UNIVERSITI TEKNOLOGI MARA

ENHANCING ACCESS TO HERITAGE INFORMATION IN INDONESIA THROUGH THE DEVELOPMENT OF KNOWLEDGE TAXONOMY: A CASE STUDY OF THE OMBILIN COAL MINING HERITAGE OF SAWAHLUNTO

MUHAMMAD ROSYIHAN HENDRAWAN

PhD

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MUHAMMAD ROSYIHAN HENDRAWAN

Thesis submitted in fulfilment
of the requirements for the degree of
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ABSTRACT

Knowledge organization (KO) is a fundamental component of cultural heritage institutions (CHIs), encompassing libraries, archives, and museums (LAMs) that safeguard and disseminate cultural heritage. Within the Ombilin Coal Mining Heritage of Sawahlunto (OCMHS), a UNESCO World Heritage Site in Indonesia, KO practices remain fragmented, with each institution applying distinct international knowledge organization systems (KOSs) standards such as ANSI/NISO Z39.19, ISO 25964 AAT, LCSH, UNESCO Thesaurus, and CIDOC-CRM. This fragmentation limits interoperability, restricts discoverability, and hampers the construction of integrated cultural heritage narratives. To address these challenges, this study employs design science research to design, develop, and evaluate a contextualized taxonomy that functions as a semantic backbone for OCMHS CHIs. The research adopts an embedded multiple case study strategy involving CHIs in Sawahlunto Municipality, which consists of a municipal library, a municipal archives, and four municipal museums. Data collection methods include semi-structured interviews, observation, focus groups, document analysis, and usability testing, with triangulation ensuring validity. Iterative design and refinement of the taxonomy were adapted from the IS Taxonomy Development with its extended framework and DSR Process Model. Stakeholders' participation through focus group discussions and scenario-based usability testing ensured that the taxonomy was both technically functional and contextually relevant. Findings reveal four interrelated issues influencing taxonomy development: heterogeneous metadata practices, semantic misalignment, the need to embed local terminologies alongside international standards, and the lack of systematic evaluation mechanisms. The developed taxonomy integrates tangible and intangible cultural heritage domains, adopts hierarchical structuring, and incorporates vernacular semantics while ensuring alignment with international KOS standards. Its implementation within free open-source content management systems, called CollectiveAccess, for a digital repository prototype demonstrated enhanced metadata consistency, semantic interoperability, and cultural authenticity. Usability testing confirmed its completeness, reliability, and ease of use, with stakeholders acknowledging improved interpretability and cross-institutional access. The study contributes theoretically by advancing contextualized taxonomy development in KO scholarship and demonstrating the applicability of DSR in cultural heritage studies. Methodologically, it offers a hybrid model integrating design science with participatory evaluation. Practically, it delivers a taxonomy artifact, a digital repository prototype, and proposes an empirical model of taxonomy development for CHI that improves access, discoverability, interoperability, and preservation of OCMHS cultural heritage. The framework is transferable to other UNESCO World Heritage sites seeking to reconcile local cultural narratives with international KOS standards.

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LIST OF ABBREVIATIONS

Abbreviations

AAT	Art & Architecture Thesaurus
AI	Artificial Intelligence
ANRI	Arsip Nasional Republik indonesia
ANSI/NISO	American National Standards Institute / National Information Standards Organization
BA	Bibliometrics Analysis
CA	CollectiveAccess
CDWA	Categories for the Description of Works of Art
CHI	Cultural Heritage Institution
CH	Cultural Heritage
CIDOC-CRM	CIDOC Conceptual Reference Model
DDC	Dewey Decimal Classification
DSR	Design Science Research
FGD	Focus Group Discussion
FAIR	Findable, Accessible, Interoperable, Reusable
FOSS	Free Open-Source Software
ICA	International Council on Archives
ISAD(G)	General International Standard Archival Description
ISO	International Organization for Standardization

KO	Knowledge Organization
KOS	Knowledge Organization System
LAM	Libraries, Archives, and Museums
LCC	Library of Congress Classification
LCSH	Library of Congress Subject Headings
LOD	Linked Open Data
MARC21	Machine-Readable Cataloging 21
NLP	Natural Language Processing
OCMHS	Ombilin Coal Mining Heritage of Sawahlunto
OUV	Outstanding Universal Value
OWL	Web Ontology Language
PT. BA-UPO	Perseroan Terbatas Bukit Asam-Unit Pertambangan Ombilin
PT. KAI	Perseroan Terbatas Kereta Api Indonesia
RDF	The Resource Description Framework
SKOS	Simple Knowledge Organization System
SLR	Systematic Literature Review
SSS	Staatsspoorwegen ter Sumatra's Westkust
UDC	Universal Decimal Classification
UNESCO	The United Nations Educational, Scientific, and Cultural Organization
UPTD	Unit Pelaksana Teknis Daerah

CHAPTER 1
INTRODUCTION

1.1 Chapter Overview

This chapter lays the foundation for the study by providing a comprehensive overview of the study context, rationale, and framing. It begins by situating the study within the broader landscape of knowledge organization (KO) in cultural heritage institutions (CHIs), emphasizing the critical role of libraries, archives, and museums (LAMs) in facilitating the preservation, access, and dissemination of heritage information to sustain collective memory (Hjørland, 2016; Rasmussen & Hjørland, 2022). Effective KO not only ensures the systematic arrangement of heritage resources but also supports cultural interpretation, public engagement, and long-term digital preservation (Kumar & Nair, 2022; Liu et al., 2023).

The chapter then articulates the motivation underpinning the study, highlighting both practical and theoretical imperatives. From a practical perspective, this study addresses the fragmentation and limited interoperability of knowledge organization systems (KOS) across institutions within the Ombilin Coal Mining Heritage of Sawahlunto (OCMHS), a UNESCO World Heritage Site that embodies Indonesia's industrial heritage.

From a theoretical perspective, the study addresses gaps in the literature by applying taxonomy development and design science research (DSR) methodologies in a localized industrial heritage context. While international KOS standards such as the Art & Architecture Thesaurus (AAT), Library of Congress Subject Headings (LCSH), UNESCO Thesaurus, ISO 25964, CIDOC-CRM, and ANSI/NISO Z.39.19 provide structured pathways for semantic alignment, they often require adaptation to reflect the cultural specificities of local institutions (Adler, 2017; Ranjgar et al., 2024).

Following this contextual and motivational framing, the chapter introduces the problem statement, which defines the research gaps and challenges that this dissertation seeks to address. It then sets out the research aim, objectives, and questions, which are logically derived from the problem statement and collectively guide the DSR Methodology Process Model (Peffers et al., 2007). The chapter further highlights the significance of the study, outlining its contributions at theoretical, methodological, and

practical levels, and its alignment with strategic heritage management imperatives. It also clarifies the scope and limitations of the study, delineating the boundaries of CHI involvement within OCMHS and identifying methodological constraints, thereby ensuring focus and feasibility. To provide conceptual clarity, operational definitions of key terms are included.

1.2 Research Background

Knowledge organization systems (KOSs) constitute a foundational pillar in the management and dissemination of information within cultural heritage institutions (CHIs), particularly libraries, archives, and museums (LAMs). They involve systematic classification, indexing, and semantic structuring of information resources to enhance discoverability, interpretability, and long-term preservation. KOSs are critical in facilitating meaningful access and engagement for diverse user groups, including heritage professionals, academic researchers, educators, and the public (Nappi et al., 2024; Smiraglia, 2014a). In the cultural heritage (CH) context, KOSs play a pivotal role not only in organizing artefacts but also in sustaining collective memory, supporting knowledge transfer, and enabling interpretive functions that have become increasingly vital in the digital era (Ranjgar et al., 2024; Zou et al., 2025).

Despite these recognized roles, CHIs worldwide continue to face persistent challenges in organizing and integrating their knowledge systems, largely due to the heterogeneous nature of heritage collections and the historically siloed evolution of descriptive practices across institutional domains. This fragmentation frequently results in inconsistent metadata, reduced semantic interoperability, and limited cross-domain integration, particularly between libraries, archives, and museums (O'Neill & Stapleton, 2022; Raemy, 2025; Ranjgar et al., 2024; Wang, 2025).

Although international initiatives have introduced structured KOSs, such as taxonomies, thesauri, ontologies, and metadata frameworks including the Art & Architecture Thesaurus (AAT), UNESCO Thesaurus, Library of Congress Subject Headings (LCSH), ISO 25964, CIDOC Conceptual Reference Model (CIDOC-CRM), and ANSI/NISO Z39.19—to support semantic alignment and compliance with FAIR principles (Poveda-Villalón et al., 2020; Vogt et al., 2025; Wilkinson et al., 2016), empirical studies consistently demonstrate that their implementation remains uneven, context-dependent, and institutionally constrained (Biagetti et al., 2021; Hendrawan,

2025a; Hendrawan, 2025b).

Within the Indonesian context, the Ombilin Coal Mining Heritage of Sawahlunto (OCMHS) exemplifies the complexity and urgency of these challenges. Inscribed as a UNESCO World Heritage Site in 2019, OCMHS represents a multi-layered industrial heritage landscape comprising mining infrastructure, transportation systems, worker settlements, and intangible sociocultural practices. Its Outstanding Universal Value (OUV) lies in its representation of Southeast Asia's industrialisation and socioeconomic transformation under colonial conditions (Emely & Gebert, 2020; Kementerian Pekerjaan Umum dan Perumahan Rakyat Republik Indonesia, 2021; UNESCO, 2019).

Following its inscription, the UNESCO World Heritage Committee issued recommendations emphasising the need for an integrated management and interpretation strategy, including a coherent interpretive framework that connects individual site components and foregrounds the diverse social histories of local communities and migrant workers (Asoka et al., 2016; Erman, 2005; Lindayanti et al., 2016; Lindayanti et al., 2017; Saputra, 2012). However, empirical evidence indicates that knowledge organization practices across OCMHS CHIs remain fragmented, with each institution employing distinct cataloguing rules, classification schemes, and descriptive logics inherited from sector-specific traditions. Similar patterns of post-inscription fragmentation have been observed in other World Heritage contexts, where institutional autonomy, legacy systems, and limited semantic coordination hinder integrated heritage interpretation and digital convergence (Camagni et al., 2020; Di Giulio et al., 2021; Veldpaus, 2016).

As a consequence, heritage materials within OCMHS are often difficult to discover, interpretive narratives remain disjointed, and collaborative digital initiatives are constrained by the absence of interoperable semantic structures (SEAMS, 2022; Syafrini et al., 2020). These issues illustrate that UNESCO recognition, while symbolically and legally significant, does not in itself resolve the operational and epistemic challenges of KO integration.

More broadly, the central problem triggering this research lies in the difficulty of adapting international KOS standards to culturally specific CH contexts, where vernacular terminologies, industrial heritage vocabularies, tangible and intangible CH elements, and historically situated meanings must be represented with cultural sensitivity and semantic accuracy. Research in KO and digital heritage consistently

highlights the tension between global interoperability and local knowledge representation, noting that universal standards often marginalise local epistemologies if applied without contextual mediation (García Gutiérrez, 2014; Binding & Tudhope, 2016; Altenhöner et al., 2020). The absence of an integrated and contextualized taxonomy not only hampers institutional workflows but also limits the ability of CHIs to participate effectively in national and international heritage knowledge ecosystems (Smiraglia, 2014b; Veldpaus, 2016; Zeng & Mayr, 2019). These risks are compounded by challenges of digital obsolescence and the potential erosion of local knowledge in digitally mediated heritage environments (Knaflic et al., 2022).

The expected utility of addressing problems of this type is well documented in prior studies. Context-aware and interoperable taxonomies have been shown to improve metadata consistency, cross-institutional collaboration, digital discoverability, and public engagement in CH environments (Kwiecien et al., 2025; Nappi et al., 2024; Poveda-Villalón et al., 2020). Moreover, participatory and empirically evaluated KO artefacts are more likely to achieve institutional adoption, long-term sustainability, and alignment with community values (Szopinski et al., 2019; Szopinski et al., 2020).

In response, this dissertation is strategically positioned at the intersection of KO theory, CHI operational practice, and enabling digital infrastructures. It aims to design, develop, and validate a contextualized taxonomy that enhances CH data access and knowledge preservation within OCMHS. Employing the Design Science Research (DSR) process model and grounded in qualitative empirical investigation, this study addresses both the technical problem of metadata fragmentation and the institutional problem of CHI disconnection. Ultimately, the research contributes a practical artefact for localized implementation and advances theoretical understanding of contextualized taxonomy development for complex cultural heritage environments. To further specify these issues, the following section outlines the research problem guiding this study.

1.3 Study Motivation

The motivation for this study arises from the intersection of practical imperatives, theoretical gaps, and strategic heritage management considerations. In cultural heritage (CH) management, effective knowledge organization (KO) is not merely an internal documentation exercise but a strategic enabler for interpretation, public engagement, and sustainable preservation. However, despite extensive global

discourse on interoperability and the proliferation of knowledge organization systems (KOSs), many cultural and industrial heritage contexts remain underrepresented in academic scholarship and unevenly addressed in institutional practice, particularly outside Euro-American heritage settings (Amiri, 2025; Biagetti et al., 2021; Mai, 2011).

From a practical perspective, this study is motivated by the persistent fragmentation and inefficiency of KO processes at the Ombilin Coal Mining Heritage of Sawahlunto (OCMHS). As a UNESCO World Heritage Site, OCMHS represents a complex industrial and social landscape encompassing mining infrastructure, railway systems, colonial-era settlements, and community facilities that together narrate the socio-technical evolution of a mining town. Nevertheless, empirical studies of World Heritage governance indicate that CHIs often continue to operate in institutional silos after inscription, maintaining legacy cataloguing practices and sector-specific standards that inhibit semantic integration (Camagni et al., 2020; Di Giulio et al., 2021; Veldpaus, 2016).

Within OCMHS, CHIs operate largely in isolation, each employing distinct KO standards and descriptive practices. The absence of a shared taxonomy or interoperable metadata framework has resulted in siloed heritage information, limited retrieval and discovery capabilities, and reduced capacity to communicate an integrated heritage narrative. Similar challenges have been documented across cultural heritage ecosystems, where fragmented KO practices constrain digital convergence, public engagement, and collaborative heritage initiatives (Hendrawan et al., 2024a; Kwiecien et al., 2025; Nappi et al., 2024). For local stakeholders, this fragmentation results in missed opportunities for cultural education, community participation, and heritage-driven socioeconomic development (Lindayanti et al., 2017; Syafrini et al., 2020).

From a theoretical perspective, the study is motivated by a well-recognised gap in the literature on contextualized taxonomy development in cultural heritage domains. While international KOS standards such as the Art & Architecture Thesaurus (AAT), UNESCO Thesaurus, CIDOC Conceptual Reference Model (CIDOC-CRM), Library of Congress Subject Headings (LCSH), ISO 25964, and ANSI/NISO Z39.19 provide robust foundations for semantic interoperability, numerous scholars have noted that these standards often lack the semantic richness required to capture site-specific terminologies, vernacular knowledge, community

narratives, and relational dimensions of artefacts and practices (García Gutiérrez, 2014; Binding & Tudhope, 2016; Altenhöner et al., 2020). As Martínez-Ávila and Beak (2016) and Smiraglia (2014a) argue, adapting KO frameworks to culturally embedded contexts requires methodological rigor, reflexivity, and participatory engagement to ensure that taxonomies reflect both formal knowledge structures and lived cultural experiences.

This study addresses this gap by developing a contextualized taxonomy through a Design Science Research (DSR) approach, grounded in embedded multiple case studies across Area A of the OCMHS (Sawahlunto Municipality), and validated through participatory and scenario-based usability testing.

From a strategic perspective, the study aligns with UNESCO's heritage stewardship principles and Indonesia's national cultural heritage agenda. Prior research demonstrates that context-aware and interoperable taxonomies strengthen KO practices within CHIs while enhancing global visibility and integration with national and international heritage knowledge networks (Kwiecien et al., 2025; Nappi et al., 2024; Poveda-Villalón et al., 2020). For OCMHS, a contextualized taxonomy supports not only institutional coordination but also inclusive access, community-based interpretation, and long-term sustainability, in line with FAIR data principles and participatory heritage governance models (Poveda-Villalón et al., 2020; Vogt et al., 2025; Wilkinson et al., 2016).

Overall, the motivation for this study is grounded in the urgent need to transform fragmented KO processes into an integrated and contextually meaningful taxonomy. By addressing practical institutional challenges, advancing theoretical discourse on contextualized taxonomy development, and responding to strategic heritage imperatives, the study positions itself at the convergence of applied practice and academic innovation. The expected outcome is a reconfiguration of how cultural heritage knowledge is captured, organized, and shared, contributing both to KO scholarship and to the sustainable management of cultural heritage institutions.

1.4 Problem Statement

Effective knowledge organization (KO) is a cornerstone of cultural heritage (CH) management, as it enables systematic documentation, contextual interpretation, and sustainable access to heritage resources for diverse user communities. For World

Heritage Sites, such as the Ombilin Coal Mining Heritage of Sawahlunto (OCMHS), effective KO is particularly critical due to the need to integrate tangible, intangible, industrial, and social heritage narratives within a coherent knowledge framework. Despite their inscription as UNESCO World Heritage Sites, CHIs within the OCMHS continue to face persistent, systemic KO challenges. UNESCO recognition primarily establishes heritage value and conservation obligations but does not prescribe integrated operational mechanisms for KO across heterogeneous cultural heritage institutions (CHIs), each operating under distinct institutional mandates, professional traditions, and descriptive standards. As a result, KO fragmentation persists, limiting interoperability, interpretive coherence, and long-term sustainability. Four interrelated problem areas are identified.

1.4.1 Fragmentation and Lack of Integration in Knowledge Organization Processes

Although OCMHS has achieved UNESCO World Heritage status, its CHIs still lack an integrated knowledge organization system (KOS) that enables coordinated description, classification, and access across institutions. KO practices remain institutionally siloed, shaped by sector-specific traditions of libraries, archives, and museums, leading to duplication of effort, semantic inconsistencies, and limited cross-institutional convergence.

This fragmentation persists not because of the absence of international standards, but because such standards are often implemented unevenly and without sufficient contextual adaptation to local institutional realities and heritage narratives. Prior studies indicate that UNESCO designation alone does not resolve underlying governance, semantic, and infrastructural fragmentation in heritage management systems (Camagni et al., 2020; Di Giulio et al., 2021; Veldpaus, 2016). These challenges are particularly acute in industrial heritage contexts, where technical, social, and intangible dimensions intersect and require integrated, cross-domain representation. Without a unified KO framework, heritage interpretation and long-term preservation within OCMHS remain fragmented and unsustainable.

1.4.2 Limited Understanding of Critical Factors for Taxonomy Development

To date, there has been limited empirical research that systematically identifies the organizational, cultural, and technical factors necessary to inform the development of a contextualized taxonomy for industrial World Heritage sites such as OCMHS. While existing KO research has extensively addressed the design and application of international KOS standards (e.g., AAT, LCSH, ISO 25964), these studies tend to emphasize formal interoperability and semantic control rather than the situated practices, institutional capacities, and cultural negotiations required in local heritage contexts (O'Neill & Stapleton, 2022; Ranjgar et al., 2024; Wang, 2025; Yuan et al., 2025).

Critical scholarship has further highlighted that the neglect of local knowledge systems and participatory design processes often results in taxonomies that are technically compliant but culturally misaligned and institutionally underutilized (García Gutiérrez, 2014; Poveda-Villalón et al., 2020). The absence of empirical insight into these contextual factors limits the theoretical robustness and practical sustainability of unified KO initiatives, particularly in post-inscription World Heritage environments such as OCMHS.

1.4.3 Absence of a Contextual Taxonomy

At present, no consolidated or contextualized taxonomy exists that can unify the collections and knowledge assets of OCMHS CHIs into a coherent semantic structure. Although international standards provide a baseline for interoperability, they often fail to capture cultural specificities, industrial heritage terminology, and the intangible knowledge embedded in local communities (Altenhöner et al., 2020; Binding & Tudhope, 2016; Chansanam et al., 2025).

Studies in KO within the cultural heritage sector consistently show that the absence of a shared semantic framework constrains cross-institutional collaboration, weakens public engagement, and hinders alignment with national and global heritage information infrastructures (Hendrawan et al., 2025b; Kwiecien et al., 2025; Nappi et al., 2024). Consequently, OCMHS lacks a knowledge framework that can simultaneously preserve cultural authenticity while maintaining semantic interoperability with international KOS ecosystems.

1.4.4 Need for Systematic Evaluation of Taxonomy

Even when taxonomies are developed, they are rarely subjected to systematic, participatory, and empirical evaluation. Taxonomy research has traditionally prioritised design over validation, resulting in artefacts whose usability, interpretability, and institutional acceptance remain largely untested (Szopinski et al., 2019; Szopinski et al., 2020).

Within cultural heritage contexts, this lack of evaluation is particularly problematic, as taxonomies must mediate between professional standards, institutional workflows, and community meanings. Without iterative design cycles, focus group discussions, and scenario-based usability testing, taxonomies risk failing to meet user needs, lacking institutional buy-in, and becoming unsustainable over time (Germanakos & Fichte, 2020; Vogt et al., 2025). For OCMHS, systematic evaluation is therefore essential to ensure that any taxonomy developed is not only technically functional but also culturally resonant and socially legitimate.

Collectively, these challenges reveal a critical research gap, including the absence of a methodologically rigorous, empirically grounded, and participatory approach to designing and evaluating a contextualized taxonomy that balances international KO standards with local cultural knowledge in an industrial World Heritage setting. Addressing this gap requires an integrated research approach that combines contextual analysis, iterative taxonomy development, and participatory evaluation. In response, this study formulates research objectives to guide the development, validation, and implementation of a contextualized CHI taxonomy for the OCMHS.

1.5 Research Objectives

i) To explore the existing conditions of knowledge organization processes across CHIs within the OCMHS

ii) To identify the critical factors influencing the development of a contextualized taxonomy.

iii) To develop a contextual taxonomy for OCMHS CHIs.

iv) To evaluate the developed taxonomy through participatory validation.

1.6 Research Questions

i) What are the existing conditions of knowledge organization processes within CHI in the OCMHS?

ii) What are the critical factors that influence the development of a contextualized taxonomy for OCMHS CHI?

iii) How can a contextual taxonomy be developed to support integrated KO across OCMHS CHIs?

iv) How effective and usable is the developed taxonomy when evaluated?

1.7 Significance of the Study

This study is significant for its ability to address critical gaps in knowledge organization (KO) within cultural heritage institutions (CHIs), while simultaneously contributing to theory, methodology, and practice. Grounded in the case of the Ombilin Coal Mining Heritage of Sawahlunto (OCMHS), the study provides both a contextually relevant and academically rigorous contribution across multiple dimensions.

From a theoretical perspective, the study extends KO theory by embedding Design Science Research (DSR) into taxonomy development, thereby moving beyond static and universalized classification frameworks. While international knowledge organization system (KOS) standards such as the Art & Architecture Thesaurus (AAT), UNESCO Thesaurus, CIDOC Conceptual Reference Model (CIDOC-CRM), Library of Congress Subject Headings (LCSH), ISO 25964, and ANSI/NISO Z39.19 provide foundational structures for semantic interoperability, prior studies have shown that these standards often insufficiently capture the cultural specificities and situated meanings embedded in local heritage contexts (García Gutiérrez, 2014; Binding & Tudhope, 2016; Altenhöner et al., 2020).

This study positions taxonomy as a living, culturally embedded framework that bridges formalized knowledge structures with situated cultural narratives. In particular, the introduction of a dual-labelling strategy, whereby local terminologies are explicitly mapped to corresponding international vocabularies, advances theoretical discourse by reconciling cultural authenticity with global interoperability. Similar approaches have been advocated in recent KO and digital heritage scholarship to mitigate semantic dominance while maintaining cross-system compatibility (Poveda-Villalón et al., 2020;

Vogt et al., 2025), thereby enriching scholarly understanding of contextual taxonomy design.

From a methodological perspective, the study contributes a hybrid research approach that integrates DSR with embedded case studies and scenario-based usability evaluation. By operationalizing usability indicators such as interpretability, task support, and institutional fit, the study advances a replicable framework for evaluating participatory taxonomies in the cultural heritage domain. Prior research has emphasized that scenario-based testing and participatory validation are critical for ensuring that knowledge organization artefacts align with real-world institutional practices and user expectations (Germanakos & Fichte, 2020; Szopinski et al., 2019; Szopinski et al., 2020). Accordingly, using scenario-based usability validation in this study helps ensure that the taxonomy is not only technically functional but also responsive to institutional capacities and user needs, thereby increasing the likelihood of long-term adoption and sustainability.

From a practical perspective, the study develops a contextualized taxonomy that functions as a semantic backbone for CHIs within OCMHS, enhancing metadata consistency, interoperability, and cultural representation. Previous studies have demonstrated that interoperable and context-aware semantic frameworks significantly improve discoverability, cross-institutional collaboration, and public engagement in cultural heritage environments (O'Neill & Stapleton, 2022; Raemy, 2025; Wang et al., 2025). In this regard, the implementation of an interoperable and contextualized taxonomy enhances the global visibility of OCMHS, facilitates integration into wider heritage knowledge networks, and promotes community engagement through accessible and inclusive digital artefacts, particularly when local narratives are explicitly represented alongside international standards (Chansanam et al., 2025; Hendrawan et al., 2024b; Hendrawan et al., 2025b).

At a strategic level, the study aligns with UNESCO's heritage stewardship principles and Indonesia's national cultural heritage agenda. By enabling structured interoperability while preserving the integrity of local knowledge, the proposed taxonomy model supports sustainable heritage governance and offers a transferable framework that can be adapted to other UNESCO or nationally designated heritage sites facing similar KO fragmentation challenges.

1.8 Scope and Study Limitation

The scope of this study is deliberately focused to ensure methodological rigor and contextual relevance. Geographically, the study is limited to Area A of the Ombilin Coal Mining Heritage of Sawahlunto (OCMHS), also known as Sawahlunto Municipality, which constitutes the core zone encompassing the principal industrial, social, and cultural sites recognized in the UNESCO World Heritage inscription. Within this area, the study involves four municipal museums, one municipal library, and one municipal archives, collectively representing the primary cultural heritage institutions (CHIs) responsible for documenting, curating, and managing OCMHS cultural heritage resources.

Substantively, the study focuses on developing a contextualized taxonomy that integrates collections across participating institutions. This focus reflects the study's aim of enhancing access to knowledge, improving semantic interoperability, and supporting integrated interpretation of cultural heritage. It is important to clarify that the study does not address physical conservation, restoration, or on-site heritage management practices, as its primary contribution lies in knowledge organization (KO) and cultural heritage studies. By clearly delineating this scope, the study ensures methodological coherence and direct alignment between its research objectives and its principal output, namely, a contextual knowledge taxonomy. Despite its focused scope, the study is subject to several limitations:

a) Geographical specificity: The study is confined to the OCMHS context. As a result, the findings and the developed taxonomy artefact are context-dependent and may require conceptual and operational adaptation before application in other cultural heritage settings.
b) Methodological constraints: The study is based on qualitative multiple case studies involving a finite number of informants, including CHI directors, curators, librarians, archivists, registrars, CH experts, and user representatives. In this study, user representatives refer to individuals who interact with or utilise cultural heritage information systems and collections, such as local community members, whose perspectives provide insight into usability, interpretability, and access needs. While this approach enables rich, in-depth exploration of institutional and user perspectives, it inherently limits the statistical generalizability of the findings beyond the participating institutions.

c) Temporal limitations: The fieldwork and participatory evaluation were conducted over a six-month period, which constrains the study's ability to observe long-term adoption, institutional embedding, and sustainability outcomes of the developed taxonomy artefact.

By clearly articulating these boundaries, the study ensures that its contributions are contextually grounded, meaning that the organizational structures, cultural practices, institutional workflows, and user contexts of the OCMHS CHIs explicitly inform the design, development, and evaluation of the taxonomy. This positioning is consistent with the principles of Design Science Research (DSR), in which artefacts are iteratively developed and refined within a specific socio-organizational setting to generate actionable and practically relevant knowledge rather than universally generalizable solutions. Moreover, beyond these scope-related considerations, the study also places strong emphasis on ethical compliance, particularly given the sensitive nature of working with community-based knowledge, institutional practices, and cultural data. Ethical procedures governing data collection, consent, and knowledge representation are discussed in the following section.

1.9 Ethical Committee

Research ethics refers to the principles and guidelines that govern the conduct of research, particularly concerning the rights, dignity, and welfare of individuals involved or affected by research activities (Saunders et al., 2023). In KO research, where human participants are often involved, ethical considerations are critical, regardless of whether the study is conducted remotely or in person.

Given that this study involves human participants, ethical clearance was obtained from the Research Ethics Committee of Universiti Teknologi MARA (REC UiTM) before the commencement of any data collection activities. The research was designed to minimize potential risks and uphold ethical standards by protecting participants' rights, ensuring informed consent, and safeguarding data confidentiality.

The REC UiTM is responsible for reviewing all research conducted under the institution's auspices, ensuring methodological integrity and participant well-being. Formal approval from the REC UiTM was secured to ensure compliance with institutional and international ethical guidelines. To ensure conceptual clarity

throughout the study, key terms and constructs are defined operationally in the following section.

1.10 Definition of Operational Terms

To ensure conceptual clarity and consistency throughout this dissertation, key operational terms are defined in accordance with established literature on KO and CH. These definitions provide a shared understanding of the study's central concepts and serve as a foundation for the subsequent chapters.

1.10.1 Knowledge Organization

Knowledge organization (KO) constitutes the overarching discipline concerned with the systematic structuring and representation of knowledge. According to ISO 5127:2017, KO encompasses the activities of classification, indexing, and metadata creation that collectively ensure efficient retrieval, accessibility, and long-term preservation of information resources (ISO, 2017). Within the scope of this dissertation, KO is conceptualized as an umbrella framework encompassing various tools, systems, and methods for managing cultural heritage knowledge across CHIs.

1.10.2 Taxonomy

Taxonomy is understood in this study as a specific form of knowledge organization system (KOS). Defined in Hedden (2022), Hlava (2022a), and Smiraglia (2014a) as a hierarchical classification scheme that organizes concepts in parent–child or broader–narrower relationships, taxonomy is particularly suited for contexts that demand both semantic precision and user comprehensibility.

Within this research, taxonomy is positioned as the semantic backbone of the OCMHS digital repository prototype, enabling alignment across heterogeneous collections while preserving cultural authenticity. Taxonomies are widely recognised for providing a pragmatic balance between conceptual rigor and operational usability, particularly in applied and institutional settings. Taxonomies offer sufficient semantic structure to support interoperability while remaining more transparent, manageable, and interpretable for practitioners and end users than more formalised ontological models

(Binding & Tudhope, 2016; Poveda-Villalón et al., 2020). Accordingly, taxonomy is adopted in this study as a flexible yet interoperable KOS structure that mediates between local cultural knowledge and global cultural heritage information infrastructures.

1.10.3 Cultural Heritage Institutions

Adapted from Roussos and Stamatoudi (2022), Thekkum Kara (2021), and UNESCO (2021), cultural heritage institutions (CHIs) are formal entities mandated to collect, preserve, and provide access to CH resources, including libraries, archives, and museums (LAMs). In this study, CHIs refer to public-sector institutions that manage cultural heritage collections or resources of OCMHS.

1.10.4 Interoperability

Interoperability is defined in ISO/IEC 2382:2015 as the capability of different systems or organizations to work together by exchanging and using information (ISO/IEC, 2015). In the context of cultural heritage information systems, interoperability is widely conceptualized as a multi-dimensional construct encompassing semantic, technical, and organizational dimensions (O'Neill & Stapleton, 2022; Raemy, 2025; Ranjgar et al., 2024; Wang, 2025).

For this study, interoperability is unpacked into three interrelated dimensions. Semantic interoperability refers to the consistent understanding and exchange of meaning across systems through shared terminologies, controlled vocabularies, and conceptual mappings. In cultural heritage contexts, this includes aligning local taxonomic terms with internationally recognized vocabularies to enable cross-system interpretation and reuse (Binding & Tudhope, 2016; Poveda-Villalón et al., 2020).

Technical interoperability concerns the compatibility of digital infrastructures, including data formats, metadata schemas, protocols, and system architectures, which collectively enable automated data exchange and integration across platforms. Prior studies emphasize that technical interoperability is a prerequisite for connecting local cultural heritage repositories with national and international aggregators and digital heritage infrastructures (Altenhöner et al., 2020; Hendrawan et al., 2024b; Longo et al., 2020).

Organizational interoperability involves institutional coordination, governance arrangements, and policy alignment necessary to support sustained collaboration across cultural heritage institutions. Research in heritage information management demonstrates that semantic and technical solutions alone are insufficient without organizational commitment to shared knowledge frameworks, common workflows, and collaborative governance structures (Camagni et al., 2020; Di Giulio et al., 2021; Raemy, 2025).

1.10.5 Knowledge Organization Systems

Knowledge organization systems (KOS) function as the technical and conceptual instruments that operationalize the principles of knowledge organization (KO). They encompass taxonomies, thesauri, ontologies, and classification schemes that provide structured semantic frameworks for representing, relating, and retrieving knowledge resources (Hlava, 2022a; Biagetti, 2021; Gnoli, 2020).

Within cultural heritage institutions (CHIs), KOS play a critical role in creating semantic coherence, enhancing information discoverability, and facilitating cross-domain integration across libraries, archives, and museums. Prior studies demonstrate that well-designed KOS improve consistency in metadata practices, support meaningful access to heterogeneous collections, and enable interoperability across institutional and disciplinary boundaries (Dahlgren & Hansson, 2020; Giannoulakis et al., 2018; Kumar & Ramesha, 2020; Qin & Zeng, 2020).

Accordingly, KOS serve as a bridging mechanism between the theoretical foundations of KO and their practical implementation within CHIs, translating abstract organizational principles into operational structures that support documentation, retrieval, and integrated heritage interpretation (Hlava, 2022a; Smiraglia, 2014a; Zeng & Mayr, 2019).

1.10.6 Ombilin Coal Mining Heritage of Sawahlunto

As defined by Emely and Gebert (2020) and UNESCO (2019), the OCMHS is a UNESCO World Heritage Site that represents a late-19th- to early-20th-century industrial landscape in West Sumatra Province, Indonesia. It comprises coal mines, railway infrastructure, colonial-era housing, and associated socio-technical systems.

By defining these terms at the outset, this study establishes a consistent conceptual framework that supports the design, development, and evaluation of the proposed artifact for OCMHS. These definitions also ensure alignment with global best practices in KO and CH management and facilitate the interpretation and implementation of findings in subsequent chapters. The next section outlines the structure of the dissertation and explains how it is organized in alignment with the DSR methodology process model.

1.11 Thesis Outline

The significance of this section cannot be overstated. Given the complex and iterative nature of design science research (DSR), a dedicated mapping structure has been adopted to assist readers in understanding and correlating the diverse components of this study. Unlike conventional empirical research formats where Chapter 1 typically presents the Introduction, Chapter 2 the Literature Review, Chapter 3 the Methodology, Chapter 4 the Findings, and Chapter 5 the Discussion and Conclusion, this study follows the DSR methodology process model proposed by Peffers et al. (2007), as illustrated in Figure 1.1. The model comprises six core phases, including A) Identify Problem and Motivate, B) Define Objectives of a Solution, C) Design and Development, D) Demonstration, E) Evaluation, and F) Communication.

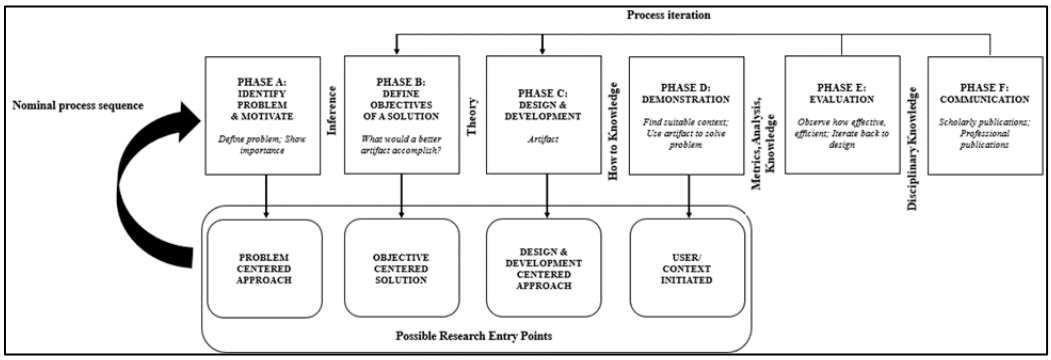


Figure 1.1 DSR Methodology Process Model (Peffers et al., 2007)

Accordingly, this study adopts a structured framework that aligns the thesis chapters with the phases of the DSR methodology process model. This alignment addresses the reporting challenges frequently encountered in DSR, particularly in the Library and Information Science (LIS) discipline, where the non-linear and artifact-driven nature of the study often complicates standard thesis structures. Effectively

communicating research contributions while maintaining academic rigour requires a systematic approach to organizing the content.

To address this challenge, van der Merwe et al. (2017) proposed a mapping between the Peffers et al. (2007) DSR methodology and the traditional structure of postgraduate research reports. Their objective was to provide doctoral and master's researchers with a coherent reporting framework for DSR-based investigations. Based on an analysis of successful theses employing DSR, van der Merwe et al. developed alignment scenarios that illustrate how each step of the DSR process can correspond to traditional dissertation sections. This mapping was later validated through doctoral workshops and was shown to be effective in helping students structure DSR theses. This study adopts the thesis report structure aligned with the six-step DSR process model, mapped to dissertation chapters as guided by van der Merwe et al. (2017), as shown in Figure 1.2.

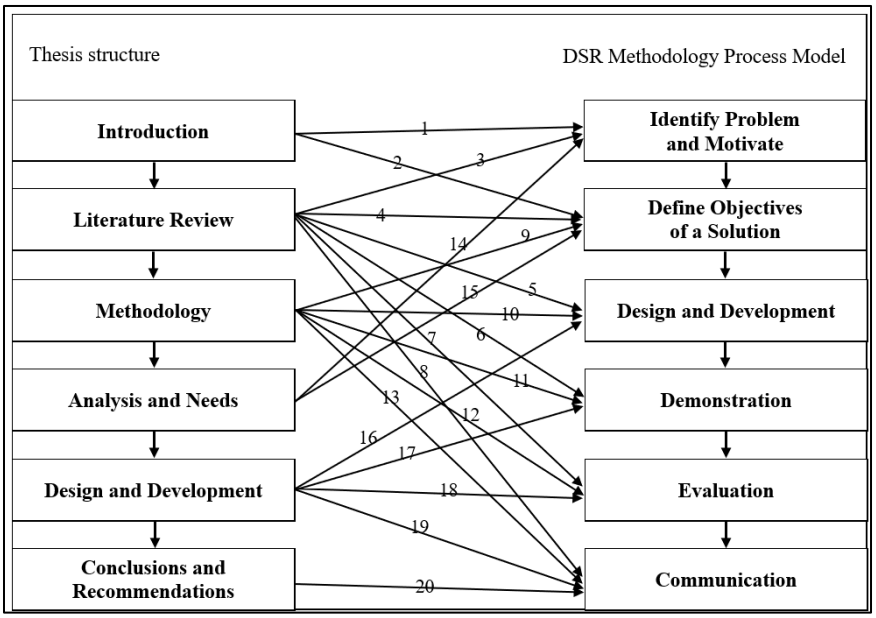


Figure 1.2 Mapping of the DSR Process Model to Thesis Report Structure Adapted from Peffers et al. (2007) and van der Merwe et al. (2017)

The adoption of this mapping model offers several academic advantages. First, it ensures that each phase of the DSR process is explicitly and systematically addressed within the thesis. Second, it enhances the clarity and coherence of research reporting by guiding the logical presentation of the designed artifact, its evaluation, and the underlying theoretical foundations. Third, by adhering to a well-defined research process, the study demonstrates academic rigor, traceability, and methodological transparency, hallmarks of high-quality scholarly research.

In conclusion, the DSR thesis mapping proposed by van der Merwe et al. (2017), aligned with the foundational model of Peffers et al. (2007), provides a robust framework for structuring and reporting DSR research. Its applicability has been validated across a variety of contexts, enabling researchers to communicate artifact development and evaluation outcomes in a structured and academically rigorous manner. By adopting this approach, the present study aims to systematically document the development of the CHI Taxonomy and its broader implications for the CH context and management within OCMHS.

1.12 Chapter Summary

This chapter has laid the foundation for the dissertation by outlining the study context, motivation, problem framing, and structural roadmap. Situated within the CH domain, the study highlights the pivotal role of KO in systematic documentation, efficient information retrieval, and meaningful interpretation of cultural heritage. The focus is on the OCMHS, a UNESCO World Heritage Site that represents a distinctive cultural and industrial heritage landscape in Indonesia.

The motivation for this study arises from practical, theoretical, and strategic imperatives. Practically, it addresses fragmented KO processes and limited interoperability across OCMHS CHIs, which hinder integrated heritage interpretation and sustainable management. Theoretically, it responds to gaps in the literature concerning the contextualized taxonomy for cultural heritage, where international KOS standards such as AAT, UNESCO Thesaurus, CIDOC-CRM, LCSH, ISO 25964, and ANSI/NISO Z.39.19 require local adaptation to capture cultural specificities. Strategically, the study aligns with UNESCO's heritage management principles and Indonesia's national CH agenda, contributing to long-term digital preservation, global visibility, and community engagement.

The problem statement was articulated around four interrelated challenges, including 1) fragmentation and lack of integration in KO processes; 2) limited understanding of taxonomy development factors; 3) absence of a contextualized taxonomy for OCMHS; and 4) the need for systematic and participatory evaluation to ensure sustainability. In response, the study proposes designing, developing, and validating a contextualized taxonomy for OCMHS. This aim is operationalized through four research objectives, which progress logically from contextual

exploration to artifact design, iterative refinement, and usability testing with stakeholder participation.

Furthermore, the chapter clarified the scope, limitations, operational definitions, and thesis structure, presenting an iterative four-phase research flow grounded in the DSR methodology and supported by an embedded multiple-case study design. Together, these elements provide methodological rigor and practical relevance, ensuring that the study makes a substantive contribution to both KO theory and CH practice. This chapter concludes by positioning the study within a clear research trajectory. Chapter 2, therefore, critically reviews the literature on KO and taxonomy development in CHIs, contrasting existing approaches and highlighting theoretical and methodological gaps that reinforce the necessity for a contextualized and participatory taxonomy as a living knowledge framework for OCMHS.

CHAPTER 2
LITERATURE REVIEW

2.1 Chapter Overview

As outlined in Chapter 1, the challenges faced by cultural heritage institutions (CHIs) in the Ombilin Coal Mining Heritage of Sawahlunto (OCMHS) context—namely, fragmented knowledge organization practices, the absence of a contextualized taxonomy, and the lack of systematic evaluation—necessitate a systematic, contextual, and interoperable approach to knowledge organization (KO). This chapter examines the theoretical and empirical foundations of such an approach, focusing on KO theories, the roles and convergence of CHIs, and taxonomy development, while identifying the literature gaps addressed through a design science research (DSR) methodology process model. The chapter concludes by positioning the proposed study within the broader scholarly discourse.

The first part of the chapter examines cultural and industrial heritage frameworks, showing how classifying heritage into tangible and intangible dimensions shapes documentation, interpretation, and knowledge representation practices. This contextual grounding introduces OCMHS as a living industrial heritage landscape, highlighting its outstanding universal value (OUV) and the complex socio-technical narratives embedded within its museums, archival records, and library collections. The review then turns to CHIs as custodians of heritage knowledge. Globally, the functional convergence of libraries, archives, and museums has emerged as a central theme in heritage management, driven by the need to integrate dispersed knowledge sources, harmonize metadata practices, and enable cross-institutional collaboration. This discourse on convergence directly informed the initial iteration of the taxonomy development presented in Chapter 5, in which insights from multiple CHIs were synthesized into a unified taxonomy framework.

The core of this chapter lies in the theoretical foundations and practical applications of KO in cultural heritage settings, with particular emphasis on taxonomy as a key knowledge organization system. It critically examines inductive, deductive, and iterative approaches to taxonomy development and their relevance to industrial heritage contexts, where international KOS standards often require contextual

adaptation to capture vernacular semantics and local narratives. From this review, four guiding design principles—hierarchical structuring, cultural embeddedness, scalability, and interoperability—are distilled and subsequently operationalized in the iterative taxonomy development described in Chapter 5.

Furthermore, the chapter incorporates a bibliometric analysis to provide a macro-level, longitudinal perspective on the development of taxonomy research in the Library and Information Science (LIS) domain. The bibliometric analysis was conducted using publications indexed in the Scopus database over 50 years (1974–2024). Data were retrieved using predefined Boolean search strings related to taxonomy development and analyzed using the Bibliometrix package in R. The analysis involved performance metrics (e.g., publication trends, productive authors, and sources) and science-mapping techniques, including co-word analysis and thematic mapping, to identify dominant, emerging, and declining research themes (Aria & Cuccurullo, 2017). This bibliometric evidence situates the present study within global scholarly trajectories, demonstrating that while taxonomy research has matured methodologically, applications in cultural heritage contexts—particularly those employing participatory and DSR-based approaches—remain marginal.

Structurally, the chapter progresses from general to specific, beginning with cultural and industrial heritage concepts, followed by the roles and convergence of CHIs, and then moving into KO theories, KOS, and taxonomy development. The chapter concludes by synthesizing insights from the systematic literature review and bibliometric analysis to identify clear research gaps, thereby justifying the need for a contextualized, interoperable, and systematically evaluated taxonomy tailored to the OCMHS context.

2.2 Cultural and Industrial Heritage Context

2.2.1 Cultural Heritage: Definition and Significance

Cultural heritage (CH) represents the collective memory and identity of a society, encompassing both tangible and intangible expressions that embody the historical, social, and cultural experiences of communities across time. The United Nations Educational, Scientific, and Cultural Organization (UNESCO) defines cultural heritage as the legacy of physical artifacts and intangible attributes inherited from past

generations, maintained in the present, and transmitted to future generations (Kumar, 2024; Sullivan, 2016; UNESCO, 2003). This definition emphasizes that CH is not static but is continuously produced and reinterpreted through dynamic interactions among people, their environment, and historical narratives, positioning heritage as a living, evolving social construct rather than a fixed collection of objects (Hitchcock et al., 2010; Smith & Waterton, 2013).

The significance of CH lies in its role in preserving collective knowledge, reinforcing cultural continuity, and enabling intergenerational transmission of values and practices. The interdependence between tangible and intangible heritage ensures that cultural narratives are not merely recorded but also enacted, interpreted, and sustained through social practice (Harrison, 2013; UNESCO, 2003). From a scholarly perspective, CH constitutes a critical resource for interdisciplinary research across history, anthropology, sociology, architecture, and digital humanities. Within the fields of knowledge organization (KO) and cultural heritage studies, this duality necessitates structured, context-sensitive systems capable of organizing heterogeneous heritage resources while preserving their semantic and cultural relationships (Hou et al., 2022; Nappi et al., 2024).

In KO contexts, the organization and interpretation of heritage materials enable cultural heritage institutions (CHIs) to transform fragmented historical records into coherent and meaningful narratives. Contextualized KOS, such as taxonomies, play a central role in mediating access to heritage knowledge by supporting discovery, interpretation, and knowledge dissemination across institutional and disciplinary boundaries (Hlava, 2022a; Smiraglia, 2014a; Zeng & Mayr, 2019). Through systematic organization, CHIs can facilitate engagement by local communities, researchers, and global audiences, ensuring that heritage knowledge remains accessible, interpretable, and reusable over time (Hou et al., 2022; Sandy & Bossaller, 2017).

Beyond its cultural and academic significance, CH also carries important socioeconomic and strategic value. Well-documented and effectively managed heritage resources contribute to cultural tourism, educational development, and community empowerment, while reinforcing a shared sense of place and identity (Mohammed et al., 2024; Ruhanen & Whitford, 2021). Increasingly, digital heritage initiatives further enhance global visibility and long-term preservation, aligning CH management with UNESCO's sustainable heritage principles and the FAIR (Findable, Accessible, Interoperable, Reusable) data framework for heritage informatics (Poveda-Villalón et

al., 2020; Vogt et al., 2025; Wilkinson et al., 2016).

Moreover, cultural heritage constitutes a multifaceted societal asset that extends beyond the preservation of historical objects to encompass identity formation, knowledge transmission, and sustainable development. Scholars consistently emphasize that the coexistence of tangible and intangible dimensions introduces significant complexity for heritage documentation and organization, as diverse materials, practices, and narratives must be systematically integrated while retaining their contextual meanings (Harrison, 2013; Smith & Waterton, 2013; Thekkum Kara, 2021). This complexity is particularly pronounced in industrial heritage contexts such as the Ombilin Coal Mining Heritage of Sawahlunto (OCMHS), where physical infrastructures, archival records, and lived community experiences intersect. Such environments demand integrated KO frameworks that accommodate heterogeneous heritage forms within a coherent, interoperable structure, thereby justifying the need for the contextualized taxonomy development explored in this study.

2.2.2 Categories of Cultural Heritage

Cultural heritage (CH) is commonly classified into tangible and intangible categories, which together encapsulate the physical manifestations and living expressions of a community's historical and cultural legacy. This distinction has been formally articulated and institutionalized within international heritage frameworks, particularly by UNESCO. As stated in the Convention for the Safeguarding of the Intangible Cultural Heritage:

"Intangible cultural heritage means the practices, representations, expressions, knowledge, skills—as well as the instruments, objects, artefacts and cultural spaces associated therewith—that communities, groups and, in some cases, individuals recognize as part of their cultural heritage." (UNESCO, 2003)

This definition underscores the inseparability of material and immaterial heritage elements, emphasizing that both tangible artifacts and intangible practices are integral to cultural identity, continuity, and interpretation.

Tangible cultural heritage comprises physical objects, structures, and landscapes that embody the historical, technological, and artistic achievements of a society. It includes movable heritage such as artworks, manuscripts, archival records, and museum objects, as well as immovable heritage such as monuments, historic buildings,

archaeological sites, and industrial landscapes (Stylianidis, 2025; Sullivan, 2016; UNESCO, 2003). These material forms provide concrete evidence of past civilizations and socioeconomic transformations, serving as anchors for collective memory and scholarly inquiry (Hitchcock et al., 2010; Smith & Waterton, 2013). In industrial heritage contexts such as the Ombilin Coal Mining Heritage of Sawahlunto (OCMHS), tangible CH is represented by mining shafts, railway infrastructure, machinery, colonial-era worker housing, and preserved mining settlements, which together testify to the technological systems and labor regimes that shaped regional development.

In contrast, intangible cultural heritage encompasses non-material expressions that are transmitted across generations, including oral traditions, performing arts, social practices, rituals, craftsmanship, and local knowledge systems (Chakrabarti & Chakrabarti, 2025; Ubertazzi, 2022; UNESCO, 2003). These elements provide the cultural meanings and social contexts that animate tangible heritage. Within OCMHS, intangible CH is reflected in miners' oral histories, labor songs, safety rituals, occupational knowledge, and community-based practices associated with mining life. Such intangible dimensions transform industrial sites from static remnants of production into dynamic cultural landscapes grounded in lived experience.

The interdependence between tangible and intangible CH has been widely recognized in heritage and KO scholarship. Material artifacts derive much of their significance from the intangible meanings, practices, and narratives that contextualize their creation and use, while intangible heritage is often anchored in specific objects, places, and spatial settings (Alivizatou, 2021; Chiodi, 2025; Harrison, 2013). This duality underscores the need for heritage information systems and taxonomies that can represent both material attributes and contextual narratives. Scholars argue that without such integrative systems, heritage documentation risks privileging physical description at the expense of cultural meaning, thereby undermining holistic interpretation and intergenerational knowledge transmission (Harrison, 2013; Hou et al., 2022; Smiraglia, 2014a).

Recognizing and integrating these two categories of heritage is particularly vital in industrial heritage contexts, where infrastructures such as factories, machinery, and transport systems must be interpreted in relation to labor histories, social relations, and community identities (Douet, 2016; Negri, 2025; Smith & Waterton, 2013). In the case of OCMHS, this duality is directly reflected in the distributed custodianship of heritage knowledge, while museums primarily safeguard tangible artifacts, archives manage

documentary records, libraries organize published and secondary sources, and community memory preserves oral histories and intangible practices. As evidenced in Chapter 4, this institutional separation reinforces fragmented KO practices and limits the construction of integrated heritage narratives across CHIs.

This fragmentation highlights the absence of a contextualized taxonomy that can unify tangible and intangible heritage within a coherent semantic framework. In response, the taxonomy developed in Chapter 5 adopts hierarchical structuring as its foundational design principle, explicitly distinguishing between tangible and intangible CH while embedding local terminology to preserve cultural resonance. At the same time, alignment with international standards such as ISO 25964, AAT, LCSH, UNESCO Thesaurus, and CIDOC-CRM ensures semantic interoperability. Through this approach, OCMHS CHIs can construct cohesive narratives that connect archival records, museum artifacts, and community knowledge, thereby enhancing accessibility to heritage, digital preservation, and interpretive storytelling in accordance with global cultural heritage management principles.

2.2.3 Industrial Heritage

Industrial heritage represents a specialized category of CH that embodies the technological, economic, and social transformations associated with industrialization. It encompasses tangible elements, such as industrial sites, machinery, transportation networks, and production infrastructures, as well as intangible dimensions, including labor practices, technical knowledge, and community narratives that emerged around industrial activity (Douet, 2016; Negri, 2025). The preservation of industrial heritage serves as a bridge between technological evolution and cultural history, offering insight into how industrial processes have shaped societies, landscapes, and local identities (Ferrero et al., 2024; Smith & Waterton, 2013).

Globally, recognition of industrial heritage gained momentum in the late 20th century with the rise of the industrial archaeology movement and the inclusion of industrial sites on UNESCO's World Heritage List. UNESCO acknowledges industrial heritage not only for its technical achievements but also for its role in illustrating human adaptation, innovation, and socioeconomic transformation. These sites often reflect the complex interplay between technology, labor, and environment, capturing the narratives of industrial communities that might otherwise be marginalized in traditional heritage

discourses (Ferrero et al., 2024; Rhodes & Hannum, 2024).

In Indonesia, the OCMHS stands as a landmark of industrial heritage, reflecting both colonial economic history and local socio-technical adaptation (SEAMS, 2022; UNESCO, 2019). Established during the Dutch colonial era in the late 19th century, the mining complex was designed to exploit high-quality coal reserves in West Sumatra and was supported by an integrated transport system of railways, tunnels, and port facilities (Asoka et al., 2016; Erman, 2005; Lindayanti et al., 2016; Lindayanti et al., 2017; Saputra, 2012). OCMHS comprises a comprehensive industrial landscape, including underground and open-pit mines, coal processing facilities, workers' housing, administrative buildings, and supporting social infrastructure, illustrating the holistic character of industrial heritage. According to UNESCO (2025), at least eleven industrial heritage sites, particularly those related to mining, have been designated as World Heritage Sites in various countries worldwide, including OCMHS, as shown in Table 2.1.

Table 2.1
The Industrial World Heritage Sites Worldwide

No.	Countries	World Heritage Site Name	Mining Type	URL
1	Belgium	Major Mining Sites of Wallonia	Coal	https://whc.unesco.org/en/list/1344
2	Chile	Sewell Mining Town	Copper	https://whc.unesco.org/en/list/1214
3	Czech/Germany	Erzgebirge/Krušnohoří Mining Region	Silver, Tin, and Uranium	https://whc.unesco.org/en/list/1478
4	France	Nord-Pas de Calais Mining Basin	Coal	https://whc.unesco.org/en/list/1360
5	Germany	Zollverein Coal Mine Industrial Complex in Essen	Coal	https://whc.unesco.org/en/list/975
6	Indonesia	The Ombilin Coal Mining Heritage of Sawahlunto	Coal	https://whc.unesco.org/en/list/1610
7	Japan	Sites of Japan's Meiji Industrial Revolution: Iron and Steel, Shipbuilding, and Coal Mining	Iron, Steel, and Coal	https://whc.unesco.org/en/list/1484
8	Norway	Røros Mining Town and the Circumference	Copper	https://whc.unesco.org/en/list/55
9	Poland	Krzemionki Prehistoric Striped Flint Mining Region	Striped Flint	https://whc.unesco.org/en/list/1599
10	Romania	Roșia Montană Mining Landscape	Gold	https://whc.unesco.org/en/list/1552
11	Sweden	Mining Area of the Great Copper Mountain in Falun	Copper	https://whc.unesco.org/en/list/1027
12	United Kingdom of Great Britain/Northern Ireland	Cornwall and West Devon Mining Landscape	Copper and Tin	https://whc.unesco.org/en/list/1215

Source: UNESCO (2025)

The outstanding universal value (OUV) of the Ombilin Coal Mining Heritage of Sawahlunto (OCMHS) is grounded in its capacity to demonstrate the interaction between colonial industrial mining technology and local social and cultural contexts in Southeast Asia (Emely & Gebert, 2020; UNESCO, 2019). In addition to its tangible industrial components—such as mines, railways, and workers' settlements- the site also embodies significant intangible heritage values, including community narratives of mining life, patterns of labor migration, and locally adapted social practices associated with industrial work (SEAMS, 2022; UNESCO, 2003; UNESCO, 2019).

This combination of material infrastructures and lived social memory positions OCMHS as a living industrial heritage landscape, in which physical remains and intangible cultural meanings intersect to form an integrated and meaningful heritage narrative rather than a static record of industrial activity (Douet, 2016; Harrison, 2013; Smith & Waterton, 201).

From a heritage management perspective, the Ombilin Coal Mining Heritage of Sawahlunto (OCMHS) is a critical case for knowledge organization (KO) given the distributed nature of its heritage collections across multiple cultural heritage institutions (CHIs). These include municipal museums, a municipal library, and a municipal archives, each responsible for preserving different but complementary components of the heritage record, such as archival documents, photographs, industrial machinery, library materials, museum artifacts, and community-based historical narratives (SEAMS, 2022; Syafrini et al., 2020; UNESCO, 2019).

While collectively representing the industrial and social history of Sawahlunto, these institutions have traditionally operated within separate organizational and descriptive systems, resulting in fragmented documentation and limited semantic integration (Smiraglia, 2014a; Zeng & Mayr, 2019). In such contexts, the development of a cohesive and contextualized taxonomy is widely recognized as essential for enabling integrated access, interpretation, and long-term preservation of complex heritage knowledge across institutional boundaries (Binding & Tudhope, 2016; Poveda-Villalón et al., 2020).

The inscription of OCMHS on the UNESCO World Heritage List in 2019 not only confirms its historical, technological, and cultural significance but also places strategic responsibility on local and municipal institutions to implement sustainable and coordinated heritage management practices, including improved documentation, interpretation, and information integration aligned with international standards

(UNESCO, 2019; UNESCO, 2011). These include systematic KO, digital preservation, and community-based interpretation, ensuring that industrial heritage contributes to cultural identity, education, tourism, and economic development, in alignment with UNESCO's principles for sustainable cultural heritage (Chairu et al., 2025; Hendrawan et al., 2025b; Ye et al., 2024).

In summary, OCMHS exemplifies the multidimensional nature of industrial heritage, where tangible infrastructures and intangible community memories converge. Its recognition as a UNESCO World Heritage Site reinforces the need for integrated knowledge systems to manage, interpret, and disseminate its rich industrial and cultural heritage. The distributed custodianship of OCMHS across museums, libraries, and archives reflects the fragmentation problem identified in Chapter 1 and analyzed in detail in Chapter 4. Addressing this challenge informed the design principles adopted in Chapter 5, where hierarchical structuring, cultural embeddedness, scalability, and interoperability were operationalized in the iterative development of a contextualized taxonomy. This foundation enables OCMHS to transition from fragmented documentation to integrated heritage interpretation, sustainable digital preservation, and alignment with UNESCO's principles of heritage stewardship.

2.3 Cultural Heritage Institutions

2.3.1 Role of Libraries, Archives, and Museums in Heritage Management

Libraries, archives, and museums (LAMs) are the core custodians of CH, functioning as CHIs that preserve, organize, and provide access to the documentary and material evidence of human history and culture. In the context of heritage management, the role of CHIs extends beyond collection storage and documentation to include knowledge transmission, public engagement, and the safeguarding of cultural identity for future generations (Hendrawan et al., 2024a; Rasmussen & Hjørland, 2022; Stauffer, 2021). These institutions function as interconnected nodes within a cultural knowledge ecosystem, where systematic knowledge organization underpins heritage interpretation, supports digital preservation infrastructures, and enables sustainable cultural heritage management across institutional and disciplinary boundaries (Gilliland, 2014; Roussos & Stamatoudi, 2022; Smiraglia, 2014a).

Libraries play a critical role in documenting and disseminating textual, bibliographic, and digital resources that support CH research and interpretation. They

maintain published materials, local history collections, manuscripts, and repositories that contextualize both tangible and intangible CH narratives (Stauffer, 2021). In heritage management, libraries serve as information hubs that provide secondary sources and reference works, complementing the primary artifacts preserved in museums and archives. In digital humanities contexts, libraries increasingly contribute to metadata curation, linked open data initiatives, and integrated catalogs, thereby enhancing global accessibility and the interoperability of heritage knowledge (Gaitanou et al., 2024).

Archives occupy a unique position as repositories of primary documentary evidence that underpins the authenticity and provenance of heritage narratives. They preserve official records, personal papers, administrative documents, maps, photographs, and audiovisual materials that trace the evolution of communities, institutions, and industrial activities (Crockett, 2015; Franks & Bernier, 2018). In industrial heritage sites such as OCMHS, archives safeguard historical records of mining operations, labor management, and colonial administration, which are essential for reconstructing socio-technical histories. In the digital era, archives play a central role in long-term digital preservation strategies, ensuring that both born-digital and digitized records remain authentic, accessible, and reusable for heritage research and legal validation (Duranti, 2020; Franks, 2018).

Museums, by contrast, serve as public-facing institutions that curate, interpret, and exhibit tangible CH to educate, inspire, and engage communities and visitors. They offer the experiential dimension of heritage management, transforming collections into narratives that communicate cultural and historical significance (Sabiescu et al., 2025). In industrial heritage settings, museums preserve machinery, tools, artifacts, and site-specific objects that, when combined with archival documentation and oral traditions, enable holistic storytelling of industrial and community life. Contemporary museum practice increasingly incorporates digital exhibitions, interactive repositories, and participatory curation, emphasizing the integration of physical and digital heritage experiences (Hendrawan & Bafadhal, 2022; Lewi et al., 2020; Zhang et al., 2024).

In modern heritage management, the roles of libraries, archives, and museums are increasingly convergent. This convergence is driven by the need for integrated KO strategies, interoperable metadata standards, and collaborative digital infrastructures that mitigate the fragmentation of CH resources or collections (Giannoulakis et al., 2018; Kumar & Ramesha, 2020; Ruthven & Chowdhury, 2015; Ye & Zhou, 2013).

Integrated CHI initiatives enable cross-institutional access and contextualization, allowing researchers and the public to connect dispersed resources into cohesive narratives. In the case of OCMHS, such convergence is critical for linking archival mining records, library materials on local history, and museum artifacts into a unified contextualized taxonomy. This aligns with UNESCO's sustainable CH management principles and the FAIR (Findable, Accessible, Interoperable, Reusable) data standards (Poveda-Villalón et al., 2020; Vogt et al., 2025; Wilkinson et al., 2016).

Moreover, libraries, archives, and museums function as interdependent pillars of heritage management, each contributing distinct yet complementary roles in preserving, organizing, and transmitting cultural knowledge (Duff et al., 2013; Gilliland, 2014; Rasmussen & Hjørland, 2022; Smiraglia, 2014a). While libraries emphasize access and bibliographic control, archives focus on provenance and evidential value, and museums foreground object-based interpretation; together, they form a distributed but interrelated heritage knowledge environment.

Research on LAM convergence consistently demonstrates that the effective integration of these institutions through shared or interoperable knowledge organization frameworks—such as contextualized taxonomies—enables fragmented collections to be transformed into accessible, interpretable, and meaningful heritage information (Binding & Tudhope, 2016; Hendrawan et al., 2025b; Hendrawan & Sulistyo-Basuki, 2026). Such integration is particularly critical for industrial heritage contexts, where documentary records, physical artifacts, and community-based narratives must be connected to support interpretation, public engagement, and long-term sustainability (Douet, 2016; Harrison, 2013).

In contemporary cultural heritage management, the roles of CHIs are increasingly convergent, driven by the need for interoperable metadata, integrated KO strategies, and collaborative digital infrastructures to overcome institutional fragmentation and semantic silos (Dahlgren & Hansson, 2020; Giannoulakis et al., 2018; Kumar & Ramesha, 2020). The absence of an integrated taxonomy has been widely identified as a key factor exacerbating fragmentation across heritage institutions, as heterogeneous descriptive traditions and metadata practices hinder cross-collection discovery and interpretation (Smiraglia, 2014a; Zeng & Mayr, 2019). Addressing this challenge requires a unifying KO framework that harmonizes institutional practices while remaining sensitive to local context and domain-specific semantics.

2.3.2 Convergence and Implications for Knowledge Organization

The convergence of CHIs has emerged as a critical paradigm in contemporary heritage management, driven by the need for integrated access to knowledge, digital interoperability, and collaborative preservation strategies (O'Neill & Stapleton, 2022; Raemy, 2025; Ranjgar et al., 2024; Wang, 2025). Traditionally, CHIs operated as distinct entities, each with specific mandates, collection types, and professional practices. Libraries primarily managed published and bibliographic resources; archives safeguarded records of evidential and historical value; and museums curated artifacts for interpretation and public display (Duff et al., 2013; Rasmussen & Hjørland, 2022). While these core functions remain, the boundaries between CHIs are increasingly blurred as digital technologies and evolving user expectations demand unified access to cultural knowledge ecosystems (Smiraglia, 2014b; Zorich et al., 2008).

Convergence refers to the integration of functions, workflows, and digital infrastructures across CHIs to optimize KO and access (Hendrawan et al., 2024a; Wang et al., 2025; Rasmussen & Hjørland, 2022). This convergence is not merely administrative or physical, but primarily conceptual and digitally enabled by metadata harmonization, linked data, and interoperable information systems (Hendrawan et al., 2024b; Navarrete, 2021; Ruthven & Chowdhury, 2015). The growing adoption of KOS, including taxonomies, thesauri, ontologies, and controlled vocabularies, facilitates this convergence by creating semantic bridges across heterogeneous collections (Smiraglia, 2014a). For instance, an artifact in a museum, an archival map of a mining site, and a historical book in a library can be linked contextually through a shared taxonomy and harmonized metadata, transforming fragmented records into integrated heritage narratives.

The implications of CHI convergence for KO are profound. First, it enhances semantic interoperability, enabling cross-CHI search and unified discovery of heritage information. Users no longer need to navigate siloed catalogs, as shared KOS and integrated metadata provide cohesive access to both tangible and intangible CH (Ranjgar et al., 2024). Second, convergence supports digital preservation and sustainability, as collaborative infrastructures allow distributed repositories to function as interconnected nodes within a broader CH network (Corujo et al., 2025; Longo et al., 2020). Third, it enriches CH interpretation by incorporating knowledge structures that reflect both institutional holdings and contextual relationships, supporting holistic

storytelling, community engagement, and educational initiatives (Duff et al., 2013; Hendrawan et al., 2025b; Ruthven & Chowdhury, 2015).

