuFind discovery method. These records are derived from "Pusako Ombilin" and were previously visualized in Table 5.

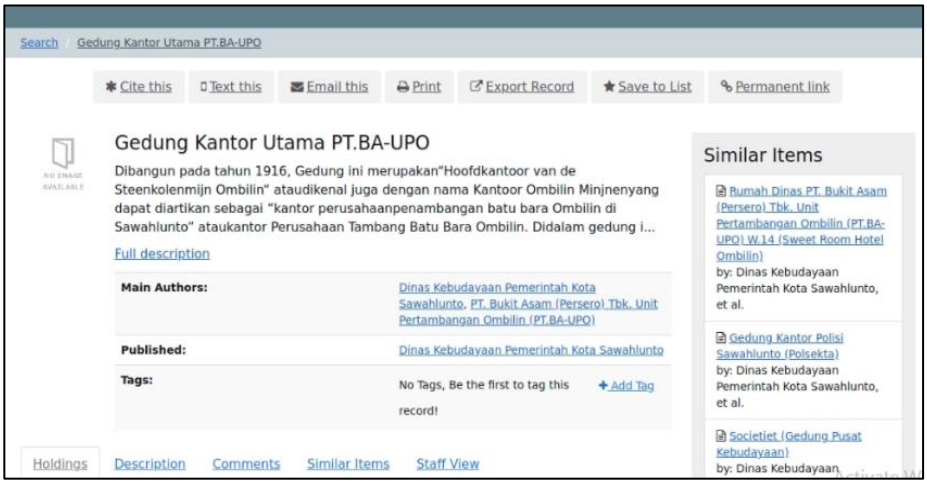


Figure 7. Display of VuFind Record results from one of the resources on "Pusako Ombilin"

Supporting Factor on Metadata Interoperability

Metadata Standard

"Pusako Ombilin" utilizes Dublin Core (DC), facilitating the description of sources and the retrieval of information items in a web search engine. DC is a versatile system for describing resources that was first designed to make it easier to find information items on the Internet. This indicates that DC has extensive applicability in providing descriptions and facilitating retrieval in online search systems. DC is also used as a common baseline for metadata interoperability via the usage of OAI-PMH. A notable instance of this is the OAI-PMH, which mandates that all participating websites must be able to export unqualified DC as a minimum requirement.

Metadata Exchange Standard and Framework

OAI-PMH is widely accepted as the standard for exchanging metadata in digital repositories. It offers a framework for interoperability that is not tied to any specific application. This framework is built on the process of collecting metadata. Metadata from many sources, including digital repositories, may be consolidated into a single database, enabling the provision of services based on centralized data. The "Pusako Ombilin" platform offers OAI-PMH capabilities that may be used in VuFind as an aggregator software for achieving metadata interoperability.

Inhibit Factors on Metadata Interoperability

Open Access Policy

Open access encompasses a range of digital materials that may be accessed online without any cost or limitations imposed by copyright or licensing. The supplier uploads many files, and each file is made accessible to anybody who can view it. Metadata interoperability in "Pusako Ombilin" may be achieved by connecting it with other digital repositories inside union catalogs. Nevertheless, the OCMHS memory institutions have yet to adopt an open-access policy. Users are limited to seeing just the bibliographic descriptors that they possess.

Human Resources

The human resources within OCMHS memory institutions play a crucial role in the development of "Pusako Ombilin" and the attainment of metadata interoperability. Metadata interoperability at the union catalog enables widespread access and worldwide visibility for "Pusako Ombilin". Memory institutes cannot fulfill their objectives without human resources. The information professionals in memory institutions such as curators, archivists, and system librarians play a crucial role in the development of "Pusako Ombilin." To achieve metadata interoperability using metadata crosswalks, one must possess extensive knowledge and specific skills in the relevant information standards. A frequent error in the use of metadata crosswalks, such as metadata standards, is their autonomous usage without considering specific terminology, methodologies, and procedures. It is important to take into account the variations in the name, description, and use of metadata items in "Pusako Ombilin."

Conclusion

Metadata interoperability of the "Pusako Ombilin" in OCMHS memory institutions may be achieved via the use of metadata crosswalks. The use of metadata crosswalks served as the first phase of achieving interoperability, resulting in the creation of a mapping system. Metadata crosswalks demonstrate that every digital repository software has the potential to work together and use standardized metadata. Metadata crosswalks are used to comprehend, examine, and depict repository software that facilitates the interchange and dissemination of data in consolidated catalogs. The "Pusako Ombilin" system showcases the effective use of free open-source software in handling cultural heritage data, emphasizing the need for standard procedures in metadata Interoperability. Its digital repository is also equipped with DC and OAI-PMH characteristics, which provide interoperability with aggregator software. The inclusion of the metadata interoperability feature in "Pusako Ombilin" would enhance data interchange and improve the accessibility of digital information and resources related to cultural heritage. The capacity to enhance the prominence of digital material on a national and global scale. Moreover, the open access policy should be applied to OCMHS memory institutions via the implementation of digital repositories. This research adds to the wider discussion on cultural heritage information management especially for memory institutions in world heritage sites.

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