In the case of the Ombilin Coal Mining Heritage of Sawahlunto (OCMHS), convergence among cultural heritage institutions (CHIs) is particularly critical due to the distributed custodianship of heritage resources across multiple local institutions. Official UNESCO documentation and site management reports indicate that the industrial heritage components of OCMHS are managed by several municipal museums, a city library, and a local archival office, each responsible for different categories of documentary, material, and historical records (SEAMS, 2022; Syafrini et al., 2020; UNESCO, 2019). These institutions have developed their descriptive practices independently, resulting in heterogeneous cataloguing standards and limited semantic interoperability.

The absence of convergence across CHIs has been widely identified in the literature as a key factor contributing to fragmented access, siloed information systems, and reduced interpretive coherence in complex heritage environments (Hendrawan et al., 2024a; Wang et al., 2025; Rasmussen & Hjørland, 2022; Smiraglia, 2014b). In the OCMHS context, such fragmentation prevents researchers, heritage professionals, and the public from interpreting the site as an integrated industrial landscape; instead, they encounter isolated representations of archives, museum artifacts, and library resources.

Scholarly work in knowledge organization and heritage informatics emphasizes that convergent KO frameworks—particularly contextualized taxonomies—play a central role in transforming dispersed institutional data into accessible, interpretable, and semantically coherent heritage information (Binding & Tudhope, 2016; Poveda-Villalón et al., 2020). For Area A of OCMHS (Sawahlunto Municipality), adopting a shared, contextualized taxonomy provides a practical mechanism to align heterogeneous descriptive traditions while remaining sensitive to local heritage semantics.

Such convergence aligns with UNESCO's principles of sustainable heritage management, which stress coordinated documentation, integrated interpretation, and long-term accessibility as core responsibilities of World Heritage Sites (UNESCO, 2021; UNESCO, 2025). More broadly, CHI convergence reframes knowledge organization from an institution-centric to a network-centric paradigm, emphasizing collaboration, semantic alignment, and user-centered access (Hendrawan et al., 2024a; Wang et al., 2025; Rasmussen & Hjørland, 2022; Smiraglia, 2014b). Through this shift,

local CHIs such as those in OCMHS are better positioned to participate in global cultural heritage knowledge ecosystems, ensuring that industrial heritage resources are not only preserved but also dynamically accessed and meaningfully interpreted across local and international contexts. This fragmentation reflects the challenge identified in Chapter 1 and evidenced in the case analysis of Chapter 4, where heterogeneous KO practices prevent semantic alignment and unified access.

Through the adoption of a contextualized taxonomy, convergence among cultural heritage institutions (CHIs) enables the integration of dispersed heritage data into accessible, interpretable, and semantically coherent information structures (Binding & Tudhope, 2016; Smiraglia, 2014a). Within such a framework, taxonomy functions as a shared semantic layer that supports cross-institutional discovery and interpretation while respecting institutional and domain-specific differences. This informed the design principles operationalized in Chapter 5, where interoperability and hierarchical structuring were emphasized as mechanisms to achieve convergence while embedding cultural specificity and ensuring scalability for future growth. In this sense, CHI convergence reframes knowledge organization from an institution-centric model—where collections are described and accessed in isolation—towards a network-centric paradigm that emphasizes interoperability, semantic alignment, and user-oriented access across distributed heritage systems (O'Neill & Stapleton, 2022; Raemy, 2025; Ranjgar et al., 2024; Wang, 2025; Zeng & Mayr, 2019). This paradigm shift is further elaborated in Chapter 6 as a strategic implication for policymakers, demonstrating how local CHIs can actively participate in global heritage ecosystems.

2.4 Knowledge Organization in Cultural Heritage Institutions

Knowledge organization (KO) in cultural heritage institutions (CHIs) has historically evolved in line with the professional mandates and epistemic traditions of libraries, archives, and museums (LAMs). While these institutions share a common goal of preserving and providing access to cultural resources, their approaches to KO differ significantly in scope, methodology, and application.

In the library domain, KO practices are predominantly structured around controlled vocabularies, classification schemes, and subject headings such as the Dewey Decimal Classification (DDC), Library of Congress Subject Headings (LCSH), and Universal Decimal Classification (UDC). These systems emphasize semantic

consistency and facilitate resource discovery through standardization, ensuring that users can retrieve materials based on shared descriptors and hierarchical subject structures (Amiri, 2025; Adler, 2017; Hjørland, 2021; Liu & Jia, 2025). However, while these tools enhance bibliographic control and interoperability, they often struggle to represent the contextual or material dimensions of cultural artifacts, which extend beyond textual surrogates.

By contrast, archival KO is deeply rooted in the principle of provenance and original order, emphasizing the contextual integrity of records rather than their topical classification. Archival description frameworks such as ISAD(G) and Encoded Archival Description (EAD) foreground the creator, the organizational context, and the functional relationships among records (Franks, 2018; Gilliland, 2014). This approach preserves evidential value and historical authenticity but provides limited thematic or subject-based access. As a result, archival systems are less adept at supporting cross-collection discovery, particularly when users seek materials thematically related rather than contextually bound.

Museums, in turn, employ object-centric KO approaches, which prioritize the description of physical attributes, material composition, and cultural functions of artifacts. Museum-specific thesauri foreground tangible characteristics and interpretive narratives, enabling museums to integrate curatorial expertise into classification practices (Dunn et al., 2019; Nappi et al., 2024). However, while this object-focused model supports cultural interpretation and exhibition design, it often lacks interoperability with bibliographic and archival systems, creating silos that restrict integrated access to knowledge resources.

These contrasts reveal the sector-specific orientations of KO practices in CHIs, including libraries that emphasize semantic standardization, archives that prioritize contextual provenance, and museums that foreground materiality and cultural interpretation. While effective within institutional silos, these approaches remain fragmented when considered collectively. For hybrid heritage environments such as OCMHS, where documentary records, bibliographic resources, and museum artifacts coexist, this fragmentation mirrors the problem outlined in Chapter 1 and elaborated in Chapter 4. Existing KO frameworks do not adequately account for cross-domain intersections, making it difficult to manage hybrid artifacts that embody both tangible and intangible values.

The absence of integrated knowledge organization frameworks that effectively bridge the library, archival, and museum domains has been consistently identified in the literature as a persistent research gap. Despite growing discourse on LAM convergence, existing approaches often remain fragmented, as they are developed within domain-specific traditions and fail to fully reconcile semantic, structural, and conceptual differences across institutional boundaries (Hendrawan et al., 2024a; Wang et al., 2025; Rasmussen & Hjørland, 2022; Smiraglia, 2014b).

Studies in cultural heritage informatics further demonstrate that cross-domain intersections—particularly between bibliographic, archival, and object-based descriptions—are inadequately addressed by current frameworks, resulting in semantic discontinuities and limited interpretive coherence (Binding & Tudhope, 2016; Longo et al., 2020). This limitation underscores the need for a contextualized taxonomy that can function as a unifying semantic layer, bridging cross-domain gaps while remaining adaptable to local heritage narratives and culturally specific meanings (Hjørland, 2016; Poveda-Villalón et al., 2020). This study, therefore, contributes to KO theory and practice by developing a contextualized taxonomy for OCMHS, providing a living framework that reconciles sectoral traditions while enabling integrated access, preservation, and interpretation of industrial heritage.

2.4.1 Theoretical Foundations of Knowledge Organization

Knowledge organization (KO) constitutes the core theoretical and practical framework that underpins how information and cultural knowledge are structured, classified, and made retrievable within CH contexts. Fundamentally, KO involves the systematic representation of CH through conceptual models, metadata structures, and classification systems that allow users to navigate from dispersed resources to coherent narratives (Hjørland, 2016; Hlava, 2022a; Joudrey & Taylor, 2018). Within CHIs, KO serves as the intellectual infrastructure that transforms collections into accessible cultural memory, supporting scholarly research, public engagement, and long-term preservation.

The theoretical foundations of KO are deeply rooted in Library and Information Science (LIS), epistemology, and domain analysis, reflecting the interplay among knowledge structures, human cognition, and social contexts. Golub and Liu (2021), Hjørland (2017a and 2017b), and Smiraglia (2015) emphasize that KO cannot be

separated from epistemological assumptions about how knowledge is created, validated, and used. They propose that KOS are socially constructed, shaped by domain-specific practices and interpretive communities. This domain-analytic perspective asserts that effective KO requires an understanding of the disciplinary, cultural, and social frameworks that influence how knowledge is organized and retrieved. For CH, this means that taxonomies must reflect the narratives and semantic relationships inherent to local heritage contexts, rather than relying solely on universal or decontextualized standards.

From an epistemological perspective, KO in CH operates at the intersection of objectivity and social constructivism. Traditional KO methods, such as classification and cataloging, historically sought objectivity and universal order, as exemplified by the Library of Congress Classification (LCC), Dewey Decimal Classification (DDC), and Universal Decimal Classification (UDC) (Amiri, 2025; Adler, 2017). However, CH collections or resources, especially those related to industrial heritage sites like OCMHS, demand a contextual and interpretive approach, as the meanings of artifacts are often co-constructed through local narratives, community memory, and historical experience.

This epistemological foundation gives rise to a critical tension between two competing paradigms in KO, including objectivity, as championed by traditional universal classification systems, and contextuality, which recognizes the situated and culturally embedded nature of knowledge. Systems like the LCC, DDC, and UDC were developed under positivist assumptions that emphasize universal, hierarchical, and stable knowledge categories. While these systems aim for neutrality and consistency, they have been widely critiqued for encoding cultural biases, Western-centric worldviews, and epistemic exclusions, particularly when applied to non-Western or marginalized KOSs (Amiri, 2025; Sandy & Bossaller, 2017).

In contrast, contextualist approaches to knowledge organization foreground the vernacular, situated, and interpretive dimensions of heritage knowledge, emphasizing that meaning is produced within specific social, linguistic, and historical contexts rather than through universal categories alone (Hjørland, 2016; Smiraglia, 2014a). Heritage scholars have consistently argued that standardized vocabularies and top-down classification systems often struggle to represent local terminologies, community narratives, and socially embedded practices, particularly in culturally and historically specific settings (Harrison, 2013; Smith & Waterton, 2013).

In industrial heritage contexts such as the Ombilin Coal Mining Heritage of Sawahlunto (OCMHS), significant cultural meanings are embedded in local languages, community narratives, labor histories, and socio-technical practices that emerged through the interaction between industrial systems and local society (Asoka et al., 2016; Erman, 2005; Lindayanti et al., 2016; Lindayanti et al., 2017; Saputra, 2012). Studies of industrial and social heritage demonstrate that everyday objects and practices—such as workers' equipment, administrative records, or songs and rituals associated with labor—often function as key carriers of social memory and identity, despite appearing marginal or generic within universal classification schemes (Douet, 2016; Harrison, 2013; Smith & Waterton, 2013).

This tension between universal standardization and contextual meaning has been widely recognized in knowledge organization research, leading scholars to advocate reflexive and hybrid approaches that combine the strengths of international standards with participatory and context-sensitive design (Hjørland, 2016; Smiraglia, 2014a; Szopinski et al., 2020). Rather than rejecting established systems such as the Library of Congress Classification (LCC), Dewey Decimal Classification (DDC), or Universal Decimal Classification (UDC), such approaches position them as interoperable reference frameworks that can be complemented by locally grounded taxonomies and user-informed semantic structures (Zeng & Mayr, 2019; Poveda-Villalón et al., 2020).

By balancing semantic objectivity for interoperability with contextual sensitivity for cultural heritage relevance, cultural heritage institutions managing complex sites such as OCMHS can develop knowledge infrastructures that are both globally integrable and locally meaningful (Hendrawan et al., 2024a; Hendrawan et al., 2025b; Syafrini et al., 2020). This balance underpins the KO framework adopted in this study, which aligns with calls for ontological pluralism in heritage representation by acknowledging multiple ways of knowing and categorizing the past within digital heritage systems (Hjørland, 2016; Harrison, 2013).

This aligns with social epistemology, which posits that knowledge is produced, validated, and understood collectively, requiring KO to embed socio-cultural dimensions into its structures (Golub & Liu, 2021; Hendrawan et al., 2025b; Hjørland, 2017a and 2017b). Domain analysis further strengthens the contextual relevance of KOS by highlighting that each knowledge domain has its own discourse, conceptual boundaries, and terminologies (Hjørland, 2017a and 2017b; Smiraglia, 2015). In CH, a domain-oriented taxonomy recognizes that a mining artifact, a colonial-era map, and an

oral tradition recording may all belong to different institutional collections but are semantically linked through the domain of industrial and social history.

Therefore, KOS must map and expose these relationships to facilitate integrated retrieval and interpretation across CHIs. This principle directly informs the development of contextualized taxonomy for OCMHS, where local mining heritage narratives must be aligned with international KOS standards, such as the Library of Congress Subject Headings (LCSH), UNESCO Thesaurus, the Art & Architecture Thesaurus (AAT), ISO 25964, CIDOC Conceptual Reference Model (CIDOC-CRM), and ANSI/NISO Z.39.19 to ensure both contextual accuracy and interoperability.

Moreover, the theoretical foundation of knowledge organization (KO) in cultural heritage (CH) studies is commonly understood to rest on three interrelated pillars. First, epistemological perspectives in KO emphasize that knowledge is contextual, socially constructed, and shaped by cultural, historical, and institutional conditions rather than being value-neutral or universal (Hjørland, 2013; Smiraglia, 2014a). Second, domain analysis provides a methodological framework for ensuring that KO systems reflect the specific semantics, discourse practices, and knowledge structures of particular domains, including cultural and industrial heritage contexts (Hjørland, 2016; Hjørland, 2017a; Smiraglia, 2015). Third, knowledge representation operationalizes these epistemological and domain-based insights by translating them into taxonomies, ontologies, and metadata frameworks that support usability, interoperability, and long-term sustainability across information systems (O'Neill & Stapleton, 2022; Raemy, 2025; Ranjgar et al., 2024; Wang, 2025).

Within this framework, international standards such as ISO 25964 play a dual role. Beyond providing technical guidance for thesaurus construction and interoperability, ISO 25964 also informs ontological design decisions that are critical for semantic precision and consistency in KO systems (ISO, 2011; Tudhope & Binding, 2018). The standard explicitly supports multilingual representations, polyhierarchical structures, and associative relationships, enabling cultural heritage institutions to model complex conceptual relationships and domain-specific interdependencies among heritage entities (Hlava, 2022b; ISO, 2011; Zeng & Mayr, 2019). These relational capabilities are particularly important in heritage settings, where artifacts, social actors, events, and narratives are semantically interconnected across temporal, spatial, and institutional boundaries (Douet, 2016; Harrison, 2013; Smith & Waterton, 2013).

As Martínez-González and Alvite-Díez (2020) and Zlodi (2023) argue, standards such as ISO 25964 are instrumental in bridging the gap between controlled vocabularies and Semantic Web technologies, enabling the formal expression of meaning and context through linked data infrastructures. By grounding knowledge organization (KO) in established theoretical and technical perspectives, cultural heritage institutions (CHIs) can move beyond fragmented cataloguing practices towards integrated, semantically rich, and contextualized knowledge organization systems (KOSs) that support interpretation, interoperability, and sustainable access (Hjørland, 2017b; Smiraglia, 2014a). Scholarship in heritage informatics consistently shows that such integrated KOSs are essential for enabling complex heritage sites to preserve, interpret, and disseminate cultural and industrial heritage in ways that remain meaningful to local communities while being accessible to broader and global audiences (Binding & Tudhope, 2016; Harrison, 2013).

Within the cultural heritage domain, the theoretical foundations of KO are commonly articulated through three interrelated pillars. First, epistemological perspectives emphasize that knowledge is contextual, socially constructed, and shaped by cultural and institutional practices rather than being neutral or universal (Hjørland, 2013; Smiraglia, 2014a). Second, domain analysis situates KO within specific disciplinary, cultural, and discursive contexts, ensuring that knowledge structures reflect the semantics and practices of particular heritage domains (Hjørland, 2002; Hjørland, 2016). Third, knowledge representation operationalizes these insights through taxonomies, ontologies, and metadata standards that support usability, semantic consistency, and long-term sustainability across information systems (Raemy, 2025; Ranjgar et al., 2024; Silva & Terra, 2024; Wang, 2025).

Applied to the context of the Ombilin Coal Mining Heritage of Sawahlunto (OCMHS), this theoretical grounding highlights the limitations of universal classification systems in capturing local semantics and culturally situated meanings. Studies in heritage and KO repeatedly demonstrate that standardized vocabularies often struggle to adequately represent vernacular terms, community narratives, and socially embedded practices that fall outside formal classification schemes (Broughton, 2015; Hendrawan et al., 2025b; Hjørland, 2016; Joudrey & Taylor, 2018). These limitations reinforce the need for contextualized, domain-sensitive KO approaches that can accommodate both global interoperability requirements and locally meaningful heritage representation.

This mirrors the problem identified in Chapter 1 and evidenced in Chapter 4, where fragmented KO practices and the absence of a contextual taxonomy hinder integrated heritage interpretation. These foundations directly informed the design principles in Chapter 5: cultural embeddedness to reflect local narratives, hierarchical structuring to integrate hybrid resources, scalability to accommodate evolving collections, and interoperability to align with international KOS standards.

By embedding ontological pluralism into taxonomy design, this study advances knowledge organization (KO) theory and practice by conceptualizing taxonomy as a dynamic and interpretive framework rather than a fixed classificatory tool. Such an approach reconciles the need for universal interoperability with the representation of situated and culturally specific meanings, a balance that has been widely advocated in domain-based KO, heritage studies, and semantic interoperability research (Hjørland, 2016; Smiraglia, 2014a; Silva & Terra, 2024; Zeng & Mayr, 2019; Poveda-Villalón et al., 2020).

2.4.2 Knowledge Organization Systems

Knowledge organization systems (KOSs) form the conceptual and structural backbone of KO in CHIs, enabling the representation, retrieval, and interoperability of information across diverse collections. At their core, KOS comprise formal frameworks, schemas, and tools designed to describe, classify, and relate knowledge entities, enabling users to navigate complex landscapes of cultural heritage resources effectively (Gnoli, 2016; Hjørland, 2017b; Smiraglia, 2014a). Within CHIs, KOS serve not only as technical instruments for cataloging but also as cognitive frameworks that shape how heritage knowledge is perceived, interpreted, and transmitted.

The spectrum of KOS ranges from basic controlled vocabularies to sophisticated semantic frameworks. At the foundational level, controlled vocabularies and authority files ensure consistent naming and indexing, which is critical for accurate retrieval and entity disambiguation (Joudrey & Taylor, 2018). Classification schemes and subject heading systems, including the Art & Architecture Thesaurus (AAT), the UNESCO Thesaurus, the Library of Congress Subject Headings (LCSH), ISO 25964, and ANSI/NISO Z.39.19, provide hierarchical and faceted structures that support systematic categorization. However, these systems often require contextual adaptation to adequately address the unique semantic needs of domain-specific collections, such as

those related to industrial heritage.

Thesauri and taxonomies are more semantically enriched KOS types, providing both hierarchical and associative relationships that go beyond simple labelling. A taxonomy is a hierarchical arrangement of concepts, typically domain-specific, that enables structured navigation from broader to narrower categories (Currás, 2010; Hedden, 2022; Hlava, 2022b). In the CH domain, taxonomies serve as organizing frameworks that link artifacts, documents, and contextual narratives into cohesive knowledge structures. For example, within OCMHS, a taxonomy could connect mining machinery housed in a museum, colonial-era archival records, and oral traditions from OCMHS communities under the broader domain of industrial heritage. This hierarchical organization enhances semantic integration across CHIs, supporting both local interpretability and global discoverability.

At a higher level of semantic complexity, ontologies and conceptual models enable machine-readable knowledge representation and interoperability across heterogeneous heritage databases. Ontologies define formalized relationships between concepts, facilitating linked data applications, semantic queries, and cross-institutional data exchange (Biagetti, 2021; Liu et al., 2023; Smiraglia, 2015). When used in conjunction with taxonomies and controlled vocabularies, ontologies help create rich heritage networks and ecosystems where tangible and intangible CH elements are contextually linked, enhancing both scholarly research and public engagement.

The integration of knowledge organization systems (KOS) into digital heritage management has significant implications for industrial heritage sites such as OCMHS, particularly when collections are distributed across multiple cultural heritage institutions (CHIs) and exhibit heterogeneous metadata practices. Prior studies consistently demonstrate that the absence of shared KOS and interoperable metadata frameworks in multi-institutional heritage environments leads to semantic fragmentation, limited discoverability, and constrained cross-collection interpretation, whereas the adoption of harmonized taxonomies and controlled vocabularies enables semantic alignment, integrated access, and sustainable digital preservation (Ruthven & Chowdhury, 2015; Zorich et al., 2008; Giannoulakis et al., 2018; Navarrete, 2021; Zeng & Mayr, 2019).

This diversity, as demonstrated in Chapter 4, reinforces the fragmentation problem outlined in Chapter 1 and underscores the absence of a contextualized taxonomy that can unify library, archival, and museum practices. Addressing this gap

directly informed the design principles in Chapter 5, where hierarchical structuring was adopted to organize hybrid collections, cultural embeddedness ensured the inclusion of local semantics, scalability accommodated future growth, and interoperability aligned local practices with international KOS standards. The iterative taxonomy development presented in Chapter 5 operationalizes these principles, transforming fragmented CH resources into integrated, meaningful, and sustainable knowledge systems. This positions taxonomy not as a static classification tool but as a living framework within KOS that evolves through participatory validation and contributes to both KO theory and CH practice, as elaborated further in Chapter 6.

2.4.3 Knowledge Organization Processes and Challenges

The processes of knowledge organization (KO) in CHIs constitute the operational backbone of CH management. KO processes encompass the systematic activities of description, classification, indexing, and semantic linking that enable heritage resources to become discoverable, interpretable, and reusable (Hjørland, 2007 and 2016; Smiraglia, 2014a). In practice, these processes involve creating and managing metadata, applying authority control, using controlled vocabularies, and applying knowledge organization systems (KOS) such as taxonomies, thesauri, and ontologies. Through these mechanisms, heterogeneous cultural heritage collections—ranging from archival records and library materials to museum objects—are transformed into coherent, navigable, and semantically structured knowledge environments that support long-term preservation, interoperability, and user-centered access (Broughton, 2015; Golub & Liu, 2021; Hlava, 2022b).

In libraries, KO processes are well-established and highly standardized, with an emphasis on KOSs. Classification systems such as Dewey Decimal Classification (DDC), Library of Congress Classification (LCC), and Library of Congress Subject Headings (LCSH) enable libraries to construct hierarchical and faceted structures that support effective knowledge retrieval (Amiri, 2025; Adler, 2017; Hjørland, 2021; Liu & Jia, 2025). Archives, by contrast, adopt KO processes centered on provenance, authenticity, and the principle of original order, reflecting the context in which records were created (Duranti, 2020; Franks, 2018). Archival KO often involves multi-level descriptions based on standards such as ISAD(G), which prioritize contextual relationships over subject-based classification, making them particularly critical for

historical reconstruction and legal validation.

Museums engage in KO processes that are object-centered and interpretative, focusing on material description, provenance, and exhibition narratives (Sabiescu et al., 2025). Museum and cultural heritage documentation is typically managed in a digital repository and supported by domain-specific vocabularies such as AAT and CIDOC-CRM (Chen, 2021; Kamal & Golub, 2025). These standards provide structured vocabularies and semantic frameworks that enable consistent categorization, cross-referencing, and interoperability across collections and institutions (O'Neill & Stapleton, 2022; Raemy, 2025; Ranjgar et al., 2024; Wang, 2025). Through these tools, museum objects are transformed from static physical items into semantically enriched entities that convey cultural meaning, historical context, and interpretative narratives.

Despite the maturity of these documentation frameworks, cultural heritage institutions continue to face persistent challenges in KO, particularly in multi-institutional and industrial heritage contexts. Differences in documentation traditions, metadata schemas, and institutional mandates often result in fragmented representations that hinder integrated interpretation and cross-domain access (Binding & Tudhope, 2016; Hjørland, 2016; Hyvönen, 2012; Qin & Zeng, 2020; Smiraglia, 2014a).

First, the fragmentation of KO practices remains a major barrier. Each CHI often employs different descriptive standards, metadata schemas, and cataloging conventions, resulting in siloed knowledge structures and limited interoperability (Giannoulakis et al., 2018; Kumar & Ramesha, 2020; Ruthven & Chowdhury, 2015; Ye & Zhou, 2013). For example, CHIs within Area A of OCMHS maintain heterogeneous cataloging systems, which impede integrated discovery and cross-CHI interpretation.

Second, semantic misalignment and the absence of localized vocabularies pose significant obstacles. While international KOS standards such as ISO 25964, ANSI/NISO Z.39.19, AAT, UNESCO Thesaurus, CIDOC-CRM, and LCSH provide foundational structures, they often fail to capture the nuanced meanings of local heritage narratives and industrial histories (Amiri, 2025; Sandy & Bossaller, 2017). For instance, local mining tools, labor practices, and community rituals at OCMHS may lack direct equivalents in international vocabularies, necessitating a contextualized taxonomy to bridge local knowledge with global semantic frameworks.

Third, the digital transformation of CHIs introduces new layers of complexity. As CHIs increasingly adopt national and international KOS standards and linked data initiatives to support online access, long-term preservation, and global visibility, they

face challenges related to limited technical infrastructure, gaps in human resources, and institutional silos (Rasmussen & Hjørland, 2022; Stauffer, 2021; Zorich et al., 2008). This is particularly evident in CHI in Area A of OCMHS, where collections are distributed, multi-format, and context-dependent, requiring sophisticated KO processes that integrate both tangible and intangible CH dimensions.

Addressing these challenges requires reconceptualizing KO processes as collaborative, domain-sensitive, and semantically enriched endeavors. This directly reflects the research problems identified in Chapter 1 and evidenced in Chapter 4, where OCMHS CHIs demonstrate fragmented practices, semantic misalignments, and infrastructural limitations. The taxonomy development presented in Chapter 5 was explicitly designed to address these issues through four guiding design principles, including hierarchical structuring to overcome fragmentation, cultural embeddedness to capture local semantics, scalability to accommodate future growth, and interoperability to ensure alignment with international KOS standards. Iteratively refined through stakeholder participation and usability testing, the contextualized taxonomy is a living KO framework that unifies OCMHS resources and collections, enhances interpretive richness, and supports UNESCO's sustainable heritage management goals.

2.5 Taxonomy for Cultural Heritage

Taxonomies, as hierarchical KOS, provide structured navigation from general to specific concepts and support both semantic clarity and user interpretability (Hedden, 2022; Hlava, 2022b). They are particularly valuable in the CH domain, where collections are heterogeneous and distributed across institutions. The development of taxonomies in LIS and CH domains has followed three dominant paths, including expert-driven, participatory, and automated. Each offers strengths, rigor, inclusivity, and scalability, but also limitations when applied in isolation (Chaudhry & Tan, 2005; Dahlgren & Hansson, 2020; Hendrawan et al., 2025b; Ledinek-Lozej, 2019). Recent scholarship advocates hybrid approaches that integrate expert authority, community input, and computational support.

Structurally, taxonomies may take the form of flat lists, strict hierarchies, faceted schemes, or polyhierarchical models. For CHIs, especially in industrial heritage settings, hierarchical designs allow resources to be linked across multiple perspectives, such as a blueprint that functions simultaneously as an archival document and a museum

artifact (Acierno et al., 2017; Chaudhry & Tan, 2005). In the OCMHS context, taxonomy is envisaged as a flexible and evolving framework: grounded in local semantics and CH narratives, yet aligned with international KOS standards such as ISO 25964, UNESCO Thesaurus, AAT, and CIDOC-CRM. Rather than repeating design principles in every section, the emphasis here is that a contextualized taxonomy offers the most pragmatic solution to unify dispersed collections and support integrated CH interpretation.

2.5.1 Definition and Evolution of Taxonomy

A taxonomy is a structured, hierarchical representation of concepts, categories, and relationships within a specific knowledge domain, designed to facilitate the organization, retrieval, and interpretation of information. In LIS, taxonomies are widely recognized as foundational components of KOS that systematically arrange entities or concepts into broader-to-narrower hierarchies (Currás, 2010; Hlava, 2022a; Smiraglia, 2014a). A well-designed taxonomy allows users to navigate from general to highly specific concepts, supporting information discovery, semantic interoperability, and knowledge management in both physical and digital environments (Binding & Tudhope, 2016; Hedden, 2022; Hendrawan & Sulistyo-Basuki, 2026; Lambe, 2014).

The term taxonomy originates from combining two Greek roots, "*taxis*" and "*nomos*". According to Currás (2010) and Hlava (2022b), the term "*nomos*" has a range of meanings, including the assignment of something, the practices or traditions associated with a particular society, and the legal or regulatory framework governing a community. The term "*taxis*" broadly encompasses various arrangements or orderings of things (Broughton, 2015; Currás, 2010; Hlava, 2022b). In knowledge organization, the term *taxonomy* generally refers to a set of principles or standards used to organize entities based on shared characteristics and explicit relationships systematically. Taxonomies provide structured frameworks that support classification, categorization, navigation, and sense-making across information environments (Broughton, 2015; Hedden, 2020; Smiraglia, 2014a).

The widespread use of taxonomies demonstrates their role in everyday and professional contexts, ranging from classifying people and social roles to organizing objects, concepts, temporal sequences, and spatial locations. Such applications span domains such as libraries, archives, museums, business information systems, digital

platforms, and scientific knowledge structures, underscoring the taxonomy's function as a foundational cognitive and organizational tool rather than a domain-specific technique (Hjørland, 2013; Hlava, 2022a; Lambe, 2014).

According to Hedden (2022), the taxonomy serves as a systematic framework for classifying and organizing information resources, facilitating users' ability to find relevant items and navigate available resources. Additionally, Broughton (2015) and Lambe (2014) mentioned that a taxonomy facilitates the systematic arrangement and categorization of knowledge, streamlining the processes of generating, capturing, storing, retrieving, and disseminating information within an organizational context. The paradigm presented in the study offers a systematic approach to performing knowledge audits, assuring the efficient use of intellectual capital.

The taxonomy is paramount in strengthening information retrieval, knowledge discovery, and user experience by organizing, enriching, and broadening the existing knowledge landscape (Hlava, 2022b). According to Currás (2010), it might also be called classification theory; taxonomy is the academic study of a system, including its fundamental basis, concepts, procedures, and rules.

The foregoing description is intentionally broad and serves as a foundational definition of taxonomy within this study, in contrast to the more restricted interpretation traditionally associated with biological classification. In biological sciences, taxonomy is primarily concerned with the systematic classification of living organisms based on shared morphological and genetic characteristics, following rigid hierarchical rules (Currás, 2010; Hlava, 2022b; McKelvey, 2022; Pavlinov, 2026). By contrast, in the field of knowledge organization, taxonomy has evolved into a more flexible conceptual framework that accommodates diverse domains, contextual meanings, and user-oriented purposes beyond biological categorization (Broughton, 2015; Smiraglia, 2014a). However, a broader definition is needed for our information and knowledge management objectives. According to Milton and Lambe (2020), three essential aspects of taxonomy will be elucidated, including first, a taxonomy is a categorization scheme; second, a taxonomy has semantic properties; and third, a taxonomy serves as a knowledge map.

The meaning and application of taxonomy have expanded significantly with the advent of the computer era and the proliferation of digital information systems. While taxonomy was traditionally rooted in biology and formal logic (McKelvey, 2022; Pavlinov, 2026), its contemporary usage increasingly encompasses the organization of

digital content, information systems, and knowledge infrastructures (Hedden, 2020; Lambe, 2014). In information and knowledge management contexts, taxonomy has been integrated with electronic technologies to support information retrieval, navigation, interoperability, and sense-making in complex digital environments, thereby extending its scope beyond static classification toward dynamic and computationally supported knowledge structures (Hjørland, 2017a; O'Neill, B., & Stapleton, 2022). The term taxonomy has recently gained traction in the Library and Information Science discipline, particularly in the development of standards and classification systems (Currás, 2010; Joudrey & Taylor, 2018; Smiraglia, 2015).

Therefore, the discussion transitions to a more abstract level. The mere establishment of a classification technique for phenomena, such as live organisms or their structures in Biology, is no longer deemed enough (Hlava, 2022b; McKelvey, 2022; Pavlinov, 2026). Conducting a comprehensive theoretical investigation that incorporates all pertinent factors has become imperative. According to Currás (2010) and Hlava (2022b), in 1813, A. de Candolle coined the term "taxonomy" to refer to the concepts and laws of systematics. Taxonomies have been present in the rigidly hierarchical realm of science since Aristotle. In his work Historia Animalium, Aristotle developed a taxonomy for the animal kingdom (Hendrawan et al., 2024c; Hlava, 2022b). Nevertheless, the most renowned scientific taxonomy is Linnaeus's Systema Naturae, a classification of flora and fauna published in 1735 (Gnoli, 2020). However, the taxonomies now being developed for intranets often do not adhere to rigid guidelines and are usually organized hierarchically. However, it has a broader meaning in logic (Hedden, 2020; Lambe, 2014).

Using taxonomy makes it feasible to devise methodologies that are formed retrospectively after identifying the classificatory components. The factors that influence the establishment of order still need to be established in advance. It is essential to consider the distinctive characteristics of the entities that need to be structured (Hjørland, 2016; Mai, 2011). The determination is made at the structural unit level, which will also serve as the classification unit, as indicated by Currás (2010), Hjørland (2017b), Hlava (2022b), Joudrey and Taylor (2018), and Smiraglia (2014a). Although there are similarities between a taxonomy and a classification system, they are distinct concepts.

The primary objective of a classification system is to systematically arrange all entities within a particular domain into a hierarchical structure of categories, where each

term has broader and narrower terms. On the other hand, a taxonomy focuses only on the ideas necessary for labeling and retrieving information and then organizing and establishing hierarchical connections among them (Hedden, 2022; Hlava, 2022a; Lambe, 2014). Table 2.2 presents a comparative analysis of characteristic attributes of classification systems and taxonomies.

Table 2.2
Characteristic Attributes of Classification Systems and Taxonomies

No.	Classification Systems	Taxonomies
1	Have codes/notations.	Do not have codes/notations.
2	Do not have synonyms/alternative labels.	Often, they have synonyms/alternative labels.
3	Comprehensive and balanced coverage of a domain.	Just the concepts needed may be hierarchically unbalanced.
4	Intended for hierarchical browsing in a top-down manner.	Developed for user browsing, searching, or viewing only partially visible content.
5	Built for a domain but independent of specific content.	Custom-built to include the topics in the content to be tagged.
6	Provide for limited expansion within the structure.	Can grow and adapt without limits.
7	A single hierarchy.	It may be polyhierarchical (a concept that appears under more than one broader concept).
8	Have categories for "other" or "not elsewhere classified."	Use concepts only for actual topics, not for "other."

Source: Hedden (2022)

The use of taxonomy extends well beyond its original disciplinary origins and has become widespread across applied domains, particularly within Library and Information Science (LIS), information architecture, and knowledge management (Hendrawan & Sulistyo-Basuki, 2026; Lambe, 2014). In these contexts, taxonomy is preferred because it provides a clear, linguistically grounded, and practically intelligible means of organizing knowledge through controlled terms and categories, rather than abstract formal notations (Hedden, 2022; Hlava, 2022b). As a word-based knowledge organization system, taxonomy supports intuitive understanding, communication, and reuse, making it especially suitable for human-centered information environments.

Taxonomies facilitate categorization by identifying similarities, interactions, interdependencies, and relational patterns among concepts or entities within a domain (Smiraglia, 2014a; Hjørland, 2017a). Depending on the analytical purpose, these relationships may be expressed through horizontal structures that emphasize associative links among taxa, or through hierarchical structures that organize concepts along broader–narrower continua, from general to specific. While hierarchical arrangements support systematic overview and comparability, horizontal or networked relations

capture functional, contextual, or semantic interconnections that are equally important in complex knowledge domains (Lambe, 2014; Mai, 2011).

Regardless of structural form, constructing a robust taxonomy requires the systematic identification of meaningful categories (*taxa*) that are conceptually clear, mutually exclusive at a given level of abstraction, and collectively exhaustive in representing the domain of interest. In applied KO, an effective taxonomy should also exhibit simplicity, memorability, and usability, ensuring it supports efficient retrieval, navigation, and sense-making for users rather than merely satisfying formal classificatory logic (Hedden, 2022; Lambe, 2014).

Within the context of CHIs encompassing LAMs, taxonomies have evolved as critical instruments for managing complex heritage collections. CH collections are inherently heterogeneous and multidimensional, comprising tangible artifacts, documentary evidence, multimedia content, and intangible cultural expressions. Cataloging systems and classification schemes, such as RDA and DDC, provide baseline organization but often fail to capture the nuanced, local, and multi-relational nature of heritage knowledge (Hjørland, 2016; Joudrey & Taylor, 2018; Salaba & Chan, 2023).

This gap has prompted the development of domain-specific taxonomies and semantic models that are explicitly designed to accommodate local cultural contexts, while remaining interoperable with international knowledge organization standards. Prior studies demonstrate that such domain-oriented taxonomies enable cultural heritage institutions to represent vernacular terminologies, contextual relationships, and community narratives that are insufficiently expressed in general bibliographic classification systems, while still supporting semantic alignment through mapping to standards such as ISO 25964, CIDOC-CRM, AAT, and LCSH (Agathos et al., 2025; Currás, 2010; Hlava, 2022b; Smiraglia, 2014a).

The evolution of taxonomy in CHIs can be traced through several phases. Initially, heritage collections were organized using rigid, institution-specific classification schemes, resulting in fragmented access across CHIs. With the digital transformation of heritage management, taxonomies began to incorporate interoperable KOS standards to support cross-institutional integration and linked data initiatives (Hendrawan et al., 2024b; Navarrete, 2021; Ruthven & Chowdhury, 2015).

In contemporary practice, taxonomies in CHIs function as hybrid structures that combine traditional hierarchical classification with semantic enrichment, domain

ontologies, and participatory input from local communities. This hybrid evolution reflects the shift from static cataloging to dynamic knowledge ecosystems, where heritage information is organized not only for preservation but also for contextual interpretation, interoperability, and user engagement (Ranjgar, 2024; Silva & Terra, 2024).

In industrial heritage contexts, such as the OCMHS, developing a contextual taxonomy is crucial for linking dispersed, multi-format collections across museums, archives, and library. A taxonomy enables semantic bridges between tangible and intangible CH. By structuring and interrelating these resources, taxonomy enhances access to heritage information, CH interpretation, and functionality, supporting the findable, accessible, interoperable, reusable (FAIR) principles (Poveda-Villalón et al., 2020; Vogt et al., 2025; Wilkinson et al., 2016).

Overall, the definition and evolution of taxonomy in Library and Information Science and cultural heritage institutions reflect a documented shift from isolated, institution-centric descriptive practices toward integrated and semantically enriched frameworks that support interoperability, contextual meaning, and networked access across local and global heritage knowledge systems (Binding & Tudhope, 2016; Hjørland, 2016; Smiraglia, 2014a; Zeng & Mayr, 2019).

As illustrated in Chapter 4, the fragmented KO practices at Sawahlunto Municipality, spanning CHIs and community narratives, mirror this global challenge and underscore the absence of a contextual taxonomy that can bridge these silos. This gap directly informed the design principles in Chapter 5, where hierarchical structuring was used to unify heterogeneous resources, cultural embeddedness ensured the representation of local semantics, scalability allowed for future growth, and interoperability aligned OCMHS collections with international KOS standards. The iterative design process operationalized these principles, progressively refining the taxonomy into a contextualized and participatory framework. This positions taxonomy not as a static classification tool but as a living framework for KO in the CH field, a contribution discussed in greater depth in Chapter 6.

2.5.2 Taxonomy Development

Taxonomy development within the Library and Information Science (LIS) and cultural heritage (CH) domains has evolved through diverse methodological traditions

shaped by epistemological assumptions, technological affordances, and institutional priorities. Broadly, literature converges around three dominant approaches: expert-driven, participatory, and automated or algorithmic taxonomy development. While these approaches are often discussed separately, a critical synthesis reveals that they are best understood in relation to one another, particularly when applied to complex and hybrid heritage environments.

Across the literature, a recurring point of agreement concerns the role of authority and semantic rigor. Expert-driven approaches, typically led by subject specialists, librarians, or curators, are consistently valued for producing controlled, coherent, and semantically precise taxonomies aligned with established classification norms (Broughton, 2015; Hjørland, 2016). These strengths make expert-led taxonomies particularly suitable for ensuring interoperability and institutional legitimacy. However, studies also converge in identifying a key limitation: such approaches tend to privilege institutional perspectives, rendering them less responsive to evolving cultural contexts and community knowledge, especially in CH settings where meaning is locally situated (Duff et al., 2013; Ruthven & Chowdhury, 2015).

In contrast, participatory approaches foreground community involvement and cultural embeddedness, precisely addressing the limitations identified in expert-driven models. By incorporating local stakeholders, heritage practitioners, and end-users, participatory taxonomy development enhances inclusivity and semantic relevance, allowing lived experiences, vernacular terminologies, and indigenous knowledge to be represented more faithfully (Chaudhry & Tan, 2005; Dahlgren & Hansson, 2020; Ledinek-Lozej, 2019). Nevertheless, the literature reveals divergence regarding their practical viability. While participatory approaches excel in cultural authenticity, they often struggle with issues of consistency, scalability, and professional acceptance, particularly when negotiated vocabularies diverge from international KOS standards. This tension between authenticity and interoperability remains largely unresolved in existing studies.

Automated or algorithmic approaches introduce a third, technologically driven dimension to taxonomy development, emphasizing efficiency, scalability, and adaptability. Leveraging techniques such as text mining, machine learning, and natural language processing, these methods enable rapid taxonomy generation and refinement in data-intensive environments (Lambe, 2014; Hedden, 2022). The literature broadly agrees on their technical advantages, especially in managing large and dynamic

datasets. However, there is also a strong consensus that automated approaches lack the cultural sensitivity and contextual nuance required for CH domains, where meanings are deeply embedded in historical, social, and linguistic practices. As a result, purely algorithmic taxonomies risk becoming technically efficient but culturally shallow.

When examined comparatively, these approaches reveal intersecting strengths and unresolved tensions rather than discrete alternatives. Expert-driven models ensure authority but risk exclusion; participatory approaches ensure inclusivity but challenge standardization; automated methods ensure scalability but risk semantic impoverishment. Crucially, the literature indicates that no single approach adequately addresses the combined requirements of semantic rigor, cultural relevance, scalability, and interoperability demanded by contemporary CHIs, particularly in industrial heritage contexts where tangible and intangible heritage intersect.

Despite extensive discussion of these approaches, two critical gaps persist (Hendrawan et al., 2025a). First, existing studies rarely integrate these methodologies into a structured, iterative design framework, resulting in ad hoc combinations rather than systematically guided development processes. Second, few studies explicitly operationalize contextualized taxonomy development that reconciles international KOS standards with localized heritage narratives through empirical validation. These gaps are particularly evident in the OCMHS context, as demonstrated in Chapter 4, where expert-driven practices dominate, and local terminologies remain marginal.

The present study addresses these unresolved issues by adopting a Design Science Research (DSR) methodology process model, which provides a principled framework for integrating expert authority, participatory input, and iterative refinement. Through DSR, taxonomy development is treated as an evolving artifact rather than a static classification structure. This approach enables hierarchical structuring to ensure semantic rigor, cultural embeddedness to foreground local voices, scalability to accommodate evolving collections, and interoperability to align with international KOS standards. These design principles, as operationalized in Chapter 5, explicitly draw on the strengths of existing approaches while mitigating their limitations.

By reframing taxonomy development as a socio-technical, design-oriented process, this study moves beyond descriptive accounts of taxonomy methodologies. It offers a critically integrated response to long-standing gaps in KO and CH scholarship. The resulting taxonomy is positioned not merely as a classificatory tool, but as a living, contextualized knowledge infrastructure that supports sustainable CH management.

The theoretical, methodological, and practical implications of this integrative approach are further elaborated in Chapter 6.

2.5.3 Structures of Taxonomy

The structure of a taxonomy determines how concepts are logically related, navigated, and interpreted within a knowledge domain. In LIS and cultural heritage institutions (CHIs), taxonomy structures function not merely as technical arrangements of terms but as cognitive and semantic infrastructures that shape retrieval behaviour, interoperability, and heritage interpretation (Chaudhry & Tan, 2005; Dahlgren & Hansson, 2020; Ledinek-Lozej, 2019). Consequently, the choice of taxonomy structure is not neutral: it directly reflects underlying assumptions about knowledge stability, user needs, and the balance between simplicity and semantic richness.

Across the literature, scholars broadly agree that no single taxonomy structure is universally optimal, particularly in CH contexts characterized by heterogeneous objects, distributed custodianship, and layered narratives. However, studies diverge in how they prioritise structural clarity, flexibility, and contextual expressiveness. This divergence becomes evident when comparing commonly adopted taxonomy structures.

Early and simpler structures, such as lists, are widely acknowledged for their ease of construction and usability (Hedden, 2020; Lambe, 2014). Lists offer minimal organisation and are effective for basic inventory control or limited datasets. Nevertheless, the literature consistently recognises their inability to express semantic relationships, contextual dependencies, or hierarchical meaning. As a result, lists are generally regarded as insufficient for CH environments, where artifacts derive significance from relationships across time, function, and social practice.

Tree and hierarchical structures represent the most established taxonomy forms in LIS and KOS development. Their strength lies in providing clear parent–child relationships that support intuitive navigation and systematic browsing (Currás, 2010; Hedden, 2022; Hlava, 2022b). Many studies converge on the view that hierarchical organisation remains foundational for interoperability and cognitive clarity. However, tensions emerge regarding rigidity. Strict hierarchies struggle to accommodate cross-cutting relationships, multiple interpretations, or objects that simultaneously belong to different conceptual categories—conditions that are common in industrial and cultural heritage. This limitation has been repeatedly highlighted in CH research, where artifacts often function across archival, museum, and community knowledge domains.

To address these shortcomings, faceted structures have been advanced as a more flexible alternative. Faceted taxonomies allow concepts to be organised along multiple dimensions, enabling users to explore heritage resources through parallel perspectives such as function, material, period, or social context (Hedden, 2022; Hlava, 2022b). The literature generally agrees that faceted approaches enhance retrieval flexibility and support complex queries. At the same time, studies caution that poorly designed facets can overwhelm users and increase cognitive load, particularly in environments with limited metadata literacy or inconsistent indexing practices. Thus, while facets address some limitations of hierarchies, they introduce new challenges related to design complexity and governance.

Polyhierarchical structures further complicate traditional hierarchical models by allowing concepts to have multiple broader terms (Currás, 2010; Hlava, 2022b). Scholars recognise polyhierarchies as particularly valuable in domains where objects possess multiple identities or functions. In CH contexts, for example, a mining blueprint may simultaneously function as an archival record, a technical artifact, and a museum object. While polyhierarchies increase semantic expressiveness, the literature also highlights their management complexity and potential to confuse users if relationships are not clearly articulated.

Other structures, such as matrices and system maps, are generally discussed as complementary rather than standalone taxonomy solutions. Matrices are valued for comparative analysis across limited dimensions, while system maps function as visual or conceptual aids that illustrate domain relationships rather than enforce retrieval logic (Hedden, 2022; Lambe, 2014). The consensus in the literature is that these structures are best used in conjunction with more formal taxonomy frameworks rather than as primary organisational systems.

Table 2.3 is a matrix detailing the advantages, limitations, and suitability of the various taxonomy structures. Each structure indicates distinct features suitable for different taxonomy needs. The choice of structures depends on the specific requirements of the organization or project, such as the complexity of the data, the nature of the relationships to be represented, and the intended audience or users. In the context of this study, the hierarchy was suitable for organizing CH data where clear parent-child relationships exist.

Table 2.3
The Advantages and Limitations of Various Taxonomy Structures

Taxonomy Structure	Advantages	Limitations
Trees: Organizes information hierarchically from a single root to multiple leaves.	Intuitive and easy to navigate.	Unwieldy with many levels, it is not ideal for complex interrelations.
Lists: Organizes items linearly, often in a specific order.	Simple to create and use.	It lacks depth and does not show relationships.
Facets: Classifies information into multiple, parallel dimensions.	• Multidimensional categorization or highly flexible • Allows multiple perspectives and search refinements	• Complexity if not well-designed • Potential overload of facets
Hierarchies: Organize information into levels, each being a subset of the one above.	• Clear and structured organization • Clear parent-child relationships • Offers systematic arrangement	• May be Inflexible for cross-category relationships • Potentially rigid structure
Polyhierarchies: A child can have more than one parent, allowing multiple classification paths.	• Multiple hierarchies for an item • Allows multiple categorizations	• Difficult to navigate and manage • Potential confusion
System Maps: Visually represent components of a system and their interrelationships.	• Visual representation of systems • Illustrates relationships	• Complexity in mapping • May lack granularity • Can become cluttered and hard to interpret
Matrices: Use a grid to categorize items along two or more axes.	• Organized in rows and columns • Facilitates comparisons	• Limited in hierarchy and depth • May become overwhelming

Taken together, the literature reveals a persistent tension between structural simplicity and semantic richness. Hierarchies support standardisation and interoperability but risk rigidity; facets and polyhierarchies enhance contextual expressiveness but increase design and governance complexity. Despite extensive discussion of individual structures, relatively few studies explicitly address how to combine these structures in a principled manner to support hybrid CH environments.

This unresolved tension is a key gap in CHI taxonomy research. Most prior studies describe taxonomy structures in isolation, offering limited guidance on how to reconcile hierarchical clarity with contextual flexibility in real-world heritage settings. As demonstrated in Chapter 4, this gap is evident in the OCMHS context, where heterogeneous KO practices across museums, library, and archives cannot be adequately integrated through flat lists or rigid hierarchies alone.

The present study addresses this gap by adopting a hierarchy-based taxonomy as the structural backbone, complemented by faceted and polyhierarchical elements to

accommodate cultural embeddedness and cross-domain relationships. This design choice is analytically grounded in the literature: hierarchy ensures semantic rigor and interoperability. At the same time, facets and polyhierarchies introduce the flexibility necessary to represent industrial heritage narratives that span institutional boundaries. These structural principles were operationalised and iteratively refined in Chapter 5, where usability testing demonstrated their effectiveness in resolving overlaps, supporting navigation, and enhancing interpretability.

By synthesising insights across taxonomy structures rather than treating them as discrete alternatives, this study advances the literature from descriptive classification toward a fit-for-purpose structural integration. In doing so, it positions taxonomy structure not merely as a technical choice but as a strategic design decision that enables CHIs to transition from fragmented documentation to cohesive, interpretable, and globally connected knowledge ecosystems. The implications of this integrative structural approach are further elaborated in Chapter 6.

2.5.4 Suitability for the Ombilin Coal Mining Heritage of Sawahlunto Context

Knowledge organization systems (KOSs) are formal tools used to structure, categorize, and retrieve information in heritage information systems. Within CHIs, particularly in the LAMs environment, KOS encompasses taxonomies, thesauri, classification schemes, ontologies, and authority files. These tools collectively ensure semantic clarity, cultural coherence, and accessibility of knowledge (Biagetti, 2021; Gnoli, 2020; Hlava, 2022a; Smiraglia, 2014a).

Among knowledge organization systems, taxonomies are widely recognized as among the most pragmatic and commonly adopted instruments, due to their relative simplicity, scalability, and adaptability for structuring domain knowledge hierarchically. Prior research in knowledge organization and information architecture demonstrates that taxonomies provide an effective balance between semantic control and operational usability, making them particularly suitable for institutional environments such as libraries, archives, and museums (Hedden, 2022; Lambe, 2014; Rasmussen & Hjørland, 2022; Smiraglia, 2014a).

In cultural heritage institutions, however, taxonomy design must move beyond basic descriptive categorization. Heritage knowledge is inherently multidimensional, encompassing narrative, functional, temporal, social, and cultural dimensions that link

tangible and intangible elements across heterogeneous media and institutional collections. Studies on the organization of cultural heritage knowledge emphasize that effective taxonomies must accommodate contextual relationships, interpretive narratives, and socially situated meanings to support integrated access, interpretation, and the long-term sustainability of heritage information (Alivizatou, 2021; Binding & Tudhope, 2016; Hosseini et al., 2023; Smiraglia, 2014a).

This is particularly pertinent for the OCMHS, which embodies a multilayered historical narrative encompassing colonial-era mining infrastructure, industrial tools, labor systems, oral traditions, and community practices (Asoka et al., 2016; Erman, 2005; Lindayanti et al., 2016; Lindayanti et al., 2017; UNESCO, 2019). The diversity and heterogeneity of heritage materials across cultural heritage institutions underscore the need for a contextualized taxonomy that can reconcile differing metadata practices, descriptive traditions, and institutional mandates. Prior studies in knowledge organization and cultural heritage informatics consistently show that fragmented KO environments—particularly those spanning libraries, archives, museums, and community memory—require integrative semantic frameworks to enable coherent access and interpretation (Binding & Tudhope, 2016; Kamal & Golub, 2025; Kumar & Ramesha, 2020).

In such contexts, a contextualized taxonomy performs a critical integrative function by providing shared conceptual structures through which institutional collections and community-based knowledge can be semantically linked. By grouping heterogeneous resources under common conceptual nodes, taxonomies facilitate the connection between documentary collections and lived cultural practices, thereby reducing institutional silos and supporting interpretive continuity across collections (Alivizatou, 2021; Smiraglia, 2014a). This semantic bridging addresses institutional siloing and enhances interpretive continuity across collections (O'Neill & Stapleton, 2022; Raemy, 2025; Ranjgar et al., 2024; Wang, 2025).

The taxonomy designed for OCMHS explicitly draws on international knowledge organization system (KOS) standards to balance local and national specificity with international semantic interoperability. Research on cultural heritage knowledge organization consistently shows that shared standards provide a common semantic framework that enables locally grounded vocabularies and heritage narratives to be represented in ways that remain interoperable across institutions and national boundaries (Hlava, 2022a; Smiraglia, 2014a; Binding & Tudhope, 2016).

Locally, the taxonomy must encode domain-specific terminology, cultural narratives, and community memory to preserve indigenous perspectives and site-specific meanings (Altenhöner et al., 2020; Chansanam et al., 2025; Hendrawan et al., 2025b; Salaba & Chan, 2023).

At the global level, alignment with ISO 25964 provides authoritative recommendations for the development, management, and interoperability of thesauri and related vocabularies for information retrieval applications. The standard specifies data models, structural principles, and exchange formats for both monolingual and multilingual thesauri, and explicitly addresses the mapping and alignment of thesauri with other KOS types, including taxonomies, classification schemes, and ontologies (ISO 25964-1:2011; ISO 25964-2:2013). The standard also focuses on establishing and maintaining mappings and interoperability between thesauri and other structured vocabularies, particularly taxonomies (ISO, 2011; ISO, 2017).

By combining local contextualization with compliance to international KOS standards, this dual-layered design supports contextual relevance while ensuring readiness for integration into linked data environments and wider cultural heritage knowledge networks. Prior studies demonstrate that standards-based vocabularies are a prerequisite for semantic interoperability, cross-institutional data exchange, and participation in global digital heritage infrastructures such as linked open data platforms (O'Neill & Stapleton, 2022; Raemy, 2025; Ranjgar et al., 2024; Wang, 2025).

Furthermore, this study adopts a hierarchical taxonomy structure, which is particularly well-suited to the multidimensional nature of CH objects. This structure aligns with the FAIR principles (Poveda-Villalón et al., 2020; Vogt et al., 2025; Wilkinson et al., 2016), facilitating flexible retrieval, semantic depth, and dynamic representation of cross-cutting themes. When embedded within a digital repository environment, taxonomies have been shown to support interoperable metadata mapping, cross-institutional data integration, and collaborative enrichment processes. Research in cultural heritage informatics demonstrates that standards-based taxonomies and controlled vocabularies enable heterogeneous metadata from libraries, archives, and museums to be semantically aligned, facilitating integrated access and reuse across institutional boundaries (Binding & Tudhope, 2016; Duff, 2013; Hlava, 2022a).

Moreover, studies on participatory knowledge organization highlight that taxonomy-based systems can accommodate expert input and community knowledge, allowing domain specialists and local communities to contribute contextual meanings,

narratives, and terminologies that enrich heritage representation (Alivizatou, 2012; Ledinek-Lozej, 2019; Smiraglia, 2014a). In this sense, taxonomies function not only as technical infrastructures for data organization but also as mediating frameworks that connect structured metadata with lived cultural heritage experiences.

The taxonomy for OCMHS is therefore designed as a contextualized framework grounded in local narratives yet interoperable with international KOS standards capable of overcoming fragmentation and supporting integrated CH interpretation. This directly addresses the fragmentation and absence of a shared taxonomy identified in Chapter 1 and evidenced in the case analysis of Chapter 4. The hierarchical structure, cultural embeddedness, scalability, and interoperability principles underpinning this design were operationalized in Chapter 5, ensuring that the taxonomy is both contextually meaningful and globally integrable. Iterative refinement and usability testing further validated its comprehensiveness, robustness, and understandability.

Furthermore, taxonomy functions not only as a technical infrastructure for knowledge organization but also as a cultural mediation framework that supports the transformation of fragmented, siloed collections into coherent, interpretable heritage narratives. Prior scholarship in digital cultural heritage emphasizes that semantically structured frameworks are essential for linking documentary records, material artifacts, and intangible heritage narratives in ways that enhance interpretation, inclusivity, and sustainability (Smiraglia, 2014a; Zorich et al., 2008).

By enabling integrated access, participatory enrichment, and semantic interoperability, contextualized taxonomies support the principles of inclusive and sustainable heritage management advocated by UNESCO, particularly in community engagement, knowledge accessibility, and the long-term stewardship of World Heritage sites (Stylianidis, 2025; UNESCO, 2025). The implications of this contextualized taxonomy for knowledge organization theory, methodology, and practice are further elaborated in Chapter 6.

2.6 Prior Research and Research Gap Identification

2.6.1 Systematic Literature Review on Taxonomy Development

The development of taxonomies in the cultural heritage (CH) domain has attracted increasing scholarly attention due to the growing demand for contextualized,

structured, and digitally interoperable knowledge organization systems (KOS). To systematically assess the scope, methods, and limitations of prior research, this study conducted a Systematic Literature Review (SLR) following the PRISMA 2020 protocol, adapted from Page et al. (2021), to ensure transparency, replicability, and methodological rigor.

The primary database used for the SLR was Scopus, selected for its comprehensive coverage of peer-reviewed journals and conference proceedings in Library and Information Science (LIS), digital humanities, and cultural heritage studies. The initial search retrieved 499 records published between 2012 and 2023. Figure 2.1 illustrates the methodological flow adopted in this SLR, from initial identification to final inclusion.

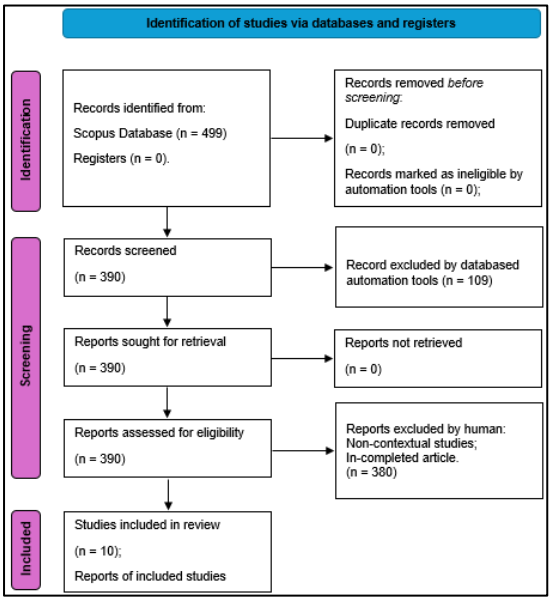


Figure 2.1 PRISMA 2020 Review Methodology Flow-Chart

To ensure robustness, the search strategy was replicated in the Scopus database, using the inclusion criteria and Boolean logic. The complete Boolean search strings as entered into the Scopus database, including field restrictions and filters, are documented in Appendix 10. The core Boolean search strategy applied in Scopus was structured as follows: *"taxonomy development," "taxonomy construction," "taxonomy evaluation,"* and *"taxonomy building"* to ensure comprehensive coverage.

The retrieved records underwent a multi-stage screening process in accordance with PRISMA 2020. First, duplicate records were automatically identified and removed using database automation tools. These included platform-level deduplication features and reference management software, which excluded records with identical titles, DOIs,

or bibliographic metadata. This process is referred to in Figure 2.1 as *"records excluded by database automation tools"*. Second, title and abstract screening was conducted to exclude studies that did not focus on taxonomy development, addressed taxonomy solely in non-CH domains (e.g., biomedical or educational taxonomies), or lacked methodological transparency.

Following this stage, 390 records proceeded to full-text eligibility assessment. Full texts were evaluated against predefined inclusion and exclusion criteria, focusing on explicit engagement with taxonomy development, structure, implementation, or evaluation within CH-related contexts. Ultimately, ten studies met all eligibility criteria and were selected for in-depth qualitative analysis.

The ten included studies were analyzed using ATLAS.ti version 25, employing thematic coding and conceptual mapping. Analytical categories included taxonomy development approach, object types, structural models, knowledge types, evaluation methods, and degree of stakeholder involvement. This process enabled cross-study comparison and supported the synthesis presented in Table 2.4. To enhance transparency, the complete bibliographic details of the ten selected studies, together with brief analytical summaries outlining their objectives, methods, and contributions, are presented in Appendix 10.

Table 2.4
Comparison and Contribution of the Current Study with Prior Research

Taxonomy Element	Taxonomy Attribute	Taxonomy Aspect	Prior Studies										Total	Current Study	Original Contribution
			Chaudhry & Jiun (2005)	Menard et al. (2010)	Souza et al. (2010)	Myridis (2012)	Srieedar & Khoo (2013)	Veldpaus (2016)	Ali & Ahmad (2020)	Chong et al. (2021)	Jansen & Proper (2021)	Batista et al. (2022)			
Subject of Taxonomy Development	Subject Involvement	Involved	1	0	0	0	1	1	1	0	0	0	**4**	Involved	(1) LAM; (2) UNESCO World Heritage Sites; (3) Heritage Coal Mining Town
		Not Involved	0	1	1	1	0	0	0	0	2	1	**6**		
	Taxonomy User	Memory Institution/CHI/LAM	1 (AM)	1 (M)	0	1 (CH)	1 (L)	1 (CH)	1 (CH)	1 (CH)	1 (L)	0	**8**	Memory Institution /CHI/LAM	
		General User	0	0	1 (KOS)	0	0	0	0	0	1 (DL)	1 (KOS)	**3**	General User	
		Public Organization	0	0	0	0	0	0	0	0	0	0	0	Public Organization	Public Organization
	Taxonomy Domain	Cultural Heritage	1	1	0	1	1	1	1	1	0	0	**7**	Cultural Heritage	
		Library & Information Science	0	0	1	0	0	0	0	0	1	1	**3**	Library & Information Science	
Object of Taxonomy Development	Object Types	Mixed Object	1	1	1	1	1	1	1	1	1	1	**10**	Mixed Object	
	Taxonomy Tools	Manual	0	0	1	1	0	1	1	1	1	0	**6**	Manual	
		Automation	1	1	0	0	1	0	0	0	0	1	**4**	Automation	
		Tree	0	0	0	0	0	0	0	0	0	0	**0**	Hierarchy	

	Taxonomy Form/Structure	List	0	0	0	0	1	0	1	0	0	0	**2**		
		Hierarchy	1	0	1	0	0	0	0	1	1	1	**5**		
		Poly-hierarchy	0	0	0	1	0	0	0	0	0	0	**1**		
		Matric	0	0	0	0	0	1	0	0	0	0	**1**		
		Facet	1	1	0	0	0	0	0	0	0	0	**2**		
	Taxonomy Function	Storage & Indexing Support	0	1	0	0	0	0	1	1	1	0	**4**	Storage & Indexing Support	
		Retrieval Support	1	1	1	1	1	0	0	0	1	0	**6**	Retrieval Support	
		Organization & Navigation Support	1	1	0	1	1	1	1	1	1	1	**9**	Organization & Navigation Support	
	Knowledge Types	Tacit	1	1	1	1	1	1	1	1	1	1	**10**	Tacit	
		Explicit	1	1	1	1	1	1	1	1	1	1	**10**	Explicit	
		Social	0	0	0	1	0	0	1	0	0	0	**2**	Social	
		Declarative	1	1	1	1	1	1	1	1	1	1	**10**	Declarative	
		Procedural	0	0	0	0	0	0	0	0	1	0	**1**		
		Causal	0	0	1	0	0	1	0	1	0	0	**3**		
		Conditional	0	0	0	0	0	0	0	0	0	0	**0**		
		Relational	0	0	1	1	1	1	0	0	0	1	**5**	Relational	
		Pragmatic	1	1	0	0	1	0	0	0	0	0	**3**	Pragmatic	
Taxonomy Development Method	Research Approach & Method	Qualitative - Case Study	1	0	0	0	0	0	0	0	0	0	**1**	Qualitative - Case Study	
		Qualitative - Design Science Method	0	0	0	0	0	0	0	0	0	0	**0**	Qualitative - Design Science Method	Qualitative - Design Science Method
		Qualitative - Experiment	0	0	0	0	0	0	0	0	0	1	**1**	Qualitative - Experiment	
		Qualitative - Interview	0	0	0	0	1	0	1	0	0	0	**2**	Qualitative - Interview	

		Qualitative - Literature Review	0	1	1	0	0	1	1	1	1	0	**6**	Qualitative - Literature Review	
		Qualitative - Observation	0	0	0	1	1	0	0	0	0	0	**2**	Qualitative - Observation	
	Taxonomy Approach	Inductive (Empirical-Conceptual)	1	0	0	1	1	0	1	0	0	1	**5**		
		Deductive (Conceptual-Empirical)	0	1	1	0	0	1	0	1	1	0	**5**		
		Iterative	0	0	0	0	0	0	0	0	0	0	**0**	Iterative	Iterative
	Taxonomy Building	Nickerson et al. (2013)	0	0	0	0	0	0	0	0	0	0	**0**	Nickerson et al. (2013)	Heritage Coal Mining Town Taxonomy Development Method
		Kundis et al. (2021)	0	0	0	0	0	0	0	0	0	0	**0**	Kundisch et al. (2021)	
		Chaudry & Jiun (2005)	1	0	0	0	0	0	0	0	0	0	**1**	Chaudry & Jiun (2005)	
		Lambe (2007)	0	0	0	0	0	0	0	0	0	0	**0**	Lambe (2007)	
		Own Framework	0	1	1	1	1	1	1	1	the 1	1	**9**	Own Framework	
Taxonomy Evaluation	Taxonomy Platform	Repository	0	0	0	0	1	0	0	0	0	0	**1**	Repository	Pusako Ombilin Repository
		Software	0	0	0	0	0	0	0	0	0	1	**1**	Software	
		Website	0	1	0	0	0	0	0	0	0	0	**1**		
		Manual Documentation	0	0	1	1	0	1	1	1	1	0	**6**	Manual Documentation	Heritage Coal Mining Town Taxonomy
		Logical Argument	0	0	0	1	0	0	1	0	0	0	**2**		

	Taxonomy Evaluation Method	Case Study	0	0	0	0	0	0	0	1	0	0	**1**	Case Study	Multiple Case Study
		Action Research	0	0	1	0	0	0	0	0	0	0	**1**		
		Experiment	0	0	0	0	0	0	0	1	2	1	**4**		
		Scenario/ Usability Testing	1	1	0	0	1	0	0	0	0	0	**3**	Scenario/ Usability Testing	
		Expert Evaluation – Expert Interview	0	0	0	0	0	0	0	0	0	0	**0**	Expert Evaluation – Expert Interview	Expert Evaluation – Expert Interview
		Expert Evaluation – FGD	0	0	0	0	0	1	0	0	0	0	**1**	Expert Evaluation – FGD	
		Expert Evaluation – Sorting	0	1	0	0	0	0	0	0	0	0	**1**		
		Totals	**17**	**19**	**17**	**18**	**19**	**17**	**18**	**17**	**21**	**17**	**180**		

Source: Hendrawan et al. (2025a)

The SLR revealed several critical gaps. Only four of the ten studies incorporated stakeholder participation, and most relied on top-down, expert-driven approaches that were detached from lived cultural narratives. Structurally, prior studies predominantly employed simple lists or linear hierarchies, with limited adoption of hybrid or scalable taxonomy structures. Moreover, none of the reviewed studies explicitly employed a Design Science Research (DSR) methodology process model to guide taxonomy development, validation, and implementation within the CH domain.

These findings address both methodological and theoretical gaps, directly informing the present study's adoption of a DSR-based, participatory, and iterative approach to taxonomy development. The implications of these gaps and the original contributions of this study are further elaborated in Chapters 3, 5, and 6.

2.6.2 Bibliometric Analysis on Taxonomy Development

While the preceding Systematic Literature Review (SLR) provides an in-depth examination of selected empirical studies, bibliometric analysis (BA) offers a macro-level perspective on the intellectual, thematic, and collaborative evolution of taxonomy research within the Library and Information Science (LIS) domain. The integration of SLR and BA enables both depth and breadth in identifying structural gaps and positioning the present study within the wider scholarly landscape.

The bibliometric analysis covers the period 1974–2024 for both theoretical and methodological reasons. The year 1974 marks the early formalization of classification, knowledge modeling, and taxonomy-related discourse within LIS and adjacent domains, corresponding with the emergence of systematic indexing theories and early computational approaches to knowledge organization. Extending the analysis to 2024 allows the study to capture contemporary developments associated with digital transformation, semantic technologies, and design-oriented research approaches, thereby providing a longitudinal (50-year) perspective on the evolution, maturation, and diversification of taxonomy research. This extended timeframe is particularly important for identifying shifts from traditional classification paradigms toward participatory, semantic, and design-oriented approaches that are central to the present study.

The bibliometric dataset was primarily sourced from Scopus, selected for its extensive coverage of peer-reviewed publications in LIS, information systems, and the digital humanities. The search was conducted using Boolean operators applied to titles,

abstracts, and keywords, as follows: "*taxonomy development*" OR "*taxonomy design*" OR "*taxonomy construction*" OR "*taxonomy building*". All Boolean search strings, database filters, and search dates are provided in Appendix 10.

As shown in Figure 2.2, a total of 268 publications were published between 1974 and 2024. After applying the inclusion criteria (English-language, final journal articles or conference papers) and excluding duplicates, non-LIS domains, and non-taxonomy-focused records through database automation and manual screening, the refined bibliometric dataset comprised 214 publications. This refined dataset served as the analytical corpus for multidimensional bibliometric analysis using Bibliometrix (R package), integrated with R version 4.3.1.

The bibliometric analysis examined performance indicators (sources, authors, documents, and productivity trends), and science mapping techniques, including co-word analysis, co-citation analysis, and bibliographic coupling, to reveal conceptual, intellectual, and social structures of taxonomy research. The thematic map generated through co-word analysis (Figure 2.2) classifies research themes according to centrality (relevance within the field) and density (degree of development), resulting in four thematic quadrants.

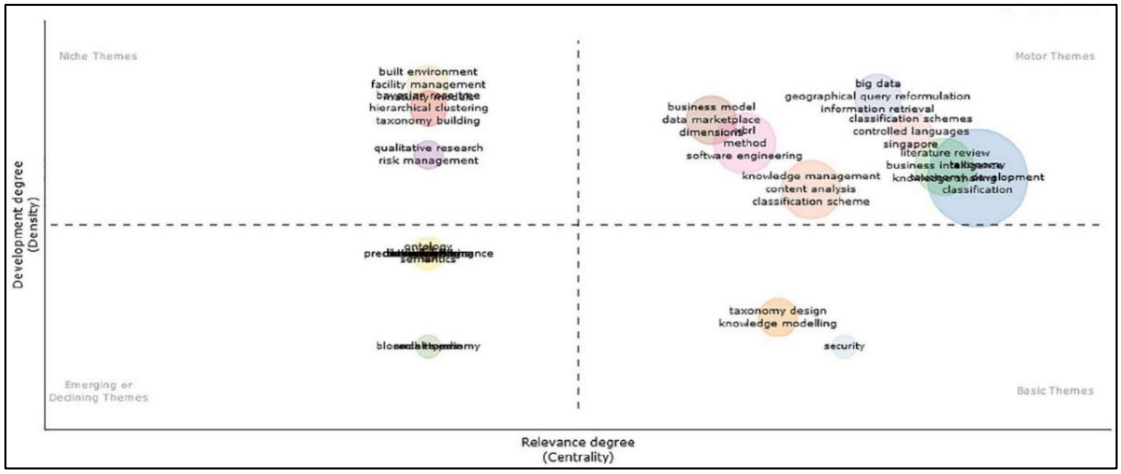


Figure 2.2 Thematic Mapping (Hendrawan et al., 2025a)

The analysis demonstrates that while taxonomy development is firmly established within LIS, cultural heritage (CH)-specific taxonomies remain underrepresented, predominantly appearing within niche or emerging quadrants rather than as motor or basic themes.

Specifically, emerging and weakly developed thematic clusters include cultural heritage informatics, digital heritage integration, participatory knowledge organization,

semantic interoperability for heritage data, and design-oriented taxonomy development.

These themes exhibit low centrality and low-to-moderate density, indicating early-stage conceptualization and limited consolidation within the broader LIS discourse. Although technically promising, their progression remains fragmented, often confined to isolated case studies or domain-specific applications. This limited advancement underscores the absence of scalable, methodologically grounded frameworks for developing CH taxonomies. In contrast, motor themes such as information retrieval, controlled vocabularies, and knowledge management demonstrate high maturity and connectivity but largely lack cultural contextualization. This imbalance highlights a structural gap between technically mature taxonomy research and culturally embedded heritage applications.

The bibliometric findings directly informed the Design Science Research (DSR) methodology adopted in this study in three key ways. First, identifying CH taxonomy as a marginal and emerging theme justified the problem-relevance stage of DSR, establishing a clear, empirically grounded research gap. Second, the dominance of non-participatory and non-iterative approaches within the literature informed the design principles adopted in Chapter 5, particularly cultural embeddedness, interoperability, scalability, and hierarchical structuring. Third, the limited presence of DSR-grounded taxonomy studies validated the methodological originality of employing a DSR process model to guide artifact design, evaluation, and refinement.

These contributions are elaborated further in Chapter 3, where the bibliometric insights are explicitly mapped to the DSR phases of problem identification, design objectives, artifact development, and evaluation. By integrating bibliometric analysis with the SLR, this study identifies three interrelated gaps, including the marginalization of CH-specific taxonomies within LIS, the limited development of participatory and contextualized taxonomy research, and the absence of systematically applied DSR frameworks in taxonomy development.

Addressing these gaps, the present study advances KO scholarship by proposing and empirically validating a DSR-grounded, contextualized taxonomy for the OCMHS, thereby repositioning CH taxonomy from a peripheral concern to a methodologically rigorous and strategically significant research domain.

Moreover, this bibliometric analysis constitutes a novel contribution, offering the first longitudinal (50-year) quantitative mapping of taxonomy development in LIS. The analysis identifies three publication phases, including 1) early development phase

(1974–1996); 2) growth and expansion phase (1997–2014); and 3) maturity phase (2015–2024) as illustrated in Table 2.5. The most significant output occurred between 2020 and 2021, likely driven by rapid digital transformation initiatives across the LAMs or CHIs sector. These temporal patterns support observations by Kundisch et al. (2022) and Oberländer et al. (2019), who report increasing methodological sophistication in taxonomy-related studies.

Table 2.5
Future Directions for Taxonomy Development Research

No.	Publication Phases	Key Trends Topic	Themes	Prominent Author and Document	Gaps & Future Directions
1	Early development (1974-1996)	"Nursing", "nursing diagnosis", "standard", "information analysis", "learning system", and "mental disease."	Declining topic: "Biomedical taxonomy" and "Bloom's taxonomy."	McCloskey and Bulechek (1995), Follette and Houts (1996)	Bioinformatics taxonomy (*Domain expansion*)
2	Growth and expansion (1997-2014)	"Classification", "cluster analysis", "information management", decision making", "information system", "data mining", "nomenclature", "methodology", "artificial intelligence", and "design"	Basic themes: "Taxonomy design"	Nickerson et al. (2009), Nickerson et al. (2013), Archibugi and Michie (1995).	Taxonomy design for under-researched domains, such as cultural heritage. (*Under-researched domain*)
			Motor themes: [1]"Classification schemes", "information systems", and "method" [2]"Big data", "XBRL", "controlled language", "software engineering"	[1]Chaudhry and Jiun (2005), Chaudhry (2010). [2]Ida (2011), Alshazly et al. (2014),	[1]Domain analysis for taxonomy development. (*Domain analysis*) [2]Taxonomy modeling tools, standards, and information ethics. (*Information standardization & ethics*)
			Niche themes: "Hierarchical clustering", and "Bayenesian rose tree"	Liu et al. (2012), Balijepally et al. (2011)	Taxonomy structure framework and visualization. (*Taxonomy archetypes and structure*)
3	Maturation (2015-2024)	"Taxonomy", "taxonomy development", "knowledge management",	Basic themes: "Knowledge modeling" and	Kundisch et al. (2022), Varshney et al. (2015)	Consensus techniques for comparing taxonomic structures

	"business model", "information use", "search engine", "ontology", "literature review" "qualitative research", "development process" "development method" and "consensus"	"taxonomy design"		(*Taxonomy benchmarking and consensus*).
		Motor themes: "Business model", "business intelligence", and "data marketplace"	Hanelt et al. (2015), Remane et al. (2017)	Taxonomy of business models and analytics. (*Taxonomy monetization*).
		Niche themes: "Qualitative research", "risk management", "taxonomy building", and "maturity model"	Szopinski et al. (2020); Kundisch et al. (2022); Omair & Alturki (2020)	Design science research method for taxonomy development (*Methodological guidance*).
		Emerging themes: "Semantic", "ontology", and "predicted maintenance"	Niu and Issa (2015)	Taxonomy and ontology for open linked data and interoperability. (*Semantic and open-linked data*)

Source: Hendrawan et al. (2025a)

Co-citation and bibliographic coupling confirm the theoretical influence of models such as Nickerson et al. (2013) and iterative development frameworks from Kundisch et al. (2022). However, consistent with Oberländer et al. (2019), the practical implementation of these frameworks remains limited, particularly in LIS subdomains such as KO and digital humanities. Keyword trend analysis shows a gradual transition from traditional models (e.g., *Bloom's Taxonomy*) toward digitally structured, semantically enriched systems featuring terms like *ontology*, *consensus*, and *classification scheme*.

Crucially, the analysis confirms the persistent absence of CH-specific themes in the motor or basic quadrants. The limited use of terms like "cultural heritage taxonomy" in niche or emerging categories underscores a critical research gap. This study addresses that gap by proposing a DSR-grounded, interoperable taxonomy for CHIs, validated through real-world case studies at OCMHS. In contrast to previous work that relied on static or top-down models, this study integrates participatory design, usability testing, and contextual adaptation into a free and open-source software (FOSS) digital repository prototype.

Additionally, this bibliometric analysis reinforces the originality and strategic positioning of the present study. The findings confirm that while taxonomy development is an established LIS discipline, CH taxonomies remain underrepresented, often appearing only in niche or emerging categories. This aligns with the research problems identified in Chapter 1 and further evidenced in Chapter 4, where OCMHS institutions face fragmentation, the absence of contextual taxonomies, and a lack of systematic evaluation.

Methodologically, the analysis highlights the limited use of structured, iterative approaches, such as DSR, in taxonomy studies. As outlined in Chapter 3, this study directly addresses that gap by embedding DSR into the development, validation, and implementation of the taxonomy. The thematic clusters also underscore the need for hybrid structures and participatory design, principles which are operationalized in Chapter 5 through hierarchical structuring, cultural embeddedness, scalability, and interoperability.

By combining insights from the SLR and bibliometric analysis, this study identifies and responds to three interrelated gaps, including 1) the marginalization of CH taxonomies within LIS; 2) the lack of participatory and contextually sensitive approaches; and 3) the absence of DSR-grounded, systematically evaluated frameworks. The present research advances the field by proposing and testing a contextualized taxonomy for OCMHS, thereby contributing theoretical, methodological, and practical insights, which are further synthesized in Chapter 6.

2.7 Chapter Summary

This chapter has critically examined literature on cultural and industrial heritage, the role and convergence of CHIs, the theoretical underpinnings of KO, the spectrum of KOSs, and the evolution of taxonomy development. Across these domains, the review identified persistent challenges in integrating diverse heritage resources, reconciling international KOS standards with local narratives, and validating taxonomies through systematic, iterative methods.

The SLR and BA reinforced these observations by demonstrating that cultural heritage taxonomies remain marginal in LIS scholarship, participatory and context-sensitive approaches are rarely applied, and structured DSR processes are almost absent. Synthesizing these insights provides a strong rationale for the present study,

which operationalizes four guiding principles, including hierarchical structuring, cultural embeddedness, scalability, and interoperability in the iterative taxonomy development detailed in Chapter 5. By consolidating these issues into a single framing at the end of the chapter, redundancy is minimized, and the conceptual trajectory from the research problem in Chapter 1 to the research design in Chapter 3 is reinforced.

Overall, the literature demonstrates significant advances in KO theory and in taxonomy methods, yet fails to provide integrated, context-sensitive solutions for fragmented CH environments. Comparative insights reveal a consistent gap, including international KOS standards that ensure interoperability but lack cultural depth, while local practices preserve authenticity but remain siloed. These gaps justify the present study's adoption of a DSR-based, hybrid taxonomy design that reconciles these tensions in the OCMHS context.

CHAPTER 3
RESEARCH METHODOLOGY

3.1 Chapter Overview

This chapter presents the research methodology adopted to design, develop, and evaluate a contextualized taxonomy for cultural heritage institutions (CHIs) within Area A of the Ombilin Coal Mining Heritage of Sawahlunto (OCMHS). The methodological design of this study is driven by the recognition that the research problem—namely, the fragmentation of knowledge organization (KO) practices across libraries, archives, and museums (LAMs) managing a shared industrial heritage—cannot be adequately addressed through descriptive or explanatory research alone.

Prior studies in the domains of Library and Information Science (LIS), Knowledge Organization (KO), and Cultural Heritage (CH) have extensively documented classification practices, metadata standards, and institutional workflows within individual CHIs. However, as demonstrated in Chapter 2, much of this literature remains analytical or comparative, focusing on identifying problems, typologies, or best practices without offering methodologically grounded solutions that can be empirically tested and iteratively refined. In particular, existing studies on heritage taxonomies have tended to emphasize either expert-driven models grounded in international standards, participatory approaches centered on community narratives, or automated techniques enabled by computational methods—yet rarely integrate these approaches within a single, evaluable design framework.

This study responds to that limitation by adopting Design Science Research (DSR) as its overarching methodological framework. DSR is specifically oriented toward the creation and evaluation of artifacts—such as models, frameworks, methods, or systems—that address real-world problems while also contributing to theoretical knowledge. The choice of DSR is therefore not incidental but is directly triggered by a set of unresolved gaps identified in the literature: 1) the absence of a systematic, theory-informed process for designing heritage taxonomies that reconcile global interoperability with local cultural meaning; 2) the lack of empirical validation of taxonomy artifacts in real institutional settings; and 3) the limited involvement of CHI practitioners and community users in taxonomy evaluation.

To ensure that the designed artifact is contextually grounded and empirically defensible, the DSR process in this study is embedded within a multiple-case study strategy involving CHIs in the Sawahlunto Municipality. These case studies provide concrete data on existing KO practices, metadata workflows, and user interactions, forming the empirical basis for both problem diagnosis and design requirements. They also function as testbeds for demonstrating and evaluating the taxonomy through participatory validation and usability testing.

The targeted users of the research outcomes include CHI professionals (librarians, archivists, curators, registrars), heritage experts, and community users who interact with OCMHS collections for research, education, and cultural engagement. The analytical goal of the study is twofold: first, to systematically diagnose the structural and semantic limitations of existing KO practices across CHIs; and second, to develop and validate a contextualized taxonomy that supports integrated access, semantic coherence, and sustainable heritage interpretation.

By integrating DSR with embedded case studies, this chapter establishes a methodological foundation that balances rigor and relevance, ensuring that the resulting taxonomy is not only theoretically informed but also practically usable, culturally embedded, and transferable to similar multi-institutional heritage contexts. This methodological design directly supports the analytical findings in Chapter 4, the artifact development and evaluation in Chapter 5, and the theoretical and practical contributions articulated in Chapter 6.

3.2 Research Design and Paradigm

Research design reflects the philosophical orientation and methodological structure that guide how knowledge is generated and validated. This study adopts a Design Science Research (DSR) paradigm situated within a pragmatic orientation. This combination is appropriate because the study addresses a real-world problem by developing and evaluating a functional artifact.

From a pragmatic perspective, knowledge in Knowledge Organization (KO) and Cultural Heritage (CH) contexts is viewed as situated and purpose-driven. Pragmatism prioritizes practical consequences and problem-solving over strict adherence to a single ontological or epistemological position. In the OCMHS context, KO practices are shaped by institutional mandates, historical trajectories, resource limitations, and

community expectations. A purely positivist approach would risk reducing this complexity to abstract variables. Conversely, a purely interpretivist approach might generate rich descriptions without offering implementable solutions. Pragmatism, therefore, provides a balanced foundation for design-oriented inquiry.

DSR complements pragmatism by offering a structured methodology for developing and evaluating artifacts. Following Hevner et al. (2004), Peffers et al. (2007), and Gregor and Hevner (2013), DSR focuses on the purposeful design of artifacts that address identified organizational problems. In this study, the artifact is a contextualized taxonomy designed to integrate fragmented KO practices across Cultural Heritage Institutions (CHIs) within OCMHS.

Theoretical tensions in the KO literature further justify selecting DSR. Standardization-oriented scholars emphasize alignment with international Knowledge Organization Systems (KOS) to ensure interoperability and sustainability. In contrast, contextual and participatory perspectives argue that the meaning of heritage is locally constructed and cannot be fully captured by top-down classification systems. These perspectives are often treated as competing approaches. DSR provides a methodological framework for reconciling them. Through iterative design and evaluation cycles, competing requirements can be negotiated, tested, and refined.

The decision to employ DSR is also empirically grounded. Preliminary engagement with OCMHS CHIs revealed discrepancies in metadata standards, inconsistent use of controlled vocabularies, siloed systems, and user difficulties in accessing coherent heritage narratives. These findings indicate that the problem is operational rather than purely conceptual. An interventionist research strategy is therefore required.

Although DSR provides the overarching paradigm, it is operationalized through an embedded multiple case study design. Case study research enables an in-depth examination of socio-technical phenomena within real-life settings (Costa et al., 2016; Dresch et al., 2015). The embedded structure allows analysis at two levels: individual institutions and the broader OCMHS heritage ecosystem. This ensures that design requirements are derived inductively from empirical data rather than imposed a priori.

The integration of DSR and case study research creates a balance between explanation and prescription (Nabukenya, 2012). The case studies function diagnostically within the DSR cycle. They inform problem identification, objective

formulation, and artifact evaluation. This approach moves beyond descriptive accounts of KO fragmentation and supports the systematic development of artifacts.

The study employs a combination of inductive, deductive, and abductive reasoning. Induction is used to identify patterns in existing KO practices through qualitative data analysis. Deduction guides alignment with established KO theories and international standards. Abductive reasoning occurs during iterative design cycles when stakeholder feedback prompts refinement of taxonomy structures.

Overall, the research design ensures that the developed taxonomy is analytically grounded, empirically validated, and practically applicable. By integrating pragmatism, DSR, and embedded case study analysis, the study advances a design-oriented contribution to knowledge organization in cultural heritage contexts.

3.2.1 Design Science Research Overview

Design Science Research (DSR) provides the methodological structure for this study. As outlined in Section 3.2, DSR is appropriate because the research seeks to develop and evaluate an artifact that addresses a practical problem. In this study, the artifact is a contextualized taxonomy intended to integrate fragmented knowledge organization (KO) practices across CHIs within OCMHS. Following Peffers et al. (2007), this study adopts the six-phase DSR process model as shown in Figure 3.1.

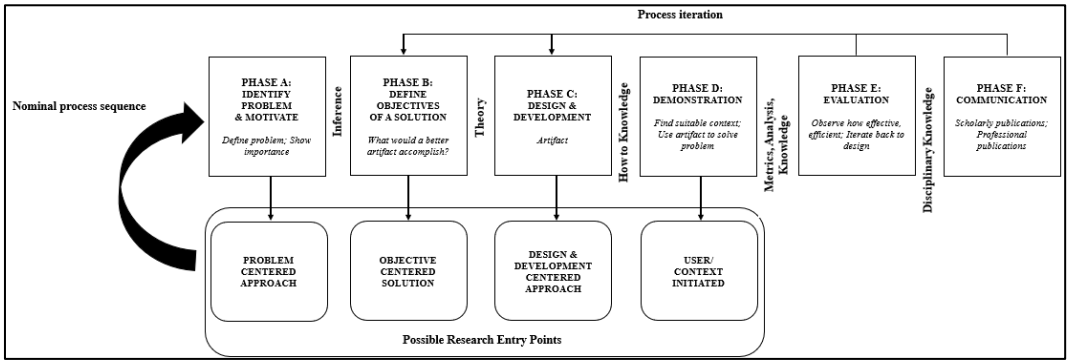


Figure 3.1 DSR Methodology Process Model of Peffers et al. (2007)

The model structures the research into the following iterative stages:

a) Phase A: Problem identification and motivation – defining the fragmentation of KO practices and justifying the need for an integrative taxonomy.
b) Phase B: Define Objectives of a Solution – establishing functional and semantic requirements derived from stakeholder needs and theoretical standards.

c) Phase C: Design and development – constructing the contextualized taxonomy based on empirical findings and established KOS principles.
d) Phase D: Demonstration – applying the taxonomy within CHI contexts to illustrate its practical applicability.
e) Phase E: Evaluation – assessing usability, comprehensiveness, robustness, and contextual fit through participatory testing.
f) Phase F: Communication – documenting and disseminating research outcomes through this thesis and related scholarly outputs.

This structured model supports transparency, repeatability, and scientific rigor while also accommodating the iterative nature of artifact refinement based on feedback and contextual testing. The application of the six core DSR phases in this study is summarized in Figure 3.2, which illustrates the methodological steps.

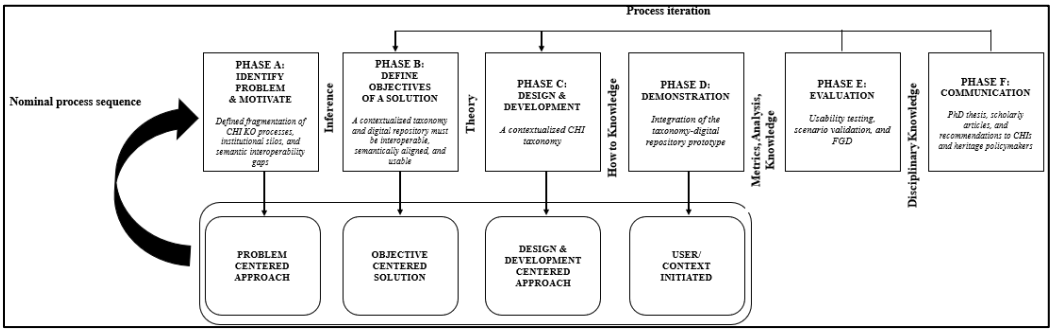


Figure 3.2 Adapted DSR Process Model Aligned with This Study

Although presented sequentially, these phases were iterative in practice. Design and evaluation activities were refined based on stakeholder feedback and empirical insights. This iterative structure ensured continuous alignment between theory, institutional needs, and artifact performance. The adoption of DSR is aligned with the research objectives for four primary reasons.

First, there is a clear problem–solution fit. The study does not aim merely to describe KO fragmentation. It seeks to develop a structured artifact that addresses it. DSR is therefore methodologically consistent with the research objective.

Second, the study requires iterative development cycles. Taxonomy design in CHI settings involves stakeholder negotiation, contextual adaptation, and refinement. DSR explicitly supports such design–evaluate–refine processes.

Third, DSR ensures a balance between rigor and relevance. The taxonomy is grounded in established KO theories and international KOS standards, including ISO 25964, ANSI/NISO Z39.19, LCSH, AAT, CIDOC-CRM, and the UNESCO Thesaurus.

At the same time, it is evaluated in real institutional contexts through participatory validation and usability testing.

Fourth, DSR enables dual contributions. It supports practical implementation within CHIs while advancing scholarly understanding of contextualized taxonomy development in cultural heritage domains.

The application of DSR in this study is summarized in Figure 3.2. This adapted model maps each DSR phase to specific research activities and thesis chapters. Such mapping enhances methodological transparency and ensures traceability between empirical diagnosis, artifact construction, and evaluation outcomes. Furthermore, DSR provides a structured yet flexible framework for integrating empirical analysis, artifact design, and stakeholder validation. Its application ensures that the developed taxonomy is theoretically informed, contextually grounded, and practically usable.

3.2.2 Embedded Multiple Case Study Strategy

To generate an in-depth understanding of existing knowledge organization (KO) practices, this study adopts an embedded multiple case study strategy as part of the overall research design. Multiple case studies are appropriate for examining complex socio-technical phenomena in real-life contexts, particularly when the boundaries between the phenomenon and its environment are not clearly defined (Yin, 2018; Halkias et al., 2022).

In this research, the case study design functions as a diagnostic and evaluative component within the broader Design Science Research (DSR) framework described in Section 3.2. It provides empirical grounding for problem identification and artifact development. While DSR structures the design process, the case studies supply contextual data that inform design requirements and evaluation criteria.

The study focuses on six interrelated Cultural Heritage Institutions (CHIs) within Sawahlunto Municipality, including one municipal library, one municipal archives, and four municipal museums. Each institution represents a primary case. Within each case, multiple embedded units of analysis are examined. These include institutional actors, classification systems, metadata workflows, and user interactions. This structure enables both within-case and cross-case analysis.

Cases were selected using purposive sampling to ensure relevance and variation (Patton, 2015). Selection criteria included institutional responsibility for cultural

heritage management, involvement in documentation practices, and significance within the OCMHS heritage ecosystem. The study follows replication logic rather than statistical generalization (Yin, 2018). This allows identification of recurring patterns across institutions (literal replication) as well as contrasts between different institutional types (theoretical replication).

Case boundaries are clearly defined. Spatially, the study is limited to Area A of OCMHS within Sawahlunto Municipality. Institutionally, boundaries are based on formal mandates and operational structures of the selected CHIs. These boundaries ensure analytical clarity while acknowledging institutional interconnections.

The embedded case study design supports methodological triangulation. Data from interviews, observations, document analysis, FGDs, and usability testing are analyzed across cases and units of analysis. This approach strengthens empirical validity and ensures that the taxonomy design is grounded in actual institutional practices. Overall, the embedded multiple case study strategy ensures contextual depth and analytical rigor. It provides the empirical foundation necessary for artifact development and evaluation within the DSR cycle.

3.3 Research Context: The Ombilin Coal Mining Heritage of Sawahlunto

This study is situated within the Ombilin Coal Mining Heritage of Sawahlunto (OCMHS), a UNESCO World Heritage Site inscribed in 2019 under the category of cultural landscape and industrial heritage (UNESCO, 2019). The research focuses on Area A of OCMHS, namely Sawahlunto Municipality, which functions as the primary administrative and interpretive center for heritage management. Specifically, as shown in Figures 3.3 and 3.4, the research focuses on CHIs located in Area A OCMHS or in Sawahlunto Municipality, West Sumatra Province, the Republic of Indonesia, which serves as the primary administrative and interpretive hub for CH management and public education. The selected Cultural Heritage Institutions (CHIs) include one municipal library, one municipal archives, and four municipal museums. These institutions play complementary roles in preserving, organizing, and disseminating knowledge related to OCMHS and its socio-cultural narratives.

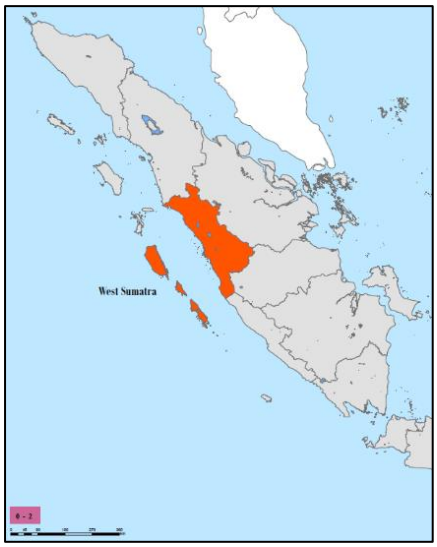


Figure 3.3 Map of West Sumatra Province Shows the Location of the OCMHS

The research context is characterized by institutional diversity and uneven digital maturity. The CHIs demonstrate varying levels of digitization, metadata implementation, classification systems, and public access mechanisms. This heterogeneity provides a suitable environment for examining fragmentation in knowledge organization (KO) practices and for developing a contextualized taxonomy.

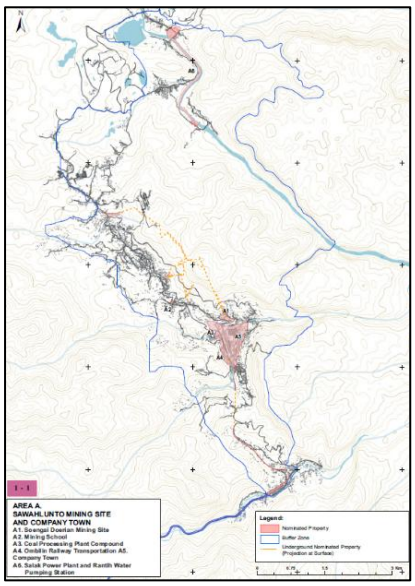


Figure 3.4 The Map of OCMHS Area A or Sawahlunto Municipality

Sawahlunto Municipality has strong historical significance as a former colonial mining town established in the late nineteenth century. Its infrastructure includes underground tunnels and industrial facilities that reflect its mining heritage (Kementerian Pekerjaan Umum dan Perumahan Rakyat Republik Indonesia, 2021; Kementerian Pendidikan dan Kebudayaan Republik Indonesia, 2014). However, the

methodological relevance of this context lies not only in its history but in its current governance structure and institutional landscape. As a UNESCO-designated site, OCMHS requires effective knowledge management and coordinated documentation practices to sustain its heritage status.

The institutional environment is further shaped by Indonesia's national legal framework on cultural heritage, museums, libraries, and archives. Relevant regulations include Law No. 11/2010 on Cultural Heritage, Law No. 43/2007 on Libraries, and Law No. 43/2009 on Archives (Kementerian Pendidikan dan Kebudayaan Republik Indonesia, 2014; Republik Indonesia, 2007; Republik Indonesia, 2009). These frameworks define institutional mandates and responsibilities for documentation, preservation, and public access. They also establish formal boundaries for the CHIs examined in this study.

Despite active efforts in heritage revitalization and public engagement, several challenges persist. These include fragmented documentation practices, inconsistent metadata standards, limited integration across institutions, and insufficient representation of intangible heritage within formal systems. These issues directly motivate the development of a contextualized taxonomy.

The institutional configuration of OCMHS, therefore, provides a bounded yet diverse setting for examining KO fragmentation. It offers both variation across institutions and shared governance structures, making it appropriate for embedded multiple case study analysis within the DSR framework.

3.3.1 Cultural Heritage Institutions Profile

This section outlines the institutional characteristics of the selected CHIs within Sawahlunto Municipality. These institutions are the primary cases in the embedded multiple-case study design. Table 3.1 summarizes the institutional distribution and management structure of the selected CHIs.

Table 3.1
Cultural Heritage Institutions in the Sawahlunto Municipality

No.	Types of Cultural Heritage Institutions	Name of Cultural Heritage Institutions	Management
1	Library	The Sawahlunto Municipality Library (*Perpustakaan Kota Sawahlunto*)	The Office of Library and Archives of the Sawahlunto Municipality
2	Archives	The Sawahlunto Municipality Archives (*Arsip Kota Sawahlunto*)	

3	Museums	The Coal Mining Museum (*Museum Tambang Batubara*)	The Office of Culture of the Sawahlunto Municipality
		The Goedang Ransoem Museum (*Museum Goedang Ransoem*)	
		The Soero Coal Mine Pit Site Museum (*Museum Situs Lubang Tambang Batubara Soero*)	
		The Railway Museum (*Museum Kereta Api)*	

Each institution operates under distinct mandates and administrative structures (Walikota Sawahlunto, 2016; Walikota Sawahlunto, 2021). Together, they form an interconnected heritage ecosystem within OCMHS. Although these institutions share responsibility for heritage preservation, their KO practices differ. Libraries typically employ standardized classification and cataloging systems. Archives apply provenance-based record structures. Museums rely on object-centered documentation practices. These variations contribute to semantic and structural fragmentation.

Rather than representing isolated entities, these institutions function as interdependent nodes within a shared heritage landscape. Their differences provide analytical insight into both fragmentation and potential convergence in taxonomy development.

3.3.1.1 The Sawahlunto Municipality Library

The Sawahlunto Municipality Library operates under the Office of Library and Archives. It serves as both a public service institution and a cultural knowledge center (Walikota Sawahlunto, 2021). The library operates from two buildings, the Muhammad Yamin Library Building and the Adinegoro Library Building, as shown in Figures 3.5 and 3.6.



Figure 3.5 The Muhammad Yamin Library Building



Figure 3.6 The Adinegoro Library Building

Institutionally, the library has undergone several regulatory formalizations, including Regional Regulation No. 3/2013 and Mayor Regulation No. 31/2016 (Walikota Sawahlunto, 2013; Walikota Sawahlunto, 2016). These regulations define its governance structure and service responsibilities. From a knowledge organization perspective, the library applies standardized cataloging and classification systems. However, integration with other CHIs remains limited. This institutional positioning makes the library a critical case for examining interoperability challenges.

3.3.1.2 The Sawahlunto Municipality Archives

The Sawahlunto Municipality Archives operates under the Office of Library and Archives, as shown in Figure 3.7. It is responsible for records management and archival preservation at the municipal level (Walikota Sawahlunto, 2021). The archives are

structured into two primary units, including one focused on records supervision and policy implementation, and another dedicated to the lifecycle management of archival materials. Its practices follow national archival regulations.



Figure 3.7 The Sawahlunto Municipality Archives

From a KO perspective, the archives employ provenance-based classification and hierarchical record structures. While this ensures administrative accountability, cross-institutional semantic integration with libraries and museums is limited. As the documentary backbone of OCMHS governance, the archives play a central role in preserving institutional memory. Its practices, therefore, provide important insights into structural differences in metadata and classification logic.

3.3.1.3 The Sawahlunto Municipality Museums

Four museums under the Office of Culture form the third institutional cluster in this study. These include the Coal Mining Museum, the Goedang Ransoem Museum, the Soero Coal Mine Pit Site Museum, and the Railway Museum (Kementerian Pendidikan dan Kebudayaan Republik Indonesia, 2014; Walikota Sawahlunto, 2016), as shown in Figures 3.8 to 3.11.



Figure 3.8 The Coal Mining Museum



Figure 3.9 The Goedang Ransoem Museum



Figure 3.10 The Soero Coal Mine Pit Site Museum



Figure 3.11 The Railway Museum

These museums emerged from adaptive reuse initiatives aimed at revitalizing former colonial industrial infrastructure. Their institutional mission combines preservation, public education, and heritage tourism (Syafrini et al., 2020). Each museum employs object-based documentation systems. However, metadata practices, labeling standards, and interpretive frameworks vary. In several cases, curatorial documentation lacks systematic semantic structuring.

These museums collectively illustrate the diversity of heritage representation within OCMHS (Hendrawan et al., 2024a). They also reveal inconsistencies in object classification, narrative framing, and the integration of documentation (Hendrawan et al., 2025b). Such variations further justify the need for a contextualized taxonomy that can bridge institutional differences.

3.3.2 Research Questions Alignment

This section explains how the research questions (RQs) are aligned with the stages of the Design Science Research (DSR) process and the corresponding data collection methods. This alignment ensures that each research question contributes directly to artifact development and evaluation within the DSR cycle.

The four research questions are positioned across the six DSR phases proposed by Peffers et al. (2007). RQ1 and RQ2 correspond to the problem identification and objective definition stages (Phases A and B). These questions diagnose existing knowledge organization (KO) practices and identify critical factors influencing taxonomy development.

RQ3 aligns with the design and demonstration stages (Phases C and D). It

focuses on constructing the contextualized taxonomy based on empirical findings and theoretical principles. RQ4 corresponds to the evaluation and communication stages (Phases E and F). It assesses the usability and effectiveness of the developed taxonomy through participatory validation and usability testing.

This alignment clarifies how the study progresses from empirical diagnosis to artifact construction and evaluation. It also ensures that each research question is methodologically grounded in specific data sources and analytical strategies. Table 3.2 presents this alignment in matrix form.

Table 3.2
Operationalization of Research Questions

Research Question (RQ)	Concepts / Constructs	Data Collection Methods	DSR Phase & Chapter Position	Analytical Approach
RQ1: What are the existing conditions of knowledge organization processes within CHI in the OCMHS?	Knowledge organization processes	Document analysis Semi-structured interviews Observation	Phase A and Phase B Chapters 2 and 4	Thematic analysis (within-case & cross-case) Open and axial coding (ATLAS.ti)
RQ2: What are the critical factors that influence the development of a contextualized taxonomy for OCMHS CHI?	Critical factors influencing the taxonomy development	Document analysis Semi-structured interviews Observation	Phase A and Phase B Chapters 2 and 4	Thematic analysis (within-case & cross-case) Open and axial coding (ATLAS.ti)
RQ3: How can a contextual taxonomy be developed to support integrated KO across OCMHS CHIs?	Contextualized Taxonomy	Focus Group Discussions Semi-structured interviews Document analysis	Phase C and Phase D Chapter 5	Deductive and inductive synthesis
RQ4: How effective and usable is the developed taxonomy when evaluated?	Usability and task relevance	Focus Group Discussions Usability testing	Phase E and Phase F Chapter 5	Scenario-based feedback analysis, Usability finding

The matrix demonstrates that:

a) RQ1 and RQ2 rely primarily on document analysis, semi-structured interviews, and observations. These methods support thematic analysis and open axial coding to identify patterns across institutions.
b) RQ3 integrates focus group discussions, interviews, and document analysis to synthesize design requirements and construct the taxonomy.

c) RQ4 employs focus group discussions and usability testing to evaluate task relevance, clarity, and contextual fit.

This structured mapping strengthens procedural clarity by linking each research question to its analytical pathway and DSR phase. It also ensures that empirical findings systematically inform the refinement of artifacts.

Having established the alignment between research questions and methodological phases, the following section details the specific data collection procedures. It explains how interviews, observations, document analysis, focus group discussions, and usability testing were conducted to generate contextually grounded evidence for developing the taxonomy.

3.4 Data Collection Methods

Data collection in this study was conducted systematically and sequentially, following the research design and paradigm outlined in Section 3.2. The methods were deliberately selected to capture in-depth insights into the existing condition of KO processes and identify critical factors influencing taxonomy development among CHI in Sawahlunto Municipality (Area A of the OCMHS). Given the exploratory and design-oriented nature of this research, qualitative approaches were prioritized, including semi-structured interviews, participant observation, document analysis, FGDs, and scenario-based usability testing. These methods collectively supported the iterative and participatory development of the contextualized taxonomy, ensuring alignment with both practical needs and theoretical foundations.

3.4.1 Semi-Structured Interviews

Semi-structured interviews were conducted during Phase A (Problem Identification) and Phase B (Define Objectives of a Solution) of the DSR process. The interviews aimed to explore existing knowledge organization (KO) practices and to identify critical factors influencing taxonomy development. This method was selected because it balances flexibility with structure. It allows in-depth exploration of institutional workflows while ensuring comparability across participants (Galletta, 2013; Williamson, 2018).

A total of 15 key informants participated in the interviews. Participants represented multiple stakeholder groups within the OCMHS ecosystem, including

cultural heritage experts, directors, registrars, curators, archivists, librarians, and community users. This diversity ensured representation of both institutional perspectives and user experiences.

Each interview lasted between 45 and 60 minutes. Interviews were conducted in institutional settings, audio-recorded with consent, and transcribed verbatim. Data were analyzed using thematic coding in ATLAS.ti (Version 25). The interview protocol was organized around eight thematic domains aligned with the objectives of taxonomy development. Table 3.3 summarizes the characteristics of the key informants. This study employed purposive and criterion-based sampling strategies consistent with qualitative and Design Science Research methodologies.

The population consisted of stakeholders involved in knowledge organization practices within Cultural Heritage Institutions (CHIs) located in Area A of OCMHS, Sawahlunto Municipality. This included institutional actors responsible for documentation, classification, records management, and curatorial functions, as well as community users who access CHI services. Participants involved in focus group discussions and usability testing were selected from both institutional and user categories to ensure balanced evaluation of artifact usability and contextual relevance. This structured sampling approach ensured variation across institutional roles while maintaining alignment with the study's diagnostic and design objectives.

Table 3.3
Basic Description of Key Informants

No.	Informant's Code	Qualifications and Selection Criteria	Categories/Represented
1	CHE 1 & CHE 2	Selected based on their long-term involvement in the OCMHS World Heritage nomination process, formal participation in national and international heritage programs (e.g., UNESCO, ICOMOS), and their expertise in Outstanding Universal Value (OUV) assessment, heritage documentation, and policy-level coordination.	**Cultural Heritage Expert**/The OCMHS Representatives
2	DIR 1	Selected due to his strategic and managerial roles within CHIs, including responsibility for institutional policy, standard-setting, and oversight of KO practices. His inclusion ensured insights into governance-level decisions affecting taxonomy adoption and interoperability.	**Director**/The Sawahlunto Municipality Museums (Office of Culture)
4	REG 1 & REG 2	Selected based on their technical responsibility for collection registration,	**Registrars**/The Sawahlunto Municipality

		documentation, classification, interpretation, and exhibition planning.	Museums (Office of Culture)
5	CUR 1 & CUR 2	Their professional expertise directly informed the semantic structure, hierarchical logic, and cultural embeddedness of the proposed taxonomy.	**Curators**/The Sawahlunto Municipality Museums (Office of Culture)
7	DIR 2	Selected due to his strategic and managerial roles within CHIs, including responsibility for institutional policy, standard-setting, and oversight of KO practices. His inclusion ensured insights into governance-level decisions affecting taxonomy adoption and interoperability.	**Director**/The Sawahlunto Municipality Library and Archives (Office of Library and Archives)
8	ARC 1 & ARC 2	Selected due to their formal qualifications and operational roles in records management, archival description, appraisal, and access provision. Their participation provided insights into provenance-based KO, metadata standards, and challenges in archival interoperability.	**Archivists**/The Sawahlunto Municipality Archives (Office of Library and Archives)
9	LIB 1 & LIB 2	Selected based on their expertise in cataloging, classification, indexing, and user services, particularly in relation to CH-related collections. Their perspectives supported alignment between the proposed taxonomy and established library KOS practices.	**Librarians**/The Sawahlunto Municipality Library (Office of Library and Archives)
10	USR 1	Selected to represent community-level engagement with CHIs. Selection criteria included active and sustained use of library, archival, or museum services related to OCMHS. Their inclusion ensured that usability, accessibility, and interpretability were addressed from a non-specialist perspective.	**Library User**/The Sawahlunto Municipality Communities
11	USR 2		**Archives User**/The Sawahlunto Municipality Communities
12	USR 3		**Museum User**/The Sawahlunto Municipality Communities
Total: 15 Informants			

The selection of key informants in this study used purposive sampling to capture diverse yet complementary perspectives across the cultural heritage institution (CHI) ecosystem of OCMHS. Informants were selected based on their professional qualifications, institutional roles, decision-making authority, and experiential knowledge relevant to KO practices and the development of the taxonomy.

The purposive selection of participants ensured that both professional and public perspectives were incorporated. Institutional participants provided insight into workflows, standards, and challenges of existing KO practices across CHIs and LAMs

within Sawahlunto Municipality. In contrast, community participants highlighted accessibility, usability, and interpretability issues from a user-centered perspective. This triangulation is crucial for developing a taxonomy that balances institutional rigor with inclusivity, cultural embeddedness, and user needs.

The insights generated from these interviews informed the case analyses and needs assessments presented in Chapter 4, providing empirical evidence for institutional profiling. Furthermore, the thematic patterns identified here became the foundation for the taxonomy design principles and evaluation indicators elaborated in Chapter 5. Ultimately, this stage of data collection demonstrates the participatory and iterative orientation of the study, ensuring that the resulting taxonomy is not only theoretically sound but also practically validated by its stakeholders, a point that contributes to the methodological and practical significance synthesized in Chapter 6.

3.4.2 Observation and Document Analysis

Participant observation was conducted across CHIs in Sawahlunto Municipality (Area A of the OCMHS) over two months (April to May 2024). This method enabled the researcher to directly observe institutional workflows, cataloging practices, and user interactions with CH resources, thereby providing empirical grounding for the problems of fragmentation and lack of interoperability identified in Chapter 1. Observations were systematically documented in field notes and later cross-referenced with interview data, ensuring consistency and identifying discrepancies between formal procedures and actual practices.

In parallel, a systematic document analysis was carried out to provide contextual and operational insights into the KO practices of CHIs. The documents reviewed included collection catalogs, internal classification lists, inventory registers, institutional policies, and the official UNESCO World Heritage Nomination Dossier. These sources provided essential evidence of institutional logic, descriptive standards, and policy frameworks, complementing the observational data and revealing significant variations across CHIs. For instance, while museums emphasized object-based cataloging, archives adhered to provenance-driven record structures, and libraries applied KOS standards mirroring the theoretical contrasts highlighted in Chapter 2.

The integration of observation and document analysis was essential for triangulation in Phase A (Problem Identification) and Phase B (Define Objectives) of

the DSR methodology. Together with semi-structured interviews, these methods allowed for a comprehensive and empirically validated understanding of the critical factors influencing taxonomy development in OCMHS. They not only informed the institutional profiling and needs analysis presented in Chapter 4 but also shaped the design principles synthesized in Chapter 5, particularly regarding hierarchical structuring, cultural embeddedness, and interoperability.

By employing observation and document analysis alongside interviews, this study ensured methodological triangulation, enhancing the credibility and validity of its findings. Beyond their immediate role in grounding taxonomy design, these methods also contribute to the methodological rigor of the research, demonstrating how participatory and multi-modal data collection strategies can strengthen DSR applications in the CH domain.

Participant observation was conducted across three Cultural Heritage Institutions (CHIs) within the Sawahlunto Municipality, namely the Municipal Library, Municipal Archives, and Municipal Museum. The researcher adopted a moderate participant–observer role, maintaining analytical distance while engaging in non-disruptive interaction with institutional actors. This positioning enabled the researcher to observe operational workflows in their natural settings while minimizing intervention bias.

Observation sessions were conducted over multiple site visits from April to May 2024. Each session lasted approximately two to four hours and focused on routine knowledge organization (KO) activities. These activities included accessioning procedures, metadata entry practices, subject classification decisions, digitization processes, record retrieval tasks, and user assistance interactions.

Field notes were systematically recorded in structured observation logbooks (see Appendix D). Each entry documented, including 1) observed workflow sequences; 2) tools and classification schemes used; 3) verbal explanations provided by staff during operational activities; and 4) discrepancies between documented procedures and actual practice. To enhance interpretive validity, preliminary observations were clarified through brief follow-up discussions with institutional actors immediately after each session. This ensured that interpretations reflected institutional realities rather than solely researcher inference.

Analytically, participant observation served to identify operational patterns, structural bottlenecks, and semantic inconsistencies that informed both the diagnosis of

existing KO conditions (RO1) and the identification of critical factors influencing taxonomy development (RO2). Participant observation was guided by a semi-structured analytical protocol aligned with the study's research objectives. Rather than relying on unstructured observation, the researcher employed a set of guiding dimensions to ensure systematic, comparable data capture across institutional settings. The observation protocol centered on five analytical domains:

a) Accessioning and Registration Processes – How collections were received, documented, and integrated into institutional records.
b) Classification and Vocabulary Use – What schemes, controlled vocabularies, or ad hoc systems were employed.
c) Integration of Local Terminology – Whether and how local mining heritage terms were embedded within metadata structures.
d) Digital Infrastructure and Metadata Platforms – The extent of digitization, system functionality, and interoperability mechanisms.
e) Operational Constraints and Redundancies – Identification of workflow inefficiencies, manual dependencies, and institutional siloing.

Additional attention was given to decision-making processes during subject assignment, cross-referencing practices across collections, the treatment of intangible cultural heritage, and user navigation behaviors within digital systems. This structured observational focus ensured that thematic significance was determined based on conceptual relevance and explanatory power rather than frequency of occurrence. The protocol also strengthened methodological coherence by aligning observational evidence with the coding structure applied during thematic analysis.

In parallel with participant observation, a range of institutional documents was identified and analyzed to contextualize and triangulate findings. These documents were selected based on their relevance to KO practices and taxonomy-related workflows. The documents examined included:

a) Accession registers and inventory ledgers
b) Internal cataloguing manuals and classification guidelines
c) Archival finding aids and fonds descriptions
d) Metadata templates and data entry forms
e) Digitization workflow documentation
f) Institutional reports and strategic plans
g) Government regulations related to cultural heritage management

h) Exhibition catalogues
i) Draft terminology lists and local lexicon compilations

These documentary sources provided formal representations of institutional policies and practices, enabling comparison between prescribed standards and observed operational implementation. Document analysis was conducted using a structured analytical matrix to ensure consistency and rigor. Each document was examined according to four primary evaluative dimensions, including 1) the classification logic employed; 2) Metadata structure and field completeness; 3) Integration (or absence) of local terminology; and 4) Evidence of interoperability with national or international standards.

Documents were coded using the same thematic framework applied to interviews and observational data, namely, knowledge organization practices, knowledge organization systems (KOS), digital knowledge systems, standardization framework, cultural heritage representation, limitations, challenges, and opportunities.

This parallel coding approach ensured methodological triangulation and strengthened credibility by enabling cross-source validation. Where discrepancies were identified between documented procedures and actual practice, these were analytically interpreted as indicators of structural or systemic limitations within the existing KO environment. Through this systematic approach, document analysis functioned not merely as contextual background but also as empirical evidence informing the design requirements for the taxonomy within the Design Science Research (DSR) process model.

3.4.3 Focus Group Discussions

In Phases C (Design and Development) and E (Evaluation) of the DSR process, one focus group discussion (FGD) was conducted in each phase as a core participatory mechanism for an artifact known as contextualized taxonomy refinement and validation. These FGDs operationalized the call made in Chapter 1 for a systematic evaluation of taxonomy and directly addressed the literature gaps identified in Chapter 2, where participatory and iterative approaches to taxonomy development were found to be underutilized.

The first FGD was conducted during Phase C to support the design and stabilization of the contextualized taxonomy. The FGD was held on 30 April 2024 at

the Meeting Room of Museum Goedang Ransoem. A total of 8 stakeholder representatives, including curators, the registrar, the archivist, the librarian, and the CH expert, participated in collaborative sessions structured around a walkthrough of the taxonomy. Participants reviewed category labels, hierarchical depth, and semantic relationships to ensure the taxonomy reflected institutional workflows and local cultural narratives. Their feedback informed immediate refinement, embedding cultural authenticity and usability into the evolving design.

The second FGD was held on 28 May 2024 at the Meeting Hall Office of Culture of the Sawahlunto Municipality, involving A total of 15 stakeholder representatives, including the curators, registrar, archivist, librarian, and CH expert and CHI users, which was held in Phase E, and facilitated the evaluation of the taxonomy using five established usability indicators from Szopinski et al. (2019) and Szopinski et al. (2020), including comprehensiveness, robustness, understandability, extensibility, and wording. This evaluation was not limited to technical functionality but emphasized participatory validation, enabling stakeholders to collectively assess the taxonomy's effectiveness, identify ambiguities, and propose refinements. Structured protocols guided the discussions, which included guided scenario tasks, collaborative review exercises, and open dialogue.

Both FGDs were audio-recorded, transcribed verbatim, and analyzed thematically. The findings captured consensus points, critical observations, and actionable recommendations that informed the usability testing results presented in Chapter 5. Moreover, the iterative and participatory nature of the FGDs demonstrates the methodological rigor of this study, ensuring that the taxonomy is not only theoretically sound but also institutionally relevant and culturally embedded. This participatory validation process underpins the practical and methodological contributions highlighted in Chapter 6, offering a replicable model for future CHI-based taxonomy initiatives.

3.4.4 Usability Testing

To evaluate the functionality and user experience of the contextualized taxonomy, scenario-based usability testing was conducted as a core activity in Phase E (Evaluation) of the DSR methodology. This directly addressed the need for systematic taxonomy evaluation identified in Chapter 1 and filled the methodological gap

highlighted in Chapter 2, where few prior studies integrated participatory and scenario-driven evaluation methods in taxonomy research.

Usability testing is an evaluation method that involves real users to assess how effectively, efficiently, and satisfactorily a system, product, or artifact can be used in the context of its intended tasks. Rubin and Chisnell (2008) and Ruthven and Chowdhury (2015) define usability testing as the systematic observation of representative users as they interact with a product or system to complete predetermined tasks. The primary goal is not only to identify technical errors or obstacles but also to understand the user experience, including ease, clarity, and the cognitive and emotional perceptions that arise during the interaction.

Within a DSR framework, usability testing is a critical component of the demonstration and evaluation phase, in which developed artifacts are tested in real-world scenarios to validate their usability (Barnum, 2011; Lewis, 2012). This process provides empirical evidence regarding the extent to which artifacts meet user needs and support organizational goals. Thus, usability testing plays a dual role: first, as an evaluation mechanism to verify the artifact's effectiveness; second, as a reflective tool that generates input for iterative cycles of improvement and development.

In this study, usability testing was designed as a complementary extension to the second FGD, involving both CHI stakeholders and community users. Participants interacted with the digital repository prototype and performed structured tasks such as classifying artifacts, retrieving information, and proposing new categories. During these sessions, the researcher observed navigation pathways, documented hesitations or errors, and recorded verbalized cognitive reflections during task execution. This approach provided participatory evaluation of the taxonomy's performance across five usability indicators proposed by Szopinski et al. (2019) and Szopinski et al. (2020), while grounding the evaluation in real-world usage contexts derived from the institutional case analysis presented in Chapter 4. To ensure methodological rigor and comparability, the evaluation framework was structured around five usability indicators:

a) Comprehensiveness: Measured by the ability of participants to classify a wide range of objects, documents, and narratives without encountering conceptual gaps, thus reflecting the taxonomy's coverage of the OCMHS context.

b) Robustness: Assessed through navigation exercises, where participants evaluated the stability and logical consistency of hierarchical paths across multiple use cases.
c) Understandability: Validated through interpretive tasks, measuring the clarity of category labels and the intuitive placement of artifacts within the taxonomy.
d) Extensibility: Tested by scenarios requiring participants to propose and integrate new categories, such as emerging rituals or digital heritage, without disrupting existing structures.
e) Wording: Examined through participant reflections on the cultural authenticity, semantic clarity, and accessibility of labels, balancing local terminology with global intelligibility.

The collaborative classification of new objects during usability tasks served as a practical validation, providing empirical evidence of the taxonomy's completeness and adaptability. These results reinforced the usability testing findings, which analyzed strengths and refinements against each indicator in each phase, as shown in Table 3.4. Importantly, the participatory approach ensured that evaluation outcomes reflected not only technical performance but also cultural embeddedness and institutional relevance.

Table 3.4
Flow of Usability Testing for the OCMHS Taxonomy

Phase	Description	Activities / Methods	Expected Outcomes
Planning	Establishing the evaluation objectives and scope of the usability testing.	Defining five usability indicators (comprehensiveness, robustness, understandability, extensibility, wording); preparing the FGD protocol.	A structured evaluation framework aligned with the DSR approach.
Participant Selection	Recruiting representative participants from different OCMHS CHI stakeholders.	Purposive sampling for participants.	Inclusion of multiple perspectives from professionals and community stakeholders.
Scenario Task Design	Developing realistic tasks based on the actual practices of cultural heritage management.	Classifying items, navigating hierarchical pathways, interpreting labels, adding new categories, and comparing local or national and international terms from international KOS standards.	Authentic scenarios reflecting real-life CHI practices.
Data Collection	Gathering data through direct observation and reflective engagement with participants.	Verbal protocol analysis was conducted concurrently with task execution, systematic navigation observation, post-task reflective debriefing sessions, audio documentation, and verbatim transcription.	Rich qualitative data captures user interaction, difficulties, and perceptions.
Data Analysis	Conducting thematic analysis to identify	Coding with ATLAS.ti; clustering comments into themes such as	Evaluative findings that inform both

	recurring patterns in relation to each evaluation indicator.	clarity, semantic gap, cultural resonance, etc.	artefact improvement and theoretical insights.
Synthesis & Iteration	Integrating findings into artefact refinement and theoretical reflection.	Narrating findings per indicator, feeding results into DSR Phase E (Evaluation), and taxonomy refinements.	Feedback for improving the artifact and methodological contribution to future CH studies.

By embedding usability testing within the DSR cycle, this study demonstrates how evaluation can move beyond abstract metrics toward participatory, scenario-driven validation. This methodological innovation enhances the research's originality by establishing a replicable framework for evaluating taxonomies in hybrid CHI environments. Ultimately, the process ensured that the developed taxonomy is theoretically sound, practically usable, and strategically sustainable for OCMHS and the CH domain.

3.5 Data Analysis Procedures

The data analysis procedures were structured to ensure systematic progression from empirical diagnosis to artifact development and evaluation within the Design Science Research (DSR) framework. The analysis followed sequential yet iterative stages, allowing findings from earlier phases to inform subsequent design and evaluation activities, as shown in Table 3.5. This structured approach strengthened methodological transparency while maintaining alignment with the objectives of contextualized taxonomy development.

Table 3.5
Data Analysis Flow

Analytical Stage	Data Sources	Analytical Method	Output	DSR Phase
Stage 1: Coding	Interviews, observations, documents	Thematic analysis + Gioia method	First-order concepts, themes	Phase A–B
Stage 2: Within-Case	CHI-specific data	Pattern analysis	Institutional profiles	Phase A–B
Stage 3: Cross-Case	All cases	Replication logic	Structural tensions	Phase B
Stage 4: Design Translation	Synthesized categories	Inductive–deductive synthesis	Taxonomy structure	Phase C
Stage 5: Evaluation	Usability tasks, FGDs	Task metrics + thematic coding	Refinement insights	Phase D–E

The first stage involved qualitative coding of data collected through semi-structured interviews, observations, and document analysis. A hybrid analytical strategy

was employed, combining thematic analysis (Braun & Clarke, 2006) and the Gioia methodology (Gioia et al., 2013). Thematic analysis enabled systematic identification of recurring patterns across institutional contexts. The Gioia methodology was applied to preserve participants' original expressions while facilitating conceptual abstraction. The coding process progressed through three levels. Open coding captured first-order concepts grounded in participants' language. Axial coding grouped related concepts into second-order themes. Selective coding then synthesized these themes into aggregate dimensions that informed higher-level interpretation. This stage primarily supported Phase A (Problem Identification) and Phase B (Define Objectives of a Solution) of the DSR process.

The second stage involved within-case analysis. Each Cultural Heritage Institution (CHI) was examined independently to understand its specific knowledge organization (KO) workflows, classification systems, metadata practices, and levels of digital readiness. This analysis produced institution-specific diagnostic insights and clarified how fragmentation manifested in different organizational contexts. By maintaining analytical separation at this stage, the study ensured that institutional nuances were preserved before cross-case comparison.

The third stage consisted of cross-case synthesis. Guided by replication logic (Yin, 2018), the analysis examined patterns across institutions. Literal replication was identified when similar challenges recurred across multiple CHIs. Theoretical replication emerged when contrasting practices were observed between institutional types, such as between libraries and archives. This comparative analysis revealed structural tensions, including differences between international standards and locally embedded terminologies, as well as variations in analog and digital documentation systems. These findings directly informed the articulation of taxonomy design objectives.

The fourth stage involved design translation. Analytical categories derived from empirical findings were transformed into artifact features. This stage combined inductive enrichment from locally specific terminology with deductive alignment to established international Knowledge Organization System (KOS) standards, including ISO 25964, ANSI/NISO Z39.19, LCSH, AAT, CIDOC-CRM, and the UNESCO Thesaurus. Through this integration, the contextualized taxonomy was constructed to achieve both semantic interoperability and cultural relevance. This stage corresponds to Phase C (Design and Development) within the DSR framework.

The fifth stage focused on evaluating the developed taxonomy. Scenario-based usability testing was conducted to assess task clarity, efficiency, and structural coherence. Participants performed classification and retrieval tasks designed to simulate real institutional use. Quantitative indicators such as task success rate, time to completion, and error occurrence were recorded. In addition, focus group discussions were conducted to gather qualitative feedback regarding usability, interpretability, and contextual fit. The qualitative feedback was thematically coded to identify areas for refinement. This evaluative stage covered Phases D (Demonstration) and E (Evaluation) of the DSR cycle.

Throughout the analytical process, alignment with the DSR phases was maintained explicitly. Diagnostic coding and case analyses supported Phases A and B. Design translation corresponded to Phase C. Usability testing and stakeholder validation addressed Phases D and E. The synthesis of findings across stages informed Phase F (Communication) through structured documentation in this thesis. The iterative movement between empirical findings and artifact refinement ensured that the resulting taxonomy was analytically grounded, empirically validated, and contextually responsive to the needs of CHIs within OCMHS.

Collectively, these analytical procedures demonstrate a coherent integration of qualitative inquiry and artifact evaluation. By structuring the analysis into clearly defined yet interconnected stages, the study maintains methodological rigor while making a design-oriented contribution to knowledge organization in cultural heritage contexts.

3.6 Validity and Reliability

Ensuring the validity and reliability of research findings is fundamental in qualitative inquiry, particularly within a Design Science Research (DSR) framework that emphasizes iterative artifact development, stakeholder participation, and contextual relevance. In this study, the trustworthiness of the findings was established by systematically embedding strategies for credibility, transferability, dependability, and confirmability throughout all phases of the DSR process, in line with the criteria proposed by Lincoln and Guba (1985).

Rather than treating validity and reliability as isolated methodological checks, this study operationalizes them as process-oriented mechanisms integrated into data

collection, analysis, artifact design, and evaluation. This approach aligns with the epistemological foundations of interpretive Knowledge Organization (KO) research and the iterative logic of DSR (Gregor & Hevner, 2013).

3.6.1 Validity

In this study, validity refers to the extent to which the research accurately captures and represents the socio-technical realities of knowledge organization practices and taxonomy requirements within Cultural Heritage Institutions (CHIs) in the Ombilin Coal Mining Heritage of Sawahlunto (OCMHS). To ensure validity, several complementary strategies were employed:

a) Methodological and Source Triangulation: was applied by combining multiple qualitative data collection methods, including semi-structured interviews, participant observation, document analysis, and focus group discussions (FGDs). These methods were analyzed using thematic analysis, iterative coding procedures, and scenario-based usability evaluation. The integration of diverse data sources and analytical perspectives reduced single-method bias and enabled cross-verification of findings across institutional roles and user groups (Yin, 2018).

b) Member checking: was conducted during the early phases of the DSR process (Phase A: Problem Identification and Phase B: Define Objectives). Preliminary interpretations, thematic patterns, and representations of institutional practices were validated with key informants, including curators, registrars, archivists, librarians, and cultural heritage experts. This process ensured that the findings accurately reflected local terminologies, institutional workflows, and cultural meanings, thereby strengthening ecological and contextual validity.

c) Artificial and naturalistic evaluation strategies were employed following the framework proposed by Venable et al. (2016). Artificial evaluation was conducted through iterative taxonomy prototyping and scenario-based testing in controlled settings. In contrast, naturalistic evaluation took place during FGDs and usability testing involving CHI practitioners and community users. This dual evaluation approach ensured that the developed taxonomy was both conceptually sound and practically applicable within real-world CHI environments.

d) Expert validation and participatory engagement were systematically integrated throughout the design and evaluation phases. Feedback from subject matter experts and institutional stakeholders was incorporated into successive taxonomy refinements, enhancing semantic accuracy, institutional relevance, and practical usability. This participatory validation strengthened the cultural fidelity of the taxonomy and increased its potential for long-term adoption across CHIs.

3.6.2 Reliability

Reliability in qualitative research is understood as the consistency, transparency, and dependability of analytical procedures rather than statistical replicability. In this study, reliability was ensured through systematic documentation, auditability of analytical decisions, and iterative verification across DSR phases.

An explicit audit trail was maintained using ATLAS.ti version 25, which documented coding schemes, analytical memos, category development, and iterative refinements. This enabled traceability of analytical decisions and ensured consistency in interpretation throughout the research lifecycle. The use of computer-assisted qualitative data analysis software also enhanced procedural transparency and methodological rigor.

Referential adequacy was applied by setting aside a subset of raw data during the initial coding stages and revisiting it later in the analysis. This strategy allowed the researcher to assess coding stability and thematic comprehensiveness over time, thereby strengthening confirmability and reducing the influence of researcher bias (Lincoln & Guba, 1985).

In addition, formative and summative evaluation strategies were systematically integrated into the DSR process. Formative evaluation occurred through iterative feedback cycles during FGDs and usability testing, informing continuous refinement of the taxonomy. Summative evaluation was conducted during the final validation stage, focusing on usability, task relevance, clarity, navigability, and perceived usefulness of the taxonomy in real CHI contexts. These evaluation activities ensured that reliability extended beyond data analysis to include artifact performance and implementation consistency.

Trustworthiness in this study was further strengthened through thick description of institutional contexts, KO practices, and user interactions across multiple CHIs within Sawahlunto Municipality. Although the study is context-specific, the detailed documentation of methodological procedures, design principles, and evaluation strategies supports analytical transferability to other industrial heritage settings facing similar fragmentation and interoperability challenges.

Aligning validity and reliability strategies with DSR evaluation criteria ensures that the developed taxonomy is not only empirically grounded but also methodologically robust and contextually sensitive. Table 3.5 summarizes the validity and reliability strategies employed in this study, mapping each strategy to relevant DSR evaluation criteria and corresponding thesis chapters. This table demonstrates how trustworthiness was systematically embedded throughout the research process, from problem identification and case analysis to artifact design, evaluation, and final validation.

Table 3.6
Reliability Strategies Aligned with DSR Evaluation Criteria and Thesis Chapters

Evaluation Dimension	Strategy Used In This Study	DSR Evaluation Criteria	Relevant Thesis Chapters	References
Internal Validity	Triangulation across interviews, observations, documents, FGDs; thematic coding and usability testing	Credibility of findings; logical coherence	Ch. 1 (Problem Statement); Ch. 4 (Case Analysis)	Gregor & Hevner (2013); Yin (2018)
Contextual Validity	Thick description of CHIs; stakeholder engagement in taxonomy design and validation	Ecological validity; contextual fit	Ch. 2 (Gap: need for contextualization); Ch. 5 (Evaluation Findings)	Patton (2015); Gregor & Hevner (2013)
Construct Validity	Member checking during early and late DSR phases	Stakeholder-informed representation of concepts	Ch. 4 (Design Phases A & B of DSR); Ch. 5 (Validation)	Yin (2018); Lincoln & Guba (1985)
Reliability	ATLAS.ti audit trail	Consistency in coding and interpretation	Ch. 3 (Data Analysis Procedures)	McHugh (2012); Gregor & Hevner (2013)
Confirmability	Referential adequacy through re-coding reserved raw data	External benchmarking for analytical rigor	Ch. 3 (Methodology); Ch. 4 (Empirical Data Validation)	Lincoln & Guba (1985)
Formative Evaluation	Iterative artifact refinement via FGDs and usability testing	Ex-ante utility evaluation; refinement cycles	Ch. 5 (Design Refinements)	Venable et al. (2016)

Summative Evaluation	Final validation through participatory testing	Ex-post evaluation of artifact utility and usability	Ch. 5 (Usability Testing Findings); Ch. 6 (Discussion & Conclusion)	Venable et al. (2016)
Transparency and Replicability	Documentation of coding, design decisions, and taxonomy versions	Traceability and repeatability of design logic	Ch. 3 (Audit Trail); Ch. 6 (Study Contribution)	Gregor & Hevner (2013)
Transferability	Multi-case grounding across CHIs	Generalizability across CHIs	Ch. 4 (Cross-CHI Analysis); Ch. 6 (Implications)	Gregor & Hevner (2013)

3.7 Ethical Considerations

This study was conducted in strict adherence to internationally recognized ethical research standards, including the principles of autonomy, beneficence, non-maleficence, and justice (Kushwaha et al., 2024), and aligned with the guidelines provided by the Research Ethics Committee (REC) at Universiti Teknologi MARA (UiTM), Malaysia. Ethical integrity was upheld across all stages of the research process, ensuring the protection of participants' rights, dignity, and well-being while safeguarding the scholarly rigor, transparency, and trustworthiness of the study.

Given the nature of this research, which required direct engagement with human participants as outlined in Table 3.3, ethical considerations were treated not as procedural requirements but as a critical foundation of the research design. They were embedded throughout the DSR phases, from problem identification to artifact evaluation and communication of findings.

3.7.1 Informed Consent and Voluntary Participation

All participants were provided with detailed information sheets outlining the purpose, scope, and implications of the research. This included clear descriptions of their roles in semi-structured interviews, observations, FGDs, and usability testing. Written informed consent was obtained before participation, ensuring that individuals were fully aware of their right to withdraw at any stage without penalty. Voluntariness was emphasized throughout, thereby upholding the principle of autonomy.

3.7.2 Confidentiality and Data Protection

Participant anonymity was maintained by assigning codes (e.g., LIB 1, DIR 1, CUR 2, ARC 1, USR 3) as shown in Table 3.3 rather than using personal identifiers in transcripts and reports. All digital recordings, transcripts, and field notes were securely stored in password-protected folders accessible only to the researcher and supervisory team. In compliance with the Research Ethics Committee (REC) UiTM guidelines and international data protection standards, sensitive institutional and personal data were safeguarded against unauthorized access, modification, or disclosure.

3.7.3 Minimizing Harm and Ensuring Beneficence

The study was carefully designed to minimize risks to participants, particularly considering that some informants were institutional staff or community representatives whose professional or personal perspectives could be sensitive. Discussion protocols avoided intrusive or coercive questions, and participants were encouraged to share only information they were comfortable disclosing. The research ensured beneficence by directly improving KO practices in CHIs, thereby creating long-term institutional and community benefits.

3.7.4 Respect for Cultural Sensitivity and Local Narratives

As the study is situated in the context of the OCMHS with strong cultural and community significance, special consideration was given to cultural sensitivity. Local terminologies, indigenous knowledge, and community narratives were treated respectfully, with validation from CHI practitioners to avoid misrepresentation. This approach ensured that the taxonomy development process remained culturally embedded, aligned with the design principles identified in Chapter 5, and reinforced the study's commitment to inclusivity and authenticity.

3.7.5 Ethical Approval and Compliance

Formal ethical approval was obtained from the REC UiTM before commencing fieldwork. The approval covered all data collection methods, including interviews,

observations, FGDs, and usability testing. Ethical compliance was maintained through regular reporting to supervisors and adherence to institutional guidelines for research conduct.

3.7.6 Ethical Dissemination of Findings

The principle of ethical responsibility extended to the dissemination phase. Research findings were communicated to academic audiences through thesis chapters and publications and shared with participating CHIs in accessible formats. This ensured that stakeholders benefited from the research outcomes and that the developed contextualized taxonomy could be applied sustainably within their institutional settings.

3.8 Chapter Summary

This chapter has outlined the methodological foundation of the study, which employed a qualitative, embedded multiple case study strategy within a DSR paradigm to design, develop, and evaluate a contextualized taxonomy for the OCMHS. The research was systematically structured across six iterative DSR phases, following the model of Peffers et al. (2007), and operationalized through a sequence of exploration, design, demonstration, evaluation, and communication activities.

Multiple data collection methods were used to ensure depth, credibility, and contextual richness. These included semi-structured interviews, participant observation, document analysis, FGDs, and scenario-based usability testing. Each method was purposefully aligned with specific DSR phases: interviews, observation, and document analysis informed the problem identification and objective-setting phases (A and B); FGDs supported the design and demonstration phases (C and D); while usability testing complemented the evaluation phase (E). Data were analyzed using thematic coding and constant comparison techniques, facilitated by ATLAS.ti version 25, producing eight thematic code groups that directly informed the taxonomy's dimensions, characteristics, and hierarchical logic.

Validity and reliability were rigorously addressed through multiple strategies, including method and source triangulation, member checking, audit trails, and referential adequacy. In addition, participatory validation and iterative refinements ensured alignment between the artifact and stakeholder needs, reinforcing both internal

coherence and ecological validity. The evaluation framework applied five indicators to assess the artifact's functionality, usability, and sustainability within CHI workflows. Ethical integrity was strictly maintained in line with REC UiTM guidelines, ensuring informed consent, voluntary participation, anonymity, cultural sensitivity, and responsible stewardship of sensitive heritage data. These ethical considerations were embedded not only as compliance measures but also as enablers of institutional trust, stakeholder buy-in, and cultural authenticity.

Overall, this chapter has provided a comprehensive justification for the selected methodological pathway, demonstrating how each component contributes to the rigor, trustworthiness, and contextual relevance of the study's outcomes. By integrating user-informed design with domain-specific knowledge and international KOS standards, the study ensures that the developed contextualized taxonomy is both theoretically grounded and pragmatically sustainable. This methodological foundation directly supports the analytical insights in Chapter 4, the artifact development in Chapter 5, and the broader theoretical and practical implications to be synthesized in Chapter 6.

CHAPTER 4
FINDINGS

4.1 Chapter Overview

This chapter presents a within-case analysis of cultural heritage institutions (CHIs) situated in Sawahlunto Municipality, designated as Area A of the Ombilin Coal Mining Heritage of Sawahlunto (OCMHS). Each institution is examined as an independent unit of analysis to capture the institutional, operational, and contextual dynamics shaping knowledge organization (KO) practices. Adopting Eisenhardt's (1989) recommendation, the within-case approach employed here avoids prescriptive rigidity; instead, it emphasizes systematic assembly, interpretation, and sense-making of context-rich qualitative evidence derived from semi-structured interviews, participant observation, and document analysis.

The purpose of this chapter is twofold. First, it consolidates empirical findings relevant to research objective 1 (RO1), which explores the current state of KO processes within Sawahlunto Municipality CHIs, and addresses research objective 2 (RO2), which identifies the critical institutional, cultural, and technical factors influencing the development of a contextualized taxonomy. These objectives are embedded in the design science research (DSR) process model (Peffers et al., 2007), specifically in Phases A (problem identification and motivation) and B (defining the solution objectives). By doing so, the findings presented in this chapter not only diagnose the KO challenges and KO opportunities in Area A of OCMHS (Sawahlunto Municipality) but also establish the foundational requirements for subsequent taxonomy design.

Consistent with Yin (2018), who underscores the importance of preserving explanatory power in multiple-case research, each case is presented independently before moving towards synthesis. This allows for the retention of institutional distinctiveness while also enabling cross-case comparisons to identify convergent patterns. The findings are thematically presented to address the two ROs and are organized around, including 1) the urgency of contextualized taxonomy development; 2) the identification of taxonomy subjects and objects; and 3) the establishment of convergence dimensions across CHIs.

By providing a descriptive and diagnostic baseline, this chapter serves as a bridge between the problem framing in Chapter 1, the literature synthesis and research gap in Chapter 2, and the methodological implementation in Chapter 3. Moreover, the empirical patterns identified here directly inform the design principles and prototype development in Chapter 5 and serve as benchmarks against which the usability testing and evaluation results in Chapter 6 are assessed. In this sense, Chapter 4 plays a pivotal role in linking theoretical insight, methodological strategy, and practical design, ensuring that the development of a contextualized taxonomy for OCMHS is both empirically grounded and strategically justified.

This chapter presents the empirical findings from the embedded multiple-case study strategy. Within the Design Science Research (DSR) framework, the analysis conducted in this chapter corresponds to Phase A (Problem Identification) and Phase B (Define Objectives of a Solution). The case study is therefore not presented as a standalone descriptive inquiry. Rather, it functions as a diagnostic and generative mechanism that identifies structural fragmentation, articulates critical factors, and extracts design requirements for the contextualized taxonomy developed in Chapter 5. By grounding artifact development in empirically validated institutional realities, this chapter ensures methodological coherence between the case study strategy and the DSR process model.

4.2 Overview of the Case Contexts and Thematic Analysis Process

To explore the existing conditions of knowledge organization (KO) processes and identify the critical factors influencing taxonomy development across CHIs at the OCMHS, this study employed inductive thematic analysis as its primary analytical strategy. While Chapter 3 detailed the methodological procedures, this section focuses on how empirical data were interpreted to generate diagnostic insights. The analysis transformed raw qualitative material into conceptual patterns that reveal structural conditions shaping KO practices in Sawahlunto Municipality.

Thematic analysis was conducted following the six-step protocol of Braun and Clarke (2006), refined through grounded theory principles (Strauss & Corbin, 1998), and contextualized within KO and cultural heritage (CH) studies. However, beyond procedural rigor, the purpose of the analysis was diagnostic. Analytically, this indicates

that the chapter is primarily a findings chapter; it reports and interprets empirical patterns rather than re-elaborating on methodological techniques.

The analytical progression involved familiarizing oneself with the data, identifying keywords, generating code, categorizing themes, interpreting relationships, and constructing a preliminary conceptual model (Naeem et al., 2023). While these stages ensured systematic coding, the interpretive emphasis lies in how the patterned meanings across institutions revealed structural limitations, epistemic tensions, and opportunities for reform.

Through iterative coding and cross-case comparison, eight thematic domains were identified, including 1) Knowledge Organization Practices; 2) Knowledge Organization Systems (KOS); 3) Digital Knowledge Systems; 4) Standardization Framework; 5) Cultural Heritage Representation; 6) Knowledge Organization Limitations; 7) Knowledge Organization Challenges; and 8) Knowledge Organization Opportunities.

To clarify their analytical scope, the first four domains primarily capture structural and operational conditions (procedural activities, formal classification systems, technological infrastructure, and governing standards). The fifth domain addresses representational logic and cultural embedding. The final three domains synthesize systemic drivers of change, distinguishing between structural constraints (limitations), adaptive pressures (challenges), and reform potentials (opportunities). This conceptual differentiation provides the analytical architecture guiding the subsequent findings.

Table 4.1 illustrates the transformation from verbatim quotations to conceptual constructs. The table is not presented merely as methodological documentation; analytically, it demonstrates how localized discourses and institutional narratives were abstracted into structured diagnostic categories.

Table 4.1
Inductive Thematic Analysis Process

Informant Quotation (Examples)	Keywords	Codes	Themes	Conceptualization
"We begin by reviewing the content of each library material, whether a book, report, or magazine." (LIB 1)	Processing collections	Collection stewardship	Knowledge organization (KO) practices	Knowledge organization (KO) processes
"Every artifact is recorded manually, from origin to	Entry registration	Standard documentation	Standardization framework	

cultural value, before classification." (CUR 2)				
"For classification, we follow DDC and national standards, but local mining heritage often does not fit neatly." (LIB 2)	Standardized classification	Classification framework	Knowledge organization system (KOS)	
"We have started digitizing the most frequently requested collections, but coverage remains limited." (DIR 2)	Digitization planning	Digital platform initiation	Digital knowledge systems	
"Local mining terms are not just words; they carry deep cultural and historical meanings." (USR 1)	Localized subject terms	Cultural terminology	Cultural heritage (CH) representation	
"Currently, each institution manages collections differently, and there is no shared platform." (CHE 1)	Siloed resources	Fragmented documentation	Knowledge organization (KO) limitations	Critical factors influencing taxonomy development
"Community members should be involved to ensure the taxonomy reflects living culture." (CUR 2)	Community contribution	Taxonomy co-creation	Knowledge organization (KO) challenges	
"If we could collaborate across sectors, information access would be more inclusive and connected to local culture." (DIR 2)	Cross-sector integration	Integrated access	Knowledge organization (KO) opportunities	

The inductive thematic analysis summarized in Table 4.1 demonstrates how raw empirical data were systematically transformed into conceptual insights that directly address the study's research objectives (RO1 and RO2). Specifically, RO1 explores the existing conditions of KO processes, which are evidenced through patterns such as stewardship, accessioning, metadata description, and reliance on universal standards. Meanwhile, RO2 identifies the critical factors influencing taxonomy development, which are reflected in themes that highlight institutional fragmentation, limited digitization, semantic misalignments, and the need for contextual adaptation and co-creation.

The thematic consolidation revealed recurring institutional patterns across CHIs. Analytically, this indicates that fragmentation is not accidental but structurally embedded within disciplinary traditions. For instance, quotations concerning manual registration and siloed systems were coded under "KO limitations," revealing systemic fragmentation rather than isolated operational inefficiencies. Similarly, statements concerning reliance on DDC, ISAD(G), or curatorial narratives were coded under KOS and Standardization Framework domains. Analytically, this pattern reveals an epistemic

tension between universal classification standards and localized cultural semantics. The issue is therefore not a rejection of standards, but their limited adaptability within the OCMHS context.

The prominence of digitization planning codes and the gaps in digital infrastructure further indicate a structural disjuncture between analog practices and readiness for digital transformation. This pattern reveals technological fragility rather than mere resource scarcity. It suggests institutional vulnerability in achieving long-term interoperability and sustainability. Meanwhile, recurring references to community terminology and participatory involvement were consolidated under Cultural Heritage Representation and KO Opportunities. Analytically, this reveals a latent capacity for reform embedded in stakeholder awareness. The institutions recognize the necessity of contextual adaptation, even if structural mechanisms are not yet fully developed.

As qualitative analysis involves interpretive judgment, it is important to acknowledge the researcher's positionality. The researcher's academic background in knowledge organization and cultural heritage studies informed the sensitivity to classification logic, semantic structures, and institutional convergence patterns. This disciplinary familiarity facilitated deeper interpretive insight into the epistemic dimensions of KO practices. To mitigate potential bias, several measures were implemented. First, triangulation was conducted across interviews, document analysis, and observational data. Second, iterative coding cycles were performed, comparing interpretations across institutions to avoid premature abstraction. Third, cross-case synthesis ensured that emerging interpretations were not confined to a single institutional perspective. These procedures enhance credibility, transparency, and trustworthiness without altering the empirical data.

The observations documented in Appendix D were validated through multi-actor triangulation involving institutional leaders, curators, registrars, librarians, archivists, members of the Cultural Heritage Expert Team, and user representatives. Field findings were confirmed through iterative interviews, participatory focus group discussions (FGD 1 and FGD 2), and cross-verification with institutional documents such as inventory books, archival forms, and internal classification drafts. This layered validation process ensured that observational insights were not solely researcher-generated interpretations but collectively examined and confirmed by key stakeholders within the OCMHS knowledge ecosystem.

The integrated interpretation of Table 4.1 and subsequent thematic distributions reveals three pivotal systemic tensions, including 1) the gap between universal KO standards and localized cultural semantics; 2) the disjuncture between analog practices and digital transformation readiness; and 3) the fragmentation across institutional silos versus the potential for cross-sector convergence. Analytically, these tensions indicate structural misalignment rather than isolated inefficiencies. They reveal that KO challenges in OCMHS are multi-layered, encompassing epistemic, technological, and governance dimensions.

This synthesis provides the empirical bridge to Chapter 5. The themes do not merely justify taxonomy development; they inform its design parameters. The identification of fragmentation suggests the need for linking mechanisms and cross-referencing layers. Digital fragility signals the necessity for modularity and scalability. Representational gaps indicate the need to include new facets and vocabularies that reflect intangible heritage and local terminology. Thus, Section 4.2 establishes the diagnostic foundation for artifact construction within the DSR cycle, transitioning from empirical interpretation to structured design intervention.

Although frequency distributions and Sankey diagrams are presented throughout sections 4.3 to 4.6 to illustrate the relative prominence of codes across informants and institutional roles, thematic significance in this study was determined based on conceptual relevance, explanatory depth, and analytical coherence rather than numerical occurrence alone. In other words, coding intensity serves as supportive evidence for pattern recognition, while interpretive meaning and structural implications guide the identification of key findings. This distinction is essential in qualitative inquiry, where importance is established through interpretive insight rather than statistical magnitude.

4.3 Case Study Analysis in The Sawahlunto Municipality Library

The Sawahlunto Municipality Library occupies a pivotal position within the OCMHS knowledge ecosystem, functioning as both a public information centre and a custodian of the community's cultural memory. Its significance lies not only in storing and disseminating information but also in mediating the narratives of industrial heritage and collective identity that shape the living memory of Sawahlunto. Evidence from interviews, observations, and document analysis reveals a dual orientation: while the

Sawahlunto Municipality Library demonstrates strong human-facing knowledge practices, it remains constrained in the technical, infrastructural, and semantic dimensions of knowledge organization. This combination of strengths and weaknesses provides crucial insights into the existing conditions of the KO process (RO1) and critical influencing factors (RO2) that justify the development of a contextualized taxonomy.

The Library's KO profile is characterized by strengths in mediation and narrative representation, yet constrained by limited semantic structures, weak digitization pipelines, and insufficient standardization frameworks. These conditions collectively illustrate the heterogeneous and fragmented state of KO within OCMHS CHIs, thereby underlining the necessity of a contextualized taxonomy.

4.3.1 Existing Condition of Knowledge Organization Processes at the Sawahlunto Municipality Library

4.3.1.1 Knowledge Organization Practices

Knowledge organization (KO) practices constitute a fundamental theme for understanding how the Sawahlunto Municipality Library, as a CHI, executes its role in managing, preserving, and disseminating OCMHS-related knowledge. Five key practices were identified, namely *accessioning process, collection stewardship, knowledge mediation,* metadata description, and subject analysis. Data were derived from semi-structured interviews with six institutional actors, direct observations, and analysis of operational documents, as shown in Table 4.2 and Figure 4.1.

Table 4.2
Knowledge Organization Practices in the Sawahlunto Municipality Library

Knowledge Organization Practices	By Informants						By Institutions
	Heritage Expert 1	Heritage Expert 2	Director	Librarian 1	Librarian 2	Library User	Totals in Library
Accessioning Process	1	0	1	1	1	0	4
Collection Stewardship	1	1	5	2	1	1	11
Knowledge Mediation	2	6	1	4	2	1	16
Metadata Description	0	0	3	1	1	0	5
Subject Analysis	0	1	0	1	1	0	3

Totals	4	8	10	9	6	2	39

Source: Researcher finding (2025)

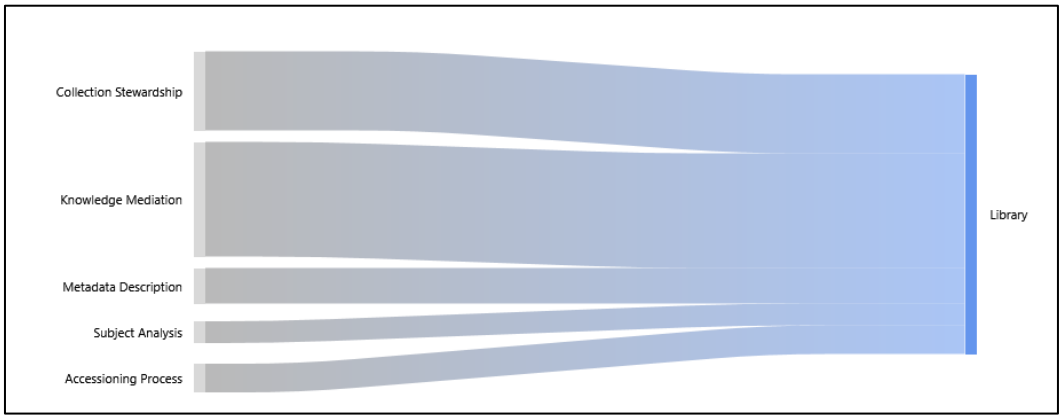


Figure 4.1 Sankey Diagram of Knowledge Organization Practices in the Sawahlunto Municipality

The Sawahlunto Municipality Library's KO practices are dominated by knowledge mediation and collection stewardship, which underscore its active role in guiding users and safeguarding heritage collections. These functions sustain community engagement and reinforce cultural identity. However, technical activities such as metadata description, subject analysis, and accessioning remain underdeveloped, revealing a structural imbalance between narrative-oriented practices and standardized description. This imbalance directly limits interoperability and retrieval accuracy across CHIs.

4.3.1.2 Knowledge Organization Systems

Knowledge organization systems (KOSs) encompass the formal structures, schemes, and frameworks used by CHIs to classify, organize, and provide access to information. Within the Sawahlunto Municipality Library, *KOSs* serve as the foundational mechanisms for managing OCMHS-related collections and ensuring access to knowledge. The analysis identifies four core components of *KOSs*, namely *classification scheme, schema alignment, controlled vocabulary,* and *vocabulary hierarchy*, as shown in Table 4.3 and Figure 4.2.

Table 4.3
Knowledge Organization Systems in the Sawahlunto Municipality Library

Knowledge Organization Systems	By Informants						By Institutions
	Heritage Expert 1	Heritage Expert 2	Director	Librarian 1	Librarian 2	Library User	Totals in Library
Classification Scheme	2	1	7	7	5	1	23
Controlled Vocabulary	0	0	0	1	1	0	2
Schema Alignment	1	1	0	3	2	0	7
Vocabulary Hierarchy	0	1	0	1	0	0	2
Totals	3	3	7	12	8	1	34

Source: Researcher finding (2025)

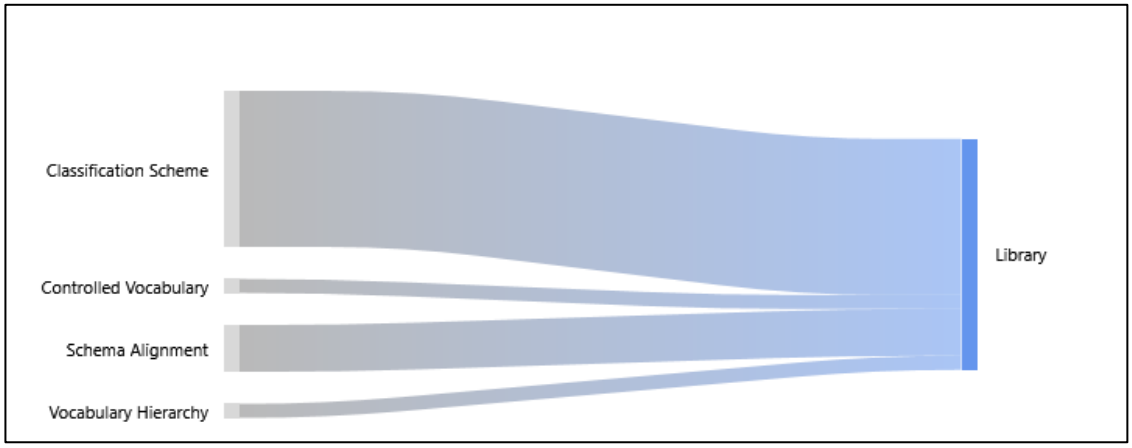


Figure 4.2 Sankey Diagram of Knowledge Organization Systems in the Sawahlunto Municipality Library

The Sawahlunto Municipality Library depends primarily on DDC classification, which provides order but lacks sensitivity to local cultural realities. Efforts at schema alignment exist but remain fragmented, while controlled vocabularies and hierarchical structures are almost absent. This over-reliance on universal schemes without local enrichment results in semantic thinness, constraining the library's ability to represent culturally specific terms and intangible expressions central to OCMHS.

4.3.1.3 Digital Knowledge Systems

Digital knowledge systems in the Sawahlunto Municipality Library form the technological and infrastructural backbone supporting collection management and user access in the digital era. These systems, encompassing *digital platforms*, *digitization preparedness*, *metadata platforms*, and *system accessibility*, as shown in Table 4.4 and

Figure 4.3, are critical for transforming conventional *KO practices* into integrated, interoperable, and sustainable digital environments.

Table 4.4
Digital Knowledge Systems in the Sawahlunto Municipality Library

Digital Knowledge Systems	By Informants						By Institutions
	Heritage Expert 1	Heritage Expert 2	Library Director	Librarian 1	Librarian 2	Library User	Totals in Library
Digital Platform	1	0	4	3	4	4	16
Digitization Preparedness	0	0	1	3	1	0	5
Metadata Platform	0	0	1	1	1	0	3
System Accessibility	0	0	2	1	2	0	5
Totals	1	0	8	8	8	4	29

Source: Researcher finding (2025)

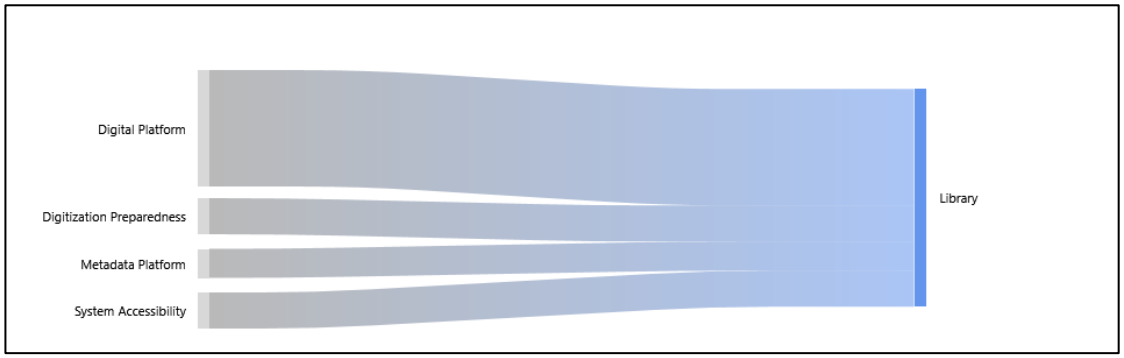


Figure 4.3 Sankey Diagram of Digital Knowledge Systems in the Sawahlunto Municipality Library

The Sawahlunto Municipality Library demonstrates encouraging uptake of digital platforms, such as InLIS Lite Version 3 provided by the National Library of the Republic of Indonesia, which librarians and library users widely use. However, preparedness for digitization, metadata platforms, and accessibility strategies remains minimal. The digital transformation is therefore platform-centric rather than holistic, leaving significant gaps in sustainability, inclusivity, and semantic integration.

4.3.1.4 Standardization Framework

The *standardization framework* at the Sawahlunto Municipality Library reflects the extent to which its KO practices align with formal principles of classification, documentation, and retrieval. Standardization is a crucial dimension because it

underpins not only operational consistency within the library but also interoperability across CHIs under the OCMHS. Based on the thematic analysis, five codes were identified, such as *retrieval structure*, *metadata standard, vocabulary compliance, scheme integration*, and *standard documentation*, as shown in Table 4.5 and Figure 4.4.

Table 4.5
Standardization Framework in the Sawahlunto Municipality Library

Standardization Framework	**By Informants**						**By Institutions**
	Heritage Expert 1	**Heritage Expert 2**	**Library Director**	**Librarian 1**	**Librarian 2**	**Library User**	**Totals in Library**
Retrieval Structure	0	0	0	4	5	12	21
Scheme Integration	0	1	1	1	1	0	4
Standard Documentation	0	1	1	1	0	0	4
Vocabulary Compliance	0	1	1	1	2	2	7
Metadata Standard	0	0	2	3	3	0	8
Totals	1	3	5	10	8	14	44

Source: Researcher finding (2025)

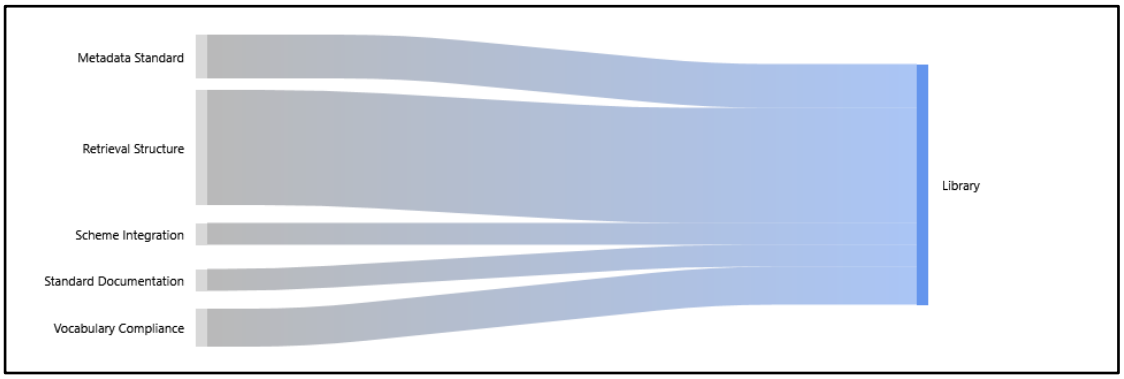


Figure 4.4 Sankey Diagram of Standardization Framework in the Sawahlunto Municipality Library

Operational access mechanisms, such as retrieval structures and basic metadata standards, are relatively established. However, vocabulary compliance, scheme integration across CHIs, and standard documentation are weak. This imbalance highlights the Sawahlunto Municipality Library's emphasis on short-term user-facing access while neglecting the systemic standardization necessary for long-term interoperability.

4.3.1.5 Cultural Heritage Representation

Cultural heritage (CH) representation in the Sawahlunto Municipality Library reflects how the institution organizes, interprets, and communicates the unique socio-historical and cultural narratives of the OCMHS. Unlike purely technical KO practices, *CH representation* emphasizes contextualization, cultural embeddedness, and interpretative depth, ensuring that collections are not only accessible but also meaningful to diverse stakeholders. Based on thematic analysis, four codes were identified, including *intangible cultural heritage, local terminology, narrative description,* and *sociohistorical reference*, as shown in Table 4.6 and Figure 4.5.

Table 4.6
Cultural Heritage Representation in the Sawahlunto Municipality Library

Cultural Heritage Representation	By Informants						By Institutions
	Heritage Expert 1	Heritage Expert 2	Library Director	Librarian 1	Librarian 2	Library User	Totals in Library
Intangible Cultural Heritage	1	1	1	2	2	2	9
Local Terminology	0	0	1	3	4	3	11
Narrative Description	2	1	1	2	4	2	12
Sociohistorical Reference	1	1	1	2	2	6	13
Totals	4	3	4	9	12	13	45

Source: Researcher finding (2025)

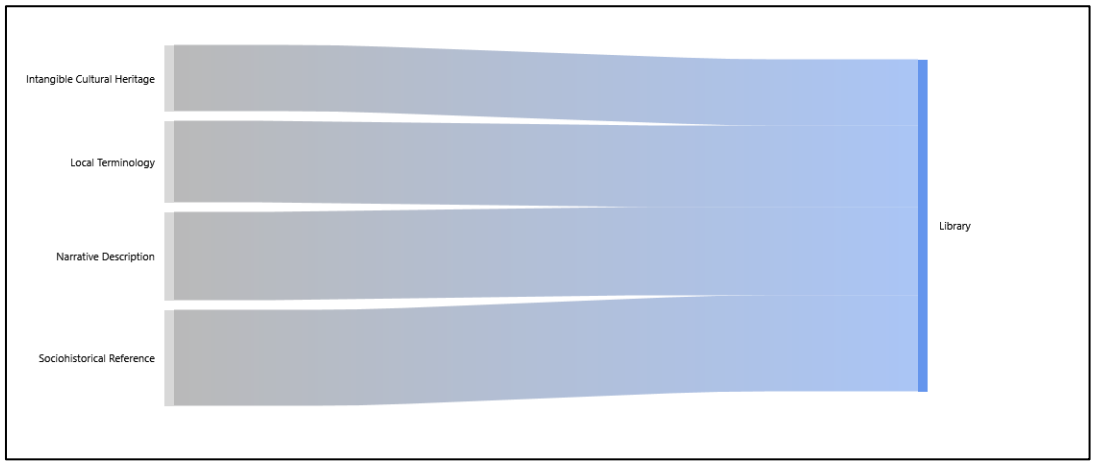


Figure 4.5 Sankey Diagram of Cultural Heritage Representation in the Sawahlunto Municipality Library

The Sawahlunto Municipality Library excels in embedding sociohistorical narratives and descriptive storytelling into its records, thereby reinforcing its identity as

a cultural mediator. Local terminology and intangible heritage are also recognized, though their integration remains partial and unsystematic. Without structured vocabularies or semantic frameworks, these culturally rich descriptors risk marginalization in cross-institutional contexts.

4.3.2 Critical Factors Influencing the Taxonomy Development at the Sawahlunto Municipality Library

4.3.2.1 Knowledge Organization Limitations

This subsection critically examines the structural and operational constraints that hinder the effectiveness of the KOSs at the Sawahlunto Municipality Library. Understanding these limitations is crucial for justifying the urgent need to develop a contextualized taxonomy. Four major codes of *KO limitation* are analyzed, namely *infrastructure constraints, classification rigidity, fragmented sources,* and *manual dependency*, as shown in Table 4.7 and Figure 4.6.

Table 4.7
Knowledge Organization Limitations in the Sawahlunto Municipality Library

Knowledge Organization Limitations	By Informants						By Institutions
	Heritage Expert 1	Heritage Expert 2	Library Director	Librarian 1	Librarian 2	Library User	Totals in Library
Classification Rigidity	2	0	1	4	3	2	12
Fragmented Sources	2	2	1	2	2	1	10
Infrastructure Constraints	2	0	4	4	5	3	18
Manual Dependency	1	1	1	3	1	0	7
Totals	7	3	7	13	11	6	47

Source: Researcher finding (2025)

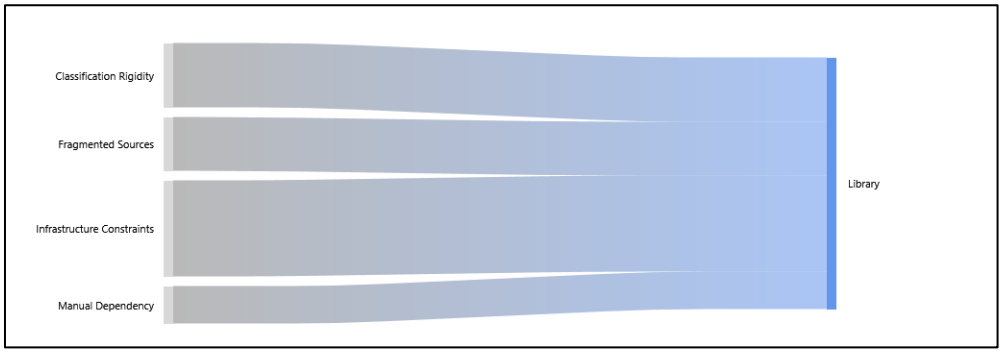


Figure 4.6 Sankey Diagram of Knowledge Organization Limitations in the Sawahlunto Municipality Library

Four interdependent barriers shape the Sawahlunto Municipality Library's KOSs: inadequate infrastructure, classification rigidity, fragmented sources, and persistent reliance on manual processes. Together, these limitations obstruct digital transformation, reduce interoperability, and perpetuate inefficiencies that hinder scalability.

4.3.2.2 Knowledge Organization Challenges

Knowledge organization (KO) challenges in the Sawahlunto Municipality Library reflect a combination of conceptual, operational, and systemic barriers that constrain the institution's capacity to develop a representative, adaptive, and user-responsive information structure. Within the OCMHS context, these challenges underscore the need for a contextualized taxonomy that reconciles international classification schemes with local cultural realities. Four major codes were identified, namely *contextual adaptation, user-based classification, taxonomy co-creation,* and *classification growth*, as shown in Table 4.8 and Figure 4.7.

Table 4.8
Knowledge Organization Challenges in the Sawahlunto Municipality Library

Knowledge Organization Challenges	**By Informants**						**By Institutions**
	Heritage Expert 1	**Heritage Expert 2**	**Library Director**	**Librarian 1**	**Librarian 2**	**Library User**	**Totals in Library**
Classification Growth	0	0	1	3	1	1	6
Contextual Adaptation	1	1	7	15	2	9	35
Taxonomy Co-Creation	0	0	2	5	4	1	12
User Based	1	1	1	2	4	5	14
Totals	2	2	11	25	11	16	67

Source: Researcher finding (2025)

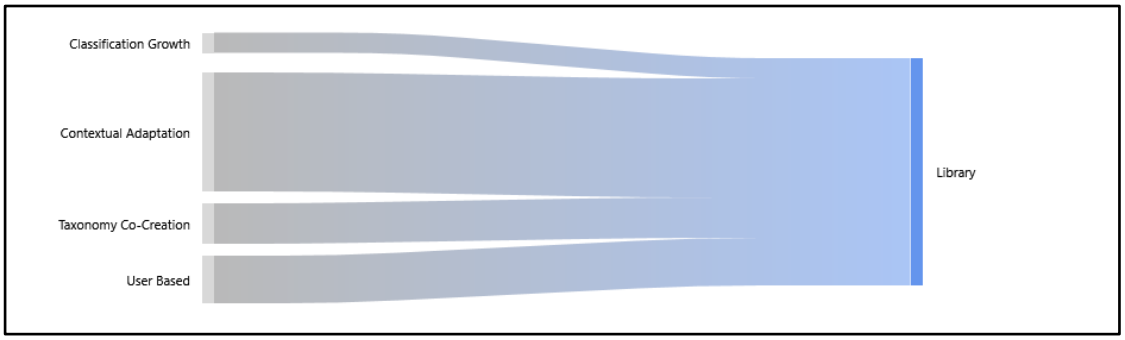


Figure 4.7 Sankey Diagram of Knowledge Organization Challenges in the Sawahlunto Municipality Library

KO challenges arise not only operationally but also conceptually. Foremost among them is contextual adaptation, the inability of universal schemes like DDC to adequately capture local terminologies and heritage realities. This is compounded by gaps in user-centered classification, the absence of participatory co-creation of taxonomy, and limited capacity for system growth. These challenges reveal a systemic misalignment between institutional logics and community information needs.

4.3.2.3 Knowledge Organization Opportunities

Opportunities to strengthen knowledge organization (KO) practices at the Sawahlunto Municipality Library offer strategic openings to transform current limitations into enablers of contextualized taxonomy development. Five interrelated codes were identified in this category, namely *capacity development, contextual customization, convergence, open access*, and *practice benchmarking*, as shown in Table 4.9 and Figure 4.8. These dimensions reflect institutional readiness and potential for innovation in managing OCMHS CH resources.

Table 4.9
Knowledge Organization Opportunities in the Sawahlunto Municipality Library

Knowledge Organization Opportunities	By Informants						By Institutions
	Heritage Expert 1	Heritage Expert 2	Library Director	Librarian 1	Librarian 2	Library User	Totals in Library
Capacity Development	4	4	4	7	6	1	26
Contextual Customization	1	6	2	1	6	7	23
Convergence	2	2	3	2	1	1	11
Open Access	3	1	3	6	2	6	21
Practice Benchmarking	2	0	3	2	1	1	9
Totals	12	13	15	18	16	16	90

Source: Researcher finding (2025)

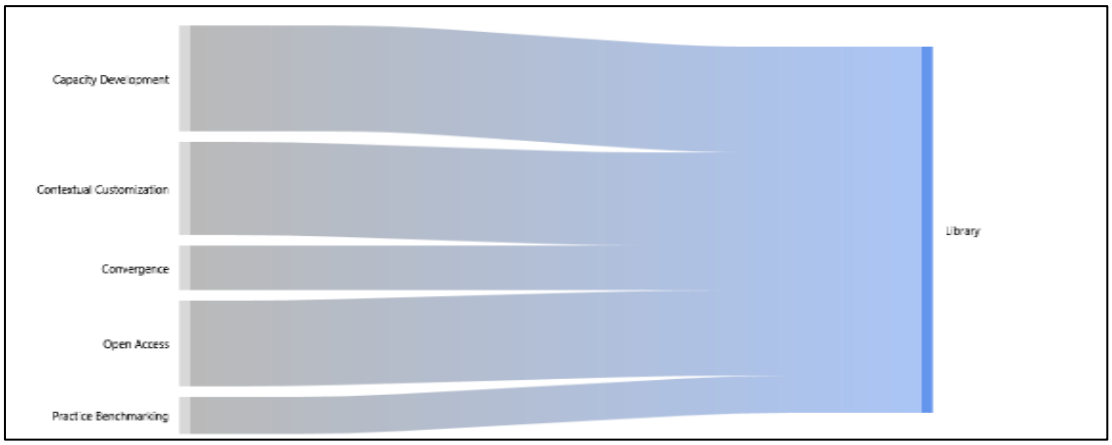


Figure 4.8 Sankey Diagram of Knowledge Organization Opportunities in the Sawahlunto Municipality Library

Despite all of the constraints, the Sawahlunto Municipality Library demonstrates strong potential for reform. Stakeholders expressed readiness for capacity development, contextual customization, and institutional convergence, supported by a willingness to adopt open access practices and benchmark against external models. This institutional optimism signals fertile ground for introducing a contextualized taxonomy.

4.3.3 Overview of Existing Conditions of Knowledge Organization Processes and Critical Factors Influencing Taxonomy Development at the Sawahlunto Municipality Library

The taxonomy must be designed to address limitations in infrastructure and rigidity, to bridge the gap between institutional and user logics, and to capitalize on opportunities for convergence and contextual enrichment. In other words, it must be locally grounded yet globally interoperable, developed through participatory mechanisms, and supported by governance and infrastructure strategies. Table 4.10 and Figure 4.9 present the cumulative distribution of 395 coded references across six categories of informants, categorized into two overarching concepts, including the existing condition of KO processes and the critical influencing factors for taxonomy development. The high volume of coding reflects the conceptual and operational intensity surrounding KO within the library context.

Table 4.10
Existing Conditions of Knowledge Organization Processes and Critical Factors Influencing Taxonomy Development at the Sawahlunto Municipality Library

Concepts	Themes	By Informants						By Institutions
		Heritage Expert 1	Heritage Expert 2	Director	Librarian 1	Librarian 2	Library User	Totals in Library
Knowledge Organization Processes	Knowledge Organization Practices	4	8	10	9	6	2	39
	Knowledge Organization Systems	3	3	7	12	8	1	34
	Standardization Framework	1	3	5	10	11	14	44
	Digital Knowledge Systems	1	0	8	8	8	4	29
	Cultural Heritage Representation	4	3	4	9	12	13	45
Critical Factors	Knowledge Organization Limitations	7	3	7	13	11	6	47
	Knowledge Organization Challenges	2	2	11	25	11	16	67
	Knowledge Organization Opportunities	12	13	15	18	16	16	90
Totals		34	35	67	104	83	72	395

Source: Researcher finding (2025)

Collectively, Table 4.10 reveals that library-based knowledge organization practices demonstrate relatively stable classification consistency but limited semantic expansion beyond standardized cataloging systems. The distribution of codes suggests an emphasis on procedural stewardship and metadata compliance rather than cross-institutional interoperability. While the frequency patterns indicate structural order, they also expose the limited integration of locally embedded cultural semantics within cataloging frameworks. These findings highlight library institutional strength in maintaining technical consistency, yet also reveal the need for semantic enrichment to support contextualized interpretation of heritage.

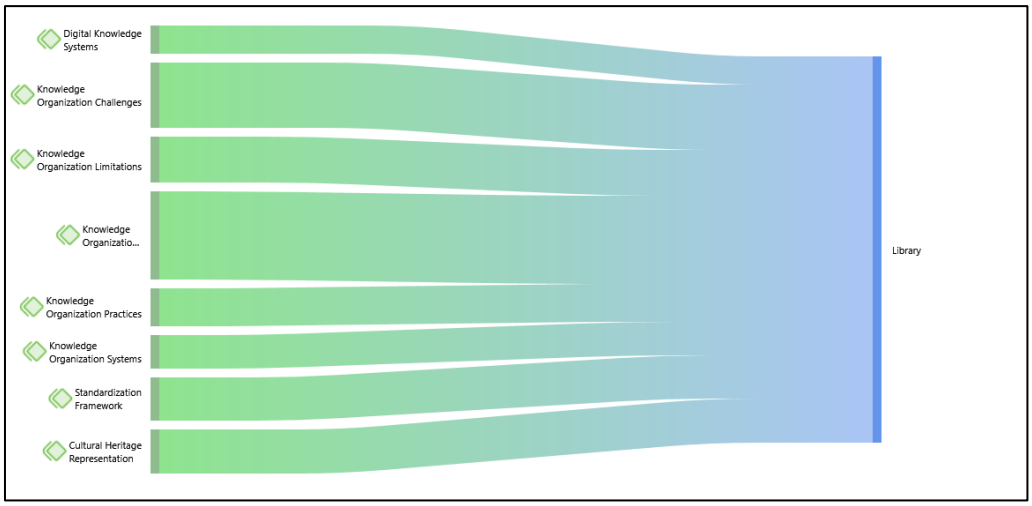


Figure 4.9 Sankey Diagram of Existing Conditions of Knowledge Organization Processes and Critical Factors Influencing Taxonomy Development at the Sawahlunto Municipality Library

The Sawahlunto Municipality Library case illustrates a paradoxical position, such that it is simultaneously a strong mediator of cultural memory and a weak implementer of technical and semantic standards. Patterns identified, such as the dominance of mediation over technical KO, the reliance on universal schemes, the platform-centric digital approach, and the strength of narrative over formal modeling, are not isolated phenomena but symptomatic of the broader OCMHS ecosystem. These findings directly address RO1 and RO2, providing the empirical foundation for the taxonomy design principles articulated in Chapter 5.

By bridging cultural richness with systemic constraints, the Sawahlunto Municipality Library exemplifies the urgent need for a contextualized taxonomy that is adaptive, participatory, and integrative. This system can unify fragmented practices while safeguarding the authenticity of local cultural expression.

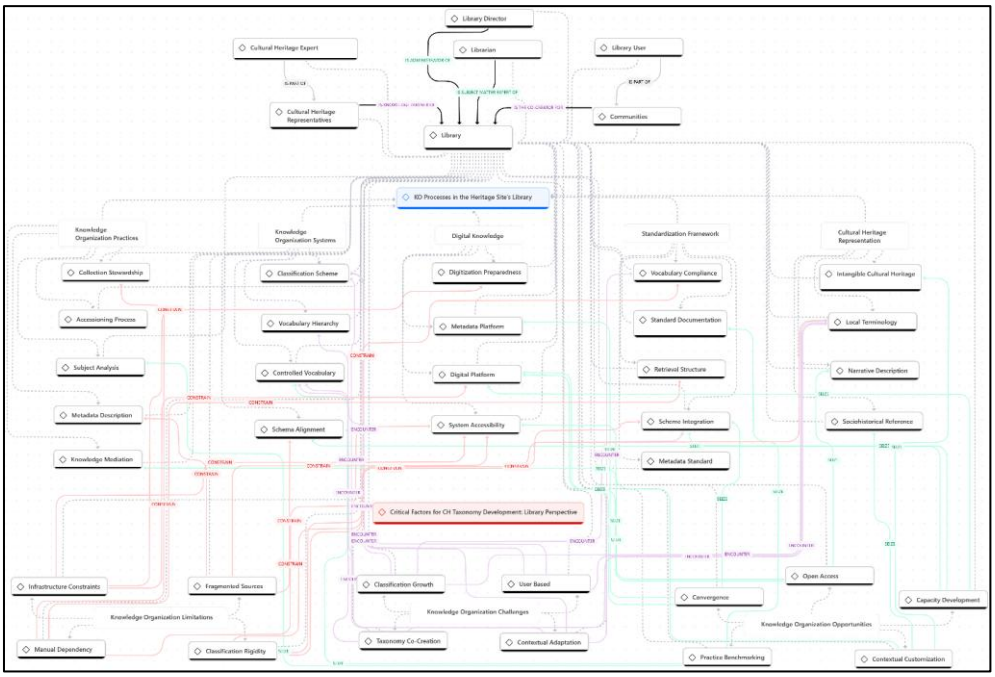


Figure 4.10 Network Model of Existing Conditions of Knowledge Organization Processes and Critical Factors Influencing the Taxonomy Development at the Sawahlunto Municipality Library

Figure 4.10 illustrates the network model of existing conditions of KO processes and critical factors influencing the taxonomy development at the Sawahlunto Municipality Library. This model illustrates the interconnections among key institutional actors, the operational KO field, and the strategic factors shaping taxonomy reform. The three-layer structure comprising the actor layer, KO processes layer, and justification layer highlights both formal and collaborative relationships, the technical and cultural dimensions of KO, and the interplay of *KO limitations*, *KO challenges*, and *KO opportunities*. Color-coded linkages distinguish areas of systemic constraint, emergent challenges, and leverage points for innovation, underscoring that taxonomy development is a non-linear, iterative, and participatory process that must balance compliance with formal standards and sensitivity to OCMHS's sociohistorical context.

The network is structured into three interdependent layers, reflecting the multidirectional, iterative, and interconnected nature of KO within the CH context. The diagram not only captures operational workflows but also depicts the systemic constraints, opportunities, and collaborative linkages that define the library's position within the broader OCMHS information ecosystem.

The first layer is the actor layer, which is at the top of the diagram, and identifies the principal stakeholders who shape and enact *KO practices*. These include the library director, the librarian, the CH expert, library users, and communities. Solid lines

indicate formal organizational hierarchies and reporting relationships, such as between the library director and librarians, while dashed connectors signify advisory and collaborative linkages with external expertise and community stakeholders. Librarians play a central operational role, serving as gatekeepers that mediate between institutional policy and user engagement. CH experts provide specialist knowledge to ensure that KO processes remain contextually grounded in the sociohistorical realities of OCMHS. Communities contribute both as users and as repositories of lived heritage, offering terminology, narratives, and perspectives that inform the contextualization of taxonomy.

The second layer is the KO processes layer, which forms the operational and technical core of the model. It consists of five main themes, including *KO practices, KOS, digital knowledge system, standardization framework*, and *CH representation,* which are highly interconnected, as shown by directional flows linking, for example, schema alignment with metadata description, or local terminology with *CH representation*. Color-coded connections distinguish KO limitations (red), KO challenges (purple), and KO opportunities (green), allowing quick visual identification of pressure points and strategic leverage areas. The third layer is the justification layer, which forms the base of the model and captures the three principal themes influencing taxonomy development, including *KO limitations*, *KO challenges*, and *KO opportunities*.

Each theme is linked to specific KO process nodes, illustrating both origins and impacts. For instance, infrastructure constraints directly affect digitization readiness and system accessibility, while contextual customization is linked to CH representation and refinement of the classification scheme. From an interpretive perspective, the model highlights the non-linear and reciprocal nature of KO reform in the library context. *KO limitations*, such as rigid classification systems and fragmented sources, restrict semantic adaptability and hinder cross-CHI interoperability. However, the network also presents substantial opportunities for capacity development, contextualization, and open access initiatives that can catalyze innovation. The density and diversity of interconnections suggest that sustainable taxonomy development will require a collaborative, user-centered, and culturally responsive approach, one that balances compliance with formal standards and sensitivity to local heritage values.

Moreover, this network model serves as both an analytical tool for diagnosing current systemic configurations and a strategic map for guiding future reforms. It

underscores that taxonomy development within the Sawahlunto Municipality Library is not merely a technical exercise, but a socio-technical process embedded within the cultural, historical, and institutional context of OCMHS. A successful taxonomy will need to integrate structural coherence, technological capacity, and participatory governance to ensure semantic richness, interoperability, and cultural authenticity.

The network model presented in Figure 4.10 was not constructed solely as a researcher's interpretive artifact but was iteratively refined through empirical validation. First, the structural configuration of actors, KO processes, and influencing factors was derived directly from coded interview data, document analysis, and observational findings. Second, preliminary versions of the model were presented during follow-up discussions with selected institutional stakeholders, including the library director and librarians, to ensure conceptual accuracy and contextual plausibility. This member validation process confirmed that the depicted interconnections reflected actual institutional dynamics rather than abstract analytical imposition. In addition, triangulation across data sources—interviews, documents, and field observations—provided methodological validation by ensuring consistency between reported practices and observable workflows. Within the DSR framework, this model represents a diagnostically validated representation for Phase A (Problem Identification), serving as an empirically grounded input for subsequent taxonomy design.

The synthesis presented here underscores that the Sawahlunto Municipality Library is at a transitional juncture. While infrastructure and classification rigidity pose significant constraints, the strong orientation toward CH representation, the willingness to embrace contextual adaptation, and the optimism for open and convergent systems reveal fertile ground for taxonomy reform. These conditions directly justify applying a DSR approach to systematically design, implement, and evaluate a contextualized taxonomy. Moreover, the analysis links back to the problem statement in Chapter 1 and the gaps in the literature in Chapter 2, confirming that neither universal classification systems nor isolated institutional practices are sufficient. The insights derived here set the stage for Chapter 5, where taxonomy design principles, hierarchical structuring, cultural embeddedness, scalability, and interoperability are operationalized to address the challenges and leverage the opportunities identified in this case.

4.4 Case Study Analysis in The Sawahlunto Municipality Archives

The Sawahlunto Municipality Archives play a crucial role in safeguarding the documentary memory of the OCMHS, ranging from colonial-era administrative records to contemporary governance files. Unlike library or museums, archives are defined by the principle of provenance and the imperative to preserve authenticity and evidential value.

This case analysis demonstrates that while the archives contribute significantly to the historical depth of OCMHS representation, their KO practices remain fragmented, technologically constrained, and only partially aligned with international archival standards. These findings provide important insights into both the RO1 and RO2. Archival KO practices are defined by strengths in authenticity and provenance control, but are constrained by weak metadata, limited digitization, and restricted thematic representation. These conditions highlight the need for a taxonomy that integrates archival rigor with semantic enrichment and community relevance.

4.4.1 Existing Conditions of Knowledge Organization Processes at the Sawahlunto Municipality Archives

4.4.1.1 Knowledge Organization Practices

Data for this subsection were collected from six key informants, comprising two archivists, two CH experts, one institutional director, and one archives user. This subsection provides a focused analysis of five codes of KO practices, namely *accessioning process*, *collection stewardship*, *knowledge mediation*, *metadata description*, and *subject analysis*, as shown in Table 4.11 and Figure 4.10. These accounts were triangulated with field observations and document analysis of internal registers, inventory procedures, and policy frameworks.

Table 4.11
Knowledge Organization Practices in the Sawahlunto Municipality Archives

Knowledge Organization Practices	By Informants						By Institutions
	Archivist 1	Archivist 2	Heritage Expert 1	Heritage Expert 2	Archives Director	Archives User	Totals in Archives
Accessioning Process	1	2	0	1	1	0	5
Collection Stewardship	3	3	2	2	2	0	12
Knowledge	2	3	1	3	4	0	13

Mediation							
Metadata Description	1	2	1	2	2	0	8
Subject Analysis	1	0	0	0	2	0	3
Totals	8	10	4	8	11	0	41

Source: Researcher finding (2025)

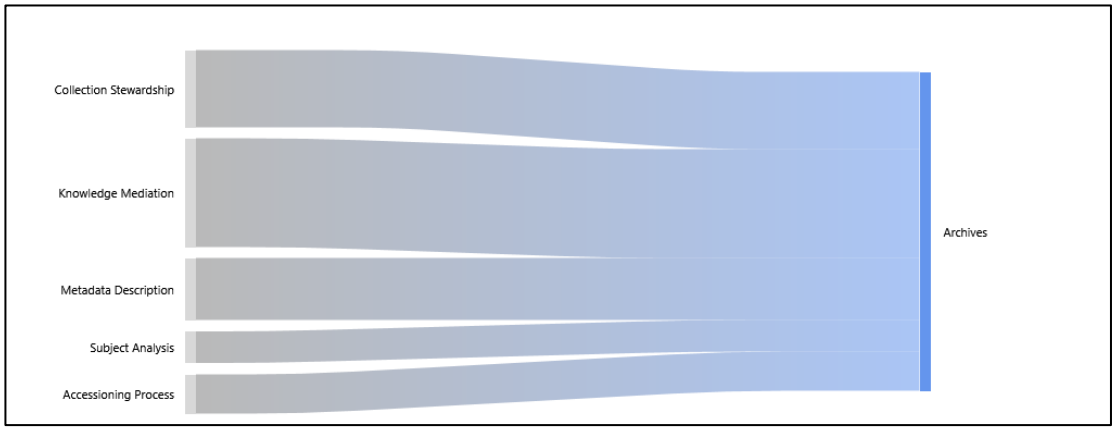


Figure 4.11 Sankey Diagram of Knowledge Organization Practices in the Sawahlunto Municipality Archives

Archival practices are strongly oriented toward record appraisal, arrangement, and custody, emphasizing authenticity and original order. However, metadata description and subject analysis are weakly institutionalized, often relying on manual registers or basic spreadsheets. This imbalance means that while authenticity is preserved, access and retrieval remain limited, with significant dependency on archivists' tacit knowledge.

4.4.1.2 Knowledge Organization Systems

Within the Sawahlunto Municipality Archives, *KOS* plays a central role not only in maintaining administrative coherence but also in ensuring that documentary heritage relating to the OCMHS can be contextualized and accessed across generations. The analysis of this case focuses on four principal components of archival *KOS*, including *classification scheme, controlled vocabulary, schema alignment,* and *vocabulary hierarchy*, as shown in Table 4.12 and Figure 4.12.

Table 4.12
Knowledge Organization Systems in the Sawahlunto Municipality Archives

Knowledge Organization Systems	By Informants						By Institutions
	Archivist 1	Archivist 2	Heritage Expert 1	Heritage Expert 2	Archives Director	Archives User	Totals in Archives
Classification Scheme	4	5	2	1	8	0	20
Controlled Vocabulary	1	2	0	0	0	0	3
Schema Alignment	2	2	1	1	0	0	6
Vocabulary Hierarchy	1	1	0	1	0	0	3
Totals	8	10	3	3	8	0	32

Source: Researcher finding (2025)

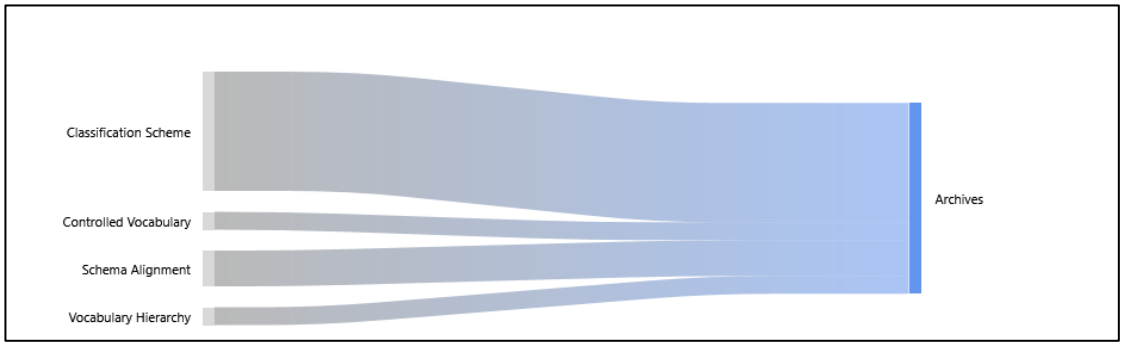


Figure 4.12 Sankey Diagram of Knowledge Organization Systems in the Sawahlunto Municipality Archives

The Sawahlunto Municipality Archives employs ANRI guidelines and ISAD(G) as guiding frameworks, yet implementation is partial and inconsistent. Many records remain outside formal descriptive control, and schema alignment with library or museum systems is minimal. Controlled vocabularies are rare, and hierarchical structuring tends to follow provenance logic rather than thematic categorization, making cross-domain access challenging. This reliance on provenance-based description without semantic enrichment creates silos that hinder integration with broader CHIs.

4.4.1.3 Digital Knowledge Systems

This subsection critically examines the extent of the adoption of digital systems within the Sawahlunto Municipality Archives, drawing on interviews, observations, and institutional documentation. Table 4.13 and Figure 4.13 summarize the components of *digital knowledge systems* currently observable in the archival setting.

Table 4.13
Digital Knowledge Systems in the Sawahlunto Municipality Archives

Digital Knowledge Systems	By Informants						By Institutions
	Archivist 1	Archivist 2	Heritage Expert 1	Heritage Expert 2	Archives Director	Archives User	Totals in Archives
Digital Platform	1	2	1	0	3	1	8
Digitization Preparedness	0	1	0	0	1	1	3
Metadata Platform	0	0	0	0	2	1	3
System Accessibility	1	1	0	0	5	1	8
Totals	2	4	1	0	11	4	22

Source: Researcher finding (2025)

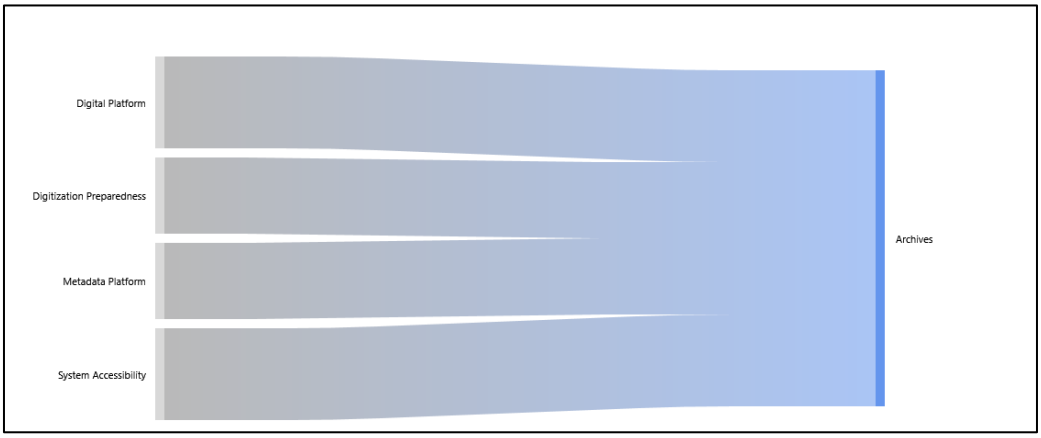


Figure 4.13 Sankey Diagram of Digital Knowledge Systems in the Sawahlunto Municipality Archives

Digital infrastructures in the Sawahlunto Municipality Archives are underdeveloped. Digitization efforts are sporadic, metadata platforms are limited, and public access portals are largely absent. Storage often relies on basic tools such as Excel or standalone databases, which are not interoperable with other CHI systems. This digital fragility puts archival collections at risk of becoming invisible within the broader OCMHS knowledge ecosystem.

4.4.1.4 Standardization Framework

This subsection critically examines the extent to which the Sawahlunto Municipality Archives has implemented five core codes of the standardization framework, including *retrieval structure, metadata standard, scheme integration, standard documentation,* and *vocabulary compliance*, as shown in Table 4.14 and Figure 4.14.

Table 4.14
Standardization Framework in the Sawahlunto Municipality Archives

Standardization Framework	By Informants						By Institutions
	Archivist 1	Archivist 2	Heritage Expert 1	Heritage Expert 2	Archives Director	Archives User	Totals in Archives
Retrieval Structure	2	2	0	0	1	2	7
Metadata Standard	0	0	0	0	1	0	1
Scheme Integration	0	4	0	1	0	0	5
Standard Documentation	1	1	1	1	2	2	8
Vocabulary Compliance	1	1	0	1	1	3	7
Totals	4	8	1	3	5	7	28

Source: Researcher finding (2025)

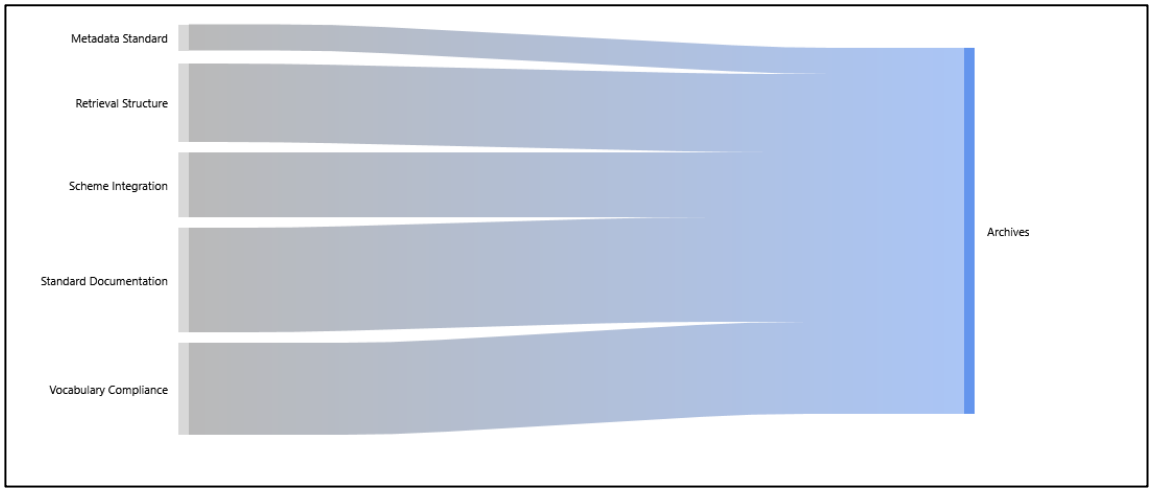


Figure 4.14 Sankey Diagram of Standardization Framework in the Sawahlunto Municipality Archives

While the archives demonstrate awareness of international standards, including ISAD(G) and ANRI guidelines, their application is inconsistent due to resource constraints and limited staff training. Retrieval systems remain rudimentary, with keyword search and manual file indexing dominating practice. This reflects a standardization framework that is aspirational but limited in execution.

4.4.1.5 Cultural Heritage Representation

The *cultural heritage (CH) representation* within archival institutions extends beyond the custodial function of preserving *documents*. It encompasses the articulation of historical narratives, communal identity, intangible practices, and local terminology in ways that ensure both semantic depth and cultural resonance, as shown in Table 4.15 and Figure 4.15.

Table 4.15
Cultural Heritage Representation in the Sawahlunto Municipality Archives

Cultural Heritage Representation	By Informants						By Institutions
	Archivist 1	Archivist 2	Heritage Expert 1	Heritage Expert 2	Archives Director	Archives User	Totals in Archives
Intangible Cultural Heritage	1	1	2	1	1	3	9
Local Terminology	3	1	0	0	1	6	12
Narrative Description	2	1	3	1	1	5	13
Sociohistorical Reference	3	2	1	1	1	7	15
Totals	9	5	6	3	4	21	48

Source: Researcher finding (2025)

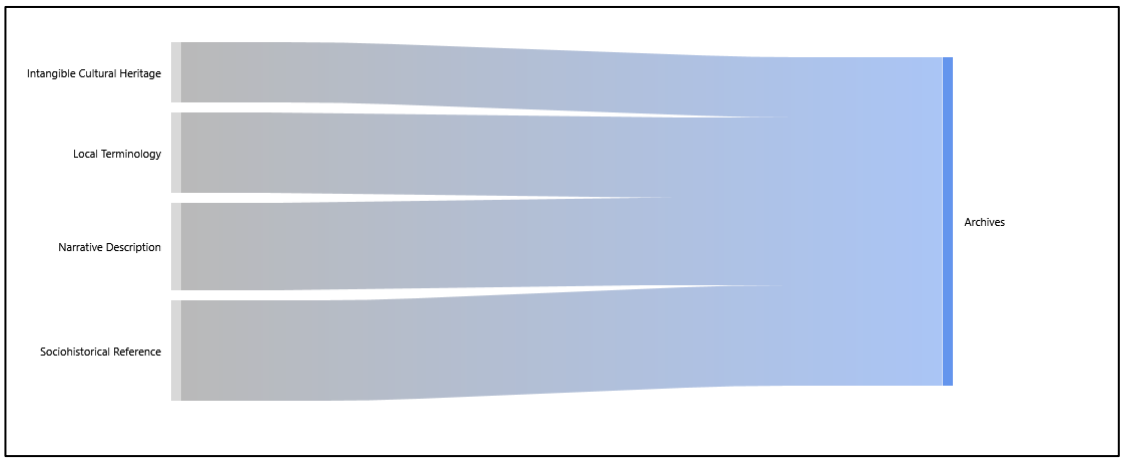


Figure 4.15 Sankey Diagram of Cultural Heritage Representation in the Sawahlunto Municipality Archives

The Sawahlunto Municipality Archives contribute significantly to sociohistorical authenticity by preserving unique documents. However, the representation of intangible CH and community narratives is weak, as the archival mandate has traditionally prioritized official documentation. This results in a narrow representational scope, privileging state or institutional voices over community perspectives.

4.4.2 Critical Factors Influencing the Taxonomy Development at the Sawahlunto Municipality Archives

4.4.2.1 Knowledge Organization Limitations

In the Sawahlunto Municipality Archives, several structural, procedural, and technological constraints substantially impede the institution's capacity to preserve,

organize, and disseminate documentary heritage in ways that are responsive to the OCMHS context. The findings in Table 4.16 and Figure 4.16 indicate that the two most prevalent limitations are *infrastructure constraints* and *manual dependency.*

Table 4.16
Knowledge Organization Limitations in the Sawahlunto Municipality Archives

Knowledge Organization Limitations	By Informants						By Institutions
	Archivist 1	Archivist 2	Heritage Expert 1	Heritage Expert 2	Archives Director	Archives User	Totals in Archives
Classification Rigidity	5	2	3	0	1	3	14
Fragmented Sources	3	0	2	2	1	3	11
Infrastructure Constraints	6	5	2	0	5	3	21
Manual Dependency	7	2	1	1	1	9	21
Totals	21	9	8	3	8	18	67

Source: Researcher finding (2025)

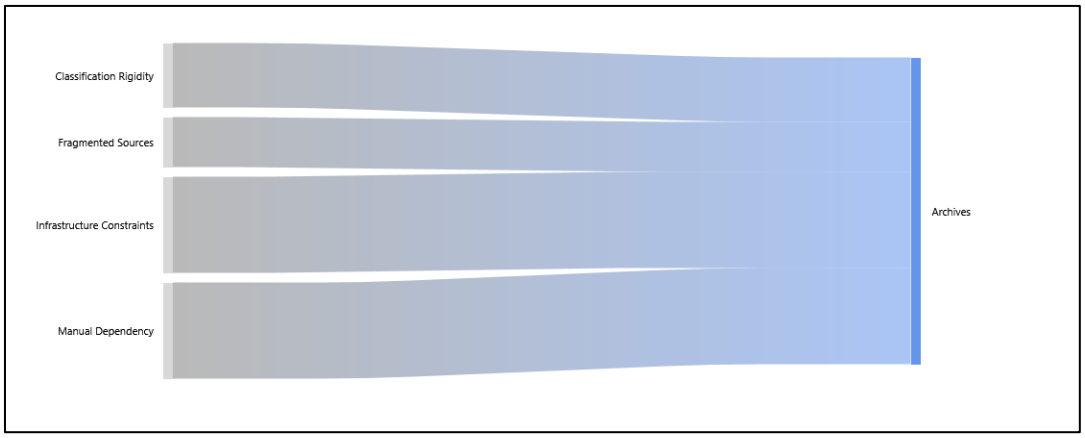


Figure 4.16 Sankey Diagram of Knowledge Organization Limitations in the Sawahlunto Municipality Archives

The most pressing limitations at Sawahlunto Municipality Archives include technological deficits, rigid adherence to provenance without semantic bridges, and fragmented storage systems. Manual dependency remains high, slowing retrieval and increasing risks of data loss. These limitations create significant barriers to interoperability with the library and museums within Sawahlunto Municipality.

4.4.2.2 Knowledge Organization Challenges

The challenges manifest in conceptual rigidity, limited adaptability, and the exclusion of users and stakeholders in system development. Within the Sawahlunto

Municipality Archives, such barriers constitute pivotal indicators of the gap between current practices and the institutional aspiration to construct a more contextualized taxonomy. The findings, as shown in Table 4.17 and Figure 4.17, provide a visual representation of the magnitude and interrelation of these KO challenges.

Table 4.17
Knowledge Organization Challenges in the Sawahlunto Municipality Archives

Knowledge Organization Challenges	By Informants						By Institutions
	Archivist 1	Archivist 2	Heritage Expert 1	Heritage Expert 2	Archives Director	Archives User	Totals in Archives
Classification Growth	1	1	0	0	1	1	4
Contextual Adaptation	6	5	4	1	8	5	29
Taxonomy Co-Creation	2	3	0	1	2	6	14
User-Based	2	3	1	1	1	9	17
Totals	11	12	5	3	12	21	64

Source: Researcher finding (2025)

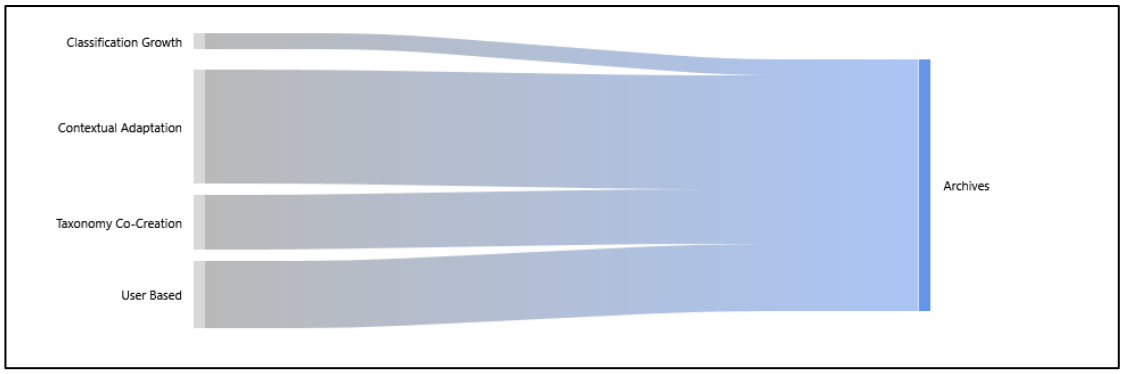


Figure 4.17 Sankey Diagram of Knowledge Organization Challenges in the Sawahlunto Municipality Archives

KO challenges at Sawahlunto Municipality Archives arise from the tension between archival tradition and the need for contextual adaptation. Archivists recognize the necessity of thematic access for users but remain bound to provenance-based arrangement. Additionally, the Sawahlunto Municipality archives lack mechanisms for co-creating taxonomies with communities, and the limited growth of classification systems restricts the integration of new record types, such as digitally born materials or community-generated archives.

4.4.2.3 Knowledge Organization Opportunities

Opportunities represent enabling factors that can strengthen institutional capacity, foster inclusivity, and promote interoperability within broader cultural heritage ecosystems. Within the Sawahlunto Municipality Archives, five major opportunities have been identified, *including capacity development, contextual customization, open access, convergence,* and *practice benchmarking,* as shown in Table 4.18 and Figure 4.18, which offers a visual representation of the relative intensity of each *KO opportunity,* each of which constitutes a strategic lever for advancing toward a contextualized taxonomy.

Table 4.18
Knowledge Organization Opportunities in the Sawahlunto Municipality Archives

Knowledge Organization Opportunities	**By Informants**						**By Institutions**
	Archivist 1	**Archivist 2**	**Heritage Expert 1**	**Heritage Expert 2**	**Archives Director**	**Archives User**	**Totals in Archives**
Capacity Development	5	6	5	5	7	1	29
Contextual Customization	3	3	1	6	2	5	20
Convergence	3	4	2	2	5	1	17
Open Access	3	3	3	1	3	7	20
Practice Benchmarking	3	1	2	0	3	1	10
Totals	17	17	13	14	20	15	96

Source: Researcher finding (2025)

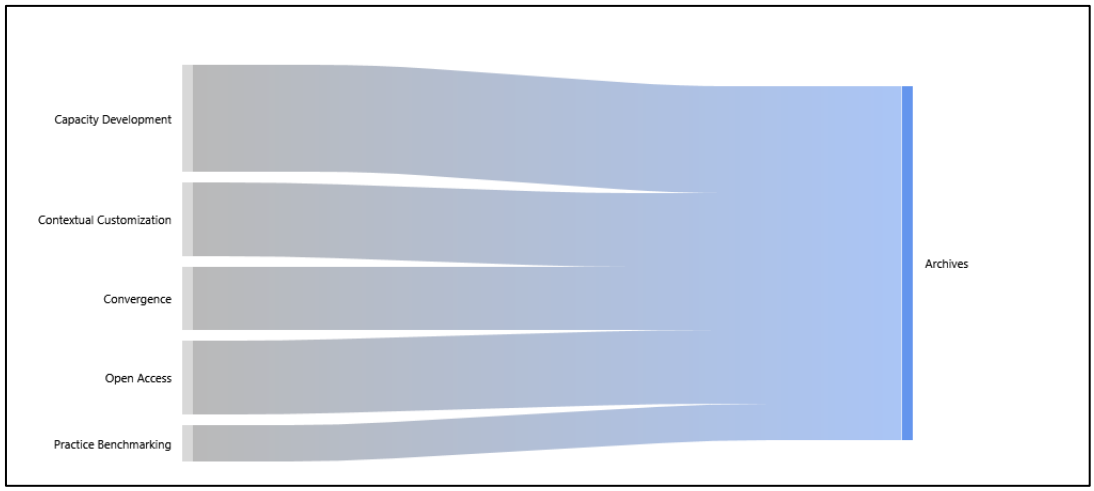


Figure 4.18 Sankey Diagram of Knowledge Organization Opportunities in the Sawahlunto Municipality Archives

Despite constraints, the Sawahlunto Municipality Archives offer opportunities for capacity development and interoperability. Archivists expressed openness to

training, and the growing recognition of the value of community records indicates potential for participatory enrichment. Moreover, existing ANRI guidelines and ISAD(G) structures, though limited, provide a foundation for mapping to broader metadata standards.

4.4.3 Overview of Existing Conditions of Knowledge Organization Processes and Critical Factors Influencing the Taxonomy Development at the Sawahlunto Municipality Archives

The archival context reinforces the need for a taxonomy that balances provenance integrity with semantic accessibility, integrates fragmented sources, and opens pathways for participatory enrichment. This requires both infrastructural investment and conceptual innovation. As presented in Table 4.19 and Figure 4.19, which visualize the intensity and interrelations among various existing conditions of the KO process and the critical factors influencing the taxonomy development at the Sawahlunto Municipality Archives, the dataset was derived from semi-structured interviews with six categories of informants.

Table 4.19
Existing Conditions of Knowledge Organization Processes and Critical Factors Influencing the Taxonomy Development at the Sawahlunto Municipality Archives

Concepts	Themes	By Informants						By Institutions
		Archivist 1	Archivist 2	Heritage Expert 1	Heritage Expert 2	Archives Director	Archives User	Totals in Archives
Knowledge Organization Processes	Knowledge Organization Practices	8	10	4	8	11	0	41
	Knowledge Organization Systems	8	10	3	3	8	0	32
	Standardization Framework	4	8	1	3	5	7	28
	Digital Knowledge Systems	2	4	1	0	11	4	22
	Cultural Heritage Representation	9	5	6	3	4	21	48
Critical Factors	Knowledge Organization Limitations	21	9	8	3	8	18	67
	Knowledge Organization Challenges	11	12	5	3	12	21	64

	Knowledge Organization Opportunities	17	17	13	14	20	15	96
Totals		80	75	41	37	79	86	398

Source: Researcher finding (2025)

The archival data presented in Table 4.19 indicate a dominant reliance on provenance-based structuring and regulatory stewardship standards. While this approach ensures institutional accountability and document traceability, it also constrains semantic flexibility. The relatively lower representation of cross-sector interoperability codes suggests that archival systems remain internally coherent yet externally fragmented. These patterns underscore the structural tension between archival rigor and integrative semantic modeling, which becomes a critical consideration for taxonomy development.

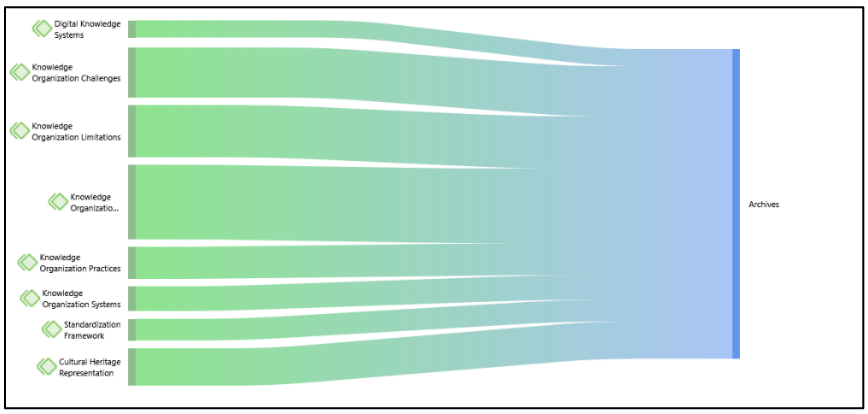


Figure 4.19 Sankey Diagram of Existing Conditions of Knowledge Organization Processes and Critical Factors Influencing the Taxonomy Development at the Sawahlunto Municipality Archives

The Sawahlunto Archives illustrate a paradox of preservation without accessibility: they excel in maintaining the evidential authenticity of records but struggle to provide rich, user-centered access. The patterns identified manual reliance, schema rigidity, digital fragility, and narrow representational scope mirror systemic issues across CHIs. These findings directly address RO1 by documenting the existing state of archival KO and inform RO2 by specifying design requirements for taxonomy development, including 1) Introduce semantic layers to complement provenance structures; 2) Develop metadata crosswalks for interoperability with libraries and museums; 3) Establish digitization pipelines and metadata platforms for digital resilience; and 4) Expand representational strategies to include community archives and intangible heritage.

By doing so, the contextualized taxonomy can preserve archival integrity while enabling integrated discovery across the OCMHS CHI network. This case thus strengthens the rationale for a taxonomy that is authentically archival, semantically enriched, and participatory, setting the stage for comparative insights in Section 4.6 and design translation in Chapter 5.

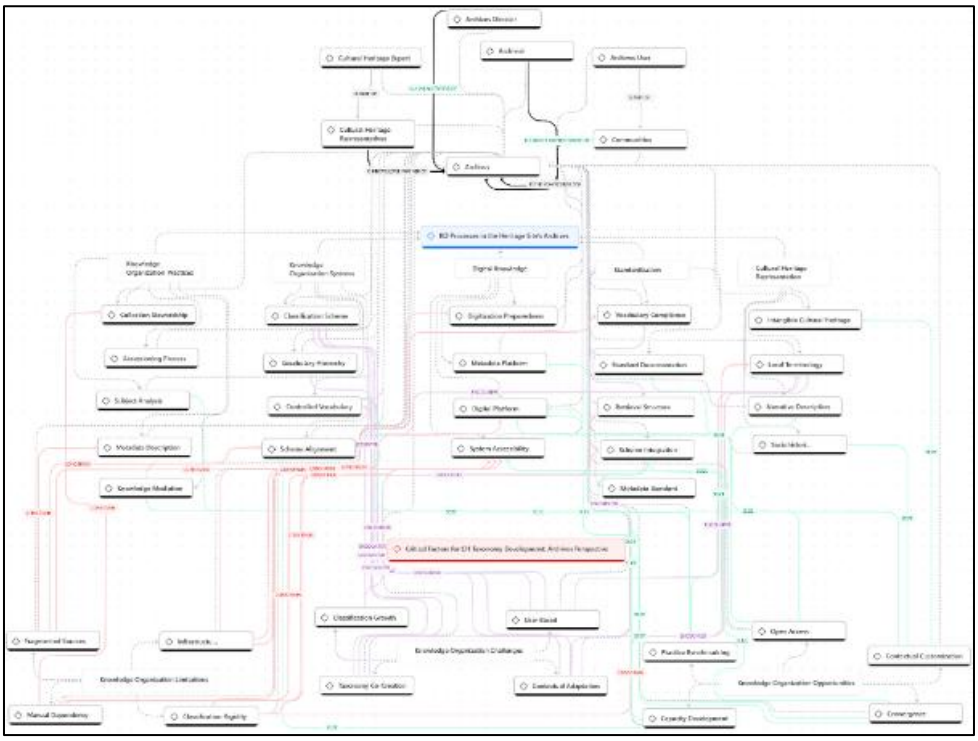


Figure 4.20 Network Model of Existing Conditions of Knowledge Organization Processes and Critical Factors Influencing the Taxonomy Development at the Sawahlunto Municipality Archives

Figure 4.20 illustrates the network model of existing conditions of KO processes and critical factors influencing the taxonomy development at the Sawahlunto Municipality Archives. This model illustrates the relationships among key archival actors, interconnected KO process themes, systemic KO limitations, KO challenges, and KO opportunities that influence taxonomy development. Organized into three interlinked layers, including the actor layer, the KO processes layer, and the justification layer, the network depicts both hierarchical and collaborative flows, integrating technical and CH considerations. Color-coded connections distinguish structural constraints, adaptive challenges, and strategic opportunities, highlighting that taxonomy development in the archives is a nonlinear, iterative process that requires a balance between formal standardization and the sociohistorical context of OCMHS archival collections.

The model is arranged into three interdependent layers, illustrating the multidirectional and iterative relationships that shape archival *KO practices*. It visualizes how decision-making hierarchies, operational workflows, and contextual reform drivers intersect, thereby portraying the archives not simply as a technical unit but as an integral node in the broader OCMHS CH information network.

The first layer is the actor layer, which identifies the primary stakeholders involved in archival KO. These include the archives director, archivists, CH experts, archives users, or communities. Solid connectors indicate formal organizational authority, such as between the archives director and archivists, while dotted lines depict collaborative and consultative interactions with external experts and community representatives. Archivists play a pivotal role as operational intermediaries, translating strategic directives into daily archival processes, whereas CH experts contribute specialized knowledge to ensure semantic accuracy and historical authenticity. Communities are positioned as both contributors and beneficiaries, offering oral traditions, local terminology, and contextually embedded narratives essential for the contextualization of taxonomy.

The second layer is the existing condition of the KO processes layer, which forms the operational and technical backbone of the network. It encompasses five core KO themes, including *KO practices, KOS, digital knowledge system, standardization framework,* and *CH representation, which* are interconnected through directional linkages, showing operational dependencies such as between schema alignment and metadata description, or between local terminology and narrative description. Color-coded flows distinguish *KO limitations* (red), *KO challenges* (purple), and *KO opportunities* (green), providing visual cues for identifying systemic weaknesses and reform potential. The third layer is the justification layer, which comprises three critical factors influencing taxonomy development, including *KO limitations*, *KO challenges*, and KO *opportunities*.

Connections between these critical factors and the existing condition of KO processes above reveal both the sources of systemic issues and their operational impacts. For example, fragmented sources are closely tied to the lack of integrated metadata platforms, while contextual customization is directly linked to the archives' ability to represent *intangible CH*. From an interpretive perspective, the model underscores that KO reform in the Sawahlunto Municipality Archives is a non-linear, reciprocal process shaped by technical, organizational, and socio-cultural dimensions.

KO limitations, such as classification rigidity and infrastructure constraints, restrict semantic adaptability and interoperability, while challenges such as the absence of participatory taxonomy co-creation limit responsiveness to user needs. However, opportunities in capacity development, convergence across CHIs, and open access initiatives present viable pathways for transformation.

Additionally, this network model functions as both a diagnostic tool for assessing the current state of archival KO and a strategic roadmap for guiding taxonomy reform. It affirms that sustainable and contextually relevant taxonomy development in the archival context requires balancing formal standardization with cultural specificity, enhancing digital infrastructure, and fostering collaborative governance that includes archivists, subject experts, and the community.

The network model presented in Figure 4.20 was developed through a systematic synthesis of coded qualitative data derived from semi-structured interviews, document analysis, and field observations within the archival context. The configuration of actors, KO processes, and influencing factors reflects patterns consistently identified during within-case analysis. To enhance validity, the preliminary structure of the model was shared and discussed with selected archival stakeholders, including the archives director and senior archivists, to confirm that the depicted relationships accurately represented institutional workflows and decision-making dynamics. This member validation process ensured contextual plausibility and minimized researcher-imposed abstraction. Furthermore, methodological triangulation across multiple data sources strengthened analytical credibility by aligning interview narratives with documentary evidence and observed practices. Within the Design Science Research (DSR) framework, Figure 4.20 thus functions as a diagnostically validated representation corresponding to Phase A (Problem Identification), providing an empirically grounded basis for defining taxonomy design objectives in subsequent phases.

The synthesis of findings in this section demonstrates that the Sawahlunto Municipality Archives operate within a paradoxical environment where structural rigidity and infrastructural limitations coexist with growing awareness of reform opportunities. The predominance of cultural heritage representation and *KO practices* highlights the institution's strength in preserving sociohistorical narratives. However, the persistent weaknesses in standardization and digital systems reveal vulnerabilities in ensuring interoperability, scalability, and long-term preservation. At the same time,

the strong emphasis on *KO opportunities* indicates that stakeholders perceive contextual customization, capacity development, and open access as viable levers for systemic transformation. Collectively, these dynamics imply that the development of a contextualized taxonomy must be positioned as both a corrective response to entrenched limitations and a strategic vehicle for leveraging institutional and community-driven opportunities. Such an approach ensures that archival KO evolves into a participatory, culturally embedded, and technically resilient system that sustains the heritage values of the OCMHS while enabling inclusive access across generations.

4.5 Case Study Analysis in The Sawahlunto Municipality Museums

Museums in Sawahlunto serve as primary custodians of the tangible CH of the OCMHS, including mining tools, industrial machinery, household artifacts, and cultural performances, unlike library and archives at Sawahlunto Municipality, which emphasize textual or documentary heritage, museums foreground material culture and visitor interpretation. This case analysis reveals that museums are strong in cultural representation and narrative mediation, but face persistent weaknesses in standardization, metadata structuring, and interoperability. These findings contribute directly to RO1 and to RO2.

Museums demonstrate strong narrative richness and cultural resonance, but weak systematization and interoperability. Their reliance on curatorial interpretation underscores the need for a taxonomy that translates cultural narratives into structured, interoperable systems without losing authenticity.

4.5.1 Existing Conditions of Knowledge Organization Processes at the Sawahlunto Municipality Museums

4.5.1.1 Knowledge Organization Practices

As custodians of OCMHS, the museums are entrusted not only with preserving material artifacts but also with contextualizing and transmitting knowledge to the wider public. Their KO practices thus extend beyond administrative, encompassing representational strategies that embed cultural meanings, historical narratives, and visitor engagement into the organization of collections. This subsection provides a

focused analysis of five KO practices, namely accessioning process, collection stewardship, knowledge mediation, metadata description, and subject analysis, as shown in Table 4.20 and Figure 4.21.

Table 4.20
Knowledge Organization Practices in the Sawahlunto Municipality Museums

Knowledge Organization Practices	By Informants								By Institutions
	Heritage Expert 1	Heritage Expert 2	Curator 1	Curator 2	Museum Director	Registrar 1	Registrar 2	Museum User	Totals in Museums
Accessioning Process	1	1	2	3	2	1	2	0	12
Collection Stewardship	1	2	2	2	1	3	3	0	14
Knowledge Mediation	1	2	3	2	2	2	2	1	15
Metadata Description	0	2	2	2	1	2	1	0	10
Subject Analysis	1	1	2	2	2	2	1	0	11
Totals	4	8	11	11	8	10	9	1	62

Source: Researcher finding (2025)

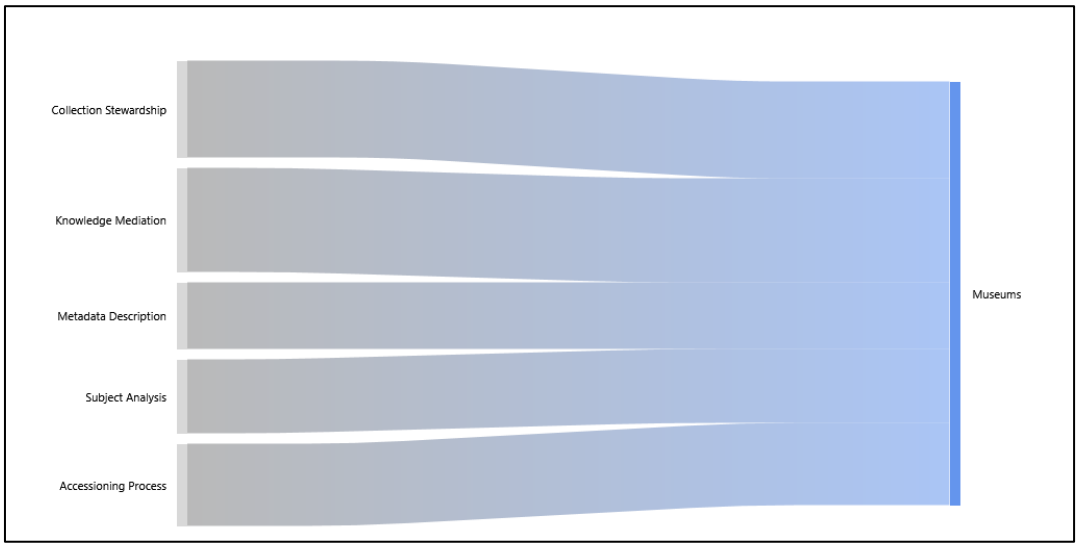


Figure 4.21 Sankey Diagram of Knowledge Organization Practices in the Sawahlunto Municipality Museums

The Sawahlunto Municipality Museums KO practices emphasize collection stewardship and exhibit curation. Object accessioning and physical preservation are systematically conducted, reflecting strong stewardship traditions. However, metadata description and subject analysis remain underdeveloped, with cataloguing often reliant on descriptive labels or curator narratives rather than structured vocabularies. This human-centered orientation fosters cultural richness but limits semantic precision.

4.5.1.2 Knowledge Organization Systems

In the Sawahlunto Municipality Museums, which function as repositories of the material and intangible legacies of the OCMHS, the effective implementation of *KOS* is particularly critical given the complex interplay of industrial, cultural, and socio-historical dimensions embedded in their collections. The analysis in this subsection focuses on four components, including *classification scheme*, *controlled vocabulary*, *schema alignment*, and *vocabulary* hierarchy, as shown in Table 4.21 and Figure 4.22, as applied in the museum setting.

Table 4.21
Knowledge Organization Systems in the Sawahlunto Municipality Museums

Knowledge Organization Systems	By Informants								By Institutions
	Heritage Expert 1	Heritage Expert 2	Curator 1	Curator 2	Museum Director	Registrar 1	Registrar 2	Museum User	Totals in Museums
Classification Scheme	1	1	5	4	1	2	2	0	16
Controlled Vocabulary	0	0	2	2	0	1	0	0	5
Schema Alignment	1	1	3	3	1	2	2	0	13
Vocabulary Hierarchy	1	1	3	1	1	1	2	0	10
Totals	3	3	13	10	3	6	6	0	44

Source: Researcher finding (2025)

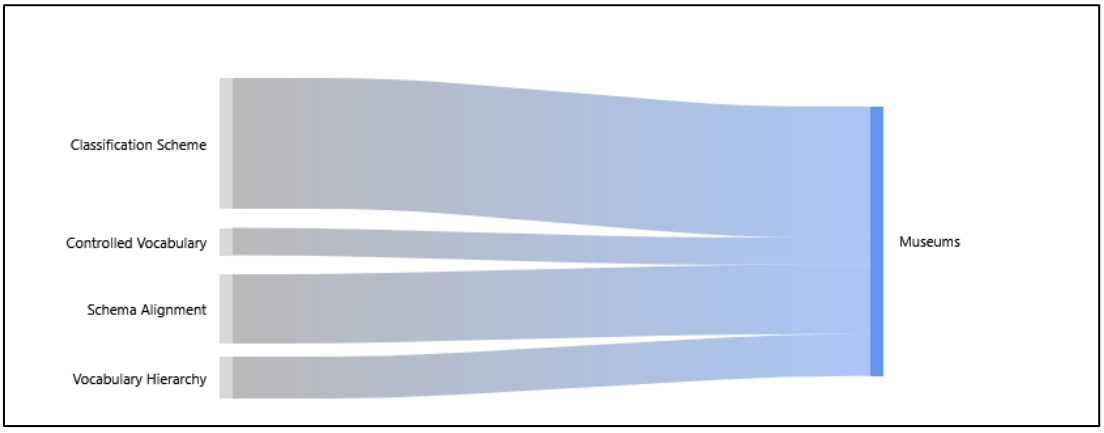


Figure 4.22 Sankey Diagram of Knowledge Organization Systems in the Sawahlunto Municipality Museums

The use of formal classification systems is minimal. The Sawahlunto Municipality Museums employ ad hoc descriptive practices, sometimes using Excel sheets or simple catalogues that are not aligned with international KOS standards. Controlled vocabularies are rarely applied, and hierarchy is shallow, focusing on object type or display theme rather than semantic depth. This reinforces internal curatorial logics but weakens interoperability across institutions.

4.5.1.3 Digital Knowledge Systems

In the case of the Sawahlunto Municipality Museums, which serve as custodians of tangible and intangible CH associated with the OCMHS, *digital knowledge systems* represent both an operational necessity and a strategic opportunity for sustainable preservation, enhanced public engagement, and interoperability across CHIs. This subsection critically examines four components of *digital knowledge systems*, including *digitization preparedness*, *digital platform*, *metadata platform*, and *system accessibility,* as shown in Table 4.22 and Figure 4.23, which visually reinforces this discrepancy between preparedness and implementation, based on triangulated data from interviews, field observations, and institutional documentation.

Table 4.22
Digital Knowledge Systems in the Sawahlunto Municipality Museums

Digital Knowledge Systems	By Informants								By Institutions
	Heritage Expert 1	Heritage Expert 2	Curator 1	Curator 2	Museum Director	Registrar 1	Registrar 2	Museum User	Totals in Museums
Digital Platform	0	0	1	1	0	0	1	0	3
Digitization Preparedness	1	0	3	3	2	2	3	0	14
Metadata Platform	0	0	0	0	0	0	0	0	0
System Accessibility	0	0	0	0	0	0	0	0	0
Totals	1	0	4	4	2	2	4	0	17

Source: Researcher finding (2025)

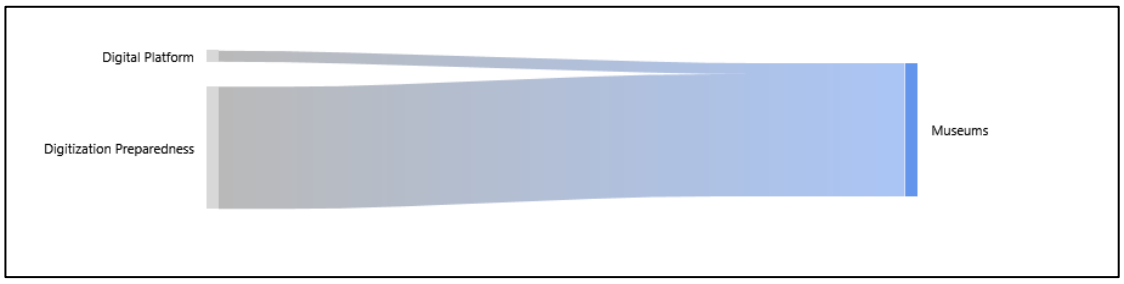


Figure 4.23 Sankey Diagram of Digital Knowledge Systems in the Sawahlunto Municipality Museums

Digital infrastructures are uneven. The Sawahlunto Municipality museums have begun digitizing their collections, but efforts are fragmented and often tied to exhibitions rather than to systematic archiving. Metadata platforms are absent, and there is no central repository for discovery. Accessibility is further constrained by reliance on static displays, limiting broader digital engagement.

4.5.1.4 Standardization Framework

Within the Sawahlunto Municipality Museums, which are responsible for preserving and communicating the multifaceted CH of the OCMHS, standardization is essential to align curatorial and collection management practices with established professional norms and to enable integration across CHIs. This section critically evaluates the extent of implementation of five key codes, including *vocabulary compliance*, *standard documentation*, *retrieval structure*, *scheme integration*, and *metadata standard*, as shown in Table 4.23 and Figure 4.24, which further illustrates the distribution of emphasis across the four codes.

Table 4.23
Standardization Framework in the Sawahlunto Municipality Museums

Standardization Framework	**By Informants**								**By Institutions**
	Heritage Expert 1	**Heritage Expert 2**	**Curator 1**	**Curator 2**	**Museum Director**	**Registrar 1**	**Registrar 2**	**Museum User**	**Totals in Museums**
Retrieval Structure	1	1	1	0	1	0	0	0	4
Scheme Integration	0	0	1	1	0	1	0	1	4
Standard Documentation	0	0	3	1	1	0	1	2	8
Vocabulary Compliance	1	2	2	2	1	1	2	1	12
Metadata Standard	0	0	0	0	0	0	0	0	0
Totals	2	3	7	4	3	2	3	4	28

Source: Researcher finding (2025)

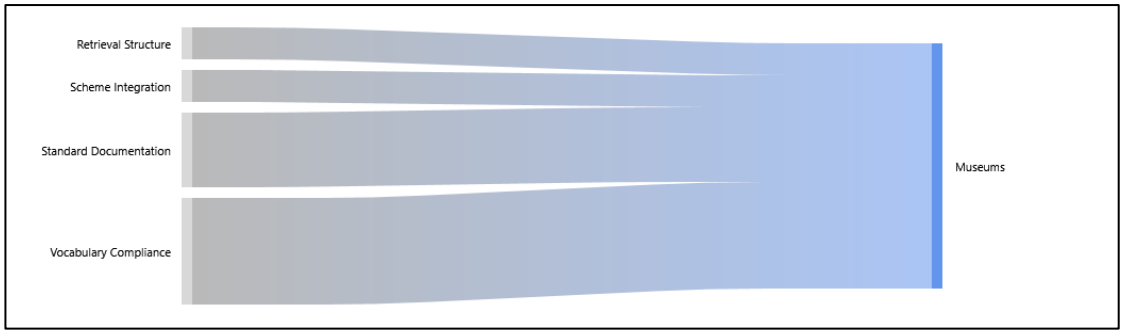


Figure 4.24 Sankey Diagram of Standardization Framework in the Sawahlunto Municipality Museums

Standardization remains weak at Sawahlunto Municipality Museums. While some practices echo museum documentation norms such as object identity, provenance notes, and basic catalogs, there is little integration with international standards.

Retrieval mechanisms at Sawahlunto Municipality Museums are mostly manual and localized, impeding interoperability across Sawahlunto Municipality's CHIs. This creates gaps in cross-institutional knowledge exchange.

4.5.1.5 Cultural Heritage Representation

Within the Sawahlunto Municipality Museums, which function as custodians of the OCMHS CH, representational practices extend beyond the preservation of tangible artifacts to include the articulation of *intangible CH*, *narrative description*, *local terminology*, and *sociohistorical reference*, as shown in Table 4.24 and Figure. 4.25. These codes collectively capture the interpretive strategies through which the museums situate their collections within broader cultural and historical frameworks.

Table 4.24
Cultural Heritage Representation in the Sawahlunto Municipality Museums

Cultural Heritage Representation	By Informants								By Institutions
	Heritage Expert 1	**Heritage Expert 2**	**Curator 1**	**Curator 2**	**Museum Director**	**Registrar 1**	**Registrar 2**	**Museum User**	**Totals in Museums**
Intangible Cultural Heritage	2	1	5	8	2	2	3	9	32
Local Terminology	1	0	2	3	0	1	1	6	14
Narrative Description	1	1	4	6	1	2	3	6	24
Sociohistorical Reference	1	1	2	4	1	1	2	1	13
Totals	5	3	13	21	4	6	9	22	83

Source: Researcher finding (2025)

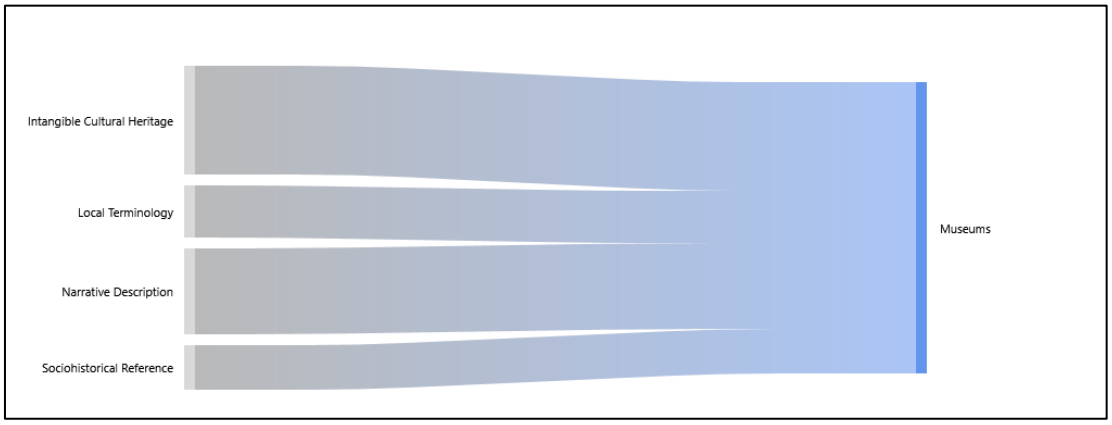


Figure 4.25 Sankey Diagram of Cultural Heritage Representation in the Sawahlunto Municipality Museums

The Sawahlunto Municipality Museums excel at narrative and cultural contextualization. Exhibits incorporate local terminologies and embed artifacts within sociohistorical narratives of mining, colonial life, and community traditions. Intangible CH, such as oral tradition and arts performance, is often represented through exhibition design, though rarely documented systematically in catalogues. This creates a rich but non-standardized landscape of representations.

4.5.2 Critical Factors Influencing the Taxonomy Development at the Sawahlunto Municipality Museums

4.5.2.1 Knowledge Organization Limitations

As key custodians of OCMHS's industrial and socio-cultural heritage, the Sawahlunto Municipality Museums face constraints that not only compromise the efficiency of internal processes but also reduce their capacity to engage with broader CH networks. The limitations identified in this study can be grouped into four major categories, including *classification rigidity*, *infrastructure constraints*, *fragmented sources*, and *manual dependency*, as shown in Table 4.25 and Figure 4.26.

Table 4.25
Knowledge Organization Limitations in the Sawahlunto Municipality Museums

Knowledge Organization Limitations	By Informants								By Institutions
	Heritage Expert 1	Heritage Expert 2	Curator 1	Curator 2	Museum Director	Registrar 1	Registrar 2	Museum User	Totals in Museums
Classification Rigidity	2	1	6	8	3	1	2	4	27
Fragmented Sources	3	3	4	1	3	4	1	5	24
Infrastructure Constraints	2	0	7	2	4	4	4	3	26
Manual Dependency	1	1	3	1	1	1	1	1	10
Totals	8	5	20	12	11	10	8	13	87

Source: Researcher finding (2025)

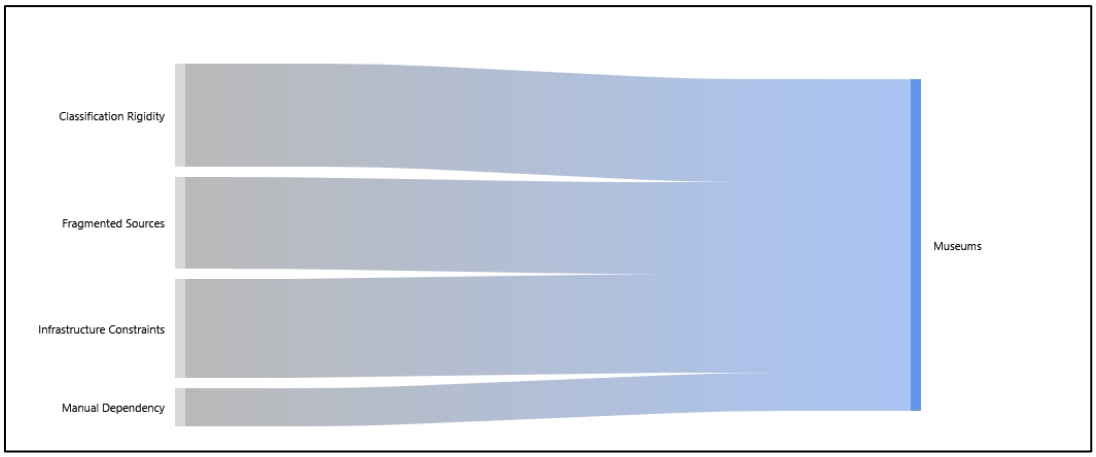


Figure 4.26 Sankey Diagram of Knowledge Organization Limitations in the Sawahlunto Municipality Museums

Key limitations in the Sawahlunto Municipality Museums include the absence of structured metadata, dependence on manual cataloguing, and fragmented digitization initiatives. These constraints make the Sawahlunto Municipality Museums vulnerable to data loss, hinder cross-domain access, and reduce the potential for linked discovery.

4.5.2.2 Knowledge Organization Challenges

As CHIs embedded in the OCMHS ecosystem, the Sawahlunto Municipality Museums must balance the dual responsibilities of adhering to professional standards while ensuring that local cultural meanings, narratives, and community identities are adequately reflected. This subsection identifies four major codes of *KO challenges*, including *contextual adaptation*, *user-based approach*, *taxonomy co-creation*, and *classification growth*, as shown in Table 4.26 and Figure 4.27, which provides a visual representation of the distribution and weight of the identified *KO challenges.*

Table 4.26
Knowledge Organization Challenges in the Sawahlunto Municipality Museums

Knowledge Organization Challenges	**By Informants**								**By Institutions**
	Heritage Expert 1	**Heritage Expert 2**	**Curator 1**	**Curator 2**	**Museum Director**	**Registrar 1**	**Registrar 2**	**Museum User**	**Totals in Museums**
Classification Growth	0	0	2	3	1	1	1	1	9
Contextual Adaptation	2	1	3	10	3	2	2	6	29
Taxonomy Co-Creation	0	1	4	4	1	3	1	6	20
User-Based	1	2	5	4	3	3	2	3	23
Totals	3	4	14	21	8	9	6	16	81

Source: Researcher finding (2025)

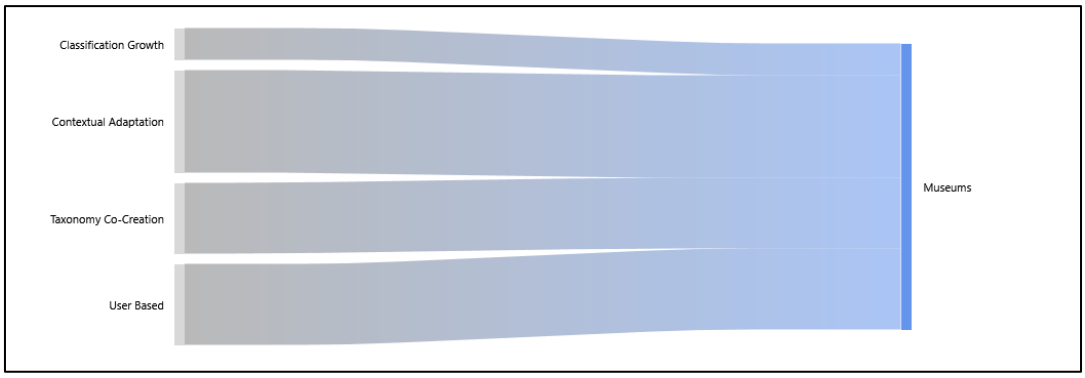


Figure 4.27 Sankey Diagram of Knowledge Organization Challenges in the Sawahlunto Municipality Museums

Challenges at the Sawahlunto Municipality Museums arise from the tension between narrative freedom and structural consistency. Curators value storytelling and local terminologies, but these practices are difficult to reconcile with the technical vocabularies required for interoperability. Additionally, the lack of mechanisms for co-creating taxonomy prevents local communities from contributing to artifact classification, reducing inclusivity.

4.5.2.3 Knowledge Organization Opportunities

In the context of the Sawahlunto Municipality museums, these opportunities reflect not only internal institutional readiness but also broader systemic opportunities to enhance collaboration, digital transformation, and culturally responsive representation of OCMHS CH. This subsection examines five key opportunity codes, including capacity development, contextual customization, convergence, open access, and practice benchmarking, as shown in Table 4.27 and Figure 4.28.

Table 4.27
Knowledge Organization Opportunities in the Sawahlunto Municipality Museums

Knowledge Organization Opportunities	**By Informants**								**By Institutions**
	Heritage Expert 1	**Heritage Expert 2**	**Curator 1**	**Curator 2**	**Museum Director**	**Registrar 1**	**Registrar 2**	**Museum User**	**Totals in Museums**
Capacity Development	6	5	6	8	3	4	4	0	36
Contextual Customization	1	6	12	2	3	4	1	4	33
Convergence	2	2	3	9	2	1	3	2	24
Open Access	3	1	4	5	5	3	1	2	24
Practice Benchmarking	2	1	1	1	0	1	1	1	8
Totals	14	15	26	25	13	13	10	9	125

Source: Researcher finding (2025)

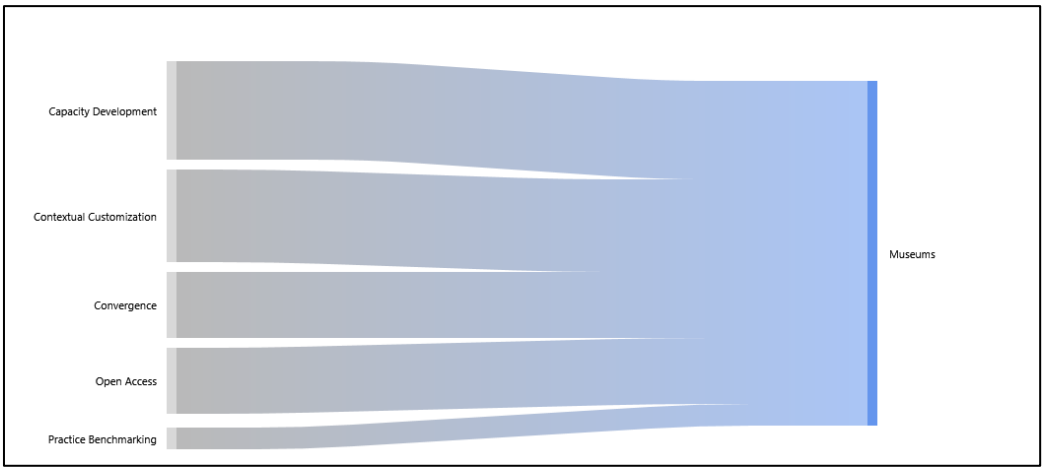


Figure 4.28 Sankey Diagram of Knowledge Organization Opportunities in the Sawahlunto Municipality Museums

Museums at Sawahlunto Municipality offer substantial opportunities in cultural representation, community engagement, and participatory design. The emphasis on local terminology and narrative interpretation provides a strong basis for embedding community voices into taxonomy development. Furthermore, museums' experiential orientation aligns well with digital storytelling and Semantic Web tools, creating opportunities for innovative integration.

4.5.3 Overview of Existing Conditions of Knowledge Organization Processes and Critical Factors Influencing the Taxonomy Development at the Sawahlunto Municipality Museums

Sawahlunto Municipality Museums highlight the need for a taxonomy that captures cultural narratives, integrates local terminology, and provides structural interoperability. This requires balancing curatorial freedom with standardized frameworks, ensuring that heritage interpretation remains authentic while also technically functional. Among all identified themes, as shown in Table 4.28 and Figure 4.29, which provides a dynamic visualization of the relative weight of each theme.

Table 4.28
Existing Conditions of Knowledge Organization Processes and Critical Factors Influencing the Taxonomy Development at the Sawahlunto Municipality Museums

Concepts	Themes	By Informants								By Institutions
		Heritage Expert 1	Heritage Expert 2	Curator 1	Curator 2	Museum Director	Registrar 1	Registrar 2	Museum User	Totals in Museums
Knowledge Organization Processes	Knowledge Organization Practices	4	8	11	11	8	10	9	1	62
	Knowledge Organization Systems	3	3	13	10	3	6	6	0	44
	Standardization Framework	2	3	7	4	3	2	3	4	28
	Digital Knowledge Systems	1	0	4	4	2	2	4	0	17
	Cultural Heritage Representation	5	3	13	21	4	6	9	22	83
Critical Factors	Knowledge Organization Limitations	8	5	20	12	11	10	8	13	87
	Knowledge Organization Challenges	3	4	14	21	8	9	6	16	81
	Knowledge Organization Opportunities	14	15	26	25	13	13	10	9	125
Totals		40	41	108	108	52	58	55	65	527

Source: Researcher finding (2025)

The museum data reflected in Table 4.28 demonstrate a comparatively higher concentration of culturally embedded semantics and narrative-based classification practices. However, this richness in interpretive content is accompanied by inconsistencies in formal metadata structuring and digital integration. The code distributions reveal an institutional orientation toward storytelling and curatorial interpretation rather than standardized semantic alignment. This imbalance illustrates how museums contribute strong cultural contextualization while lacking systemic interoperability mechanisms.

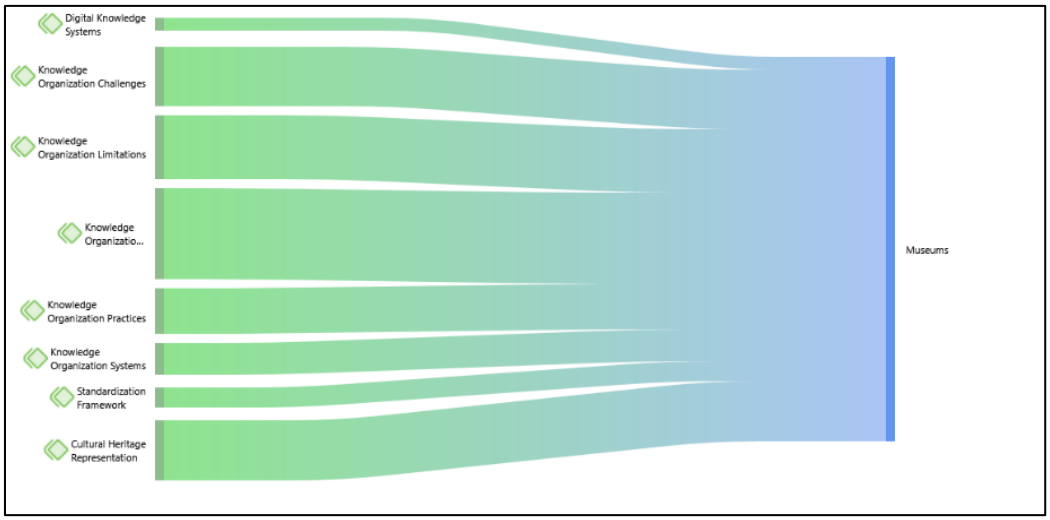


Figure 4.29 Sankey Diagram of Existing Conditions of Knowledge Organization Processes and Critical Factors Influencing the Taxonomy Development at the Sawahlunto Municipality Museums

The case of Sawahlunto Municipality Museums illustrates a paradox of richness without systematization: their cultural narratives and local terminologies enrich heritage interpretation, yet their weak metadata structures and fragmented digital systems limit broader accessibility. Patterns observed in manual cataloguing, reliance on curator narratives, limited standardization, and uneven digitization mirror systemic challenges across CHIs.

For RO1, this case confirms that existing KO practices in museums prioritize cultural authenticity over technical precision. For RO2, it identifies taxonomy requirements, including 1) Embedding local terminologies and narratives as primary labels, supplemented with standardized equivalents for interoperability; 2) Developing structured metadata frameworks aligned with international KOS standards to complement curatorial practices; 3) Establishing cross-institutional metadata crosswalks to bridge museums, archives, and libraries; and 4) Leveraging museums'

cultural strengths for participatory taxonomy development, ensuring community voices are systematically represented.

Moreover, museums demonstrate both the richness and fragility of KO within the CH context, including richness in cultural meaning, fragility in technical resilience. Their experiences underscore the central rationale for a contextualized taxonomy that is both culturally embedded and globally interoperable, directly advancing the objectives of this study.

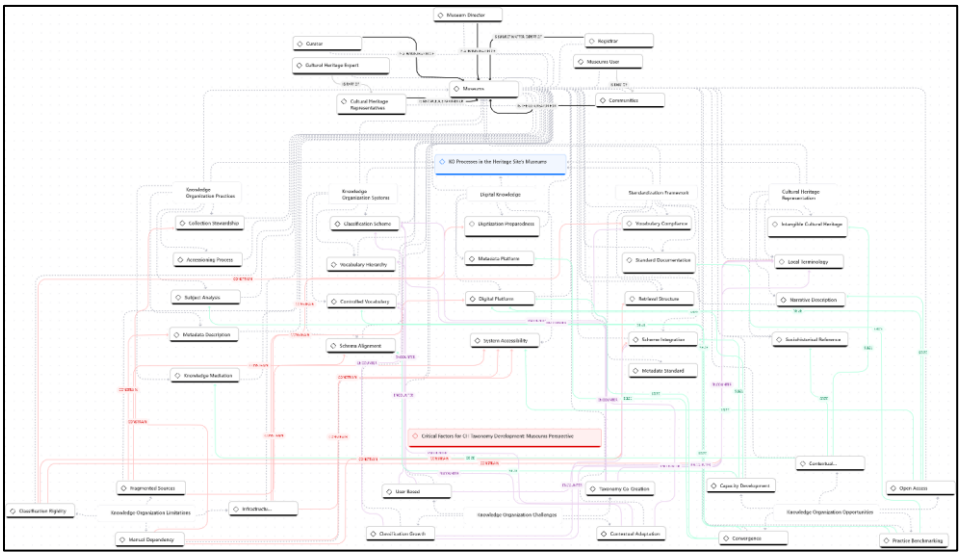


Figure 4.30 Network Model of Existing Conditions of Knowledge Organization Processes and Critical Factors Influencing the Taxonomy Development at the Sawahlunto Municipality Museums

The network model illustrated in Figure 4.30 provides a comprehensive visualization of the interrelationships between institutional actors, KO processes, and the critical factors influencing the development of a contextualized taxonomy within the Sawahlunto Municipality Museums. The diagram is structured in three interdependent layers, illustrating the multidirectional and iterative nature of KO within the CH context. Rather than representing a linear progression, the model captures the complexity of institutional dynamics, showing how decision-making, operational processes, and reform drivers converge to shape the development of the taxonomy.

The first layer is the actor layer, which identifies the principal stakeholders engaged in KO-related decision-making and implementation. These include the museum director, curators, registrars, CH experts, and museum users. The arrangement of connections reflects both hierarchical and collaborative relationships. Solid lines denote formal reporting or authority structures, such as those from the museum director

to the curators and registrars. In contrast, dotted lines indicate advisory and consultative linkages, such as those between CH experts and museum staff or subject-matter experts in museums. The positioning of communities or users reflects their dual role as both knowledge contributors and end beneficiaries, providing cultural validation and ensuring that the taxonomy reflects lived heritage experiences. Curators and registrars are depicted as operational intermediaries who interpret strategic direction into practical *KO practices*, while CH experts offer specialist input to align classification practices with socio-historical authenticity.

The second layer is the KO processes layer, which constitutes the operational core of the network. It integrates five themes, including *KO practices*, *KOS*, *digital knowledge*, *a standardization framework*, and *CH representation*. Each component is interconnected, showing functional dependencies. For example, schema alignment directly supports metadata structuring, while local terminology enhances *CH representation*. Color-coded directional flows clarify whether connections are associated with *KO limitations* (red), *KO challenges* (purple), or *KO opportunities* (green), providing an immediate visual cue of systemic strengths and weaknesses. The third layer is the justification layer, which encapsulates the strategic and operational rationale for developing the taxonomy. It is organized into three thematic clusters, including *KO limitations*, *KO challenges*, and *KO opportunities*. These clusters are directly linked to specific KO process nodes, demonstrating how constraints, such as infrastructure limitations, arise from and influence core operational areas, such as digital platform implementation. In contrast, opportunities such as capacity development are closely tied to the advancement of metadata standards and digitization readiness.

From an interpretive standpoint, the density of connections in the model underscores the non-linear, interdependent, and multi-scalar nature of taxonomy development in the Sawahlunto Municipality Museums. Limitations are shown to exert downward pressure on system adaptability, particularly where rigid classification frameworks and fragmented data sources restrict semantic expressiveness and interoperability. Conversely, opportunities, most notably in capacity building, contextual customization, and inter-institutional convergence, emerge as strategic leverage points capable of catalyzing system reform. The coexistence of these countervailing forces reflects the museum's transitional status as a CHI with established operational routines yet actively seeking structural innovations that reconcile formal classification standards with local cultural realities.

Ultimately, this network model functions as both a diagnostic and prescriptive tool. It captures the current state of KO within museums, revealing where cultural representation and standardization intersect or conflict, and mapping pathways for collaborative, user-centered, and technology-enabled taxonomy development. It affirms that sustainable taxonomy development in this context requires a flexible, iterative, and participatory approach that balances structural coherence with contextual sensitivity, ensuring that the resulting system is technically robust, semantically inclusive, and culturally authentic.

The network model presented in Figure 4.30 was constructed through the systematic synthesis of coded qualitative data from semi-structured interviews with museum directors, curators, registrars, CH experts, and community users, as well as from document analysis and field observations. The structural configuration of actors, KO processes, and influencing factors reflects recurring relational patterns identified during within-case analysis. To ensure contextual validity, a preliminary version of the model was discussed with selected museum stakeholders, including curators and registrars, to confirm the accuracy of depicted workflows, decision-making hierarchies, and reform drivers. This member validation process strengthened the credibility of the model by aligning analytical abstraction with institutional realities. Additionally, triangulation across interview narratives, documentary evidence, and observed practices provided methodological validation of the relationships illustrated in the network. Within the Design Science Research (DSR) framework, Figure 4.30 serves as a diagnostically validated representation for Phase A (Problem Identification), providing an empirically grounded basis for defining taxonomy design requirements in subsequent phases.

The expected user requirements derived from within-case and cross-case analysis offer actionable insights that directly inform the design and development of the proposed artifact. These requirements, spanning metadata standardization, culturally grounded classification schemes, multilingual support, flexible access control, and interoperability across systems, are not only reflective of institutional constraints but also of the aspirational capabilities envisioned by stakeholders. Importantly, these identified requirements function as the critical link between empirical diagnosis and artifact construction, namely, contextualized taxonomy, serving as the conceptual and practical foundation for the design activities in Chapter 5. In accordance with the DSR process model, these user-defined needs guide the transition to Phase C until Phase F,

ensuring that the artifact responds meaningfully to real-world institutional contexts and is co-shaped by the end-users it intends to serve.

The findings from this overview reveal that strong cultural representational practices and significant systemic deficiencies simultaneously characterize knowledge organization within the Sawahlunto Municipality Museums. The prominence of cultural heritage representation underscores the museum's success in embedding intangible traditions, narrative storytelling, and local terminologies within its curatorial practices. This strength positions the museums as critical mediators of collective memory and community identity, demonstrating their epistemological role beyond object custodianship. However, the limited emphasis on digital knowledge systems highlights a persistent gap in the technological infrastructure necessary to support long-term preservation, interoperability, and digital accessibility.

At the strategic level, the coexistence of substantial opportunities alongside persistent limitations and challenges illustrates a transitional institutional environment. Opportunities such as capacity development, contextual customization, and inter-institutional convergence signal readiness for reform and indicate strong human capital and cultural flexibility within the museums. Conversely, barriers such as classification rigidity, fragmented sources, and the absence of participatory mechanisms reinforce institutional inertia, constraining adaptive capacity. These tensions imply that taxonomy development must be conceptualized not only as a technical intervention but also as a socio-technical transformation embedded within cultural, operational, and institutional realities.

Overall, the analytical implications highlight three critical insights. *First*, the development of a contextualized taxonomy must leverage the museums' representational strengths while simultaneously addressing infrastructural and systemic weaknesses. *Second*, the taxonomy must be designed to reconcile institutional routines with community knowledge systems, ensuring that classification structures are semantically rich, culturally grounded, and socially inclusive. *Third*, sustainable reform requires balancing short-term interventions such as capacity-building and metadata structuring with long-term strategies for interoperability, digital transformation, and participatory governance. Collectively, these implications affirm that the museums' transition toward contextualized taxonomy is both feasible and necessary, provided that opportunities are strategically harnessed and systemic barriers are systematically addressed.

4.6 Cross-Case Analysis of Knowledge Organization Processes and Critical Factors Influencing Taxonomy Development

The cross-case analysis brings together insights from libraries, archives, and museums to illuminate broader patterns of KO within the OCMHS. While each institution demonstrates distinct traditions, their shared challenges and opportunities converge on critical themes that directly address RO1 and RO2. This synthesis reveals systemic fragmentation, uneven adoption of standards, weak digital infrastructures, and strong but underutilized cultural narratives.

While the preceding tables provide institution-specific coding distributions, their analytical significance emerges more clearly when examined comparatively. The cross-case Table 4.28 and Figures 4.29 to 4.30 are not intended to present frequency counts in isolation, but to reveal patterned divergences and convergences across institutional types. Through replication logic, these tables highlight systemic asymmetries in stewardship emphasis, semantic modeling, and digital readiness. The comparative patterns provide the empirical basis for identifying structural tensions that inform the design requirements for the taxonomy.

Taken together, Table 4.28 and Figures 4.29 to 4.30 do not merely quantify thematic occurrences but illuminate structural imbalances across CHIs. The frequency distributions signal institutional priorities, epistemic orientations, and varying levels of digital maturity; rather than interpreting numerical differences as statistical claims, the tables function as analytical indicators that support qualitative interpretation. Their cumulative significance lies in revealing the asymmetric development of knowledge-organization features across libraries, archives, and museums. These asymmetries directly inform the articulation of critical needs and convergence dimensions presented in the subsequent section.

4.6.1 Commonalities in the Existing Condition of Knowledge Organization Process

Across the CHIs of the OCMHS, a set of recurring patterns characterizes the existing condition of knowledge organization (KO). Although each institution operates within its own disciplinary logic and descriptive tradition, several structural similarities reveal systemic constraints that transcend institutional boundaries. These include

fragmentation of knowledge organization systems, digital fragility, and representational gaps. These commonalities not only describe the current state of KO practices but also directly inform the structural architecture of the contextualized taxonomy developed in this study.

First, fragmentation emerges as the most pervasive condition. The Sawahlunto Municipality Library relies primarily on bibliographic standards such as DDC and INDOMARC; the Sawahlunto Municipality Archives adhere to ISAD(G) and ANRI guidelines rooted in provenance and original order; and the Sawahlunto Municipality Museums organize collections through curatorial narratives and object-centered interpretation. While these approaches reflect disciplinary coherence, their application remains institution-specific and disconnected. The absence of shared semantic bridges prevents cross-institutional discoverability and inhibits the construction of an integrated heritage narrative for OCMHS.

This fragmentation was not treated merely as a coordination problem but was translated into a core design principle. The taxonomy, therefore, incorporates a multi-layered structure consisting of: 1) a shared upper-level conceptual framework applicable across CHIs; 2) domain-specific extensions that preserve disciplinary logics; and 3) cross-referencing mechanisms that function as semantic bridges between library subject access, archival provenance descriptors, and museum object narratives. In this way, fragmentation becomes the justification for embedding interoperability as an intrinsic structural layer within the taxonomy rather than an external add-on.

Second, digital fragility is consistently observed across institutions. Although the library employs an automation system, its digital infrastructure remains limited in scalability and integration. The archives continue to rely heavily on manual inventories and basic digital files, while the museums maintain ad hoc catalogues and standalone registries. These systems lack interoperability and are not designed for long-term digital sustainability.

This uneven digital maturity directly informed the technical configuration of the taxonomy. Rather than designing a technologically complex system requiring advanced infrastructure, the taxonomy was structured to be modular, lightweight, and scalable. Hierarchical depth was intentionally controlled, semantic relationships were simplified without sacrificing granularity, and category structures were designed to be implementable in both analog and digital environments. Modularity enables incremental adoption, allowing CHIs to implement components progressively

according to institutional capacity. Thus, digital fragility informed the taxonomy's emphasis on simplicity, extensibility, and compatibility with low-resource contexts.

Third, a narrow scope of representation is evident across CHIs. Institutional records and formal documentation dominate descriptive practices, while intangible CH, local terminologies, oral traditions, and community-specific epistemologies remain inconsistently integrated. Although museums occasionally incorporate local narratives, such practices are rarely standardized or cross-referenced with library and archival vocabularies. As a result, significant dimensions of OCMHS heritage remain semantically underrepresented.

This representational gap was addressed by introducing dedicated semantic facets within the taxonomy. New upper-level and mid-level categories were designed to explicitly accommodate intangible cultural heritage, sociohistorical context, community terminology, and local knowledge systems. Dual-labelling mechanisms were incorporated to align international standards with local descriptors, ensuring that cultural specificity does not compromise interoperability. In this sense, representational deficits directly shaped the taxonomy's semantic inclusivity and hierarchical design.

Taken together, these commonalities reveal that KO within OCMHS is characterized by institutional isolation, uneven digital readiness, and incomplete cultural representation. However, these conditions were not treated solely as diagnostic observations. Instead, they were systematically translated into structural features of the taxonomy, including interoperability layers, modular architecture, and culturally embedded semantic categories. This translation marks the transition from empirical diagnosis (DSR Phase A–B) to artifact construction (Phase C), ensuring that the proposed taxonomy is grounded in the lived operational realities of CHIs.

4.6.2 Critical Factors Influencing Taxonomy Development

Beyond the identified structural commonalities, the cross-case analysis also reveals a constellation of critical factors shaping the trajectory of taxonomy development within the OCMHS context. These factors manifest as operational limitations, conceptual and participatory challenges, and institutional opportunities. Importantly, these elements do not function merely as background; they serve as explicit design parameters in the development of the taxonomy.

The first cluster of factors concerns KO limitations. Infrastructural constraints,

including limited hardware capacity, unstable connectivity, and continued reliance on manual registries, restrict the operational scalability of KO practices. Additionally, rigid application of universal classification schemes such as DDC and ISAD(G) constrains semantic flexibility and limits the representation of culturally nuanced concepts.

These limitations informed two critical design responses. First, infrastructural constraints led to prioritizing structural clarity over technological sophistication, ensuring that the taxonomy remains implementable without requiring advanced digital platforms. Second, classification rigidity motivated the development of contextual semantic extensions, enabling local terminology and culturally specific descriptors to coexist within standardized hierarchical frameworks. This hybrid structure reconciles global metadata alignment with local epistemological richness.

The second cluster comprises KO challenges that are conceptual and participatory. Informants emphasized the marginalization of indigenous terminology, oral traditions, and intangible CH within existing systems. User perspectives further revealed that institutional logics often misalign with everyday information-seeking behavior. Moreover, the absence of participatory mechanisms prevents communities from contributing to definitional and classificatory decisions.

These challenges were directly translated into governance and structural components within the taxonomy framework. Participatory gaps informed the integration of iterative validation mechanisms, including stakeholder feedback loops and co-creation sessions embedded within the DSR cycle. Conceptual misalignment between institutional and community vocabularies led to the incorporation of dual-labelling systems and cross-domain descriptors. The taxonomy is therefore designed as a dialogic infrastructure rather than a static classification tool, allowing refinement through iterative stakeholder engagement.

The third cluster consists of KO opportunities. Across CHIs, institutional actors demonstrated openness to capacity development, contextual customization, convergence, and open access initiatives. Unlike the limitations and challenges that constrain the feasibility of taxonomy, these opportunities function as enabling conditions for reform.

These enabling conditions shaped the taxonomy's interoperability architecture. Recognizing institutional readiness for convergence, the design incorporates cross-referencing capabilities, metadata mapping, and extensible semantic layers to support long-term cross-CHI integration. Capacity development readiness also informed the

inclusion of documentation guidelines and hierarchical transparency to facilitate professional training and adoption.

In synthesis, the critical factors influencing taxonomy development reflect a dual dynamic of constraint and potential. Limitations necessitated simplification and modularity; conceptual challenges required semantic flexibility and participatory governance; opportunities encouraged interoperability and convergence-oriented design. By explicitly translating these empirical findings into structural, semantic, and governance features, the study ensures that taxonomy development is not merely justified by context but directly shaped by it.

Through this translation, the DSR methodology fulfills its core logic: empirical diagnosis informs artifact construction, and artifact construction addresses empirically grounded needs. The resulting taxonomy is therefore positioned as a socio-technical infrastructure that reconciles disciplinary traditions, technological disparities, and community knowledge within the OCMHS heritage ecosystem.

4.6.3 Divergences Across Cases

Beyond the commonalities and shared constraints across CHIs in the OCMHS, the cross-case analysis also reveals important divergences in KO practices. These divergences arise from the distinct institutional mandates, professional traditions, and representational logics that define CHIs. While these differences reflect the diversity of CHIs, they also underscore the challenges of developing a taxonomy that is both integrative and contextually sensitive.

The first divergence is found in the principle of organization applied within each CHI. The Sawahlunto Municipality Archives operate according to the principle of provenance, emphasizing the original order and custodial history of records. This approach ensures authenticity and evidential integrity but restricts flexibility in recontextualizing materials for public discovery. In contrast, the Sawahlunto Municipality Library adheres to bibliographic classification schemes such as DDC and INDOMARC, privileging intellectual subject arrangement but lacking sensitivity to local cultural categories. The Sawahlunto Municipality Museums, meanwhile, rely on narrative-driven, curatorial logics, emphasizing storytelling and interpretative depth over formal classification. This divergence in organizing principles, provenance, bibliographic order, and narrative representation illustrates how each CHI embodies a

distinct epistemic tradition, complicating integration into a unified knowledge system.

A second divergence lies in the extent of digital transformation. The Sawahlunto Municipality Library, supported by the national library automation system, known as InlisLite Version 3.0, has made relatively greater progress in adopting digital catalogues, albeit in fragmented and incomplete forms. The Sawahlunto Municipality Museums, on the other hand, demonstrate only modest digitization efforts, often limited to ad-hoc registries or exhibition-based documentation. The Sawahlunto Municipality Archives remain the least digitized, relying heavily on manual registers and handwritten inventories. This uneven progression toward digitization reflects not only resource disparities but also differing institutional priorities. The Sawahlunto Municipality Library is more oriented toward access services, the Sawahlunto Municipality Museums toward interpretive display, and the archives toward custodial preservation.

The third divergence concerns the representation of CH itself. The Sawahlunto Municipality Library privileges published materials and institutional documentation, thereby emphasizing formal and textual knowledge. The Sawahlunto Municipality Archives, by contrast, preserve administrative records and official documentation, privileging authenticity and governance over cultural interpretation. The Sawahlunto Municipality Museums emphasize objects, material artifacts, and narrative contextualization, incorporating intangible CH and local terminologies more readily than the other two CHIs. This divergence in representational scope leads to asymmetrical coverage, including community voices and intangible CH, which are more visible in museums but remain marginalized in archival and library systems.

Moreover, the cases diverge in their readiness for taxonomy reform. Librarians expressed openness to incorporating localized vocabularies and enhancing metadata structures, suggesting moderate institutional flexibility. Archivists demonstrated strong adherence to provenance principles, expressing concerns that cross-institutional integration could compromise archival integrity. Curators, conversely, showed enthusiasm for taxonomy development that could formalize their narrative-based systems while preserving cultural authenticity. These divergent attitudes reveal differing levels of institutional willingness to pursue cross-domain reform, highlighting the negotiation required for taxonomy co-creation.

In synthesis, divergences across cases are defined by epistemic traditions, such as provenance, bibliographic order, and narrative logics; uneven digital transformation; asymmetrical cultural representation; and varied reform readiness. While these

divergences complicate the design of a unified taxonomy, they also point to the necessity of a flexible, layered, and contextually adaptive taxonomy framework. Such a framework must preserve archival integrity, respect bibliographic order, and embrace curatorial narratives, while also enabling interoperability and cultural inclusivity. These findings reinforce the rationale for a contextualized taxonomy that balances standardization with pluralism, ensuring that integration does not erase but rather accommodates the institutional distinctiveness of each CHI within the OCMHS.

4.6.4 Integrated Cross-Case Synthesis and Visual Mapping

The integrated synthesis of cross-case findings reveals a systemic and multi-layered picture of the KO ecosystem across CHIs within the OCMHS. Building upon Sections 4.6.1 through 4.6.2, this synthesis consolidates institutional practices, structural constraints, and reform drivers into a unified interpretive framework. The purpose is not only to visualize thematic distributions but to explain the institutional logics underlying these patterns. Through visual mapping techniques, structural convergences, divergences, and interdependencies are identified and analytically interpreted, providing a holistic foundation for the subsequent design phase in Chapter 5. Figure 4.31 presents a Sankey diagram illustrating thematic flows between KO process domains and CHI clusters. The width of each stream corresponds to coding frequency, indicating the relative salience of themes within each institutional context.

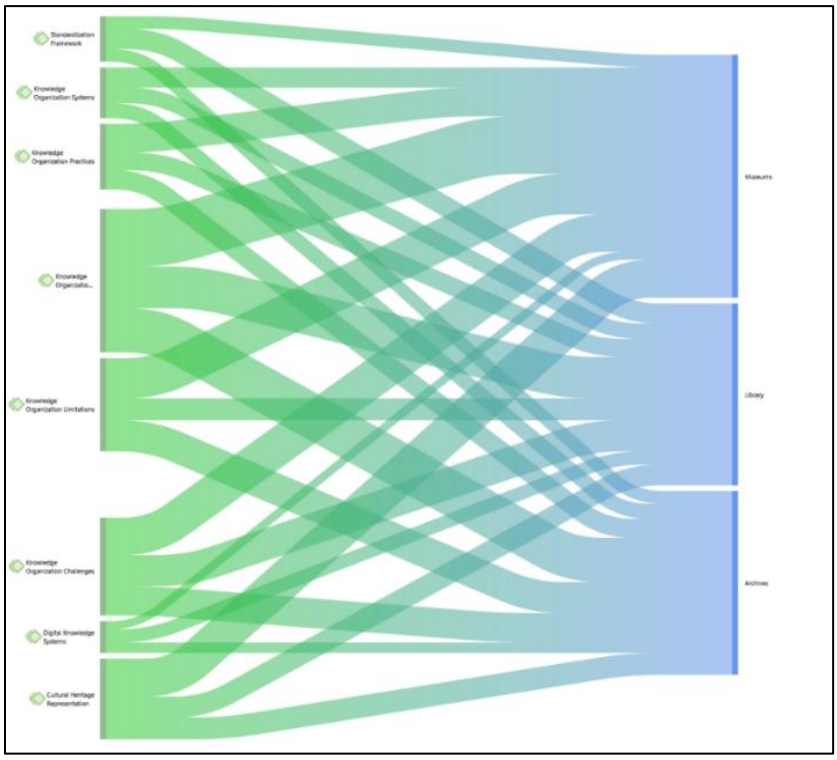


Figure 4.31 Sankey Diagram of Existing Conditions of Knowledge Organization Processes and Critical Factors Influencing the Taxonomy Development at the Sawahlunto Municipality Cultural Heritage Institutions

The diagram shows dominant flows from KO challenges, KO limitations, and CH representation across CHIs. The Sawahlunto Municipality Museums exhibit the strongest association with CH representation. This prominence reflects their institutional mandate as interpretive and narrative-centered institutions, where storytelling, exhibition logic, and symbolic mediation constitute the core operational focus. Their governance structure prioritizes cultural communication and public engagement, which explains the strength of representational flows.

The Sawahlunto Municipality Library demonstrates stronger linkages with the standardization framework. This pattern is attributable to the professional training of librarians and their institutional obligation to comply with bibliographic standards such as INDOMARC, DDC, and RDA. As a public information service unit operating within a regulated library governance system, the unit emphasizes standardization, which is structurally embedded in its workflow.

The Sawahlunto Municipality Archives are characterized by increased flows due to KO limitations and KO challenges. This pattern can be explained by infrastructural constraints and governance arrangements that prioritize record preservation over system modernization. The archives operate under rigid

administrative mandates emphasizing provenance and evidential integrity, which limits flexibility and slows digital transformation. The relative scarcity of technical staff and digital resources further amplifies these constraints.

Conversely, thinner flows from digital knowledge systems and KOS across CHIs reflect uneven technological investment and limited institutional capacity for integrated metadata infrastructure. These weaker flows are not indicative of conceptual neglect but rather reflect resource limitations, fragmented digital initiatives, and the absence of coordinated governance for digital transformation across CHIs. Complementing this analysis, Figure 4.32 presents a consolidated network model integrating actor configurations, KO process domains, and systemic drivers influencing taxonomy development.

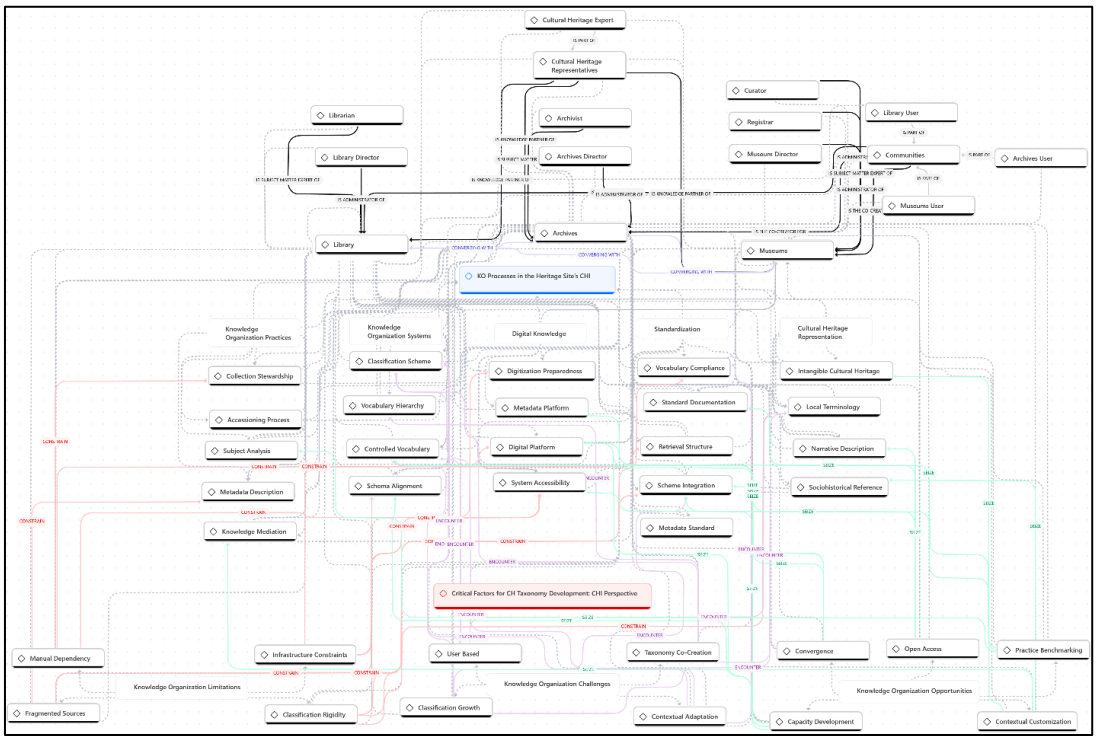


Figure 4.32 Network Model of Existing Conditions of Knowledge Organization Processes and Critical Factors Influencing Taxonomy Development at the Sawahlunto Municipality Cultural Heritage Institutions

The actor layer illustrates governance and operational roles. Solid connectors represent formal authority structures, while dotted connectors indicate advisory and participatory relationships. The predominance of hierarchical connectors reflects centralized administrative governance within municipal CHIs. This structural arrangement explains the limited cross-institutional collaboration observed in earlier sections. Participatory linkages appear weaker because community engagement

mechanisms remain informal and episodic rather than institutionally embedded.

The KO processes layer consolidates thematic domains and demonstrates interdependencies, such as schema alignment, that feed into metadata description and local terminology, enriching CH representation. The density of connections surrounding CH representation and KO challenges reflects the high cultural salience of OCMHS and the mounting pressures for institutional reform. National policy imperatives, UNESCO recognition, and rising community expectations for inclusive representation of heritage reinforce these patterns.

The justification layer visualizes systemic drivers: limitations (red), challenges (purple), and opportunities (green). The strong presence of opportunity flows indicates institutional openness to capacity development and convergence. This is consistent with interview data showing professional willingness to adopt new frameworks, provided adequate training and infrastructural support are available. The coexistence of strong limitations and opportunities suggests a transitional institutional environment—one characterized by structural constraints and reform readiness.

From a cross-case perspective, the synthesis affirms that taxonomy reform must fulfil two interrelated requirements, including contextual sensitivity and global interoperability. The strong CH representation flows indicate the need to embed sociohistorical values and local terminology within the taxonomy layers. The strong standardization flows highlight the need to maintain alignment with international metadata standards. The weaker digital flows signal that the taxonomy must remain technically adaptable and scalable to uneven infrastructural environments.

The synthesis further reveals institutional interdependence. Museums require stronger metadata rigor to complement narrative richness; libraries require semantic flexibility to integrate culturally embedded descriptors; archives require digital upgrading and reduced classification rigidity to enable interoperability. These asymmetries are structurally linked to governance mandates, resource allocation patterns, and professional training backgrounds.

The cross-case network model presented in Figure 4.32 was constructed through an integrative synthesis of coded data from the three institutional cases, namely the Sawahlunto Municipality Library, Archives, and Museums. The structural relationships depicted in the model emerged from comparative thematic analysis and frequency-weighted coding patterns across Tables 4.10, 4.19, and 4.28. To enhance analytical credibility, the integrative configuration was reviewed through cross-case validation by

comparing recurrent themes, actor configurations, and systemic drivers identified independently in each institutional model (Figures 4.10, 4.20, and 4.30). This process ensured that the cross-case abstraction did not override institutional distinctiveness but instead reflected empirically grounded patterns of convergence. Furthermore, triangulation across interview data, documentary analysis, and visual mapping outputs from ATLAS.ti strengthened the methodological validation of the relationships illustrated. Within the DSR framework, Figure 4.32 represents a synthesized diagnostic artifact corresponding to Phase A (Problem Identification) and Phase B (Definition of Objectives of a Solution), providing a validated empirical foundation for subsequent taxonomy design and development.

4.6.4.1 Integrated Cross-Case Synthesis Analytical Implications

The integrated synthesis of cross-case findings underscores the systemic and interdependent nature of KO processes within the OCMHS CHIs. The Sankey and network model visualizations reveal that while each CHI exhibits distinctive operational strengths, all remain constrained by structural fragmentation, limited digital adoption, and uneven standardization. The Sawahlunto Municipality Museums demonstrate cultural richness through strong CH representation and narrative practices. However, this strength is weakened by the absence of structured metadata and controlled vocabularies, which limit interoperability.

The Sawahlunto Municipality Library demonstrates the benefits of adherence to formal metadata standards and retrieval frameworks, yet its rigidity limits the incorporation of local terminology and intangible CH expressions. The Sawahlunto Municipality Archives exhibit strong provenance-based classification but are constrained by infrastructure limitations, manual dependence, and fragmented documentation, collectively reducing their adaptability and relevance.

The analytical synthesis reveals that taxonomy reform must be approached as a systemic intervention rather than an isolated technical adjustment. The evidence highlights two central implications. First, contextual sensitivity must be embedded into taxonomy design, ensuring that cultural semantics, sociohistorical narratives, and intangible CH are represented as integral elements of knowledge structures. Second, cross-institutional interoperability must be prioritized, requiring harmonized metadata standards, shared controlled vocabularies, and coordinated digital infrastructures to

unify access to CH resources within OCMHS.

Furthermore, the synthesis demonstrates that institutional roles and actor networks are central to shaping reform pathways. The absence of participatory mechanisms in current KO processes indicates a critical gap that risks marginalizing community voices and diminishing cultural authenticity. The analytical implication here is the need for participatory co-creation strategies that actively involve curators, librarians, archivists, CH experts, and local communities in defining the taxonomy's structure, terms, and categories. Such inclusivity will enhance both legitimacy and sustainability.

Ultimately, the cross-case synthesis affirms that a contextualized taxonomy must function as both a technical infrastructure and a cultural mediator. Its role extends beyond classification to bridging the epistemic divides between institutions, reconciling technical standards with cultural narratives, and fostering institutional convergence. This systemic approach ensures that OCMHS CHIs are not only repositories of CH but also active agents in preserving, communicating, and sustaining cultural identity within globally interoperable frameworks.

The cross-case synthesis underscores three pivotal tensions structuring knowledge organization practices across OCMHS CHIs. First, a persistent gap exists between universal KO standards and localized cultural semantics. While international standards ensure interoperability and technical rigor, they often fail to accommodate community-embedded meanings and historically situated terminologies. Second, a disjuncture emerges between analog documentation practices and varying levels of digital transformation readiness. Institutions demonstrate uneven digital maturity, resulting in fragmented metadata environments. Third, institutional silos remain dominant, yet there is observable potential for cross-sector convergence across libraries, archives, and museums. These tensions are not incidental inconsistencies but structural dynamics that shape the necessity and direction of contextualized taxonomy development.

Across cases, certain features of knowledge organization are consistently emphasized, while others remain structurally muted. Emphasized features include collection stewardship standards, regulatory compliance, and consistent institution-specific classification. These reflect mandates centered on custodianship and internal administrative coherence. In contrast, cross-institutional semantic interoperability, integration of intangible heritage, and user-centered retrieval optimization remain

comparatively muted. Their limited development suggests that current KO practices prioritize internal operational stability over systemic integration. The contextualized taxonomy proposed in this study is therefore designed not to replace existing strengths but to address systematically underdeveloped dimensions identified through empirical analysis.

4.7 Taxonomy Development Needs

Building upon the cross-case analysis presented in Section 4.6, this section synthesizes the empirical findings into a structured assessment of the urgency for developing a contextualized taxonomy across the CHIs of the OCMHS. The analysis has revealed persistent fragmentation in KO processes, uneven application of classification standards, and a lack of systematic interoperability across the CHI domains. Simultaneously, these institutions are experiencing increasing internal and external pressures to enhance cultural representation, improve digital accessibility, and achieve semantic integration. In this context, a diagnostic framework was required to prioritize taxonomy development interventions and situate them within the subsequent phases of the DSR methodology, specifically Phases C through F, as elaborated in Chapter 5.

To operationalize this diagnostic assessment, an interpretive two-level scale (Low–High) was employed to categorize both the existing conditions of KO processes and the critical factors influencing taxonomy development. The choice of a binary classification over tertile or quartile scales was methodologically justified, given the limited number of CHIs and the discrete distribution of code frequencies derived from thematic content analysis. As highlighted by Miller (2005) and Neuendorf (2017), in descriptive content analysis with small samples and non-normal distributions, using range-based or median cutoff thresholds provides a valid and parsimonious analytical approach. Accordingly, a range-based method was applied to the total score distribution, using the following formula:

$$\text{Interval} = \frac{X_{\max} - X_{\min}}{k} = \frac{311 - 68}{2} = 121.5 \tag{4.1}$$

Accordingly, a range-based method was applied to the aggregated scores, with thresholds defined as: Low = 68–189 and High = 190–311. This classification enabled

the cross-tabulation of KO processes and critical factors, producing the taxonomy development needs matrix as shown in Table 4.29.

Table 4.29
Matrix of Taxonomy Development Needs Based

KO Processes	Critical Factors	Needs Category	Interpretation
Low	High	Critical Need	Indicates the most urgent need. KO practices are weak while institutional and societal pressures are high. Requires a foundational intervention to avoid systemic failure or missed opportunities.
High	High	Urgent Need	Existing systems are functional, but rising external demands necessitate immediate adaptation to ensure relevance and interoperability.
High	Low	Non-Immediate Need	Systems are relatively sufficient, and no immediate internal or external pressures exist. Ongoing monitoring and gradual improvements are sufficient.
Low	Low	Latent Need	Systems are underdeveloped but not currently pressured by internal or external demands. Long-term strategic planning is advised, but urgent action is not required.

The matrix presented in Table 4.29 serves not merely as a classificatory device but as an interpretive analytical framework that translates empirical coding intensity into strategic intervention priorities. The Low–High configuration allows the study to move beyond descriptive aggregation toward diagnostic evaluation. In this context, the matrix operates as a cross-tabulation between internal systemic capacity (KO processes) and external/internal reform drivers (critical factors), thereby revealing the structural alignment or misalignment between institutional readiness and reform pressures.

Conceptually, the “Critical Need” quadrant represents the most structurally unstable condition, where weak KO infrastructures coexist with heightened institutional and societal demands for transformation. This configuration signals a systemic vulnerability, including institutions' lack of sufficient technical robustness while simultaneously facing increasing expectations for interoperability, inclusivity, and digital integration. In contrast, the “Urgent Need” quadrant indicates adaptive strain within otherwise functional systems, while the “Latent Need” quadrant reflects institutional inertia without immediate pressure for reform. The absence of cases in these latter categories reinforces the severity and uniformity of structural imbalance across CHIs within the OCMHS ecosystem.

Importantly, the matrix does not reduce qualitative insights into simplistic quantification; rather, it functions as a visual decision-support mechanism within the DSR paradigm. By identifying the convergence of low operational capacity and high

reform drivers, the matrix provides empirical justification for transitioning from diagnostic phases (DSR Phase A and Phase B) to artifact construction (Phase C onwards). Thus, Table 4.29 substantiates that taxonomy development is not optional optimization but a foundational systemic intervention required to prevent further fragmentation and representational inequity.

Table 4.30 presents the actual distribution of scores across the CHIs, summarizing their classification within this framework. The results demonstrate that all CHIs scored within the Low range for KO processes, covering themes such as *KO practices*, *KOS*, *digital knowledge systems*, *standardization framework*, and *CH representation*. Conversely, all scored within the High range for critical factors, including *KO limitations*, *KO challenges*, and *KO opportunities*. This consistent Low–High combination places all CHIs squarely in the Critical Need quadrant, indicating the most urgent level of intervention.

Table 4.30
Existing Knowledge Organization Process Conditions and Taxonomy Development Needs

Concepts	Themes	Library	Archives	Museums	Total	Category	Interpretation
Knowledge Organization Processes	Knowledge Organization Practices	39	41	62	142	Low	Low
	Knowledge Organization Systems	34	32	44	110	Low	
	Digital Knowledge Systems	29	22	17	68	Low	
	Standardization Framework	44	28	28	100	Low	
	Cultural Heritage Representation	45	48	83	176	Low	
Critical Factors	KO Limitations	47	67	87	201	High	High
	KO Challenges	67	64	81	212	High	
	KO Opportunities	90	96	125	311	High	
Total		395	398	527	1320	—	Critical Need

Note: Classification thresholds use a binary, range-based categorization with a median cutoff.
Source: Researcher finding (2025)

The interpretation of these findings reveals a structural imbalance. Internally, collection stewardship and accessioning remain largely manual, metadata practices lack cultural granularity, and schema alignment across CHIs is minimal. Externally, reform pressures intensify due to community expectations for inclusive representation of

heritage, national policy mandates for interoperability, and international emphasis on participatory knowledge systems.

Notably, the high score for KO Opportunities indicates institutional openness to innovation, co-creation, and capacity development. This suggests that, although infrastructure is weak, institutional actors recognize the urgency of reform and are receptive to change. This convergence of internal weakness and strategic openness creates a window of opportunity for coordinated systemic intervention.

A closer examination of the distribution across themes further clarifies the structural dynamics underlying this Critical Need classification. Although all CHIs fall within the Low category for KO processes, there is variation in thematic intensity. Museums exhibit relatively higher scores in Cultural Heritage Representation (83) and Knowledge Organization Practices (62), reflecting their strong curatorial orientation toward embedding narrative and intangible heritage. In contrast, the Archives demonstrate comparatively lower Digital Knowledge Systems scores (22), indicating a more pronounced technological gap and reliance on manual workflows. The Library presents moderate but still insufficient scores across standardization and metadata-related themes, suggesting technical awareness without systemic integration.

This thematic divergence reveals that the Low classification does not imply uniform weakness but differentiated structural constraints. Museums are representationally rich yet technologically underdeveloped; Archives are procedurally structured yet digitally fragile; Libraries possess standardization familiarity yet lack contextual flexibility. These asymmetries reinforce the need for a contextualized taxonomy that accommodates institutional heterogeneity rather than imposing uniform reform.

Among critical factors, the exceptionally high score for KO Opportunities (311) across institutions indicates not only reform pressure but also institutional readiness. Unlike purely deficit-based diagnoses, the data suggest that stakeholders recognize the urgency of transformation and are receptive to capacity development, convergence, and participatory governance. This combination of structural weakness and strategic openness creates what may be interpreted as a reform window within the OCMHS ecosystem.

Within the DSR framework, Table 4.30 therefore serves a dual function: diagnostically, it confirms structural imbalance; strategically, it justifies constructing artifacts as coordinated reform rather than incremental optimization. The evidence

demonstrates that taxonomy development must simultaneously address infrastructural fragility, semantic fragmentation (inconsistent terminology and meaning across institutions), and governance gaps, while leveraging institutional willingness to innovate.

If left unaddressed, these imbalances risk entrenching inefficiencies, weakening cross-institutional collaboration, and marginalizing culturally embedded knowledge. Conversely, prioritizing taxonomy development offers an opportunity to establish a sustainable, interoperable, and culturally resonant framework that aligns local heritage values with international best practices.

From a theoretical standpoint, these findings reinforce that the development of taxonomy in the CH domain cannot be reduced to a technical exercise in classification. Rather, it represents an epistemological reconfiguration — that is, a restructuring of how knowledge is conceptualized, organized, and legitimized — by reconciling formal standards with local narratives, terminologies, and intangible heritage. In this sense, the development of taxonomy becomes a socio-technical intervention that integrates structural systems with cultural meaning-making processes.

Overall, the analytical implications confirm that developing the taxonomy for OCMHS is not merely beneficial but foundational. It is both a methodological progression within the DSR process and a strategic reform pathway that enables CHIs to evolve into semantically coherent (internally consistent in meaning), user-centered, and culturally embedded knowledge infrastructures capable of sustaining the representation of heritage for future generations.

4.8 Subject and Object of Taxonomy Ending Condition

The determination of the subject and object of taxonomy is the decisive final condition in the Design Science Research (DSR) cycle, as articulated by Peffers et al. (2007). In DSR, an artifact is considered complete not merely when it has been designed and evaluated, but when its contextual boundaries are clearly defined. The articulation of subject and object dimensions, therefore, establishes the operational scope of the taxonomy: who participates in and uses the system (subject), and what knowledge resources are represented within it (object). This clarification ensures that the taxonomy is neither abstractly conceptual nor disconnected from institutional realities.

The sustainability of taxonomy initiatives depends on the alignment between

these two dimensions (Szopinski et al., 2019; 2020). The subject dimension concerns stakeholder roles, capacities, and expectations. The object dimension defines the domain of representation, including tangible and intangible cultural heritage (CH). Sustainability emerges when the taxonomy meaningfully reflects stakeholder practices while accurately structuring the complexity of heritage resources. In other words, the taxonomy must achieve functional fit (alignment with institutional workflows) and representational fit (alignment with heritage knowledge structures).

Within the Sawahlunto Municipality CHIs, this alignment is particularly critical due to three empirically identified tensions: fragmented metadata standards, uneven digitization readiness, and the gap between universal classification frameworks and local terminologies. Defining the subject–object boundary, therefore, functions as a bridge between diagnosis (Chapter 4) and design (Chapter 5). It clarifies what the taxonomy must accommodate and whom it must serve.

Importantly, this articulation also establishes the criteria for later evaluation. The taxonomy will be assessed in Chapter 5 based on (1) stakeholder usability and participatory validity (subject dimension) and (2) semantic coverage and representational completeness (object dimension). Thus, Section 4.8 does not merely define scope; it defines the benchmarks against which the artifact's maturity and effectiveness will be evaluated.

4.8.1 Subject of Taxonomy

The development of a contextualized taxonomy within the OCMHS is fundamentally dependent on multi-actor participation. The subject of taxonomy development, therefore, extends beyond formal institutional hierarchies and includes directors, curators, archivists, librarians, registrars, cultural heritage (CH) experts, and community representatives.

The cross-case findings demonstrated that knowledge organization (KO) practices across Sawahlunto Municipality's CHIs do not operate within isolated silos but emerge through continuous interaction between strategic governance and operational practice. Directors provide policy direction and resource allocation; CHI professionals manage accessioning, metadata structuring, and classification in daily workflows; CH experts contribute sociohistorical interpretation to ensure semantic accuracy; and community representatives safeguard vernacular terminology, oral

traditions, and intangible CH expressions that are often marginalized in formal documentation systems.

This participatory configuration is consistent with scholarship emphasizing that classification systems detached from lived practice risk cultural distortion and operational irrelevance. Rather than conceptualizing taxonomy as an internally imposed technical schema, this study frames it as a collaboratively shaped knowledge infrastructure. In the OCMHS context, such collaboration ensures that the taxonomy reflects institutional standards while simultaneously embedding collective memory and local epistemologies. Accordingly, taxonomy is defined as a coalition of stakeholders whose combined roles safeguard methodological rigor, semantic inclusivity, and cultural authenticity.

Within this coalition, two principal user categories are distinguished: institutional users and public users. Institutional users—including directors, CH experts, curators, registrars, archivists, and librarians—prioritize workflow efficiency, metadata compliance, preservation integrity, and alignment with standardization frameworks. Public users—comprising community members, students, tourists, and researchers—prioritize accessibility, interpretive clarity, narrative richness, and cultural resonance. The empirical findings reveal that these expectations are not identical but complementary. Consequently, the taxonomy must balance structural precision with user-centered accessibility, ensuring it functions as both a governance tool and a discovery interface. This dual orientation directly informs the evaluation criteria in Chapter 5, where the artifact will be assessed for usability, stakeholder acceptance, participatory legitimacy, and operational compatibility.

Importantly, the articulation of the subject is not solely technical but also ethical and epistemological. In postcolonial heritage contexts such as OCMHS, knowledge production is historically shaped by asymmetries between institutional authority and community voice. By explicitly embedding community participation within the subject dimension, the taxonomy moves beyond object cataloging toward representing lived experience and collective memory. This repositioning transforms CHIs from passive custodians of artifacts into active mediators of knowledge democracy. As a result, the taxonomy becomes not merely a classification mechanism but a culturally embedded infrastructure designed to sustain inclusivity, authenticity, and equitable representation across CH environments.

4.8.2 Object of Taxonomy

The object of taxonomy within the Sawahlunto Municipality CHIs encompasses a heterogeneous body of cultural heritage (CH) resources spanning documentary, material, and intangible domains. Museum collections preserve industrial artifacts such as mining machinery, architectural remnants, and tools of everyday labor. Archival holdings document administrative records, maps, correspondence, and colonial documentation that trace the socio-political and economic history of mining enterprises. The library curates secondary literature, technical publications, and scholarly interpretations related to mining technology and community narratives. In addition to these tangible resources, intangible CH—such as oral traditions, rituals, folklore, and vernacular expressions—constitutes a critical object category that traverses institutional boundaries and requires flexible modes of representation.

The empirical findings in Chapter 4 revealed that existing KO systems tend to privilege tangible objects while inconsistently representing intangible and community-based knowledge. This representational imbalance directly informs the design of the taxonomy. Rather than homogenizing diverse materials into uniform descriptive structures, the taxonomy is designed to accommodate epistemic diversity—that is, different forms of knowledge that require distinct yet interoperable metadata treatments. Artifacts, records, narratives, and oral traditions are therefore modeled as related but differentiated object classes, each with appropriate descriptive attributes. Cross-referencing mechanisms are incorporated to link physical artifacts with associated narratives, events, and practices, enabling hybrid representation and preventing the dominance of a single object type.

The selection of technical and methodological tools further operationalizes this object definition. CollectiveAccess (CA) was adopted as the digital platform for the repository prototype because it supports hierarchical taxonomies, controlled vocabularies, faceted structures, and multilingual thesauri aligned with international standards. This platform enables modular structuring, meaning that object categories can expand without destabilizing the overall system. Complementary methods—such as focus groups and metadata mapping exercises—ensure that object categories and descriptors reflect both institutional documentation practices and community-based terminologies. In this way, the object dimension is not abstractly defined but empirically grounded and co-shaped by stakeholders.

Structurally, the taxonomy adopts a layered hierarchical framework that integrates top-down classification with bottom-up indexing. The hierarchical backbone provides structural coherence and interoperability, while faceted elements allow the inclusion of local terminologies, intangible practices, and contextual descriptors. This design directly responds to earlier findings of digital fragility and classificatory rigidity by prioritizing simplicity, modularity, and scalability. In practical terms, this means that the taxonomy can function effectively in environments with uneven digital infrastructure while remaining adaptable to future technological integration.

Beyond classification, the taxonomy is conceived as a multifunctional infrastructure. For institutional actors, it supports accessioning, stewardship, metadata description, and preservation planning. For public users, it facilitates retrieval, browsing, storytelling, and interpretive engagement. The encoding of multiple knowledge types—explicit (catalog records and documents), tacit (community practices), contextual (sociohistorical interpretation), and procedural (workflow documentation)—ensures that CH is represented as a living system rather than as static data.

Importantly, the articulation of the object dimension also shapes the evaluation criteria applied in Chapter 5. The taxonomy will be assessed not only for structural correctness and interoperability, but also for representational adequacy, inclusivity of intangible CH, cross-referencing capability, and adaptability to institutional workflows. By clearly defining what must be represented and how different knowledge types are structured, the object articulation establishes the ontological boundaries of the artifact. It ensures that the taxonomy remains technically robust, semantically inclusive, and culturally authentic within the OCMHS context.

Taken together, the subject–object articulation defines the epistemological and ontological boundaries of the taxonomy—that is, how knowledge is conceptualized and which entities are recognized within the system. The subject dimension ensures participatory inclusivity and governance compatibility, while the object dimension ensures representational completeness and semantic coherence.

Within the DSR framework (Peffers et al., 2007), this articulation constitutes the formal ending condition of the diagnostic-design cycle. It confirms that the taxonomy is contextually grounded, institutionally feasible, and representationally comprehensive. More importantly, it establishes the evaluative benchmarks applied in Chapter 5, where the taxonomy will be assessed for usability, interoperability, semantic

inclusivity, and cultural authenticity. Thus, Section 4.8 not only concludes the diagnostic phase but also structurally anchors the transition to artifact construction and evaluation.

4.9 Cultural Heritage Institution Convergence Dimensions

The convergence of CHIs has emerged as a defining paradigm in contemporary KO discourse, driven by the imperatives of interoperability, resource optimization, and unified access to CH resources (Duff et al., 2013; Zorich et al., 2008). In the context of Sawahlunto Municipality, the findings presented in this chapter reveal that while CHIs continue to operate within their traditional institutional mandates, overlapping practices in taxonomy development, metadata description, digitization, and CH representation point to a growing potential for systemic integration. This convergence does not signify the erasure of institutional boundaries; rather, it signals the possibility of developing shared infrastructures and collaborative frameworks that amplify institutional strengths while addressing structural weaknesses.

The within-case analyses revealed distinct KO trajectories, yet they converged on several shared challenges. Synthesizing these findings across cases allows for a comparative understanding of institutional strengths and weaknesses, and more importantly, clarifies the design requirements for a contextualized taxonomy.

The cross-case comparison presented in Table 4.31 is not constructed as a conceptual abstraction, but is directly derived from the empirical findings reported in Tables 4.2 through 4.30. Specifically, the KO orientation dimension is drawn from the coded interview and document analysis results presented in Tables 4.10, 4.20, and 4.28. The technological readiness and metadata practice dimensions are grounded in the thematic distributions and digital system evaluations, as well as the aggregated scoring matrices in Tables 4.29 and 4.30. By consolidating these within-case findings into comparative analytical categories, Table 4.31 synthesizes dispersed empirical evidence into an integrated cross-institutional framework. This ensures that the convergence analysis is empirically traceable and analytically consistent with the diagnostic stages of the DSR process.

Table 4.31
Cross-Case Comparison of Knowledge Organization Practices in Sawahlunto Municipality Cultural Heritage Institutions

Aspect	Library	Archives	Museums	Convergence / Divergence
KO orientation	Controlled vocabularies; subject access (DDC).	Provenance, original order, and record authenticity.	Object-centric description; curatorial narratives; exhibition-driven.	Divergence: different epistemic logics.
Metadata practice	Standardized bibliographic records (INDOMARC).	Limited digital catalogues; descriptive finding aids.	Ad hoc cataloging, inconsistent metadata, often in analog formats.	Convergence: metadata inconsistency across CHIs.
Technological readiness	Moderate digital infrastructure (OPAC, local databases).	Minimal digitization, heavy reliance on paper-based inventories.	Partial digitization; limited adoption of digital repositories.	Convergence: all face analog–digital tensions.
Cultural contextualization	Low integration of local/indigenous terms; reliance on imported standards.	Retains administrative context; minimal community language integration.	High use of local narratives, but poorly standardized.	Divergence: Museums are strong in cultural embedding, library/archives are weak.
Interoperability	Some compatibility with national/international KOSs.	Limited interoperability; highly localized.	Almost no interoperability with external KOSs.	Convergence: lack of cross-CHI interoperability.
Institutional silos	Operates independently with limited collaboration with archives/museums.	Separate mandate and practices, minimal cross-institutional exchange.	Independent curation, little integration with library/archive metadata.	Convergence: institutional silos persist across CHIs.

A closer inspection reveals that each convergence or divergence identified in Table 4.31 corresponds to specific empirical patterns documented earlier in this chapter. For example, the divergence among epistemic logics (controlled vocabularies in libraries, provenance principles in archives, and narrative, object-centric descriptions in museums) reflects the thematic coding distributions reported in the within-case tables. Similarly, the convergence in metadata inconsistency is supported by the low scores recorded for Digital Knowledge Systems and Standardization Framework across all CHIs in Table 4.30. The limited cross-referencing and the absence of interoperable schema alignment corroborate the persistence of institutional silos. By explicitly grounding the convergence dimensions in previously analyzed data, Table 4.31 functions as a meta-synthesis rather than an isolated summary, reinforcing methodological transparency and strengthening the analytical bridge between empirical diagnosis and the design requirements for taxonomy.

The cross-case synthesis demonstrates that, despite institutional diversity, Sawahlunto Municipality CHIs face common challenges, including inconsistent metadata, limited digitization, and persistent silos. At the same time, divergent strengths such as library' structured vocabularies, archives' provenance principles, and museums' narrative richness offer complementary elements that can be unified within a taxonomy. These insights directly inform the taxonomy design principles developed in Chapter 5, particularly the emphasis on hierarchical structuring, dual labelling, and interoperability mechanisms.

From a thematic perspective, convergence is evident in the shared emphasis on contextual representation of CH, particularly in the incorporation of local terminologies, sociohistorical narratives, and intangible CH elements. While each CHI employs distinct descriptive practices, all collectively recognize the need to situate collections within the lived experiences of the OCMHS mining community. This thematic alignment provides a foundation for a contextualized taxonomy to serve as a cross-institutional representational framework.

The technological dimension highlights uneven but complementary capacities across CHIs in Sawahlunto Municipality. The library demonstrates the highest degree of digital readiness through its adoption of INDOMARC-based cataloging and OPAC functionalities. At the same time, the archives and museums remain at earlier stages of digital transformation, with initiatives limited to partial digitization and static online displays. Despite these disparities, convergence is feasible through shared digital infrastructures, interoperable metadata platforms, and integrated repository systems. Leveraging the library's relatively advanced digital infrastructure as a central node could accelerate the collective digital maturity of CHIs within the OCMHS.

In terms of functional convergence, overlaps are apparent in core KO processes such as accessioning, cataloging, stewardship, and knowledge mediation. Although practices vary in their execution across CHIs, their shared functional objectives of preservation, access, and interpretation create opportunities to develop standardized workflows and interoperable systems. By aligning these practices within a contextualized taxonomy, institutions can reduce duplication, streamline resource allocation, and improve user experience through unified retrieval pathways.

Moreover, the socio-cultural dimension underscores the collective responsibility of Sawahlunto Municipality's CHIs to represent collective memory and sustain cultural continuity. Museums excel in narrative storytelling and intangible CH documentation;

library contribute through structured bibliographic frameworks and accessibility mechanisms; archives provide provenance-based authenticity and administrative authority. Convergence across these socio-cultural roles allows each institution to reinforce the other, creating a holistic ecosystem of heritage knowledge that is both technically robust and culturally resonant. Importantly, convergence is not only an institutional imperative but also a community-driven expectation, as local stakeholders increasingly demand integrated, inclusive, and participatory heritage platforms.

Taken together, these four dimensions, thematic, technological, functional, and socio-cultural, illustrate the multi-scalar nature of CHI convergence within Sawahlunto Municipality. Convergence provides not only a pathway to operationalizing a contextualized taxonomy but also a strategic mechanism for enhancing institutional efficiency, user engagement, and cultural representation. By situating the Sawahlunto Municipality CHIs within the broader heritage studies and digital humanities discourse, this analysis affirms that convergence is both a necessity and an opportunity, including a necessity to address fragmented systems and limited resources, and an opportunity to establish a sustainable, interoperable, and community-oriented KO framework for the OCMHS.

4.9.1 Thematic Convergence

Before elaborating on the conceptual dimensions of thematic convergence, it is important to note that this analysis is directly grounded in the within-case coding results presented in Tables 4.10, 4.20, and 4.28, as well as the aggregated distribution in Table 4.30. The recurring prominence of themes such as collection stewardship, accessioning process, metadata description, and cultural heritage representation across all CHIs indicates empirical alignment in core KO activities. Although expressed through different institutional logics, these themes consistently appeared with high coding density across cases, thereby providing the empirical foundation for identifying thematic convergence.

At the thematic level, convergence is reflected in the alignment of *KO practices* across the CHIs of Sawahlunto Municipality, despite their differing institutional mandates. The findings demonstrate that activities such as *accessioning process*, *collection stewardship*, *metadata description*, and *knowledge mediation* are consistently undertaken by CHIs, albeit framed differently within their respective workflows.

Museums emphasize curatorial interpretation and narrative enrichment, archives prioritize provenance and evidential integrity, while library focus on cataloging and subject indexing to facilitate scholarly access. Collectively, these practices constitute what Hjørland (2017a) terms a "domain-analytic unity," in which diverse institutions engage in parallel processes of knowledge structuring that can be harmonized through shared taxonomic frameworks.

A further thematic point of convergence lies in the representation of CH, particularly the documentation of intangible CH, the incorporation of local terminology, and the deployment of narrative description. Museums contextualize artifacts within community life and collective memory; archives safeguard official and administrative narratives as collective memory; and library extend interpretive depth through scholarly perspectives and secondary sources. While each institution emphasizes distinct aspects, these perspectives are complementary rather than contradictory, together forming a multi-perspectival framework that enables a richer, more holistic representation of the OCMHS.

Such thematic convergence underscores the feasibility and sustainability of developing a shared taxonomy. Categories such as *intangible CH*, *sociohistorical reference*, and *local terminology* resonate across institutional boundaries and provide conceptual anchors around which cross-institutional integration can occur. By embedding these shared thematic elements within a contextualized taxonomy, Sawahlunto Municipality CHIs can reconcile their institutional differences while advancing a unified representational framework that reflects both the diversity and the interconnectedness of local heritage knowledge.

4.9.2 Technological Convergence

The identification of technological convergence is based on a comparative assessment of Digital Knowledge Systems and Standardization Framework scores in Table 4.30, as well as on the digital infrastructure patterns visualized in Figures 4.10, 4.20, and 4.30. Across all CHIs, Digital Knowledge Systems were categorized within the Low range, while KO Challenges and KO Opportunities were consistently High. This empirical configuration reflects a shared recognition of the need for digital transformation despite uneven infrastructural capacities, thereby justifying interpreting technological convergence as both a constraint and an aspirational trajectory.

Technological convergence constitutes the second major dimension of integration, evident in the gradual but shared shift of CHIs within Sawahlunto Municipality toward the adoption of digital knowledge systems and metadata infrastructures. Although each institution is at a different stage of technological maturity, CHIs clearly recognize that digital platforms are indispensable for ensuring unified access, long-term preservation, and public engagement. The museums and archives reported partial reliance on basic digital tools and selective digitization projects, whereas the library, though comparatively more advanced in its automation system, remains partly constrained by legacy cataloging practices and the limited scalability of its digital infrastructure. These differences reveal uneven adoption trajectories, but they also underscore a shared aspiration for digital modernization as a collective institutional priority.

The scholarly literature emphasizes that metadata standards function as a "lingua franca" for enabling interoperability across diverse CHIs (Giannoulakis et al., 2018; Kumar & Ramesha, 2020; Kamal & Golub, 2025; Qin & Zeng, 2020; Ye & Zhou, 2013). In the case of Sawahlunto Municipality, this underscores the potential for convergence through shared metadata schemas and open standards that accommodate heterogeneous CH resources. Such infrastructures would allow mining artifacts, colonial administrative records, and oral traditions to coexist within a unified digital repository, bridging disciplinary and institutional silos.

Technological convergence, therefore, represents more than the adoption of digital tools; it reflects a shared institutional acknowledgment of the necessity to harmonize infrastructures to mitigate risks of digital fragmentation. Aligning metadata practices, digitization workflows, and access platforms across CHI's technological convergence not only enhances the technical robustness of CH management but also strengthens the foundations for the contextualized taxonomy. This trajectory points to the need for strategic investment in interoperable platforms, capacity building in metadata competence, and coordinated policy frameworks to collectively transform Sawahlunto Municipality's CHIs into digitally integrated, publicly accessible CH ecosystems.

4.9.3 Functional Convergence

Functional convergence emerges from cross-case synthesis of operational practices documented in Tables 4.2–4.28, particularly in relation to stewardship, documentation workflows, and knowledge mediation activities. Although each CHI operates under distinct professional standards, the thematic analysis revealed repeated overlaps in accessioning, descriptive practices, and user-oriented mediation processes. These overlaps, visible in the network models and coding clusters, substantiate the claim that functional objectives across CHIs are increasingly complementary rather than isolated.

Functional convergence emerges as a particularly significant dimension in the case of Sawahlunto Municipality, where CHIs increasingly share overlapping purposes and collaborative functions despite their distinct institutional mandates. The findings indicate that CHIs collectively pursue core functions of knowledge preservation, public education, community engagement, and cultural continuity. While museums traditionally emphasize exhibition and interpretation, archives prioritize record authenticity and evidential value, and library focus on scholarly access and bibliographic services, these distinctions are progressively blurred in practice. For instance, oral traditions documented by archivists are frequently curated within museum exhibitions, while historical accounts published and preserved in library directly inform interpretive narratives across both museum displays and archival storytelling.

The literature reinforces this observation, with Duff (2013) and Rasmussen and Hjørland (2022) arguing that convergence becomes most evident at the functional level, as digital affordances and evolving user expectations erode rigid institutional boundaries. The findings of this study similarly demonstrate that functional integration across CHIs in Sawahlunto Municipality reflects the functional ecology of CHIs conceptualized by Hendrawan et al. (2024a) and Zorich et al. (2008), in which collaboration and complementarity replace the strict demarcation of institutional roles. Within this ecology, the integration of KO practices and cultural representation across domains ensures that CH resources are not only preserved but are also communicated in ways that sustain collective memory and cultural identity.

This functional convergence provides a compelling rationale for developing a contextualized taxonomy, as it directly aligns with the shared institutional goals of accessibility, interpretation, and community service. By acknowledging and

formalizing these overlapping functions, a unified taxonomy can act as a cross-domain infrastructure that strengthens inter-institutional cooperation, enhances user-centered access, and ensures that the CH within OCMHS is preserved and interpreted holistically. In this way, functional convergence serves as both an empirical reality and a strategic foundation for KO systemic reform and innovation in the CH domain.

4.9.4 Socio-Cultural Convergence

The socio-cultural convergence identified in this section is grounded in the thematic prominence of Cultural Heritage Representation and KO Opportunities across all institutions, as evidenced in Table 4.30. Notably, museums recorded the highest coding intensity in the representation of narrative and intangible heritage, as shown in Table 4.28. At the same time, archives and library demonstrated emerging recognition of community terminology and sociohistorical contextualization. This cross-case pattern indicates not only institutional differences but also a shared movement toward embedding local epistemologies within formal KO structures.

The socio-cultural dimension is perhaps the most critical area of convergence, as it positions CHIs not merely as custodians of collections but also as mediators between CH and the community. The findings of this study indicate that while user involvement remains uneven across institutions, with museums and archives engaging communities in sporadic initiatives and library largely orienting their services toward academic audiences, there is nevertheless a discernible shift toward participatory practices. This is most evident in the emphasis placed on intangible CH, narrative description, and the integration of local or national terminology, all of which highlight an emerging alignment of institutional practices with community knowledge systems. Through these developments, CHIs in Sawahlunto Municipality are gradually advancing towards a participatory heritage model that foregrounds inclusivity and cultural resonance.

The literature lends strong support to this trajectory. Hendrawan et al. (2025a and 2025b) underscore that sustainable taxonomy and KO frameworks must extend beyond institutional integration to include communities as active co-creators of cultural meaning. Such participatory models challenge the traditional asymmetry of knowledge production, ensuring that community voices, collective memory, and epistemologies are embedded within institutional knowledge structures. In the context of the

Sawahlunto Municipality, socio-cultural convergence extends beyond technical and functional efficiency, embodying a broader commitment to community empowerment. By positioning local communities as custodians and narrators of living heritage, convergence in this domain enhances not only the authenticity of CH representation but also the legitimacy and sustainability of taxonomy development.

This socio-cultural convergence, therefore, provides a critical foundation for designing contextualized taxonomies. It ensures that the system evolves into a dialogic platform where institutional expertise and community knowledge intersect, reinforcing the role of CHIs as agents of cultural continuity and knowledge democracy. In doing so, it embeds the taxonomy within the lived social fabric of OCMHS, making it a tool for enhancing access to heritage information.

4.9.5 Challenges and Opportunities of Convergence

The challenges and opportunities discussed in this section are empirically substantiated by the matrix analysis in Table 4.29 and the aggregated score distribution in Table 4.30, where all CHIs were classified within the Critical Need quadrant. The Low–High configuration (weak internal KO processes combined with strong external reform pressures) provides quantitative reinforcement for the qualitative findings derived from interviews and document analysis. Furthermore, the network and Sankey models presented earlier in this chapter visually corroborate the coexistence of structural rigidity and reform potential across institutional contexts.

While the advantages of CHI convergence are substantial, the findings also reveal several critical challenges that must be addressed before integration can be fully realized. Institutional silos remain a significant barrier, as CHIs in Sawahlunto Municipality operate under distinct governance arrangements, funding streams, and professional mandates. These structural separations perpetuate fragmented practices and inhibit collaborative knowledge infrastructures. Equally pressing are the disparities in digital readiness, most notably the absence of robust metadata platforms and interoperable systems in several CHIs. This digital unevenness constrains the potential for immediate technological convergence and risks reinforcing asymmetries in access and representation.

Furthermore, the attempt to balance hierarchical governance structures with participatory community involvement generates tensions, as illustrated in the network

and Sankey models presented in this chapter. While directors and senior managers retain formal authority, the inclusion of community voices and intangible CH requires a shift toward shared decision-making models that challenge existing institutional hierarchies.

Despite these challenges, the opportunities presented by convergence are considerable. From a resource perspective, convergence enables optimization through shared infrastructures, reducing operational redundancies while enhancing cost efficiency. Technologically, it enables interoperability with global CH platforms, ensuring that the OCMHS's CH is both visible and relevant in international networks. Critically, convergence provides a framework for bridging professional standards with local knowledge traditions. This creates fertile ground for integrating intangible practices, such as oral traditions, folksongs, and community rituals, into formal classification systems, ensuring they are preserved alongside archival and museum artifacts. In this way, Sawahlunto Municipality CHIs are repositioned not as isolated custodians but as active participants in a global heritage network and ecosystem.

Taken together, the convergence of CHIs in Sawahlunto Municipality can be understood across four interrelated dimensions: thematic, technological, functional, and socio-cultural. Each dimension demonstrates both overlaps and complementarities among institutional practices, aspirations, and community responsibilities, collectively forming the foundation for a unified, contextualized taxonomy. While the persistence of institutional silos and digital disparities remains a constraint, the opportunities for enhanced interoperability, participatory inclusivity, and long-term sustainability provide a compelling rationale for pursuing convergence. Within the DSR methodology process model, identifying these convergence dimensions is crucial to the problem–solution linkage, ensuring that the taxonomy developed for the OCMHS is not only grounded in institutional realities but also collaboratively sustainable among diverse stakeholders.

Importantly, the four convergence dimensions identified in this section are not independent or isolated constructs. Rather, they operate in a mutually reinforcing configuration. Thematic convergence provides the conceptual common ground by identifying shared knowledge domains and representational priorities. Technological convergence functions as an enabling infrastructure, facilitating interoperability and digital integration necessary for cross-institutional alignment. Functional convergence translates thematic alignment into coordinated workflows and service delivery mechanisms, while socio-cultural convergence ensures that integration remains

participatory, inclusive, and culturally grounded. In this sense, technological and functional convergence support and operationalize thematic convergence, whereas socio-cultural convergence legitimizes and sustains the entire framework. Together, these dimensions form an interdependent convergence architecture that underpins the development of a unified and contextualized taxonomy within the OCMHS ecosystem.

4.10 Chapter Summary

This chapter has provided a comprehensive examination of the existing conditions of KO processes and the critical factors influencing taxonomy development across the CHIs of the OCMHS. Through the within-case analyses, each institution demonstrated distinctive strengths reflective of its mandate: the museums excelled in narrative interpretation and cultural mediation; the library prioritized structured user access and bibliographic control; and the archives maintained a strong focus on historical documentation and provenance-based curation. At the same time, shared limitations were identified across the CHIs, particularly the reliance on manual processes, fragmented classification schemes, and insufficient adoption of metadata standards, all of which hinder interoperability and sustainability.

The subsequent cross-case analysis revealed convergences and divergences in KO practices, systems, and frameworks. Across all CHIs, knowledge mediation and collection stewardship emerged as consistent institutional priorities, underscoring the central role of CHI professionals as cultural mediators between collections and communities. However, technical domains such as subject analysis, schema alignment, digital infrastructure, and standardization frameworks were found to be underdeveloped, limiting the scalability and integration of heritage information systems. CH representation emerged as a thematic convergence, demonstrating a shared institutional commitment to embedding local terminology, sociohistorical context, and intangible cultural heritage into organizational processes. This highlights the critical need for taxonomic structures that can balance international KOS standards with locally embedded cultural narratives.

The taxonomy development needs assessment, operationalized through a binary Low–High classification, revealed a consistent placement of all CHIs in the Critical Need quadrant. This classification reflects a structural imbalance: weak internal KO capacities coupled with high internal and external pressures for reform. On one hand,

institutional practices remain constrained by outdated infrastructures, fragmented metadata, and rigid classification frameworks. On the other hand, external pressures arising from societal expectations for inclusive representation, policy imperatives for interoperability, and opportunities for participatory co-creation demand systemic innovation. The findings thus confirm that taxonomy development is both urgent and strategic, requiring not merely technical adjustments but a systemic reconfiguration of knowledge infrastructures.

In conclusion, this chapter affirms that taxonomy in the OCMHS context must function as more than a classificatory mechanism. It must operate as a mediating infrastructure, reconciling the diverse institutional logics of library, archives, and museums, while enabling multilingual, multivocal, and culturally authentic representation. By addressing both the technical deficits and the cultural imperatives identified in this analysis, the proposed contextualized taxonomy will provide a sustainable framework that enhances interoperability, supports inclusive interpretation of cultural heritage, and strengthens the role of CHIs as agents of knowledge democracy. These insights serve as the empirical and conceptual foundation for Chapter 5, which, guided by the DSR methodology process model, transitions from diagnostic analysis to solution-oriented action through the design, construction, and evaluation of the contextualized taxonomy framework for the CHIs of OCMHS.

In line with the DSR methodology, the empirical findings in this chapter serve two interrelated functions. They substantiate the structural fragmentation and epistemic tensions identified in Phase A and articulate explicit design objectives and convergence requirements for Phase B. The embedded case study thus operates as both diagnostic and generative within the DSR cycle. The taxonomy design presented in Chapter 5 emerges directly from the empirical tensions, emphasized features, and muted dimensions identified herein, ensuring that the artifact is grounded in institutional realities rather than abstract theoretical modeling.

CHAPTER 5
DEVELOPMENT AND EVALUATION

5.1 Chapter Overview

This chapter aims to synthesize the empirical findings related to the third and fourth research objectives (RO3 and RO4), namely 1) to develop a contextual taxonomy for the Cultural Heritage Institutions (CHIs) of the Ombilin Coal Mining Heritage of Sawahlunto (OCMHS), and 2) to evaluate the developed taxonomy through participatory validation within CHIs of the Sawahlunto Municipality. The discussion outlines the development and evaluation activities conducted during Phases C (Design and Development), D (Demonstration), E (Evaluation), and F (Communication), following the Design Science Research (DSR) process model. In accordance with Peffers et al. (2007), the DSR cycle is operationalised through iterative artifact construction, stakeholder engagement, and evaluation processes. The artifact in this context refers to the contextualized taxonomy tailored for CHIs within the OCMHS setting.

The objectives of these phases are twofold. Firstly, they document the translation of the theoretical underpinnings, insights from the literature, and empirical evidence from Phases A and B, as presented in Chapter 4, into a tangible artifact, including a contextual taxonomy. This process entailed designing a hierarchical taxonomy schema, integrating it with relevant metadata standards, and developing usage guidelines to ensure conceptual rigor and operational applicability for CHIs within Sawahlunto Municipality or Area A of the OCMHS. Secondly, the artifact was implemented and evaluated in practice, where its utility was assessed through structured task performance, usability testing, and stakeholder feedback.

The taxonomy development approach adopted was based on the framework proposed by Nickerson et al. (2013), extended by the iterative refinement principles of Kundisch et al. (2021). Multiple iterations of the taxonomy were designed, tested, and refined with input from CHI professionals, subject matter experts, and end users. Each iteration provided empirical evidence that illuminated both the strengths and limitations of the taxonomy, thereby supporting a rigorous, context-sensitive development process.

This chapter is organized into three primary dimensions. The first dimension,

Phase C, discusses the design principles, hierarchical structuring, semantic relationships, metadata alignment, controlled vocabularies, and iterative refinement of the taxonomy. The second dimension, encompassing Phases D and E, addresses the taxonomy's implementation within a digital repository prototype, the design of evaluation protocols, qualitative usability assessments, qualitative stakeholder reflections, and synthesis of key findings. The third dimension, represented by Phase F, involves communicating results. By integrating these phases, the chapter demonstrates that the proposed taxonomy functions as a unifying semantic framework that bridges diverse CHI practices and enhances interoperability, usability, and the interpretation of cultural heritage resources.

This chapter builds on the empirical diagnosis presented in Chapter 4, which found that Sawahlunto Municipality's CHIs exhibited fragmented KO practices, limited semantic interoperability, uneven digital readiness, and strong yet unsystematized cultural representation. The taxonomy developed herein directly responds to these institutional conditions within the OCMHS heritage ecosystem.

5.2 Phase C – Design and Development of Taxonomy

The objective of Phase C was to construct, refine, and stabilize the taxonomy as the principal output of this research. Anchored in the DSR framework, this phase emphasized translating conceptual and contextual requirements into a structured, semantically coherent, and culturally relevant taxonomy tailored to CHIs within the OCMHS. The design process aimed to balance the integration of theoretical foundations in KO with practical implementation needs, while ensuring semantic interoperability across various CHI.

Through iterative cycles of modelling, validation, and refinement, Phase C established the hierarchical architecture, semantic relationships, and compliance with internationally recognized standards. Simultaneously, local terminologies and heritage-specific categories were embedded to reflect the unique cultural context of the Sawahlunto Municipality CHIs. This phase ensured that the resulting taxonomy was not only theoretically rigorous but also operationally viable for integration into digital repository environments within the municipality.

5.2.1 Design Principles and Rationale

The taxonomy design was informed by four core principles, including semantic clarity, cultural contextualization, scalability, and interoperability. These principles were instrumental in ensuring that the taxonomy serves both as an academic framework and a functional tool for CHI professionals. The decision to adopt a taxonomy-based approach was underpinned by its inherent capability to support hierarchical structuring of concepts while facilitating cross-domain semantic linkages, thereby bridging the traditional disciplinary silos among museums, archives, and library.

By incorporating locally specific cultural heritage (CH) terminologies and practices, the taxonomy preserved contextual authenticity. Concurrently, alignment with international metadata and classification standards enabled global semantic interoperability. These design considerations not only enhanced the effectiveness of information organization, retrieval, and reuse but also laid the groundwork for future scalability, accommodating new CH categories and supporting multilingual access. Ultimately, the taxonomy improves institutional workflows and fosters deeper engagement with diverse user communities.

5.2.1.1 Hierarchical Structure

The taxonomy was constructed following a general-to-specific hierarchical logic, enabling intuitive navigation from broad cultural categories to highly contextualized terms pertinent to the OCMHS. This structural approach aligns with international best practices in KO, as articulated in standards such as ANSI/NISO Z39.19 and ISO 25964, which recommend including scope notes and cross-references in controlled vocabularies to support semantic interoperability. At the same time, the taxonomy remains sensitive to local cultural realities, as identified through empirical fieldwork and the preliminary analyses presented in Phases A and B in Chapter 4.

By providing a hierarchical structure, the taxonomy facilitates consistent classification, discovery, and retrieval of cultural materials for users across CHIs in the Sawahlunto Municipality. This approach balances universal KO principles with local specificity, allowing for both semantic coherence and cultural fidelity. The taxonomy is structured into four levels of granularity:

a) Domain Level (Main Categories): At the highest level, the taxonomy defines broad conceptual anchors that serve as the foundational domains for subsequent classification layers. These main categories are aligned with UNESCO's intangible and tangible cultural heritage domains, including Oral Tradition, Performing Arts, Traditional Craftsmanship, Tools and Equipment, and Old Town Area. These were translated into Bahasa Indonesia as *Tradisi Lisan, Seni Pertunjukan, Kemahiran Kerajinan Tradisional, Peralatan dan Perlengkapan*, and *Kawasan Kota Lama*, respectively. These high-level domains function as shared semantic frameworks across CHIs, thereby facilitating cross-domain interoperability. In practice, this structure enables the classification of heterogeneous resources within globally recognized domains while allowing adaptation to the OCMHS's contextual realities.
b) Parent Level (Sub-Categories): The second level introduces sub-categories that refine the broad domains into thematically coherent clusters of cultural heritage knowledge. These sub-categories enhance semantic precision and contextual relevance. For instance, under *Peralatan dan Perlengkapan* (Tools and Equipment), the sub-category *Alat Pertambangan* (Mining Tools) was defined to distinguish artifacts directly associated with coal extraction from other utilitarian items used in everyday life. This level of structuring not only supports more accurate classification but also mirrors how local communities conceptualize and differentiate their material culture, thereby preserving cultural meaning while adhering to international KOS standards.
c) Child Level (Specific Categories): This level introduces more concrete and functionally specific groupings that reflect institutional practices and community understandings. For example, under *Alat Pertambangan* (Mining Tools), the child level *Alat Tambang Tradisional* (Hand Tools) was developed to capture traditional mining artifacts such as *Belincong* (Mattocks), *Pahat* (Chisels), and *Keranjang* (Bamboo Baskets). The identification of these categories was grounded in the analysis of historical sources and co-constructed through participatory engagement with CHI personnel during fieldwork. This approach ensures that the taxonomy aligns with CHI workflows, meets user expectations for descriptive precision, and remains faithful to the cultural context it represents.

d) Grandchild Levels (Contextualized Entries): At the most granular level, the taxonomy captures highly contextualized entries that embody the cultural essence of the OCMHS. For example, within *Alat Tambang Tradisional* (Hand Tools), the entry *Belincong* (Mattocks) was defined to reflect both its functional role and symbolic significance in historical coal extraction. At this level, cultural embeddedness becomes critical. Each term was validated through triangulated methods, including field interviews with CHI professionals and subject matter experts, archival document analysis, and consultation of regional lexicons. This methodological rigor ensures local authenticity, reduces terminological ambiguity, and strengthens both the scientific robustness and cultural resonance of the taxonomy.

It is important to emphasize that this multi-level structure was not designed as a purely technical exercise. Rather, it was a co-designed framework, developed collaboratively with CHI professionals to reduce cognitive load and improve usability across institutions. For instance, Curator 1 (CUR1) remarked that classifying artifacts such as *Belincong* (Mattocks) directly under *Alat Pertambangan* (Mining Tools), instead of embedding them within abstract, Western-oriented classification systems, resulted in a taxonomy that felt more intuitive and aligned with their curatorial practices.

> *"When we classify an artifact like the 'Belincong (Mattocks),' we want to see it directly under mining tools, not buried in an abstract Western-centric hierarchy. This hierarchy feels natural to us." (CUR 1)*

Similarly, Archivist 1 (ARC 1) emphasized the importance of hierarchical clarity in mediating between local authenticity and global interoperability. While recognizing the necessity of aligning records with international standards, ARC 1 asserted that the taxonomy should first and foremost foreground local categories:

> *"We need to map our records into international standards, but the taxonomy should first reflect our local categories. The way this hierarchy is built makes both possible." (ARC 1)*

These reflections underscore the critical role of hierarchical design not only in facilitating practical usability within CHIs but also in ensuring semantic and cultural alignment. The taxonomy, therefore, serves a dual function, bridging institutional practices with broader international frameworks.

The resulting hierarchical schema embodies a balanced synthesis between

cultural authenticity and technical interoperability, ensuring that the taxonomy remains both contextually grounded and globally compliant. By embedding local terminologies and knowledge systems within a structured semantic framework, the taxonomy establishes a solid foundation for current CHI applications while maintaining the scalability essential for future evolution. This scalability is particularly vital, as it allows for the seamless integration of emerging heritage categories and practices without disrupting the structural coherence of the taxonomy. In this regard, the taxonomy functions as a culturally responsive and technically sustainable framework, designed to evolve in parallel with institutional needs and the dynamic landscape of cultural heritage management.

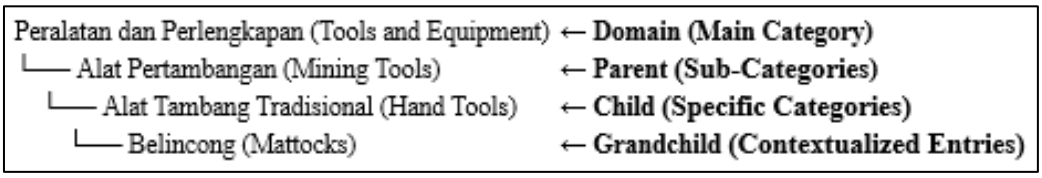


Figure 5.1 Illustrative Hierarchy Example for Tools and Equipment Domain

Figure 5.1 highlights the taxonomy's capacity to scale progressively from broad conceptual anchors at the domain level to culturally specific entities at the grandchild level or contextualized entries. The example of *Belincong* (Mattocks), a traditional mining tool widely used in OCMHS practices, demonstrates how elements of material culture can be contextually embedded within the taxonomy while remaining accessible and navigable in the digital repository prototype.

By structuring terms in this manner, the taxonomy not only preserves cultural specificity but also supports systematic access for CHI professionals, researchers, and other stakeholders. These findings align with user feedback collected during participatory sessions. For example, Curator 2 (CUR 2) emphasized the importance of the hierarchical model in facilitating meaningful understanding:

> *"The tree helps us visualize not only where an item belongs, but also how it connects to other tools and stories. It guides us through the cultural logic of our cultural heritage." (CUR 2)*

This visualization reinforces the core design principle of a general-to-specific hierarchical structure, in which broad CH domains are progressively refined into increasingly specific, contextualized entries. Such an approach ensures semantic coherence and interoperability with established international knowledge organization

systems (KOSs) standards while safeguarding the semantic fidelity of local terminologies and cultural expressions.

By embedding both global interoperability and local authenticity within a unified hierarchical framework, the taxonomy fulfils a dual function: it facilitates technical integration across systems and platforms, and it preserves the interpretive depth and cultural resonance of the OCMHS. This layered design was further validated during focus group discussions and field evaluations, affirming the taxonomy's relevance in aligning institutional workflows with community knowledge systems.

5.2.1.2 Cultural Embeddedness

The taxonomy was intentionally grounded in local cultural logics to ensure that its categories reflected more than abstract technical constructs. Rather than adopting Western classification schemas wholesale, the design employed community-anchored semantics, embedding terms, categories, and hierarchical structures derived directly from oral traditions, archival documentation, and curatorial practices within the CHIs of Sawahlunto Municipality.

For instance, while a typical international KOS standard might categorize tools strictly based on function, such as digging, cutting, or carrying, the OCMHS taxonomy reflects locally meaningful categories of use and significance. Terms such as *Belincong* (Mattocks) and *Keranjang* (Bamboo Baskets) were deliberately retained in their original forms rather than translated into generic technical equivalents. This design choice reinforces cultural authenticity, ensuring that classification resonates with the lived experiences and terminologies familiar to local stakeholders. Moreover, it helps users recognize, validate, and preserve their CH while maintaining the semantic integrity of traditional expressions.

Importantly, the cultural embeddedness of the taxonomy extends beyond material culture to encompass intangible CH domains. This ensures a holistic system that accounts for both physical artifacts and living traditions. For example, within the domain or main category of *Tradisi Lisan* (Oral Tradition), subcategories such as *Cerita Rakyat* (Folklore), *Legenda* (Legends), *Bahasa Daerah* (Mother Tongue), and *Nyanyian Rakyat* (Folksongs) were systematically incorporated. These inclusions underscore the taxonomy's function not merely as a classificatory tool, but also as a medium for safeguarding oral traditions and the collective memory of the community.

This perspective was echoed during focus group discussions. Registrar 1 (REG 1) noted the importance of ensuring that intangible elements were adequately represented.

> *"Excluding stories, songs, and rites and ceremonies would render the system incomplete, since such practices are integral to understanding the socio-cultural fabric of OCMHS's cultural heritage." (REG 1)*

Similarly, Archivist 2 (ARC 2) emphasized the importance of preserving local terminology in its original form. Replacing culturally embedded expressions such as *Belincong* with generic English equivalents like *"Mattocks"* was seen as a potential threat to cultural identity and semantic integrity. Instead, participants advocated a local-first lexical strategy, in which indigenous terms are presented as the primary entries, with translations provided only where necessary. This approach ensures that cultural authenticity is foregrounded, while also allowing for broader cross-cultural accessibility.

> *"Keeping the local or national words matters. If we replace Belincong with 'Mattocks,' we lose part of our identity. Visitors should see our terms first, then maybe the English, but not the other way around." (ARC 2)*

These insights affirm that the taxonomy's cultural embeddedness is not merely a design preference but a critical strategy for safeguarding the authenticity of the OCMHS's cultural heritage. By anchoring categories in local terminologies, oral traditions, and lived practices, the taxonomy actively resists the imposition of generic or externally derived classifications. This preserves semantic nuance and community-specific cultural logic within the taxonomy's framework.

At the same time, its structured alignment with international standards enables semantic interoperability across diverse CHIs, allowing the taxonomy to function as a shared semantic infrastructure. This dual anchoring of local cultural specificity and global technical interoperability embodies the DSR principle of contextual alignment, whereby artifacts are iteratively refined through both stakeholder engagement and formal technical criteria. Consequently, the taxonomy emerges as more than a functional KOS; it becomes a culturally resonant artifact, co-constructed with local actors, that encapsulates the narratives, practices, and identity markers of the community it serves.



Figure 5.2 Illustrative Hierarchy Example for Oral Tradition Domain

This hierarchical tree shows that intangible CH is deliberately assigned the same structural weight as tangible categories, such as *Peralatan dan Perlengkapan* (Tools and Equipment). This design decision reflects three critical principles that underpin the taxonomy's cultural and technical integrity.

First, cultural embeddedness is achieved by retaining original local terms such as *Legenda* (Legends) and *Nyanyian Rakyat* (Folksongs), thereby preserving indigenous semantics rather than subsuming them under abstract or overly generalized translations. This reinforces the community's voice within the taxonomy and safeguards culturally specific expressions.

Second, the taxonomy encompasses multiple dimensions of oral traditions, including narrative, performative, and linguistic aspects, ensuring that intangible CH is preserved alongside tangible elements. In doing so, the system reflects the holistic nature of cultural heritage as experienced and transmitted by the local community.

Third, including a grandchild level in the hierarchy facilitates documenting specific, named traditions that hold unique significance for the community. These entries can be digitally cross-referenced within the digital repository prototype, thereby supporting both discoverability and contextual interpretation.

Collectively, these design features ensure that *Tradisi Lisan* (Oral Traditions) are not marginalized within the system but are instead structurally and semantically

integrated, reflecting their foundational role in the cultural fabric of the OCMHS. This perspective was powerfully articulated by Museum Director 1 (DIR 1) during the participatory focus group discussion:

> *"Our legenda (legends) and peribahasa (proverbs) are the soul of the OCMHS. Without them, the tools and buildings are just objects. The taxonomy must hold both the hands that worked and the voices that told the stories." (DIR 1)*

Such stakeholder insights affirm that the taxonomy serves not only as a classificatory tool but also as a medium of cultural continuity, preserving both the physical legacies and the intangible narratives that give meaning to the OCMHS.

5.2.1.3 Scalability

A central design principle underpinning the taxonomy is its inherent capacity for future expansion without compromising the internal logic or usability of the existing schema. Scalability was deliberately embedded through both the hierarchical structuring of categories and the semantic design of interrelationships, ensuring that additional domains, including contextualized entries, can be incorporated seamlessly. Accordingly, the taxonomy is not conceived as a static classification tool, but rather as a dynamic, living system responsive to the evolving documentation needs of CHIs in Sawahlunto Municipality and, by extension, the CH domain. This design choice ensures long-term sustainability, enabling the taxonomy to remain relevant as new forms of cultural expression, particularly those emerging in digital environments, are introduced.

The principle of scalability manifests in several dimensions. Firstly, the taxonomy was designed with expandable hierarchical depth, allowing each conceptual branch to be extended further, down to the grandchild level, where specific practices, artifacts, or narratives can be incorporated. This layered approach ensures that the classification framework remains responsive to the evolving nature of CH documentation, without compromising structural clarity or semantic interoperability. For example, within the main category of Kemahiran Kerajinan Tradisional (Traditional Craftsmanship), future sub-branches may be developed to accommodate hybrid or contemporary adaptations that blend traditional techniques with modern innovations, thereby preserving historical continuity while acknowledging cultural evolution.

Secondly, the taxonomy supports cross-domain adaptability, ensuring that while

its initial focus is on CH domains specific to the OCMHS, its modular structure allows for future expansion into broader CH domains. This adaptability is particularly critical as CHIs increasingly incorporate born-digital content and community-generated materials into their digital repositories. In such cases, a taxonomy capable of transcending traditional boundaries between tangible and intangible CH is essential. By accommodating diversification without compromising semantic coherence, the taxonomy positions itself as a versatile tool preserving OCMHS-specific content while anticipating future documentation and convergence initiatives.

Thirdly, semantic flexibility was embedded as a core architectural feature, allowing for the taxonomy to remain resilient in the face of new conceptual insertions. This is operationalized through controlled vocabularies and associative semantic links. These mechanisms enable the seamless integration of emerging terms while maintaining consistency in meaning and application across CHIs. For instance, the introduction of a new category related to mining practices could be semantically associated with both *Peralatan dan Perlengkapan* (Tools and Equipment) and *Pengetahuan Mengenai Alam* (Knowledge of Nature), without necessitating a reclassification of existing records. This flexibility ensures that the taxonomy evolves in tandem with shifting CH narratives and practices, functioning as a truly dynamic KOS.

Fourthly, scalability was validated through its technical implementation within a digital repository prototype. Empirical testing confirmed that the category trees could be expanded both horizontally by introducing additional sibling branches and vertically by adding deeper hierarchical levels, without compromising interface usability or system performance. This implementation enables incremental updates through routine institutional workflows, embedding scalability and governance mechanisms into the system's operational design. As a result, the taxonomy not only fulfils current classification requirements but also remains robust and adaptable for future digitization and reinterpretation efforts by CHIs in Sawahlunto Municipality. This perspective was strongly supported by Museum Curator 1 (CUR 1) during the taxonomy validation FGD:

> *"We cannot freeze cultural heritage in time. New rituals, new crafts, and even new environmental concerns keep appearing. If the taxonomy cannot grow with them, it will become irrelevant in less than a decade." (CUR 1)*

This reflection underscores the need to embed scalability as a core design principle. In this context, scalability ensures that the taxonomy transcends the limitations of a static classificatory system, instead operating as an anticipatory framework that evolves in response to emerging cultural dynamics, knowledge forms, and documentation needs.

By integrating this forward-looking perspective, the taxonomy aligns with the foundational principles of DSR, which emphasize that artifacts must demonstrate long-term utility, quality, and adaptability within real-world application environments. As such, the taxonomy positions itself not only as a technically sound system but also as a resilient and future-oriented infrastructure for CH documentation and management.

5.2.1.4 Interoperability

The fourth guiding principle underpinning the taxonomy design is interoperability, defined as the capability of the taxonomy to operate seamlessly across institutional, national, and international KOS standards. This principle was prioritized to ensure that the taxonomy does not operate in isolation but rather serves as a semantic bridge between locally embedded CH narratives and broader global metadata infrastructures.

By embedding interoperability into the taxonomy, collections within the OCMHS can be meaningfully connected to established standards, while simultaneously preserving the unique cultural semantics derived from fieldwork and community input. This ensures that the taxonomy meets institutional needs for classification and access, while also facilitating knowledge exchange across CHIs and international CH platforms. In this dual capacity, interoperability enhances both the technical relevance and the cultural legitimacy of the taxonomy, affirming its role as a locally grounded yet globally connected KOS.

A key mechanism for ensuring interoperability was the creation of a crosswalk to widely recognized metadata standards. Each taxonomic category was carefully mapped to appropriate schemas to maintain semantic consistency and data exchangeability across institutional and disciplinary boundaries. For example:

a) Textual materials were aligned with MARC21 bibliographic fields to ensure compatibility with international library cataloging systems.

b) Performing arts entries were mapped to Categories for the Description of Works of Art (CDWA), supporting museum documentation practices.
c) Archival fonds were structured in accordance with ISAD(G) standards, enabling multilevel archival descriptions.

This crosswalk approach ensures that CHI records generated in Sawahlunto Municipality can be disseminated and integrated into broader digital infrastructures without semantic distortion or loss of cultural meaning. In doing so, the taxonomy enhances both local cataloging efficiency and the global discoverability of OCMHS CH resources.

To further strengthen semantic precision and global interoperability, taxonomic terms were anchored to internationally established controlled vocabularies, including the Art and Architecture Thesaurus (AAT), Library of Congress Subject Headings (LCSH), and the UNESCO Thesaurus. This anchoring supports multilingual access, disciplinary neutrality, and semantic integrity, ensuring that concepts are consistently understood across linguistic and professional contexts. Additionally, by referencing these vocabularies, the taxonomy facilitates accurate indexing, retrieval, and cross-platform linking, enabling integration into Linked Open Data (LOD) environments and broader semantic web ecosystems.

Interoperability also extends to cross-institutional integration, allowing the taxonomy to function as a shared semantic backbone for the OCMHS digital repository. Its design enables individual CHIs to map their records onto a common framework without compromising their institutional uniqueness. For example, the concept *Keranjang* (Bamboo Baskets) is classified under *Alat Pertambangan* (Mining Tools) for curatorial use in museums, while also being semantically linked to *Daftar Pekerja* (Labor Registers) in archival collections and to *Kartografi* (Cartographic Materials) in library holdings. This integrative structure accommodates the diverse ways in which artifacts are contextualised across institutions, reducing redundancy and enabling a more coherent representation of CH.

From a technical perspective, the taxonomy was designed with explicit attention to machine-readability and Semantic Web compatibility. Adopting a simple knowledge organization system (SKOS)-compliant format makes the taxonomy machine-readable, facilitating automated data exchange, integration, and retrieval across digital systems. This design feature positions the taxonomy within the global ecosystem of semantic technologies, enabling its future inclusion in LOD initiatives and ensuring that OCMHS

CH resources can be interlinked with international knowledge repositories. Importantly, this approach transforms the taxonomy from a static classification list into a dynamic knowledge graph that maps contextual relationships among artifacts, narratives, and practices across institutional and geographic boundaries. This benefit was underscored by Librarian 1 (LIB 1) during the evaluation FGD:

> *"If our records remain trapped in local systems, international researchers will never find them. This taxonomy, by speaking the language of global standards, opens the door to global visibility." (LIB 1)*

Such insights demonstrate how interoperability extends the taxonomy's function beyond its immediate utility for local cataloging. It enables global scholarly engagement, allowing the CH of OCMHS to be represented, discovered, and understood within the international research ecosystem.

Moreover, interoperability transforms the taxonomy into a globally connected semantic framework that balances cultural specificity with technical compatibility. It ensures that the taxonomy not only reflects local meanings and practices but also enables their documentation, retrieval, and reuse within global metadata infrastructures. This dual orientation reinforces the taxonomy's alignment with DSR principles, particularly those relating to utility, quality, and contextual relevance. Taken together, the four guiding principles, hierarchical structure, cultural embeddedness, scalability, and interoperability, provide a coherent and systematic rationale for the taxonomy's design:

a) Hierarchical structure ensures logical organization, navigability, and clarity across both tangible and intangible CH domains.
b) Cultural embeddedness grounds the taxonomy in the lived practices, oral traditions, and linguistic realities of the OCMHS community.
c) Scalability allows the taxonomy to evolve with changing documentation needs, technological developments, and institutional transformations.
d) Interoperability positions the taxonomy for integration within international metadata infrastructures and linked data ecosystems.

Collectively, these principles establish the taxonomy as both a culturally authentic framework and a technically robust infrastructure, effectively bridging local CH narratives with international KOS standards.

5.2.2 Iterative Taxonomy Development Process

The taxonomy was developed through a multi-iteration design–evaluation cycle, consistent with the DSR paradigm and informed by established taxonomy development methodologies, particularly the framework proposed by Nickerson et al. (2013) and further extended by Kundisch et al. (2021). This iterative approach ensured that the taxonomy was not constructed as a static, one-time artifact, but rather as a progressively refined system grounded in empirical data and shaped by continuous stakeholder engagement.

Each iteration began with a prototyping phase, during which preliminary taxonomic structures and categories were developed based on findings from earlier research phases and initial design requirements. This was followed by structured stakeholder engagement, which involved a range of qualitative methods including observations, semi-structured interviews, focus group discussions (FGDs), document analysis, and usability testing sessions. These activities were conducted across multiple CHIs within the Sawahlunto Municipality to capture institutional diversity and contextual specificity.

The subsequent validation phase enabled a critical assessment of the taxonomy's relevance, clarity, and operational functionality across different CHI environments. Feedback gathered from CHI professionals and subject matter experts during this phase informed iterative refinements to the taxonomy schema. This included adjustments to category labels, restructuring of hierarchical levels, incorporation of missing terms, and refinement of definitions, thereby enhancing the taxonomy's practical usability while maintaining conceptual and theoretical rigor.

By combining methodological rigor with participatory design principles, the iterative process ensured that the resulting taxonomy was both technically robust and culturally resonant. It reflects not only the formal requirements for semantic interoperability with international metadata standards but also the local cultural logic and knowledge practices of the OCMHS community. This dual orientation aligns with the overarching goals of the research, including producing a taxonomy that functions as a sustainable, context-sensitive KOS capable of bridging international KOS standards with locally meaningful heritage documentation.

5.2.2.1 Iteration 1: Foundational Schema Drafting

The first iteration focused on developing a foundational taxonomy schema that would serve as the structural baseline for subsequent refinements. This phase was informed by an extensive review of the literature on KOS and a close examination of international standards, including the UNESCO Thesaurus, the Art and Architecture Thesaurus (AAT), and the Library of Congress Subject Headings (LCSH). These standards provided well-established semantic anchors, ensuring alignment with global frameworks and enhancing the taxonomy's potential for interoperability.

Concurrently, initial field data collected during the institutional profiling activities presented in Chapter 4 provided critical insights into existing KO practices across CHIs in the Sawahlunto Municipality. These insights highlighted key contextual factors, such as terminology use, cataloging habits, and cultural representation, that affect the development of taxonomy specific to the OCMHS. By synthesizing global best practices with empirical evidence from the field, this iteration aimed to capture the breadth of CH domains, encompassing both tangible and intangible dimensions relevant to the OCMHS.

The key objective during this stage was to ensure conceptual clarity, logical consistency, and usability for CHI professionals. A preliminary hierarchical structure was constructed to represent the full spectrum of OCMHS-related heritage content. On the tangible CH side, broad domain-level categories such as *Peralatan dan Perlengkapan* (Tools and Equipment) were established to systematically organize material artifacts, including mining tools, machinery, and associated work-related items. In parallel, intangible CH was addressed through categories like *Tradisi Lisan* (Oral Tradition), ensuring that narratives, folklore, and collective memory practices were embedded within the same semantic framework.

This dual emphasis was not merely classificatory; it was a deliberate attempt to reflect the holistic nature of CH, in which physical artifacts and intangible expressions are intricately linked. As such, the outcome of this iteration was the creation of a balanced, culturally grounded schema that acknowledged both the material and immaterial dimensions of the OCMHS. This schema served as a solid foundation for the next phase of stakeholder engagement and iterative refinement.

A second key activity during this iteration involved conducting a series of FGDs with selected subject matter experts from Sawahlunto Municipality CHIs. These FGDs

functioned as an essential platform for evaluating the taxonomy's coherence and logical structure, with particular attention given to the integrity of hierarchical relationships across parent, child, and grandchild levels.

For example, participants critically examined whether hierarchical pathways such as *Alat Tambang Tradisional* (Hand Tools) → *Belincong* (Mattocks) and *Tradisi Lisan* (Oral Tradition) → *Cerita Rakyat* (Folklore) → *Legenda* (Legends) were positioned appropriately and semantically consistent with both local knowledge systems and international classification standards. These deliberations extended beyond technical classification; they became a form of cultural validation, testing the taxonomy's ability to translate lived experience and heritage logic into structured categories. The feedback generated from these sessions was instrumental in validating the cultural authenticity, semantic clarity, and practical usability of the taxonomy. This ensured that the emerging structure evolved not only as a product of academic rigor but also as an operationally meaningful framework for institutional implementation across CHIs.

Additionally, deliberate attention was paid to embedding cultural markers in the taxonomy by incorporating local terminology directly into the schema. Terms such as *Belincong* (Mattocks) and *Keranjang* (Bamboo Baskets) were intentionally retained in their original linguistic forms, thereby reinforcing cultural authenticity and enhancing terminological recognition among CHI professionals in Sawahlunto Municipality. This design strategy not only preserved indigenous knowledge systems but also improved the taxonomy's relevance and accessibility for both local communities and institutional users, while simultaneously maintaining semantic alignment with international metadata standards.

Insights generated from the preliminary FGD revealed critical practical concerns among CHI professionals, particularly the dual requirement for cultural specificity and systemic interoperability in the taxonomy's design. Curator 1 (CUR 1) emphasized that taxonomic clarity must go beyond technical categorization and reflect the narrative dimensions of cultural heritage interpretation. CUR 1 noted that terminological precision directly influences the authenticity and emotional resonance of heritage representation:

> *"We cannot just classify 'tools'; for our visitors, it matters that we say Belincong, not just 'mattock.' Otherwise, the meaning is lost."* (CUR 1).

This reflection underscores that the taxonomy must function not only as an organizational instrument but also as a cultural storytelling device, ensuring that the lived experiences and linguistic heritage of the community are meaningfully represented within both institutional and digital environments. The curators strongly advocated for the faithful inclusion of local terminologies and cultural nuances, viewing them as essential to safeguarding authenticity and fostering engagement across both local and external audiences.

Their feedback highlighted that the taxonomy should not be perceived as a neutral classificatory tool, but rather as a cultural interface, a system that conveys identity, values, and lived experience. By embedding indigenous vocabularies and interpretive markers into the taxonomy's hierarchical structure, the design transcends abstract classification and evolves into a framework aligned with heritage storytelling and visitor interpretation. In doing so, the taxonomy serves a dual function: it upholds scholarly and technical rigor while also supporting community recognition, cultural continuity, and intercultural communication.

In contrast, Archivist 2 (ARC 2) raised concerns regarding the operational imperatives of interoperability and cross-institutional integration, reflecting the structural realities of archival workflows. ARC 2 stressed that classification systems must remain communicable with external metadata infrastructures, cautioning that a taxonomy overly constrained by local semantics would risk incompatibility in collaborative or inter-institutional contexts:

> *"Our catalogues must talk to other systems. If this taxonomy is only local, it will not help when we exchange records."* (ARC 2)

This reflection illustrates the tension between cultural specificity and technical universality, highlighting the need to design a taxonomy that is both authentically local and globally interoperable. By embedding interoperability as a core design principle, the taxonomy is positioned not only as a tool for local documentation but also as a semantic bridge, enabling CHIs in Sawahlunto Municipality to participate in broader archival networks, metadata exchanges, and linked heritage infrastructures.

This observation underscored the need to design a taxonomy that, while firmly rooted in local CH practices, remains mappable to international standards and compatible with external cataloging systems. Stakeholder reflections highlighted the delicate balance between safeguarding cultural authenticity and enabling semantic

interoperability, ensuring the taxonomy could serve as a semantic bridge across CHIs rather than becoming isolated within a purely localized framework.

Moreover, these insights reaffirmed the dual imperatives that shaped the taxonomy's development: the preservation of cultural embeddedness on one hand, and the facilitation of semantic integration on the other. This dialectical orientation provided a foundational rationale for subsequent design iterations, ensuring that the taxonomy evolved to be both culturally meaningful and technically functional within broader KO networks.

The evaluation of the first iteration revealed a critical tension that would recur throughout subsequent stages of taxonomy refinement. On one side, there was strong demand for cultural authenticity, particularly voiced by museum stakeholders, who emphasized the importance of embedding local terminology, vernacular expressions, and contextual markers into the taxonomy's hierarchical structure. This position reflected the belief that a taxonomy disconnected from its cultural roots would undermine the interpretive richness of CH objects and narratives, ultimately diminishing its relevance for both local communities and external audiences.

Conversely, the necessity of system interoperability was equally emphasized, particularly by archivists and other CHI professionals. Their insistence on alignment with established metadata standards such as ISAD(G) and Library of Congress Subject Headings (LCSH) stemmed from an operational requirement to ensure that institutional catalogs can communicate effectively with external repositories, national platforms, and international metadata infrastructures. Without this alignment, there exists a significant risk of data silos, reduced interoperability, and diminished discoverability, all of which could compromise the long-term sustainability of the digital repository.

The juxtaposition of these two perspectives, cultural embeddedness and interoperability, surfaced during the evaluation as a dual design tension that would guide the direction of subsequent development. Rather than viewing them as mutually exclusive, this research adopted the tension as a generative principle, positioning the taxonomy as both a locally grounded knowledge framework and a globally interoperable semantic layer. This dialectical insight became a key element of the design rationale for future iterations, ensuring that each refinement was evaluated against both cultural and technical benchmarks.

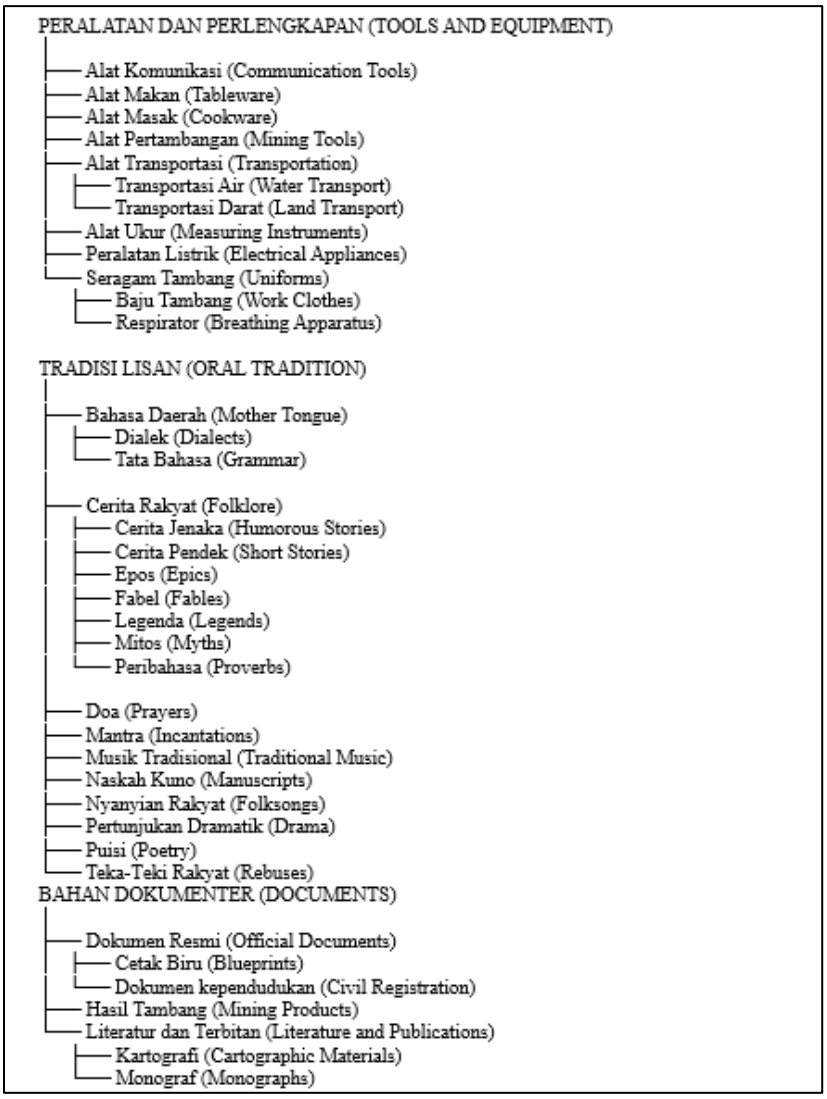


Figure 5.3 Iteration 1 – Baseline Schema

The preliminary taxonomy developed in Iteration 1 provided an initial snapshot of how both tangible and intangible CH domains of the OCMHS were conceptually organized, as illustrated in Figure 5.3. The category *Peralatan dan Perlengkapan* (Tools and Equipment) represented the material culture associated with mining practices. It was arranged hierarchically, from general equipment classifications to specific, culturally recognized implements. By embedding vernacular terminologies directly within the taxonomy, this category reflected sensitivity to local and national linguistic markers, ensuring that classification served not only a functional purpose but also carried interpretive significance for both professionals and community stakeholders.

In contrast, the *Tradisi Lisan* (Oral Tradition) domain, the main category, reflected the intangible CH dimension, capturing the richness of collective memory, oral transmission, and identity, as preserved across its various subcategories. The

inclusion of this domain underscored the recognition that narrative-driven heritage, such as folklore, is an equally vital knowledge asset alongside physical artifacts. By integrating both tangible and intangible elements within a unified taxonomy, the study reaffirmed their interdependence in the documentation and interpretation of CH.

The domain *Bahan Dokumenter* (Documents) served as a bridging domain across CHIs, highlighting the critical role of institutional repositories in preserving textual, administrative, and historical records of the OCMHS. Its inclusion ensured that the taxonomy could function as a cross-domain semantic framework, facilitating alignment between narrative traditions, object-based collections, and documentary holdings. This cross-cutting role of documentation also positioned the taxonomy to support the integration of both curatorial and archival practices.

Taken together, this preliminary schema illustrated that even at its earliest stage, the taxonomy could capture the duality of CH domains, tangible and intangible, while also revealing early tensions between local specificity and global interoperability. On one hand, the use of localized and national terminologies reinforced the taxonomy's cultural authenticity and resonance with community contexts. On the other hand, the imperative of metadata alignment, particularly in the archival domain, exposed the challenges of ensuring semantic compatibility across diverse institutional systems.

This emerging duality between contextual fidelity and technical standardization served as an early signal of the design negotiations that would continue to shape subsequent iterations of the taxonomy. It highlighted the need for a framework that could accommodate cultural depth and narrative integrity, while remaining functionally compatible with broader metadata infrastructures and knowledge exchange networks.

5.2.2.2 Iteration 2: Stakeholder Validation and Refinement

The second iteration was undertaken to validate the baseline taxonomy developed in Iteration 1 through structured stakeholder engagement. While the initial iteration focused on constructing a preliminary hierarchical framework that integrated both tangible and intangible CH domains, Iteration 2 aimed to evaluate whether the emerging taxonomy was perceived as coherent, meaningful, and usable by professionals within the CHIs of Sawahlunto Municipality. This second iteration integrated stakeholder input through FGDs and participatory classification tasks. Key refinements included the introduction of dual labelling, enrichment of categories with context-

specific items, and clearer associative relationships across domains. This marked the transition from a purely standards-driven baseline to a taxonomy reflecting local semantics and institutional practices.

Importantly, this validation process extended beyond a purely technical assessment. It also involved testing the taxonomy's alignment with stakeholders' cognitive models, institutional workflows, and cultural expectations. CHI professionals and subject matter experts were invited to review the structure and placement of taxonomic categories and subcategories to determine whether the taxonomy accurately represented their lived practices in cataloguing, curating, and interpreting OCMHS-related CH. Moreover, this engagement allowed stakeholders to assess how well the taxonomy captured cultural embeddedness, particularly through the use of locally grounded terms, community narratives, and context-specific classifications.

In addition, Iteration 2 sought to assess the taxonomy's practical usability across institutional settings. By foregrounding the experiences of curators, archivists, librarians, and other practitioners, this phase helped identify where the taxonomy effectively supported KO and where refinements were needed to accommodate institutional constraints or domain-specific requirements better. This approach reaffirmed the methodological principle that validation must be both participatory and context-sensitive, ensuring that the taxonomy is not only technically rigorous but also socially and culturally grounded.

The validation activities in the Iteration 2 sessions were designed to actively engage participants with the taxonomy by inviting them to 1) Review the Iteration 1 hierarchical structure; 2) Classify sample objects from their collections; and 3) Evaluate the extent to which the taxonomy's structure aligned with professional routines and cultural contexts. To ensure a comprehensive assessment, representative objects and themes were drawn from domains, such as *Peralatan dan Perlengkapan* (Tools and Equipment), *Tradisi Lisan* (Oral Tradition), and *Bahan Dokumenter* (Documents), thereby testing the taxonomy's functionality across both tangible and intangible CH categories.

In order to capture not only participants' evaluations but also the cognitive reasoning underlying their decisions, the study employed concurrent cognitive verbalization during task execution as part of a structured verbal protocol analysis. Participants were encouraged to articulate their thought processes as they placed objects into specific categories, expressing their interpretations of labels, their comfort with

hierarchical depth, and their assessments of cultural appropriateness. This method surfaced professionals' tacit knowledge and enabled the researcher to identify misalignments, ambiguities, or unintended interpretations within the taxonomy structure.

Overall, Iteration 2 provided critical empirical grounding for further refining the taxonomy. By integrating stakeholder insights with methodological rigor, this phase ensured that the taxonomy evolved into not only a formalized knowledge structure but also a practical, culturally resonant, and professionally endorsed classification system for documenting and interpreting OCMHS cultural heritage. The interviews conducted during Iteration 2 were complemented by a rigorous qualitative analysis of the transcribed data, using ATLAS.ti Version 25. Coding focused on recurring themes, including:

a) Terminology ambiguity: tensions between local vernacular expressions and standardized descriptors,
b) Hierarchy depth: assessing whether three or four levels were sufficient to capture the granularity of OCMHS's CH, and
c) Cross-domain overlaps: cases where archival documents referenced artifacts more commonly associated with museum holdings.

These emergent themes provided a structured evidence base for refining the taxonomy in subsequent iterations, ensuring that each revision was both empirically grounded and culturally responsive. The second iteration yielded several critical insights, highlighting both the strengths and limitations of the preliminary taxonomy, particularly regarding cultural authenticity, structural adequacy, and cross-institutional alignment.

First, regarding cultural resonance, stakeholders consistently emphasized the importance of cultural embeddedness in the use of terminology. Museum staff argued that the taxonomy should prioritize locally and nationally grounded vocabulary to preserve narrative clarity and cultural meaning. Curator 1 (CUR 1) stated that taxonomic terms should explicitly favor local or Bahasa Indonesia terms over generic descriptors, as the former convey not only the functional identity of an artifact but also its symbolic significance within the mining community:

> *"Terms must be explicit. We cannot just say 'tool' or 'equipment'. 'Belincong' means something specific to us."* (CUR 1)

Similarly, Archivist 2 (ARC 2) expressed concern about the ambiguity of broad categories such as *Bahan Dokumenter* (Documents) and recommended greater granularity, particularly to distinguish between administrative records and community manuscripts. Such differentiation ensures that both institutional records and vernacular knowledge are equitably represented in the classification system.

Second, issues of granularity and hierarchical depth emerged as a central concern. Participants noted that certain CH domains, particularly *Tradisi Lisan* (Oral Tradition), required finer categorization to capture the richness of narrative genres. Librarian 1 (LIB 1) remarked that subcategories should clearly distinguish between *myths*, *legends*, and *proverbs*, arguing that without such distinctions, intangible CH categories risk oversimplification.

> *"We need to separate the types of stories. A myth is not the same as a proverb—it carries a different kind of truth."* (LIB 1)

Similarly, Curator 2 (CUR 2) called for greater refinement within *Peralatan dan Perlengkapan* (Tools and Equipment), suggesting that child levels should distinguish between manual, mechanical, and hybrid artifacts to reflect the technological evolution of mining tools across historical periods.

Third, cross-institutional alignment emerged as a recurring theme, underscoring the challenge of harmonizing diverse institutional perspectives within a single taxonomy. Stakeholders emphasized the need for mid-level semantic bridges that enable taxonomic categories to operate across disciplinary and functional boundaries. For instance, *Cetak Biru* (Blueprints) was recognized by participants as both an archival document and a cultural artifact situated within the practices of both archivists and curators.

Such overlaps reinforced the need for interoperable descriptors that enable cross-domain dialogue, allowing CHIs to engage with the taxonomy without sacrificing their institutional interpretive frameworks. Identifying these shared conceptual spaces was critical to guiding future refinements that sought to preserve institutional specificity while enabling semantic integration. Taken together, the findings of Iteration 2 offered vital direction for subsequent design refinements. The taxonomy's development required continuous negotiation between authenticity and functionality, with stakeholder feedback reaffirming that success would depend on its ability to serve as both a culturally resonant classification system and a technically interoperable semantic

infrastructure.

The qualitative reflections from stakeholders during Iteration 2 reinforced the importance of cultural precision, structural clarity, and cross-domain sensitivity. Their perspectives illuminated the practical and interpretive challenges encountered in operationalizing the taxonomy across diverse institutional settings. Museum professionals emphasized the critical role of locally grounded terminology in achieving cultural resonance. As articulated by Curator 2 (CUR 2):

> *"If we use the word 'Beliung,' younger staff might not recognize it, but 'Belincong' immediately resonates with our local history." (CUR 2)*

This observation illustrates that local terms are not only semantically accurate but also pedagogically effective, facilitating intergenerational knowledge transmission. Such terminology directly links the classification framework to local historical consciousness and enhances cultural relevance for both staff and visitors. From the archival perspective, the need for greater categorical precision was clearly voiced. Archivist 1 (ARC 1) critiqued the overgeneralization of categories such as *Bahan Dokumenter* (Documents):

> *"In our archive, 'documents' is too broad. We separate Official Documents, Mining Products, and Literature and Publications; otherwise, retrieval will be chaotic." (ARC 1)*

This reflection underscores that overly broad taxonomic terms can hinder retrieval accuracy and disrupt institutional workflows, reinforcing the need for differentiated subcategories within the intangible CH, including the *Tradisi Lisan* (Oral Tradition) domain. Librarians, in turn, highlighted the functional diversity of intangible CH and warned against its oversimplification. As noted by Librarian 2 (LIB 2):

> *"Legends and myths cannot be mixed in one basket. Each has its cultural function, so we must reflect this distinction." (LIB 2)*

This insight supports the need for hierarchical depth within the *Tradisi Lisan* (Oral Tradition) domain, ensuring that the taxonomy captures the distinct cultural functions and interpretive contexts of various oral narrative forms. Stakeholder reflections during Iteration 2 positioned cultural resonance, categorical granularity, and functional differentiation as essential criteria for refining the taxonomy. Their feedback not only validated the limitations identified in Iteration 1 but also guided a series of

targeted restructuring efforts that advanced the taxonomy into a more robust, context-sensitive, and professionally usable framework.

First, the domain of *Tradisi Lisan* (Oral Tradition) was systematically expanded from a single undifferentiated node into ten distinct subcategories. This refinement directly addressed librarians' concerns that intangible CH genres should not be treated as homogeneous. Each narrative form, such as *Mitos* (Myths), *Legenda* (Legends), and *Peribahasa* (Proverbs), carries distinct cultural functions, levels of formality, and modes of transmission. By introducing genre-level distinctions, the taxonomy improved both cultural representativeness and the precision of indexing and retrieval across institutional collections, while aligning more closely with community practices and scholarly conventions.

Second, the *Bahan Dokumenter* (Documents) domain was restructured to improve granularity and retrieval precision. Archivists had noted that the initial formulation was overly broad and risked undermining interoperability. In response, the taxonomy was refined into well-defined subcategories:

a) *Dokumen Resmi* (Official Documents), which included seven child levels, including *Cetak Biru* (Blueprints), *Dokumen Kependudukan* (Civil Registration), *Dokumen Kesehatan* (Medical Records), *Dokumen Ketenagakerjaan dan Komersial (*Employment and Commercial Documents), *Dokumen Perjalanan* (Travel Documents), *Dokumen Pos* (Postal Documents), and *Mata Uang* (Currency);
b) *Hasil Tambang* (Mining Products), recognizing records directly linked to coal mining outputs; and
c) *Literatur dan Terbitan* (Literature and Publications), further divided into four child levels, including *Kartografi* (Cartographic Materials), *Monograf* (Monographs), *Referensi* (Reference Materials), and *Terbitan Berkala* (Periodicals).

This restructuring allowed the taxonomy to better align with archival standards while simultaneously accommodating the socio-historical diversity of OCMHS's CH, thereby bridging institutional records and community-driven textual heritage.

Third, the Peralatan dan Perlengkapan (Tools and Equipment) domain was refined into eight subcategories. Responding to curators' concerns that many artifacts did not fit neatly within the baseline classification, the taxonomy introduced clearer distinctions, such as separating *Mesin Pertambangan* (Mining Machinery) from *Alat*

Tambang Tradisional (Hand Tools), and differentiating between forms of transport (*Water* and *Land*). This refinement provided a more logical, navigable structure, clarified the classification of hybrid artifacts, and offered a more historically accurate representation of the technological evolution of mining practices within OCMHS.

Fourth, the taxonomy was expanded through the incorporation of five new domains, namely 1) *Seni Pertunjukan* (Performing Arts); 2) *Adat Istiadat Masyarakat, Ritus dan Perayaan-Perayaan* (Social Practices, Rituals, and Festive Events); 3) *Kemahiran Kerajinan Tradisional* (Traditional Craftsmanship); 4) *Kawasan Kota Lama* (Old Town Area); and 5) *Pengetahuan dan Kebiasaan Perilaku Mengenai Alam Semesta* (Knowledge and Practices Concerning Nature and the Universe). These additions strengthened the taxonomy's ability to capture cultural diversity across both tangible and intangible CH, ensuring that the system remained inclusive of the full breadth of OCMHS's CH landscape.

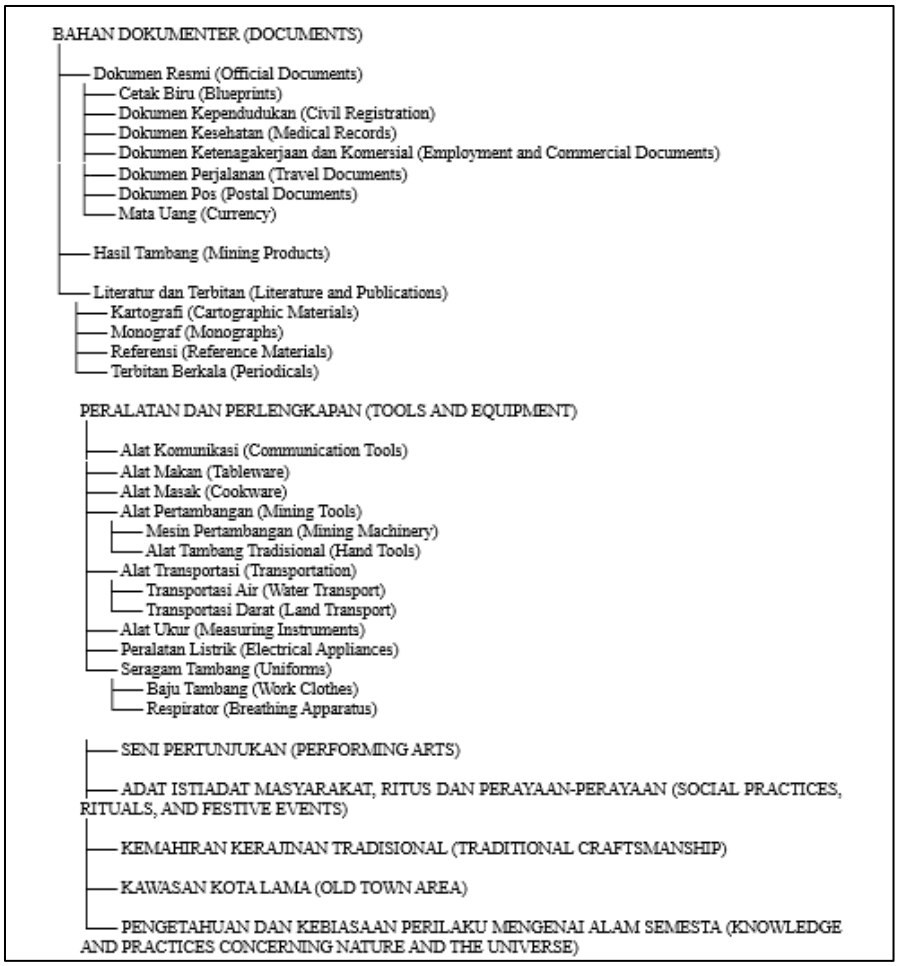


Figure 5.4 Iteration 2 – Refinements

Furthermore, these refinements, as shown in Figure 5.4, marked a decisive progression from the baseline prototype developed in Iteration 1 to a more nuanced,

culturally embedded, and functionally coherent taxonomy. They demonstrate how iterative stakeholder engagement directly shaped the taxonomy's structure, ensuring that cultural authenticity and professional interoperability were not treated as competing demands, but rather as complementary imperatives systematically embedded within the design. This dual grounding laid a stronger foundation for subsequent validation cycles and for the taxonomy's long-term integration across CHIs. The comparative summary of the initial and refined taxonomies, as shown in Table 5.1, illustrates how the design evolved from a foundational schema into a more culturally embedded and functionally robust framework.

Table 5.1
Comparative Development of the Initial and Refined Taxonomy Versions

Dimension	**Initial Taxonomy (Iteration 1 – Foundational Schema)**	**Refined Taxonomy (Iteration 2 – Stakeholder Validation & Refinement)**	**Key Improvements**
Design Basis	Literature review + international KOS standards + initial field profiling.	Structured FGDs, verbal protocol analysis, and participatory classification workshops with CHI professionals.	Transition from theory-driven to participatory co-design.
Cultural Authenticity	Embedded vernacular terms, but limited scope.	Stronger emphasis on local vocabularies; expansion of *Tradisi Lisan* (Oral Tradition) into 10 distinct subcategories.	Enhanced cultural resonance and representativeness.
Granularity & Hierarchy	Broad categories with 2–3 hierarchical levels (parent–child–grandchild).	Increased depth (up to 4 levels); clearer structural distinctions (manual vs. mechanical tools, myths vs. proverbs, etc.).	Improved structural precision and retrieval accuracy.
Domain Coverage	3 primary domains: *Peralatan dan Perlengkapan* (Tools & Equipment), *Tradisi Lisan* (Oral Traditions), *Bahan Dokumenter* (Documents).	Expanded with 5 additional domains: *Seni Pertunjukan* (Performing Arts), *Ritus & Perayaan* (Rituals & Festivals), *Kerajinan Tradisional* (Traditional Craftsmanship), *Kawasan Kota Lama* (Old Town Area), *Pengetahuan tentang Alam* (Knowledge and Practice Concerning Nature).	Broader inclusivity of OCMHS's tangible and intangible CH.
Interoperability	Initial awareness of the need for alignment with external standards.	Refined descriptors to bridge cross-domain practices.	Stronger cross-institutional integration.
Usability	Conceptual schema tested for logical consistency; preliminary FGDs for validation.	Participatory evaluation through classification exercises; feedback on terminology clarity and workflow fit.	Higher practical usability and institutional acceptance.
Outcome	Balanced baseline taxonomy integrating global anchors and local concepts.	Culturally embedded, professionally validated, and structurally refined taxonomy ready for iterative expansion.	Emergence of a hybrid framework balancing authenticity and interoperability.

Iteration 1 provided the structural baseline by synthesizing international KOS standards with initial field data, producing a balanced yet relatively broad schema that integrated tangible and intangible domains. While effective as a starting point, the initial version lacked the granularity and contextual resonance needed for practical application

across CHIs at Sawahlunto Municipality. Iteration 2 marked a decisive progression through participatory validation. Stakeholders' input refined the taxonomy into a more precise, inclusive, and culturally authentic structure. Key refinements included expanding *Tradisi Lisan* (Oral Tradition) into subcategories, restructuring *Bahan Dokumenter* (Documents) to improve retrieval precision, and adding new domains to reflect the breadth of CH within OCMHS better.

The process also strengthened interoperability by clarifying descriptors that could function across institutional boundaries, such as archival and curatorial contexts. This iterative refinement demonstrates the value of combining scholarly rigor with participatory co-design. By aligning cultural authenticity with systemic interoperability, the taxonomy transitioned from a conceptual framework into a validated classification system that addressed both professional workflows and community heritage narratives. These developments directly advance RO 3, providing a robust foundation for subsequent validation and evaluation phases.

5.2.2.3 Iteration 3: Expanded and Harmonized Taxonomy

The third iteration was conducted with the explicit aim of deepening the cultural anchorage of the taxonomy while addressing structural gaps identified in earlier stages. Unlike the first and second iterations, which focused on building a baseline schema and validating its clarity, Iteration 3 sought to extend the taxonomy's representational scope across both tangible and intangible CH domains based on stakeholder feedback. In particular, this stage prioritized greater granularity and cultural specificity in domains such as *Seni Pertunjukan* (Performing Arts), *Adat Istiadat Masyarakat dan Perayaan-Perayaan* (Social Practices and Festive Events), and *Kemahiran Kerajinan Tradisional* (Traditional Craftsmanship), thereby balancing the initial bias toward tangible artifacts. By embedding place-based narratives and lived traditions within these categories, the taxonomy was positioned not only as a classificatory instrument but also as a cultural repository that could sustain OCMHS's collective memory and identity.

The process drew upon more inclusive forms of participation. Semi-structured interviews were expanded to include not only curators, archivists, registrars, and librarians, but also community representatives and cultural experts whose lived experiences enriched the representation of oral traditions, rituals, and everyday practices. Walkthrough exercises were conducted in which participants navigated the

Iteration 2 hierarchy and proposed refinements. Curators and archivists, for example, called for the addition of records such as *Akta Kelahiran* (Birth Certificates), *Buku Nikah* (Marriage Books), *Kartu Keluarga* (Family Registers), and *Kartu Identitas* (Identification Cards) under the *Dokumen Kependudukan* (Civil Registration) subdomain. At the same time, community members emphasized the importance of recognizing miners' offerings and communal rituals under *Adat Istiadat Masyarakat dan Perayaan-Perayaan* (Social Practices and Festive Events). A collaborative validation session was then organized to ensure that refinements were not only institutionally sound but also culturally resonant.

Several substantive refinements emerged from this process. The *Tradisi Lisan* (Oral Tradition) branch was enriched with genre-specific and community-based narratives, thereby responding to librarians' earlier concerns about oversimplification while validating community insistence on the preservation of intangible CH. The *Bahan Dokumenter* (Documents) domain was broadened to incorporate new categories under *Dokumen Kependudukan* (Civil Registration) and *Dokumen Resmi* (Official Documents), ensuring that colonial archives, administrative documents, and community manuscripts were recognized as carriers of both institutional and collective memory.

The *Peralatan dan Perlengkapan* (Tools and Equipment) domain was revised to include clearer subcategories and culturally specific artifact examples, reducing ambiguity in cataloging and strengthening interpretive clarity in both exhibitions and the digital repository prototype. Intangible and social practices, such as miners' rituals and gatherings, were formally acknowledged under the *Adat Istiadat Masyarakat dan Perayaan-Perayaan* (Social Practices and Festive Events) domain, thereby addressing community calls for balance between tangible and intangible CH. Equally significant was the refinement of the *Kawasan Kota Lama* (Old Town Area), which was subdivided into *Monumen* (Monuments)*, Fasilitas Pendukung* (Support Facilities)*, Area Komersial* (Commercial Districts)*, Kompleks Industri Pertambangan* (Mining Complexes)*,* and *Tempat Tinggal* (Residential Districts). This adjustment, suggested by archivists and CH experts, provided finer distinctions for documenting OCMHS's cultural and industrial heritage.

Table 5.2
Progressive Refinements of the OCMHS Taxonomy (Iteration 1–3)

Aspect	Iteration 1 – Baseline Schema	Iteration 2 – Refinements	Iteration 3 – Expanded & Harmonized
Focus	Establishing a foundational schema integrating tangible and intangible CH	Validation and restructuring based on stakeholder feedback	Expanding coverage, strengthening cultural anchoring, and balancing domains
Stakeholder Involvement	Institutional profiling (curators, archivists, librarians)	Validation with CHI professionals through interviews, FGDs, and verbal protocol analysis.	Expanded engagement, including CHI professionals, community representatives, and CH experts
Oral Tradition	Single broad category (e.g., *Cerita Rakyat*/Folklore)	Expanded into 10 distinct subcategories (e.g., Mitos/Myths, *Peribahasa*/Proverbs, *Legenda* /Legends)	Further enriched with place-based and narrative-specific entries that embed collective memory.
Documents	Broad, undifferentiated *Bahan Dokumenter* (Documents)	Subdivided into: • *Dokumen Resmi*/Official Documents (7 child levels) • *Literatur dan Terbitan*/Literature and Publications (4 child levels) • *Hasil Tambang* (Mining Products)	Expanded further under *Dokumen Kependudukan*/*Civil Registration* (e.g., *Akta Kelahiran*/Birth Certificates, *Buku Nikah*/Marriage Books, *Kartu Keluarga*/Family Registers, *Kartu Identitas*/Identification Cards). Greater emphasis on colonial and community archives
Tools & Equipment	Generic domain covering mining-related artifacts	Refined into 8 subcategories; clearer distinctions between *Mesin Pertambangan* (Mining Machinery) and *Alat Tambang Tradisional* (Hand Tools).	Revised with explicit artifact examples; improved classification of hybrid and traditional tools
Intangible Practices & Performing Arts	Minimal coverage	Recognition of narrative genres in *Tradisi Lisan* (Oral Tradition)	Formal inclusion of miners' rituals, offerings, community gatherings, and the expanded *Seni Pertunjukan* (Performing Arts) domain.
Built Heritage (Old Town Area)	Limited recognition	Domain introduced but not detailed	Expanded into subcategories: *Monumen* (*Monuments*), *Fasilitas Pendukung* (Support Facilities), *Area Komersial* (Commercial Districts), *Kompleks Industri Pertambangan* (Mining Complexes), *Tempat Tinggal* (Residential Districts)
Outcome	A preliminary schema integrating tangible and intangible CH	A more nuanced and culturally resonant taxonomy with clearer granularity and institutional alignment	A culturally embedded, socially validated, and institutionally interoperable framework bridging community memory and professional practice

The refinement of the taxonomy during the third iteration was accompanied by rich and often passionate reflections from stakeholders, demonstrating how the

adjustments addressed cultural, institutional, and community concerns. Their voices not only validated the modifications but also revealed broader expectations for how the taxonomy should represent the OCMHS. Selected verbatim excerpts are presented below to illustrate the diversity of perspectives. Museum Curator 2 (CUR 2) emphasized the importance of intangible CH, noting:

> *"Adding categories and sub-categories for social practices, rituals, and festive events makes it feel alive. Visitors often ask for these stories, not just the tools." (CUR 2)*

This reflection highlighted the need to embed community practices and ritual traditions to complement the otherwise material-focused categorization, ensuring that the taxonomy reflects the lived experiences of Sawahlunto Municipality communities. Similarly, Archivist 2 (ARC 2) raised institutional concerns regarding the completeness of the intangible CH:

> *"Colonial administrative records are essential. Many families donated their documents without this; the taxonomy misses a key memory lane." (ARC 2)*

This observation reinforced the importance of recognizing archival records as carriers of intergenerational memory, especially those tied to colonial governance and community identity, which remain vital sources for scholarly research. From a community perspective, User 3 (USR 3) underlines the equal value between performing arts, which are included in intangible CH, and artifacts, which are included in tangible CH:

> *"Performing arts, from our ancestors to our present, are as important as the tools or activities we use in mining. Both define who we are." (USR 3)*

This statement reflected community expectations for balanced representation, validating the taxonomy's recognition of the performing arts as a domain of equal standing with material artifacts. CH Expert 1 (CHE 1) offered a technical perspective regarding spatial categorization:

> *"Differentiating the old town area into support facilities, commercial districts, mining complexes, residential districts, and so on helps us explain to researchers how the Sawahlunto Municipality's built environment evolved through industrial heritage for OCMHS." (CHE 1)*

This input underlined the value of granularity in documenting the built

environment, particularly in demonstrating urban and industrial transformations within the CH landscape. Additionally, Librarian 1 (LIB 1) emphasized the ethical and documentary responsibility in capturing CH comprehensively. This statement reinforced the principle of stewardship, reminding us that taxonomy design must not only be functional but also a legacy tool for cultural continuity:

> *"The addition of the new domain and categories in taxonomy shows respect for our OCMHS, but it must be carefully documented so that future generations understand its cultural weight." (LIB 1)*

Stakeholder reflections during this iteration underscored the cultural weight of these adjustments. Curators highlighted that the inclusion of rituals and festive events made the taxonomy feel more alive, while archivists stressed that colonial administrative records were indispensable for tracing memory pathways. Community participants emphasized the equal importance of performing arts alongside mining artifacts. At the same time, CH experts pointed to the value of differentiating the old town area to explain industrial transformations within OCMHS. Librarians were further reminded that careful documentation of new domains was essential to safeguard the taxonomy as a tool of intergenerational stewardship. These voices demonstrated that Iteration 3 had matured the taxonomy into a negotiated cultural artifact, balancing institutional standards with lived community knowledge.



Figure 5.5 Iteration 3 – Expanded and Harmonized

Moreover, Iteration 3 marked a pivotal milestone in the taxonomy's development. Earlier refinements had established its usability and semantic alignment, but this stage extended the taxonomy into the lived cultural realities of the OCMHS, as shown in Figure 5.5. It achieved dual readiness, including design readiness, by reaching sufficient maturity to represent both tangible and intangible CH within the digital repository prototype and evaluation readiness, by providing the contextual depth necessary for systematic testing across CHIs. In this way, Iteration 3 not only stabilized the taxonomy as a culturally embedded, institutionally aligned, and community-recognized system but also prepared it for Phase D of the DSR cycle. It thus transformed the taxonomy from a technical schema into a semantically enriched and socially validated framework, simultaneously serving as a scholarly infrastructure for preservation and a living representation of the OCMHS.

5.2.2.4 Iteration 4: Consolidation and Pre-Evaluation Readiness

The fourth iteration marked the culmination of the taxonomy's design cycle, in which refinements from Iterations 1 to 3 were integrated into a coherent and stable artifact prepared for structured evaluation. Unlike the exploratory expansions of earlier stages, Iteration 4 was characterized by consolidation, operational alignment, and targeted adjustments. Its purpose was to transform the taxonomy from an evolving prototype into a stabilized system, capable of functioning within institutional workflows while retaining fidelity to the cultural narratives of the OCMHS.

The fourth iteration also consolidated refinements into a stable version of the taxonomy. Categories were crosswalked with the international standards, including AAT (Getty Research Institute, 2024), UNESCO Thesaurus (UNESCO, 2024), and LCSH (Library of Congress, 2024), and CIDOC-CRM (ICOM, 2016), to ensure interoperability, while local labels were preserved through dual representation as shown in Table 5.3.

Table 5.3
Iteration 4 – Taxonomy in Crosswalked with the International KOS Standards

Domain (Main Category)	Parent (Sub-Categories)	Child (Specific Categories)	Grandchild (Contextualized Entries)	AAT	LCSH	UNESCO Thesaurus	CIDOC-CRM
Seni Pertunjukan (Performing Arts)	Seni Gerak (Movement Art)	Olahraga dan Permainan Rakyat (Traditional Sports and Games)	• Berkuda (Horse Riding) • Layang-Layang (Toy Kites) • Sepak Bola (Football)	• Horseback Riding • Toy Kites • Football	• Horse Riding • Kites • Football	• Sport • Play • Football	• E7 Activity • E7 Activity • E7 Activity
		Seni Akrobat (Acrobatics)	—	Acrobatics	Acrobatic Performances	Acrobatics	E7 Activity
		Seni Bela Diri (Martial Arts)	—	Martial arts	Martial Arts	Combat-Based Performance Arts	E7 Activity
	Seni Musik (Musical Art)	Alat Musik (Musical Instruments)	• Gamelan (Gamelan) • Harmonika (Harmonica) • Saluang (Flute) • Serunai (Oboes) • Talempong (Talempong) • Ukulele (Ukulele)	• Musical Instruments • Harmonicas • Bamboo Flutes • Double Reed Instruments • Gong Chimes • Ukuleles	• Gamelan • Harmonica • Flute • Oboes • Talempong • Ukulele	• Musical Instruments • Musical instruments • Musical Instruments • Musical Instruments • Musical Instruments • Musical Instruments	• E22 Man Made Object • E22 Man Made Object • E22 Man Made Object • E22 Man Made Object • E22 Man Made Object • E22 Man Made Object
	Seni Suara (Vocal Music)	—	—	Vocal Music	Vocal Music	Singing	E5 Event
	Seni Tari (Dance)	—	—	Dance	Dance	Dance	E5 Event
Adat Istiadat, Ritus, dan Perayaan (Social Practices, Rituals, and Festive Events)	Hukum Adat (Customary Law)	Sistem Hukum (Legal systems)	• Hubungan Rumah Tangga (Domestic Relations) • Hukum Dagang (Law Merchant) • Hukum Islam (Islamic Law) • Hukum Perkawinan (Marriage Law)	• Domestic Relations • Commercial Law • Islamic Law • Marriage Law • Criminal Law • Inheritance Law • Consensus • Land Tenure • Judicial Process	• Domestic Relations • Law Merchant • Islamic Law • Marriage Law • Criminal Law • Inheritance • Consensus • Land Tenure • Judicial Process	• Family Law • Commercial Law • Islamic Law • Marriage • Criminal Law • Inheritance • Consensus • Land Tenure • Judicial System	• E30 Right • E30 Right • E30 Right • E30 Right • E30 Right • E30 Right • E30 Right • E30 Right • E7 Activity

		• Hukum Pidana (Criminal Law) • Hukum Warisan (Inheritance) • Konsensus Hukum (Consensus) • Penguasaan Tanah (Land Tenure) • Proses Peradilan (Judicial Process) • Tata Cara Hukum (Law Procedure)	• Legal Procedure	• Law Procedure	• Legal Procedure	• E7 Activity
Ritual dan Upacara (Rites and Ceremonies)	• Adat Berkabung (Mourning Customs) • Adat dan Ritual Pernikahan (Marriage Customs and Rites) • Adat dan Ritual Politik (Political Customs and Rites)	—	• Mourning Customs • Marriage Customs • N/A	• Mourning Customs • Marriage Customs and Rites • Political Customs and Rites	• Funeral Rites • Marriage • N/A	• E7 Activity • E7 Activity • E7 Activity
	• Upacara Pemberian Nama (Naming Ceremonies) • Upacara Penanaman (Planting Rites) • Upacara Penandatanganan (Signing Ceremonies) • Upacara Pubertas (Puberty Rites)	—	• Naming Ceremonies • N/A • N/A • Rites of Passage	• Memorial Rites and Ceremonies • Municipal Ceremonial • Rain-Making Rites • Naming Ceremonies • Planting Rites • Signing Ceremonies • Puberty Rites	• N/A • N/A • N/A • Puberty	• E5 Event • E5 Event • E5 Event • E5 Event
Sistem Ekonomi Tradisional (Traditional Economic System)	Cara Pembayaran (Payment)	• Barter (Barter) • Hasil Panen (Agricultural Products) • Hasil Tangkapan (Fishing Products)	• Barter • Harvesting • Fishing	• Barter • Agricultural Products • Fishery Products	• Barter • Agricultural Products • Fishery Products	• E7 Activity • E19 Physical Object • E19 Physical Object
	Pasar (Markets)	–	Markets	Markets	Markets	E7 Activity

Sistem Kekerabatan Tradisional (Family Relatives) Struktur Sosial (Social Structure)	Jenis Kekerabatan (Kinship)	Matrilineal (Matrilineal Kinship)	Kinship	Matrilineal Kinship	Kinship	E74 Group
		Parental (Parent and Child)	Kinship	Parent and Child	Kinship	E74 Group
		Patrilineal (Patrilineal Kinship)	Kinship	Patrilineal Kinship	Kinship	E74 Group
	Sistem Kekerabatan (Consanguinity)	Ayah dan Anak (Father and Child)	Family Relationships	Father and Child	Family	E74 Group
		Ibu dan Anak (Mother and Child)	Family Relationships	Mother and Child	Family	E74 Group
		Menantu dan Mertua (In-Laws)	Extended Families	In-Laws	Family	E74 Group
		Paman dan Kemenakan (Collateral Relatives)	Collateral Relatives	Collateral Relatives	Kinship	E74 Group
	Jenis Pekerjaan (Occupations)	• Arsiparis (Archivists) • Budayawan (Cultural Workers) • Buruh (Laborers) • Demang (Village Headmen) • Dokter / Mantri (Health Personnel) • Fotografer (Photographers) • Guru (Teachers) • Insinyur (Engineers) • Kepala Tambang (Technical Personnel) • Koki (Chefs) • Kontrolir (Managers) • Kurator (Museum Curators) • Masinis (Machinists) • Pedagang (Merchants) • Pembantu Rumah Tangga (Domestic Workers) • Penambang (Miners)	• Archivists • Cultural Workers • Laborers • Village Heads • Paramedical Personnel • Photographers • Teachers • Engineers • Technical Personnel • Chefs • Managers • Museum Curators • Machinists • Merchants • Domestic Workers • Miners • Dancers • Lawyers • N/A • N/A • N/A	• Archivists • Cultural Workers • Laborers • Village Headmen • Paramedical Personnel • Photographers • Teachers • Engineers • Technical Personnel • Chefs • Managers • Museum Curators • Machinists • Merchants • Domestic Workers • Miners • Dancers • Lawyers • N/A • N/A • N/A	• Archivists • Cultural Workers • Labour • Local Government Officials • Health Personnel • Photographers • Teachers • Engineers • Technical Personnel • Chefs • Managers • Museum Curators • Machinists • Merchants • Domestic Workers • Miners • Dancers • Lawyers • N/A • Authors • Farmers • N/A • N/A	• E39 Actor • E39 Actor

			• Penari (Dancers) • Pengacara (Lawyers) • Penghulu (Elders) • Penulis (Authors) • Petani (Farmers) • Polisi (Police) • Residen (Colonial Administrators) • Sejarawan (Historians) • Seniman (Artists) • Tukang Kayu (Carpenters)	•N/A •N/A •N/A •N/A •N/A	• N/A • N/A • N/A • N/A • N/A	•N/A •N/A •N/A	• E39 Actor • E39 Actor
		Tokoh Publik (Public Figures)	•Tokoh Adat (Indigenous Leaders) •Tokoh Agama (Religious Leaders) •Tokoh kolonial (Colonial Administrators) •Pahlawan Nasional (National Heroes) •Penambang (Labor Leaders) •Jurnalis (Journalists) •Politisi (Politicians) •Tionghoa (Chinese)	• Indigenous Leaders • Religious Leaders • Colonial Administrators • National Heroes • Labor Leaders • Journalists • Politicians • Chinese People	• Indigenous Leaders • Religious Leaders • Colonial Administrators • National Heroes • Labor Leaders • Journalists • Politicians • Chinese	•Indigenous Leaders •Religious Leaders •Colonial Administrators •National Heroes •Labor Leaders •Journalists •Politicians •Chinese	•E39 Actor •E39 Actor •E39 Actor •E39 Actor •E39 Actor •E39 Actor •E39 Actor •E74 Group
		Wilayah Organisasi Sosial (Social Organization Territory)	• Koloni (Colonies) • Nagari (Rural Areas)	•Colonies •Rural Areas	•Colonies •Rural Areas	•Colonies •Rural Areas	•E74 Group •E74 Group
		Jenis Organisasi (Organization Type)	• Organisasi Buruh (Labour Union) • Partai Politik (Political Parties)	• Labor Unions • Political Parties	• Labor Unions • Political Parties	• Labor Unions • Political Parties	• E74 Groups • E74 Groups
Kawasan Kota Lama (Old Town Area)	Area Komersial (Commercial Districts)	• Bank (Banks and Banking) • Gedung Teater dan Bioskop (Cinema)	—	• Banks • Theaters • Hotels • Administration Buildings	• Banks and Banking • Motion Picture • Hotels • Office Buildings	• Banks • Cinema • Hotels • Office Services • Trade	• E74 Group • E22 Man Made Object • E22 Man Made Object

	• Hotel dan Penginapan (Hotels) • Kantor Perusahaan Tambang (Office Buildings) • Pegadaian (Pawnshops)		• Building Trades • Cooperatives • Markets • Pawnshops	• Stores • Cooperative Societies • Markets • Pawnshops	• Cooperatives • Markets • Pawnshops	• E22 Man Made Object • E22 Man Made Object • E74 Group • E22 Man Made Object • E22 Man Made Object
Fasilitas Kesehatan (Healthcare Facilities)	• Apotek (Pharmacies) • Klinik (Clinics) • Rumah Sakit (Hospitals)	—	•Pharmacies •Clinics •Hospitals	•Pharmacies •Clinics •Hospitals	• Pharmacies • Clinics • Hospitals	• E22 Man Made Object • E22 Man Made Object • E22 Man Made Object
Fasilitas Pendukung (Support Facilities)	• Dapur Umum (Community Kitchens) • Gedung Pertemuan (Assembly Halls) • Gudang Senjata (Arsenals)	—	• Kitchen Houses • Assembly Halls • Arsenals	• Community Kitchens • Assembly Halls • Arsenals	• N/A • Assembly Halls • Arsenals	• E22 Man Made Object • E22 Man Made Object • E22 Man Made Object
Kompleks Industri Pertambangan (Mining Complexes)	• Fasilitas Pengolahan (Ore-Treatment Plants) • Fasilitas Penyimpanan Hasil (Coal Washeries) • Tambang Permukaan (Coal Mining) • Kompresor Udara (Air Compressor) • Lubang Tambang (Mine Shafts) • Pembangkit Listrik (Power Plant Buildings)	—	• Ore Processing Facilities • Coal Washeries • Mining • Compressors • Mine Shafts • Power Plant Buildings • Water Pump Facilities	•Ore-Treatment Plants •Coal Storage •Coal Mines and Mining •Air Compressors •Mines and Mineral Resources •Electric Power-Plants •Pumping Stations	• Ore Processing • Coal Storage • Coal Mining • Compressor Buildings • Mining Pits • Power Plants • Pumps	• E22 Man Made Object • E22 Man Made Object • E53 Place • E22 Man Made Object • E53 Place • E22 Man Made Object • E22 Man Made Object

		• Stasiun Pompa Air (Pumping Stations)					
	Monumen (Monuments)	• Makam (Cemeteries) • Menara (Towers) • Patung (Statues)	—	• Cemeteries • Towers • Statues	• Cemeteries • Towers • Statues	•Cemeteries •Towers •Statues	•E53 Place •E22 Man Made Object •E22 Man Made Object
	Tempat Tinggal (Residential Districts)	• Barak Pekerja (Barracks) • Perumahan Kolonial (Official Residences)	—	• Barracks • Dwellings	•Barracks •Official Residences	• Barracks • Housing	• E53 Place • E53 Place
Pengetahuan dan Kebiasaan Perilaku mengenai Alam Semesta (Knowledge and Practices Concerning Nature and the Universe)	Kearifan Lokal (Local Wisdom)	• Konservasi Ekologi (Ecological Conservation) • Mitigasi Bencana (Disaster Prevention) • Toleransi (Tolerance)	—	•Ecological Conservation •Disaster Prevention •Tolerance	• Conservation of Natural Resources • Disaster Relief • Tolerance	• Ecological Knowledge • Disaster Mitigation Knowledge • Cultural Values	• E55 Type • E55 Type • E7 Activity
	Masakan Tradisional (Local Cuisine)	• Masakan Batak (Bataknese Cuisine) • Masakan Minangkabau (Minangkabau Cuisine)	—	• Bataknese Cuisine • Minangkabau Cuisine	• Traditional Food – Batak • Traditional food – Minangkabau	• Ethnic Culinary Heritage – Batak • Ethnic culinary heritage – Minangkabau	• E28 Conceptual Object • E28 Conceptual Object
	Pengetahuan Mengenai Alam (Knowledge of Nature)	•Makrokosmos (Cosmology) •Mikrokosmos (Microcosm) •Pengolahan Alam (Resource Management)	—	•Cosmology •Microcosm •Resource Management	•Cosmology •Microcosm and Macrocosm •Natural Resource Management	• Cosmology • Symbolic Ecology • Traditional Environmental Knowledge	• E28 Conceptual Object • E28 Conceptual Object • E55 Type
	Pengobatan Tradisional (Traditional Medicine)	• Bahan Pengobatan (Herbal Medicine Ingredients) • Etiologi Penyakit (Traditional Disease Classification)	—	• Medicinal Plant Ingredients • Traditional Disease Classification • Traditional Healing Methods	•Herbal Medicine Ingredients •Indigenous Explanations of Illness •Health Improvement	• Traditional Medicinal Substances • Ethnomedical Etiology • Cultural Healing Systems	• E57 Material • E28 Conceptual Object • E55 Type

	• Metode Pengobatan (Traditional Healing Methods)	Techniques – Indigenous

Usability walkthroughs confirmed improved clarity in navigating polyhierarchical paths, with stakeholders reporting higher confidence in classifying hybrid items. Iteration 4 marked the shift from experimentation to consolidation, ensuring the taxonomy was both culturally authentic and globally interoperable, ready for implementation within the digital repository prototype. At this stage, the taxonomy achieved cultural anchoring by preserving the authenticity of oral traditions, community practices, and CH-specific terminologies identified in previous iterations.

In parallel, institutional viability was secured through alignment with metadata standards, cataloguing protocols, and interoperability requirements, thereby positioning the taxonomy as both a cultural repository and a functional infrastructure for KO. Semantic consistency was also strengthened by eliminating redundancies, clarifying hierarchical ambiguities, and refining terminology. Together, these measures enhanced both human interpretability and system-level compatibility, enabling seamless integration with the digital repository prototype.

Four structured activities defined this iteration, as shown in Table 5.4. First, cross-domain harmonization ensured a balance between tangible and intangible CH. The international KOS standards, including AAT, LCSH, CIDOC-CRM, and UNESCO Thesaurus, were crosswalked against taxonomy terms to reinforce semantic interoperability. Second, prototype integration embedded the taxonomy within the digital repository sandbox, where CHI professionals and experts tested classification workflows and navigational clarity. Third, terminology refinement standardized labels across all branches, thereby reducing ambiguity and promoting inclusivity. Fourth, evaluation alignment prepared the artifact for Phase E by defining usability dimensions, namely comprehensiveness, robustness, understandability, extensibility, and wording, alongside corresponding tasks and metrics.

Table 5.4
Iteration 4 – Consolidation and Pre-Evaluation Readiness

Focus Area	Activities	Outcomes
Cross-domain harmonization	• Validation across tangible and intangible CH domains (tools and equipment, documents, oral traditions, rituals and ceremonies, performing arts). • Crosswalk with international KOS standards, including AAT, LCSH, CIDOC-CRM, and UNESCO Thesaurus.	Balanced representation across CH domains; enhanced semantic interoperability.
Prototype integration	• Embedding taxonomy in digital repository prototype sandbox.	Operational feasibility confirmed; clarity in navigation and classification efficiency.

	• Testing navigation, classification, and multilingual labels by CHI professionals and CH experts.	
Terminology refinement	• Standardization of labels across domains. • Embedding glossaries into a digital interface for context (rituals, mining lexicons).	Reduced ambiguity; improved inclusivity and cross-institutional usability.
Evaluation alignment	• Definition of usability dimensions (Comprehensiveness, robustness, understandability, extensibility, and wording). • Identification of tasks and metrics for Phase E.	Taxonomy made evaluation-ready with predefined performance and usability indicators.

The outcomes presented in Table 5.4 are grounded in primary empirical data collected during sandbox trials, follow-up discussions, and iterative stakeholder validation sessions. Although Table 5.4 summarizes design refinements, each outcome was informed by specific qualitative findings gathered from CHI professionals and heritage experts. The need for balanced representation across both tangible and intangible CH emerged consistently in earlier thematic analysis (Chapter 4), particularly regarding the marginalization of oral traditions and community narratives. During Iteration 4 validation sessions, participants emphasized the importance of maintaining equivalence between documentary, material, and intangible heritage domains. Stakeholder feedback during this phase confirmed:

> *"Previously, our system focused mostly on objects. Now I can see that oral traditions and rituals have a structured place."* (CHE 1)

Analytically, this indicates that cross-domain harmonization was not merely conceptual alignment with international KOS standards, but a response to empirically observed representational imbalance. The crosswalk among AAT, LCSH, CIDOC-CRM, and the UNESCO Thesaurus was conducted after semantic mapping exercises documented during metadata alignment workshops. These exercises revealed overlaps and terminological gaps, which informed refinements ensuring interoperability without erasing local specificity.

Operational feasibility was confirmed through sandbox trials where CHI professionals performed classification and retrieval tasks. Observation notes indicated that 1) Participants successfully navigated hierarchical pathways without external guidance; 2) Multilingual labels were correctly interpreted across roles; and 3) No structural dead-ends were encountered during navigation. For instance:

> *"The structure feels intuitive. I can follow the logic without confusion."* (LIB 2)

This empirical validation supports the claim of clarity in navigation and classification efficiency. Terminology refinement was directly informed by participant feedback regarding ambiguity and vernacular inclusion. One curator stated:

> *"Some of our local terms are missing. We need flexibility to include them."* (CUR 2)

Similarly, librarians highlighted inconsistencies in label wording during sandbox testing. These comments prompted embedding the glossary and revising standardized labels. Analytically, this demonstrates that reduced ambiguity and improved inclusivity were outcomes grounded in participatory validation rather than solely researcher-driven decisions. The identification of usability dimensions for Phase E was derived from recurring evaluative criteria expressed during validation discussions. Participants frequently assessed the taxonomy using terms such as "complete," "clear," "flexible," and "expandable."

These descriptors were inductively consolidated into five formal usability dimensions, including comprehensiveness, robustness, understandability, extensibility, and wording. Thus, evaluation readiness was not imposed externally but emerged from stakeholder language and experiential feedback, strengthening its theoretical and empirical grounding.

Iteration 4 consolidated refinements from earlier stages, ensuring the taxonomy was culturally authentic, institutionally robust, and technically interoperable. It served as the final bridge between design and evaluation, establishing the taxonomy as an evaluation-ready artifact that not only supports KO processes within CHIs but also safeguards OCMHS's collective memory. Stakeholder feedback during this phase confirmed the taxonomy's readiness for evaluation. Curator 1 (CUR 1) highlighted the integrative dimension:

> *"Now, when I search for mining tools, I also see the related stories and rituals, which makes it holistic."* (CUR 1)

This observation demonstrated how the taxonomy bridged tangible artifacts with intangible traditions, enriching curatorial interpretation and public engagement. Archivist 2 (ARC 2) stressed structural congruence with archival principles:

> *"The hierarchy finally mirrors how we think of fonds and sub-fonds. It feels*

natural now." (ARC 2)

This validation affirmed the taxonomy's technical coherence and increased its potential for adoption in archival settings. From the community perspective, User 1 (USR 1) underscored cultural completeness:

> *"I am glad the taxonomy keeps our folklore alongside the machines; our cultural heritage is accommodated."* (USR 1)

This reflection reinforced the taxonomy's legitimacy as a repository of collective memory, safeguarding symbolic traditions alongside material records. Taken together, these reflections illustrated that the taxonomy had moved beyond structural refinement to achieve a balance of holism, institutional naturalness, and cultural completeness. Iteration 4 thus represented the final consolidation phase of design, bridging Phase C (design and development) with Phases D (demonstration) and E (evaluation).

The iterative design process undertaken in this study contributes to the KO theoretical discourse on taxonomy development within the CH domain. Existing models, such as Nickerson et al. (2013), primarily emphasize the importance of objective and subjective ending conditions in determining when a taxonomy is sufficiently developed. In contrast, Kundisch et al. (2021) highlight the need for rigorous evaluation strategies.

The findings of this study extend these models by demonstrating that participatory validation and iterative stakeholder engagement can serve as evaluative criteria for assessing taxonomy maturity. In this way, the study enriches the methodological toolkit for taxonomy research by incorporating community co-creation, empirical usability feedback, and iterative refinement into the core design process. This approach illustrates that taxonomies, particularly in the CH domain, should be not only logically structured but also socially validated, ensuring they remain relevant, usable, and legitimate for the communities they are designed to serve.

Table 5.5
Progressive Development of the OCMHS Taxonomy (Iteration 1–4)

Iteration	Focus	Key Activities	Refinements / Outcomes	Stakeholder Validation
Iteration 1 – Baseline Schema	Establishing a foundational taxonomy structure.	• Literature review of international KOS standards (UNESCO Thesaurus, AAT, CIDOC-CRM, and LCSH). • Institutional profiling (curators, registrars, archivists, librarians). • Drafting of initial hierarchical schema.	• Integration of tangible (*Tools & Equipment*) and intangible (*Oral Tradition*). • Introduction of the *Documents* domain as a bridging category. • Baseline hierarchy: Domain → Parent → Child → Grandchild.	Stakeholders highlighted the need for local terminologies, genre differentiation in oral traditions, and greater archival granularity.
Iteration 2 – Validation and Refinement	Refining schema clarity and usability through participatory validation.	• Semi-structured interviews and FGDs with CHI professionals. • Concurrent verbal protocol analysis during sample classification tasks. • Reflections of terminology, granularity, and overlaps.	• *Oral Tradition* expanded into 10 subcategories (*Myths, Folklores, Proverbs, Legends*). • *Documents* restructured into Official Docs (7 child levels), Mining Products, Literature & Publications (4 child levels). • *Tools & Equipment* refined into 8 subcategories, separating *Mining Machinery* and *Hand Tools*. • Five new domains introduced (*Performing Arts, Social Practices, Craftsmanship, Old Town Area, Knowledge & Practices of Nature*).	• Curators: Need for local vocabulary. • Archivists: Demand for precision (Official vs. Community Documents). • Librarians: Intangible CH must avoid oversimplification.
Iteration 3 – Expansion and Harmonization	Embedding cultural narratives and expanding underrepresented CH domains.	• Expanded interviews, including user or community representatives. • Walkthroughs with scenario-based classifications. • Place-based narratives, tangible clarity, built heritage. • Collaborative validation sessions.	• *Oral Tradition* enriched with place-based narratives. • *Documents* expanded under *Civil Registration* (e.g., Birth Certificates, Marriage Books, ID Cards). • Tangible artifacts clarified with explicit examples.	• Curators: Need to integrate rituals and festive events. • Archivists: Inclusion of colonial records vital. • Users: Performing arts are equally important as tools. • CH Experts: Built heritage requires finer categorization.

			• *Social Practices* expanded (rituals, miners' gatherings). • *Old Town Area* refined into *Monuments, Support Facilities, Commercial Districts, Mining Complexes,* and *Residential Areas*.	
Iteration 4 – Consolidation and Pre-Evaluation Readiness	Transitioning from evolving prototype to evaluation-ready system.	• Cross-domain harmonization with international KOS standards (AAT, LCSH, CIDOC-CRM, and UNESCO Thesaurus). • Taxonomy prototype integration within the digital repository sandbox. • Terminology refinement. • Definition of evaluation dimensions and metrics.	• Balanced representation of tangible and intangible CH. • Operational feasibility confirmed in digital repository prototype. • Standardized terminologies for inclusivity have been refined. • Evaluation usability dimensions set: namely, comprehensiveness, robustness, understandability, extensibility, and wording.	• Curators: Taxonomy bridges artifacts with rituals. • Archivists: Hierarchy mirrors archival fonds/sub-fonds. • Users: Folklore preserved alongside machines or cultural completeness.

Table 5.5 shows that across four iterations, the taxonomy evolved from a baseline schema (Iteration 1) to a validated and refined framework (Iteration 2), then to an expanded and culturally embedded system (Iteration 3), and to a consolidated, evaluation-ready artifact (Iteration 4). This progression demonstrates the iterative logic of the DSR methodology process model, ensuring that the taxonomy is simultaneously culturally authentic, institutionally aligned, and technically interoperable.

5.3 Phase D – Demonstration of Taxonomy

The Demonstration Phase represented a pivotal transition in the research process, in which the developed taxonomy and its digital instantiation in the repository prototype were applied in real-world scenarios. In line with Peffers et al. (2007), this stage aimed to demonstrate the artifact's capacity to address the identified problem domain, including the fragmented and insufficiently contextualized KO practices across Sawahlunto Municipality's Cultural Heritage Institutions (CHIs). Whereas Phase C focused on iterative refinements to enhance conceptual clarity and stakeholder validation, Phase D sought to operationalize the taxonomy through practical tasks that tested its usability, adaptability, and cultural authenticity in action.

The principal purpose of this phase was to demonstrate that the taxonomy could function as more than a theoretical construct. Through interactive trials, CHI professionals engaged in activities such as classifying artifacts, navigating taxonomic hierarchies, and retrieving records across domains. These exercises enabled the taxonomy to be evaluated within authentic institutional workflows, while simultaneously surfacing insights into its effectiveness as a functional KOS. Thus, the phase provided both a proof of concept and a practical foundation for the systematic evaluation conducted in Phase E.

Importantly, the demonstration activities were structured to foreground the dual objectives of this study, including embedding cultural authenticity and ensuring cross-domain interoperability. By situating the taxonomy within sandbox trials of the digital repository prototype, participants experienced firsthand how local terminologies, oral traditions, and narrative practices could be integrated with international metadata standards within a unified digital infrastructure. This practical demonstration not only confirmed the role of taxonomy in safeguarding cultural identity but also underscored its potential for broader institutional and scholarly adoption, bridging the gap between

community-based knowledge systems and international KOS standards or frameworks.

5.3.1 Selection of Digital Platform

The selection of a digital platform represented a strategic decision within the demonstration phase of the DSR methodology, as the chosen system determined the extent to which the contextualized taxonomy could be operationalized, sustained, and scaled across CHIs. For this study, CollectiveAccess (CA) was selected as the platform to develop a prototype repository for the OCMHS. Figure 5.6 presents the landing page of the digital repository prototype named "Pusako Ombilin," which can be accessed at *https://pusako-ombilin.web.id/pawtucket*. Serving as the primary entry point for visitors, this interface provides a search menu and navigation panel that facilitate efficient information retrieval and seamless access to available collections and resources.

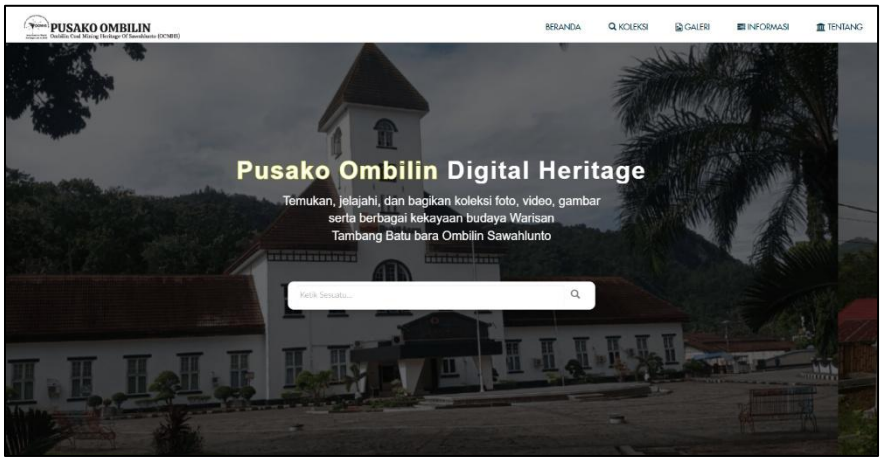


Figure 5.6 The OCMHS Digital Repository Prototype

CollectiveAccess (CA) is a free and open-source software (FOSS) developed specifically for cultural heritage institutions. Functioning as a web-based content management system (CMS), it offers a flexible framework for managing both physical and digital collections (Whirl-i-Gig, 2023). Its modular, scalable, and customizable architecture is organized into two main components, including Providence, the backend system responsible for administrative functions such as metadata management, controlled vocabularies, access control, and cataloguing workflows; and Pawtucket, the front-end interface that enables public browsing, searching, and thematic exploration of collections.

CA was chosen for three principal reasons. First, its open-source license (GPL) guarantees institutional freedom to obtain, use, modify, and redistribute the system, providing a cost-effective alternative to proprietary CMS platforms (Zorich, Waibel, & Erway, 2008; Gartner & Rafferty, 2016). Second, CA has been widely adopted by CHIs worldwide, demonstrating adaptability across a wide spectrum of cultural heritage domains, including public art, contemporary history, indigenous heritage, media archives, and university collections, as shown in Table 5.6. Such precedents affirm CA's versatility for managing heterogeneous heritage materials such as those within the OCMHS. Third, CA's technical capabilities include support for large-scale cataloguing, multilingual metadata, multiple media formats, and compatibility with international metadata standards such as Dublin Core, MARC21, CDWA, VRA Core, PB Core, and DarwinCore. These features are essential for ensuring cross-domain interoperability between the OCMHS digital repository prototype and national or international CH databases.

Table 5.6
Examples of Cultural Heritage Institutions Adopting CollectiveAccess

No	Country	Institution/CHI Name	Year	Heritage Domain
1	USA	City of San Antonio – Public Art Directory	2025	Public art & community engagement
2	USA	9/11 Memorial & Museum – Digital Archive Rebuild Project	2025	Contemporary history & memorial archives
3	Canada	Algoma University – Shingwauk Residential Schools Centre Archive	2024	Archival & Indigenous heritage
4	Norway	Sámi Archives – Indigenous Sámi Cultural Records	2023	Indigenous cultural knowledge
5	UK	Women's Art Library, Goldsmiths University	2023	Feminist art & university collections
6	Chile	Museo de la Solidaridad Salvador Allende	2021	Contemporary art & historical collections
7	Netherlands	Netherlands Institute for Sound and Vision (*Beeld en Geluid*)	2020	Media & broadcasting heritage

The international adoption of CA demonstrates its proven capacity to manage both tangible and intangible CH, making it particularly suitable for the multilayered context of the OCMHS. The heritage landscape of OCMHS encompasses industrial artifacts, archival documents, oral traditions, library materials, and community rituals. Within this study, the implementation phase translated the conceptualized taxonomy into a functional digital repository prototype using CA. This involved four key activities, including mapping taxonomy terms, configuring metadata schemas, establishing system architecture and access, and conducting functional testing.

a) Mapping taxonomy terms: Using the *List & Vocabulary* module in Providence, taxonomy terms were integrated hierarchically to represent both tangible and intangible CH categories. For instance, artifacts were embedded as structured categories, while intangible CH were cross-referenced as narrative-driven vocabularies, as shown in Figure 5.7. Local or national terminologies were deliberately preserved within the controlled vocabularies to maintain cultural specificity while ensuring semantic consistency. The dynamic nature of Providence allows administrators to update, expand, or refine entries, thus safeguarding adaptability as new cultural elements emerge.

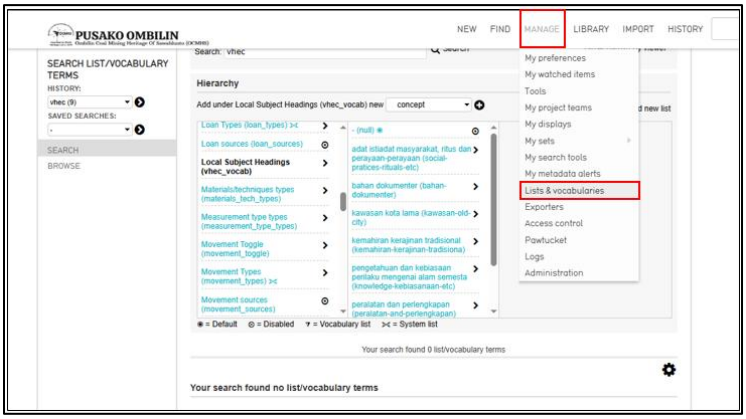


Figure 5.7 Mapping Taxonomy Terms in the OCMHS Digital Repository Prototype

b) Metadata schema configuration: The metadata schema of the digital repository prototype was configured as a multi-standard framework to accommodate the diverse collections across CHIs, as shown in Table 5.7. Museums adopted CDWA for object description, libraries used MARC21 for bibliographic control, while archives employed ISAD(G) for fonds and series descriptions.

Table 5.7
Metadata Schema for Digital Repository Prototype

Object Type	Metadata Schema	Main Fields
Library Materials	MARC21 (Machine-Readable Catalogue 21)	100 (Main Author/Personal Name)
		245 (Title and Statement of Responsibility)
		260 / 264 (Publication Information)
		300 (Physical Description)
		650 (Subject/Topical Term)
		700 (Added Author / Contributor Entity)
		020 (ISBN/ISSN/ISMN)
		856 (Electronic Access Location/URL/Link)
Archives & Finding Aids	ISAD(G) (General International Standard Archival Description)	Reference Code
		Title
		Dates
		Level of Description
		Extent and Medium
		Name of Creator

		Archival History
		Scope and Content
		Conditions of Access
		Finding Aids
Museums Artifact	CDWA (Categories for the Description of Works of Art)	Title / Titles
		Creator
		Creation Date
		Work Type
		Materials and Techniques
		Measurements
		Subject Matter
		Location
		Style/Period

Through the metadata elements module, each schema element was mapped to objects, collections, or occurrences, ensuring both administrative rigor and contextual richness. The repository further supported multilingual metadata entries, such as local languages and Indonesian and English, thereby reinforcing local accessibility while expanding international visibility.

c) System architecture and access: CA's client–server design ensures a dual-interface workflow. The Providence backend supports professional cataloguing, access control, and metadata management, while the Pawtucket frontend provides user-oriented functionalities including browsing, advanced searching, and gallery views. This duality bridges the requirements of subject-matter experts or CHI professionals with public-facing cultural engagement, thereby aligning institutional operations with community-oriented information access.

d) Functional testing: Retrieval trials were conducted to validate the taxonomy's effectiveness. Queries using both standardized descriptors and local terminologies produced accurate results, confirming the system's dual role as a retrieval tool and a cultural storytelling medium.

The implementation of the taxonomy within CA platforms as a digital repository prototype produced three critical implications. First, it demonstrated the feasibility of deploying contextualized taxonomies in CHIs by embedding local terminologies while maintaining compliance with international metadata standards. Second, it reinforced the function of digital repositories as socio-technical infrastructures that balance KOS standards requirements with cultural sensitivity and community participation. Third, it positioned the OCMHS taxonomy and digital repository prototype as a potential convergence model for CHIs, capable of harmonizing heterogeneous collections under a unified metadata and taxonomy framework.

5.3.2 Demonstration in Library – Task 1

Access to the digital repository prototype named "Pusako Ombilin," which can be accessed at *https://pusako-ombilin.web.id/pawtucket* , was facilitated through its web-based interface, where participants logged into the Providence backend for classification tasks and navigated the Pawtucket frontend for retrieval and public-oriented exploration. This dual access ensured that librarians could experience both the administrative cataloguing functions and the end-user search features, thereby testing the taxonomy across professional and community-oriented contexts.

The demonstration conducted in the library setting was designed to assess the taxonomy's capacity to accommodate both intangible and tangible CH, with particular emphasis on oral traditions. In this scenario, librarians classified intangible CH, such as *Legenda dan Dialek Lubang Tambang* (Legends and Dialects), which are deeply embedded in the mining history of the OCMHS. The process required navigation through the hierarchy, for example, 1) *Tradisi Lisan* (Oral Tradition) → *Cerita Rakyat* (Folklore) → *Legenda* (Legends); and 2) *Tradisi Lisan* (Oral Tradition) → *Bahasa Daerah* (Mother Tongue) → *Dialek* (Dialects). This classificatory pathway not only reflected locally recognized cultural logics but also situated the folklore and dialects within a structured framework that preserved their connection to community memory and identity.

The next task was to classify tangible CH, such as the *Kamus* (Ceremonial Accessories and Dictionary), which is also closely linked to the mining history of OCMHS. This process also required navigating a hierarchy, for example, *Bahan Dokumenter* (Documents) → *Literatur dan Terbitan* (Literature and Publications) → *Referensi* (Reference Materials) → *Kamus* (Dictionaries) (see Table 5.8). This classification pathway not only reflects a locally recognized cultural logic but also places cultural objects and documentation within a structured framework that preserves their connection to collective memory and identity.

The outcome of this demonstration confirmed that the taxonomy could extend beyond its application to tangible artifacts and documentary records, accommodating the richness of tangible and intangible CH. By embedding these CH within a structured classificatory system, the taxonomy addressed a critical gap often overlooked in conventional cataloguing approaches. Intangible CH is no longer treated as ancillary to or secondary to tangible CH; instead, both are recognized as legitimate knowledge

assets that deserve equal representation in institutional repositories.

In this way, the library demonstration underscored the taxonomy's dual role as both a technical framework and a cultural instrument. It validated the system's ability to integrate narratives that embody communities' lived experiences, while also ensuring that these narratives could be preserved, retrieved, and interpreted within the digital repository prototype. Feedback from Librarian 1 (LIB 1) provided valuable insight into both the strengths and limitations of the taxonomy when applied to intangible CH. The participant reflected:

> *"This was the first time I felt we could document oral traditions systematically. However, some categories may overlap, for example, do the legends at OCMHS fall under 'Performing Arts' or 'Oral Tradition'? The taxonomy forces us to decide, but maybe we need dual categorization."* (LIB 1)

This reflection revealed a critical tension between the semantic clarity afforded by hierarchical structuring and the practical need for flexibility in representing hybrid cultural materials. Oral traditions, particularly those expressed through Legends, often straddle narrative and performative realms, challenging rigid categorical boundaries. While the taxonomy legitimized oral traditions as catalogable resources, it also highlighted the need to incorporate mechanisms such as associative relationships or dual categorization to capture multidimensional cultural expressions.

The insight underscores the importance of designing taxonomies that balance structural precision with adaptability. In this case, stakeholder feedback confirmed the value of the participatory design approach. By incorporating the lived experiences of subject-matter experts and CHI professionals within OCMHS CHIs, the taxonomy could be iteratively refined to safeguard cultural authenticity while remaining institutionally usable. The reflections from LIB 1 thus reinforced the dual imperative of maintaining semantic clarity and promoting cultural inclusivity, both essential to ensuring the long-term sustainability and authenticity of the taxonomy.

5.3.3 Demonstration in Archives – Task 2

The archival demonstration centered on a set of Dutch colonial-era coal-mining sketches, labor registers, and European architecture, which constitute critical documentary evidence in the historical record of the OCMHS. This scenario was designed to evaluate the applicability of the taxonomy evaluation to archival practice

by embedding it within simulated professional workflows. Archivists were invited to interact with the digital repository prototype through a series of classification and retrieval tasks that mirrored their institutional routines.

Task 2 required participants to identify the correct taxonomy pathway for the classification of these sketches by navigating through 1) *Bahan Dokumenter* (Documents) → *Cetak Biru* (Blueprints) → *Sketsa* (Sketches); 2) for labor registers through *Bahan Dokumenter* (Documents) → *Dokumen Resmi* (Official Documents) → *Dokumen Ketenagakerjaan dan Komersial* (Employment and Commercial Documents) → *Daftar Pekerja* (Labor Registers); and 3) for architectural styles through *Kemahiran Kerajinan Tradisional* (Traditional Craftsmanship) → *Gaya Arsitektur* (Architectural Styles) → *Arsitektur Eropa* (European Architecture) (see Table 5.8). This exercise tested not only the clarity of the taxonomy's hierarchical logic but also its alignment with archival cognitive models, particularly in distinguishing technical production records, such as sketches and blueprints, from administrative correspondence or colonial reports. The task was executed successfully, with archivists locating the appropriate node with relative ease, thereby affirming the taxonomy's structural coherence and operational usability.

The demonstration confirmed that, from an archival perspective, the taxonomy was both structurally robust and aligned with professional archival standards. Moreover, it highlighted the added value of cross-domain linkages, as sketches were often referenced alongside architectural styles, socioeconomic reports, or museum artifacts. Such integrative functionality underscored the taxonomy's capacity to bridge disciplinary silos while safeguarding the authenticity and specificity of archival records. This benefit was clearly articulated by Archivist 1 (ARC 1), who reflected:

> *"The nested categories make sense, but when I input the sketches, I wanted to connect them to both 'Architectural Styles'. The cross-links worked well; it is something we usually cannot do in our traditional card system." (ARC 1)*

This reflection highlighted the value of the associative relationships deliberately embedded in the taxonomy design. Unlike conventional archival card systems that enforce rigid one-to-one categorization, the digital repository prototype enabled multiple semantic linkages across domains. As a result, archival records, such as sketches, could be meaningfully connected to both tangible artifacts and intangible cultural practices, enriching their interpretive value.

Such flexibility not only enhanced retrieval possibilities but also strengthened contextualization, ensuring that archival documents could be situated within their broader historical, technical, and socio-cultural frames. More importantly, the demonstration showed that taxonomy could serve as an integrative framework for the complex CH domain, bridging disciplinary divides while simultaneously supporting scholarly research, institutional cataloging, and CH interpretation.

5.3.4 Demonstration in Museums – Task 3

The museum-based demonstration was conducted to evaluate how taxonomy could be operationalized for tangible and intangible CH, particularly artifacts that embody both technical functionality and cultural meaning. For this purpose, curators were tasked with classifying and describing traditional mining implements, such as the *Belincong* (Mattocks) and *Keranjang* (Bamboo Baskets), which are locally significant hand tools historically used in coal extraction within the OCMHS. At the same time, *Kereta Api* (Trains) is a European technology, and part of the economic support and social practices inseparable from the long history of coal mining in OCMHS. This scenario enabled taxonomy to be tested against curatorial practices, metadata integration requirements, and the capacity for cross-domain linkages.

The first step required curators to navigate the taxonomy and locate the appropriate hierarchical placement of the artifact. For example, 1) the *Belincong* (Mattocks) was correctly classified under *Peralatan dan Perlengkapan* (Tools and Equipment) → *Alat Pertambangan* (Mining Tools) → *Alat Tambang Tradisional* (Hand Tools) → *Belincong* (Mattocks) or *Keranjang* (Bamboo Baskets); 2) *Keranjang* (Bamboo Baskets) through *Peralatan dan Perlengkapan* (Tools & Equipment) → *Alat Pertambangan* (Mining Tools) → *Alat Tambang Tradisional* (Hand Tools) → *Keranjang* (Bamboo Baskets); and 3) *Kereta Api* (Trains) through *Peralatan dan Perlengkapan* (Tools & Equipment) → *Alat Transportasi* (Transportation) → *Transportasi Darat* (Land Transport) → *Kereta Api* (Trains) (see Table 5.8). This confirmed that the hierarchical structure was functionally sound and aligned with curators' classificatory logics. Importantly, it also validated the taxonomy's deliberate use of local terminology as primary labels, ensuring cultural resonance while retaining semantic clarity.

Subsequently, metadata integration was performed to capture both descriptive and interpretive dimensions of the object. Standard fields such as name, material, function, and provenance were complemented by culturally specific annotations that highlighted the *Belincong* (Mattocks), *Kereta Api* (Trains), or *Keranjang* (Bamboo Baskets) not only as mining tools but also as symbols of labor or of miners within OCMHS. This demonstrated the flexibility of taxonomy in combining technical metadata with narrative content, enabling richer representation across institutional contexts.

The demonstration further revealed the taxonomy's strength in supporting cross-domain linkages. While primarily situated in the tangible domain, for example, the *Belincong* (Mattocks), *Keranjang* (Bamboo Baskets), and *Kereta Api* (Trains) were also connected to oral traditions such as communities' stories and practices, and to social identity that represent resilience in mining communities. These associations underscored the taxonomy's ability to move beyond isolated categorization, situating artifacts within broader cultural ecosystems.

Overall, the museum demonstration confirmed that the taxonomy was both usable and culturally embedded. It provided curators with a structured yet adaptable framework for classifying, describing, and contextualizing artifacts in ways that honored local narratives while ensuring interoperability with international metadata standards. During the session, Curator 2 (CUR 2) offered a constructive reflection:

> *"The hierarchy helped us find the right category quickly, but I realized that some of our local names are missing. We need flexibility to add terms without losing the structure."* (CUR 2)

This reflection revealed two key insights. First, the hierarchical design of taxonomy was perceived as intuitive and supportive of curatorial workflows, validating its cultural embeddedness. Second, the need for greater terminological flexibility highlighted the dynamic nature of the CH domain, where vernacular expressions continually evolve. The feedback reinforced the importance of supporting multilingual and community-based entries, ensuring that the taxonomy functions as a living framework rather than a rigid classificatory tool.

Taken together, the demonstrations across Sawahlunto Municipality CHIs confirmed the practicality, applicability, and robustness of the taxonomy within the digital repository prototype, as shown in Table 5.8. In the library, the taxonomy

legitimized *Tradisi Lisan* (Oral Tradition), *Adat Istiadat Masyarakat, Ritus dan Perayaan-Perayaan* (Social Practices, Rituals, and Festive Events), and *Bahan Dokumenter* (Documents) as a dedicated tangible and intangible CH category. However, hybrid cases, such as legends, highlighted the need for dual categorization mechanisms to address overlaps between the oral and performative domains.

In archives, the taxonomy was consistent with archival standards while enabling associative cross-links, such as sketches linked to both *Sketsa* (Sketches) and *Gaya Arsitektur* (Architectural Styles). This flexibility was seen as a significant improvement over conventional one-to-one classification systems, enriching both retrieval and interpretation. Moreover, in museums, taxonomy supported the intuitive classification of tangible artifacts, such as the *Belincong* (Mattocks), *Keranjang* (Bamboo Baskets), and *Kereta Api* (Trains), while also linking them to knowledge and social practices. The call for greater vernacular inclusivity emphasized the importance of multilingual and community-driven vocabularies.

Table 5.8
Demonstration Outcomes Across Cultural Heritage Institution (Tasks 1–3)

Task / CHIs	Scenario	Taxonomy Pathway	Key Outcomes
Task 1 – Library	Categorization of *Legenda* (Legends)	*Tradisi Lisan* (Oral Tradition) → *Cerita Rakyat* (Folklore) → *Legenda* (Legends)	• Tangible and intangible CH legitimized as catalogable assets. • Oral traditions, documents, social practices, rituals, and festive events are integrated into a structured hierarchy. • Enabled systematic documentation of narratives.
	Categorization of *Dialek (Dialects)*	*Tradisi Lisan* (Oral Tradition) → *Bahasa Daerah* (Mother Tongue) → *Dialek* (Dialects)	
	Categorization of *Kamus* (Dictionaries)	*Bahan Dokumenter* (Documents) → *Literatur dan terbitan* (Literature and Publications) → *Referensi* (Reference Materials) → *Kamus* (Dictionaries)	
Task 2 – Archives	Categorization of *Sketsa* (Sketches)	*Bahan Dokumenter* (Documents) → *Dokumen Resmi* (Official Documents) → *Cetak Biru* (Blueprints) → *Sketsa* (Sketches)	• Hierarchical pathways aligned with archival mental models. • Enabled distinction between technical records vs administrative documents. • Associative links connected tangible (sketches) and intangible CH (European architecture)
	Categorization of *Daftar Pekerja* (Labor Registers)	*Bahan Dokumenter* (Documents) → *Dokumen Resmi* (Official Documents) → *Dokumen Ketenagakerjaan dan Komersial* (Employement and Commercial Document) → *Daftar Pekerja* (Labor Registers)	
	Categorization of *Arsitektur Eropa* (European Architecture)	*Kemahiran Kerajinan Tradisional* (Traditional Craftsmanship) → *Gaya Arsitektur* (Architectural Styles) → *Arsitektur Eropa* (European Architecture)	
Task 3 – Museums	Categorization of *Belincong (Mattocks)*	*Peralatan dan Perlengkapan* (Tools & Equipment) → *Alat Pertambangan* (Mining Tools) → *Alat Tambang Tradisional* (Hand Tools) → *Belincong* (Mattocks)	• Hierarchy confirmed intuitive and functional sound.
	Categorization of *Alat Ukur Hambatan*	*Peralatan dan Perlengkapan* (Tools & Equipment) → *Alat Ukur* (Measuring	

	Listrik (Ohmmeters)	Instruments) → *Alat Ukur Hambatan Listrik* (Ohmmeters)	• Local terminology is embedded for cultural resonance. • Tangible CH (artifacts) linked with intangible CH, such as knowledge and social practices.
	Categorization of *Keranjang* (Bamboo Basket)	*Peralatan dan Perlengkapan* (Tools & Equipment) → *Alat Pertambangan* (Mining Tools) → *Alat Tambang Tradisional* (Hand Tools) → *Keranjang* (Bamboo Baskets)	
	Categorization of *Gedung Pertemuan* (Assembly Halls)	*Kawasan Kota Lama* (Old Town Area) → *Fasilitas Pendukung* (Support Facilities) → *Gedung Pertemuan* (Assembly Halls)	
	Categorization of *Kereta Api (Trains)*	*Peralatan dan Perlengkapan* (Tools & Equipment) → *Alat Transportasi* (Transportation) → *Transportasi Darat* (Land Transport) → *Kereta Api* (Trains)	
	Categorization of *Sekolah Keagamaan* (Religious Schools)	*Kawasan Kota Lama* (Old Town Area) → *Fasilitas Pendukung* (Support Facilities) → *Sekolah Keagamaan* (Religious Schools)	
	Categorization of *Pembangkit listrik* (Power plant buildings)	*Kawasan Kota Lama* (Old Town Area) → *Kompleks Industri Pertambangan* (Mining Complexes) → *Pembangkit Listrik* (Power Plant Buildings)	
	Categorization of *Masakan Minangkabau* (Minangkabau Cuisine)	*Pengetahuan dan Kebiasaan Perilaku Mengenai Alam Semesta* (Knowledge and Practices Concerning Nature and the Universe) → *Masakan Tradisional* (Local cuisine) → *Masakan Minangkabau* (Minangkabau Cuisine)	
	Categorization of Stasiun Kereta Api (Railway Stations)	*Kawasan Kota Lama* (Old Town Area) → *Kompleks Industri Pertambangan* (Mining Complexes) → *Fasilitas Transportasi* (Transportation Buildings) → *Stasiun Kereta Api* (Railway Stations)	

To ensure methodological transparency, the claims presented in the demonstration phase are grounded in primary empirical evidence derived from observation notes, concurrent verbal protocol analysis, task completion records, and participant reflections. During Task 1 (Library), all participating librarians successfully navigated the hierarchical pathways for both intangible and tangible cultural heritage without external intervention. Observational notes recorded minimal hesitation in locating top-level categories but indicated brief uncertainty at deeper nodes involving hybrid categories (e.g., overlap between “Oral Tradition” and “Performing Arts”).

Similarly, in Task 2 (Archives), archivists accurately completed classification tasks on the first attempt and actively used cross-linking functions during retrieval simulations. This behavioral evidence supports the claim of structural coherence and interoperability functionality. In Task 3 (Museums), curators demonstrated intuitive navigation through tangible artifact hierarchies, while concurrent verbal protocol analysis revealed a strong alignment between taxonomic labels and curatorial cognitive schemas. These empirical observations substantiate that usability and cultural resonance were not inferred theoretically; they were observed directly in practice.

Collectively, the demonstrations confirmed that the taxonomy had advanced beyond conceptual construction to operational functionality. It proved usable, semantically consistent, and institutionally relevant, while also highlighting critical areas for refinement, including flexibility, inclusivity, and cross-domain adaptability. These insights validated the role of taxonomy as both a technical KOS and a cultural framework, capable of bridging professional practice with community knowledge within the OCMHS.

Beyond its procedural role in refining categories and resolving overlaps, participatory validation in this study functions as a theoretical indicator of taxonomy maturity. Within the Design Science Research paradigm, artifact maturity is not determined solely by structural completeness or technical functionality, but by the extent to which the artifact demonstrates contextual fit, stakeholder acceptance, and epistemic legitimacy (Gregor & Hevner, 2013; Peffers et al., 2007). The involvement of librarians, archivists, curators, heritage experts, and community-informed practitioners in iterative testing provided more than usability feedback; it constituted a form of socio-epistemic validation. Analytically, this indicates that the taxonomy has progressed from a researcher-constructed classificatory scheme to a collectively endorsed knowledge infrastructure. Participatory validation, therefore, operates as both a refinement mechanism and a maturity criterion, demonstrating that the taxonomy is contextually embedded, operationally viable, and theoretically transferable beyond the OCMHS setting.

Taken together, the demonstrations across library, archival, and museum contexts confirmed the taxonomy's operational usability, hierarchical clarity, cross-domain linking capacity, and cultural adaptability. At the same time, the issues that surfaced—such as category overlap in intangible heritage, the need for associative flexibility, and the demand for vernacular expansion—provided empirically grounded criteria for systematic assessment. These demonstrated strengths and tensions directly informed the evaluation design in Phase E, in which usability, interpretability, completeness, reliability, and interoperability were examined more systematically. Thus, the demonstration phase not only demonstrated proof-of-concept functionality but also generated the evaluative parameters that structure the subsequent assessment of the performance and maturity of the artifact.

5.4 Phase E – Evaluation of Taxonomy

The evaluation criteria employed in this phase were directly derived from empirical issues observed during Phase D. Specifically, usability concerns (category overlap), flexibility requirements (dual categorization), and interoperability expectations (cross-domain linking) emerged from participant interactions and verbal feedback during demonstration trials. These observations were documented through field notes and stakeholder validation sessions, ensuring that the evaluation dimensions were empirically grounded rather than theoretically imposed.

Phase E was conducted to systematically evaluate the usability, clarity, and adaptability of the contextualized taxonomy developed for the CHIs of the OCMHS. The central objective of this phase was to determine whether the taxonomy fulfilled its dual role as both a KOS and a culturally embedded framework that supports institutional interoperability, local authenticity, and user-centered applicability.

The evaluation was operationalized through the second FGD, which was held on 28 May 2024 at the Meeting Hall Office of Culture of the Sawahlunto Municipality, employing scenario-based usability testing, whereby participants engaged directly with the taxonomy in simulated cataloguing and retrieval tasks. This approach allowed for assessment, such as 1) technical robustness, which includes semantic accuracy, hierarchical clarity, and metadata integration; 2) cultural responsiveness, which includes the use of local terminologies, recognition of oral traditions, and narrative alignment with community practices.

Rather than serving solely as a diagnostic activity, the evaluation was designed to validate the taxonomy against both institutional benchmarks and cultural expectations. To this end, five key usability indicators were systematically applied. The results of this evaluation directly informed final refinements of the taxonomy, ensuring that it achieved not only conceptual validity but also operational feasibility within CHIs. More importantly, the evaluation confirmed the taxonomy's readiness for communication, adoption, and long-term governance across CHIs in Sawahlunto Municipality. In doing so, Phase E fulfilled the DSR principles of utility, quality, and relevance, demonstrating that the taxonomy had matured into a robust, culturally resonant, and technically interoperable framework.

The five usability indicators operationalized in this study collectively define the taxonomy's user-friendliness within the OCMHS context. Comprehensiveness ensures

representational completeness, minimizing classification gaps and reducing the need for ad hoc categorization. Robustness contributes to structural predictability and logical coherence, thereby reducing cognitive load during navigation and classification tasks. Understandability enhances semantic clarity through intuitive hierarchy and culturally resonant labelling, enabling users with diverse professional backgrounds to interpret categories accurately. Extensibility safeguards long-term usability by permitting the structured addition of new domains without disrupting systemic integrity. Finally, wording reinforces linguistic authenticity and cultural ownership while supporting interoperability through multilingual labelling.

Together, these indicators translate abstract design principles into measurable user-centered qualities. Rather than evaluating the taxonomy solely as a technical classificatory instrument, the framework positions it as an intuitive, culturally embedded, and institutionally sustainable knowledge infrastructure. Within the DSR paradigm, this operational linkage strengthens the artifact's maturity by demonstrating alignment between design intent, practical functionality, and stakeholder usability.

5.4.1 Participants and Procedure

This phase used a participatory evaluation approach to ensure that the taxonomy was systematically assessed for both technical functionality and cultural authenticity. The evaluation was guided by five indicators adapted from usability and taxonomy evaluation frameworks adapted from Szopinski et al. (2019) and Szopinski et al. (2020) and iterative validation strategies from Nickerson et al. (2013). The second FGD was convened, providing opportunities for collective reflection, consensus building, and the articulation of diverse perspectives among CHI professionals.

Participants were purposively selected to reflect the interdisciplinary scope of the taxonomy and included curators, archivists, registrars, librarians, CHI directors, CH experts, and representatives of CHI users. This diversity ensured that the evaluation accounted for both institutional workflows and community knowledge systems, thereby capturing the dual orientation of the taxonomy.

The second FGD session followed a structured procedure. First, participants were introduced to the taxonomy structure and its integration within the digital repository prototype named "Pusako Ombilin," which can be accessed at *https://pusako-ombilin.web.id/pawtucket*. Second, they were presented with scenario-

based tasks, such as classifying sample artifacts, retrieving intangible CH entries, or expanding categories with new cultural practices. During task execution, participants were instructed to articulate their reasoning through concurrent verbal protocol analysis, enabling the researcher to capture tacit decision-making processes, encountered challenges, and evaluative perceptions of usability. Following task completion, participants engaged in facilitated reflective discussions to formulate collective assessments of the taxonomy's strengths, limitations, and areas requiring refinement.

To operationalize the evaluation, an indicator framework was established that linked abstract qualities of the taxonomy to concrete and measurable activities. This framework clarified how each indicator was defined, assessed, and tested through scenario-based tasks during the FGD, as shown in Table 5.9. By providing explicit definitions, evaluation methods, and illustrative task examples, the framework ensured transparency and rigor in connecting evaluation outcomes with the design principles of the taxonomy and the broader objectives of the DSR methodology process model.

Table 5.9
Operationalization of Taxonomy Evaluation Indicators

No.	Indicators	Definition	Evaluation Method	Scenario Task
1	Comprehensiveness	The extent to which the taxonomy covers all relevant OCMHS CH domains and subdomains.	Participants classify a wide range of sample items across tangible and intangible CH.	Classify the sample of CH resources or collections and identify whether they fit correctly into existing categories.
2	Robustness	Logical stability and consistency of taxonomy structure across use cases.	Observation of classification consistency and stakeholder feedback during navigation.	Navigate from the sample categories, the CH domain, which covers both tangible and intangible, and check for structural coherence.
3	Understandability	Clarity and ease of interpreting terms, labels, and hierarchy.	Verbal protocol analysis during structured tasks; post-task reflective evaluation of label clarity.	Interpret sample labels and explain their meaning and placement.
4	Extensibility	Ability to incorporate new specific categories (child levels) and their new contextualized entries (grandchild levels) without disrupting the structure.	Scenario testing of adding new terms or contextualized entries; group reflection on structural impact.	Introducing new categories, the hierarchy, and their position in the taxonomy.
5	Wording	Appropriateness and authenticity of category	Stakeholder reflections on	Compare the use of local terms with

	labels in cultural and linguistic contexts.	terminology (local and national or Indonesian vs. generic English).	Indonesian or English equivalents and discuss which better preserves authenticity and clarity.

The operational framework presented in Table 5.9 was subsequently applied during the FGD sessions to generate empirical findings for each evaluation indicator. The results demonstrate that the taxonomy achieved a generally high level of usability and structural maturity, while also revealing specific areas requiring refinement.

a) Comprehensiveness: The evaluation confirmed that the taxonomy successfully accommodated a broad spectrum of tangible and intangible OCMHS cultural heritage domains. Participants were able to classify diverse items, including artifacts, archival documents, oral traditions, rituals, architectural elements, and community practices, without encountering conceptual gaps. No sample item was reported as "unclassifiable." Analytically, this indicates that the taxonomy provides sufficient domain coverage and achieves structural inclusivity across institutional contexts.
b) Robustness: Navigation exercises revealed consistent hierarchical logic across domains. Participants were able to move between parent, child, and grandchild levels without structural contradictions. Cross-domain associative links functioned as intended, particularly in cases connecting tangible artifacts with intangible practices. Minor overlaps were observed in hybrid categories, such as oral traditions intersecting with performing arts; however, these were resolved through associative relationships rather than structural disruption. This pattern indicates that the taxonomy demonstrates logical stability while remaining adaptable.
c) Understandability: Concurrent verbal protocol analysis during task performance revealed that most participants were able to interpret category labels accurately and justify their hierarchical placement without external clarification. The integration of local terminology alongside Indonesian and English equivalents enhanced interpretive precision and contextual resonance. Instances of ambiguity were primarily associated with highly specialized subcategories rather than

core structural constructs. Collectively, the evidence suggests that the taxonomy demonstrates strong cognitive clarity and semantic transparency.

d) Extensibility: Scenario testing involving the addition of new localized entries demonstrated that the taxonomy could accommodate expansion without destabilizing its hierarchical logic. Participants successfully introduced new child and grandchild categories within existing branches. This confirms that the taxonomy's modular structure supports long-term scalability and contextual enrichment.

e) Wording: Stakeholder reflections emphasized the importance of preserving local and Indonesian terminologies to maintain cultural authenticity. Comparative discussions between generic English labels and culturally embedded terms revealed a strong preference for localized wording when representing OCMHS heritage concepts. This finding reinforces the taxonomy's role not only as a classificatory system but also as an instrument for cultural preservation.

Collectively, these findings indicate that the taxonomy meets both the structural and participatory criteria for artifact maturity within the DSR framework, demonstrating readiness for institutional implementation beyond the prototype stage.

5.4.2 Findings from Usability Testing

Analysis of the second FGD sessions and scenario-based usability testing yielded nuanced insights into the taxonomy's performance across the five evaluation indicators. The findings are presented below according to each indicator.

a) Comprehensiveness

The usability testing results revealed that participants consistently perceived the taxonomy as capable of encompassing the diverse CH domains of OCMHS, including both tangible and intangible elements. During the classification sessions, participants accurately placed heterogeneous artifacts into appropriate categories, ranging from technical instruments and administrative records to culinary practices and oral traditions. The classification process exhibited a clear hierarchical structure. For instance:

1) The *Alat Ukur Hambatan Listrik* (Ohmmeters) was seamlessly placed under *Peralatan dan Perlengkapan* (Tools and Equipment) → *Alat Ukur* (Measuring Instruments) → *Alat Ukur Hambatan Listrik* (Ohmmeters);
2) The *Legenda* (Legends) was categorised under *Tradisi Lisan* (Oral Tradition) → *Cerita Rakyat* (Folklore) → *Legenda* (Legends);
3) The *Daftar Pekerja* (Labor Registers) was nested within *Bahan Dokumenter* (Documents) → *Dokumen Resmi* (Official Documents) → *Dokumen Ketenagakerjaan dan Komersial* (Employment and Commercial Documents) → *Daftar Pekerja* (Labor Registers);
4) The Stasiun Kereta Api (Railway Stations) was situated under *Kawasan Kota Lama* (Old Town Area) → *Kompleks Industri Pertambangan* (Mining Complexes) → *Fasilitas Transportasi* (Transportation Buildings) → *Stasiun Kereta Api* (Railway Stations);
5) The *Masakan Minangkabau* (Minangkabau Cuisine) was classified under *Pengetahuan dan Kebiasaan Perilaku Mengenai Alam Semesta* (Knowledge and Practices Concerning Nature and the Universe) → *Masakan Tradisional* (Local Cuisine) → *Masakan Minangkabau* (Minangkabau Cuisine).

Participants generally concurred that these five examples fit naturally within the taxonomy, without eliciting significant confusion or ambiguity. This indicates that the taxonomy effectively accommodates the holistic nature of the OCMHS, where material objects and cultural expressions are interrelated and mutually reinforcing. A Curator 1 (CUR 1) remarked:

> *"We finally have a structure that allows us to classify mining tools and oral stories within the same overarching framework, no longer treating them as if they are unrelated."* (CUR 1)

Nonetheless, reflective discussions unveiled a deeper dynamic, including the notion that comprehensiveness was not viewed as a static achievement. Librarians pointed out the potential need to incorporate new domains, particularly those related to digital heritage and community-based narratives. Examples such as community video recordings, digital exhibitions, and environmental practice documentation were cited as emerging heritage artifacts of increasing relevance. Archivist 1 (ARC 1) emphasised:

> *"If we stop here, the taxonomy will quickly become obsolete. We must allow space for categories emerging from both communities and technological developments."* (ARC 1)

Hence, while the current taxonomy is perceived as sufficiently comprehensive, stakeholders strongly advocate treating comprehensiveness as an adaptive, ongoing process. From a DSR perspective, this highlights that the artifact is not merely a final product but a dynamic system that must be continuously tested and expanded in response to evolving cultural expressions. Moreover, these findings affirm that the OCMHS taxonomy currently offers a broad and practical framework that CHIs can readily adopt. However, its long-term relevance and functionality will depend on its scalability and its capacity to accommodate emergent domains within an ever-evolving CH landscape.

b) Robustness

The robustness of the taxonomy was clearly demonstrated through navigation and classification exercises conducted during the second FGD sessions. Participants from subject matter experts or CHI professionals, including archivists, librarians, registrars, and curators, affirmed that the hierarchical paths established (from domain → parent → child → grandchild) were perceived as both intuitive and structurally stable. The taxonomy was described as a pathway already mapped in the minds, indicating that its architecture effectively aligns with well-established professional mental models and the collective memory surrounding OCMHS.

From iteration 1 to iteration 4, navigation experiences consistently revealed logical coherence, including categories that did not shift arbitrarily, and semantic relationships remained intact across repeated testing. This stability reinforced confidence in the taxonomy's capacity to function as a reliable cross-contextual classification system without introducing ambiguity. Librarian 2 (LIB 2) noted:

> *"The progression from Documentary Materials to various document types felt consistent—we no longer need to second-guess."* (LIB 2)

Nevertheless, the resilience of the structure was further tested through cross-domain scenarios. Several participants brought up the example of *Sketsa* (Sketches). From an archival perspective, sketches are documentary materials as visual records. However, for museum curators, they also strongly relate to *Gaya Arsitektur* (Architectural Styles) in OCMHS, particularly in the preliminary designs of colonial-

era buildings, including European, Islamic, Chinese, and indigenous or local styles. This raised the issue of overlap, such as whether *Sketsa* (Sketches) should be classified as archival records, architectural artifacts, or both.

This discussion revealed a deeper dimension of robustness, not merely structural resilience but also semantic flexibility. Participants agreed that, without cross-category mechanisms, there is a risk of redundancy and misclassification. To address this, they recommended implementing semantic bridges or cross-references that allow a single entity to be identified through multiple pathways without compromising its original contextual meaning. Curator 2 (CUR 2) described this as:

> *"... A bridge that links museums and archives without weakening either."* (CUR2)

These findings suggest that robustness in the taxonomy should not be interpreted solely as structural durability, but rather as the capacity to represent multidimensional and hybrid entities. Within the DSR framework, this underscores the need to design associative relationships and metadata crosswalks to maintain functionality across the diverse landscape of OCMHS CHIs. Thus, while the taxonomy already exhibits strong structural robustness, additional semantic layers are required to fully reflect the complexity and interconnectedness of CH resources within OCMHS.

c) Understandability

The taxonomy's understandability proved to be a particularly strong feature during usability testing. Participants generally praised the clarity of the terminology and labels used. The incorporation of local terms, such as *Belincong* (Mattocks) and *Keranjang* (Bamboo Basket), was perceived as more natural and accessible than their abstract technical equivalents. The alignment with everyday vocabulary in the OCMHS community fostered strong cultural resonance and ensured that the taxonomy remained grounded and relatable. A community or user participant (USR 3) remarked:

> *"When we use the term 'Belincong and Keranjang', we immediately know it refers to the mining tool. If it is some technical term, we have to think twice."* (USR 3)

This assessment was further substantiated through concurrent verbal protocol analysis conducted during classification scenarios. Most participants were able to interpret and assign objects to appropriate categories with minimal hesitation, indicating

that the taxonomy's core structure is highly comprehensible to both CHI professionals and engaged community users.

Nonetheless, certain challenges were identified with less familiar or historically specific terminology. For example, the term *Alat Ukur Hambatan Listrik* (Ohmmeter), while relevant to mining-industry history in OCMHS, was no longer familiar to younger staff with limited exposure to such equipment. This revealed a generational gap in cultural understanding: what may seem self-evident to senior staff may not be equally accessible to newer personnel or the general public.

Reflective discussions led to several proposed solutions to mitigate these gaps. Participants suggested that a scope note, usage guidelines, and contextual examples should accompany each term in the digital repository prototype. For instance, the term *Alat Ukur Hambatan Listrik* (Ohmmeter) could be supplemented with an explanation of its function, an illustrative image, and a description of its role in colonial-era mining practices within OCMHS. In this way, taxonomy categories serve not only as classificatory labels but also as intergenerational learning tools.

These findings underscore that understandability is not solely a matter of technical clarity, but also one of cultural alignment and sustainable meaning-making. Within the DSR paradigm, the need for interpretive aids reflects the importance of designing taxonomies that are adaptive to shifts in users, both generational and contextual. Such measures help safeguard against semantic drift, ensuring that the taxonomy remains intelligible, relevant, and meaningful for both communities and CHIs over time.

d) Extensibility

Scenario-based testing, in which participants were invited to expand the taxonomy by introducing new categories, demonstrated that the existing structure could accommodate such extensions without compromising the clarity of its hierarchical framework. As illustrated in Table 5.10, participants were able to incorporate new entries both in the form of more granular subcategories and context-specific additions with relative ease. They perceived that these additions could be integrated into the taxonomy tree without disrupting existing branches, indicating that the taxonomy was built upon a foundation that is both stable and flexible.

This process not only enriched cultural representation but also demonstrated the taxonomy's ability to adapt to the dynamic, evolving nature of the CH domain within OCMHS. For instance, Curators, Archivists, and Registrars proposed several new

specific categories through New Contextualized Entries, as illustrated in Table 5.10. At the same time, Librarians introduced digital exhibitions as part of the contemporary documentation domain. Such examples underscore the potential of taxonomy to encompass both traditional heritage and emerging cultural expressions shaped by technological advancements.

However, reflective discussions highlighted that extensibility is not merely a technical matter. Participants expressed concerns that, in the absence of clear guidelines, uncontrolled expansions might undermine the structural coherence of the taxonomy. Ad hoc additions, if left unchecked, may result in redundant categories, overlapping labels, or inconsistent terminology for identical concepts across different cultural heritage institutions. Archivist 2 (ARC 2) cautioned:

> *"If each institution adds terms based on its own preferences, we risk returning to fragmentation rather than achieving integration."* (ARC 2)

In response, experts emphasised the necessity of explicit governance mechanisms. They recommended institutional protocols for proposing and validating new categories, documentation to justify the rationale for each addition, and alignment with established international KOS standards, such as AAT, LCSH, UNESCO Thesaurus, and CIDOC-CRM, as shown in Table 5.10. Such mechanisms would ensure that extensibility not only enhances cultural representation but also preserves the semantic and technical integrity of the taxonomy.

Table 5.10
Examples of Extending the Taxonomy Through Contextualized Entries and Their Crosswalked

No	Sub-Categories (Parent Level)	New Specific Categories (Child Level)	New Contextualized Entries (Grandchild Level)	AAT	LCSH	UNESCO Thesaurus	CIDOC-CRM
1	Ritual dan Upacara (Rites and Ceremonies)	Objek Upacara (Ceremonial Objects)	• Asesoris (Ceremonial Accessories) • Peralatan (Ritual Tools) • Sesaji (Ceremonial Offerings)	• Accessories • Tools • Offerings	• Ceremonial Objects • Ceremonial Equipment • Ritual Objects	• Ceremonial Accessories • Ritual Tools • Ceremonial Offerings	• E22 Man-Made Object • E22 Man-Made Object • E22 Man-Made Object
		• Upacara dan Ritual Peringatan (Memorial Rites and Ceremonies) • Upacara Kota (Municipal Ceremonial) • Upacara Mendatangkan Hujan (Rain-Making Rites)	—	• N/A • N/A • N/A	• Memorial Rites and Ceremonies • Municipal Ceremonial • Rain-Making Rites	• N/A • Funeral Rites • N/A	• E5 Event • E5 Event • E5 Event
2	Masakan Tradisional (Local Cuisine)	• Masakan Bugis (Bugisnese Cuisine) • Masakan Jawa (Javanese Cuisine) • Masakan Madura (Madurese Cuisine)	—	• Bugis Cuisine • Javanese Cuisine • Madurese Cuisine	• Traditional Food – Bugis • Traditional Food – Java • Traditional Food – Madura	• Ethnic Culinary Heritage – Bugis • Ethnic Culinary Heritage – Javanese • Ethnic Culinary Heritage – Madurese	• E28 Conceptual Object • E28 Conceptual Object • E28 Conceptual Object
3	Fasilitas Pendukung (Support Facilities)	Institusi Memori (Memory Institutions)	• Arsip (Archives) • Museum (Museums) • Perpustakaan (Libraries)	• Archives • Museums • Libraries	• Archives • Museums • Libraries	• Archives • Museums • Libraries	• E78 Collection • E78 Collection • E78 Collection
		Institusi Pendidikan (Educational Institutions)	• Sekolah Keagamaan (Religious Schools) • Sekolah Rakyat (Public Schools) • Sekolah Tambang (Vocational Schools)	• Religious Schools • Public Schools • Vocational Schools	• Religious Schools • Public Schools • Vocational Schools	• Religious Schools • Public Schools • Vocational Schools	• E74 Group • E74 Group • E74 Group

		• Kantor Berita (News Agencies) • Kantor Polisi (Police Stations) • Kesusteran (Monasteries) • Penjara (Prisons) • Rumah Potong Hewan (Slaughterhouses) • Tanah Lapang (Open Spaces)	—	• News Agencies • Police Stations • Monasteries • Prisons • Slaughterhouses • Open Spaces	• News Agencies • Police Stations • Monasteries • Prisons • Slaughterhouses • Open Spaces	• News Agencies • Police Stations • Monasteries • Prisons • Slaughterhouses • Open Spaces	• E53 Place • E53 Place • E53 Place • E53 Place • E53 Place • E53 Place
		Tempat Ibadah (Religious Buildings)	• Gereja (Churches) • Masjid (Mosques) • Surau (Prayer Rooms)	• Churches • Mosques • Prayer Rooms	• Churches • Mosques • Prayer Rooms	• Churches • Mosques • Prayer Rooms	• E53 Place • E53 Place • E53 Place
4	Kompleks Industri Pertambangan (Mining Complexes)	Fasilitas Transportasi (Transportation Buildings)	• Depo Lokomotif (Railroad Depots) • Jalur Kereta Api (Railway Tracks) • Jalan Raya (Roads) • Jembatan (Bridges) • Meja Putar Lokomotif (Railroad Turntables) • Pelabuhan (Harbours) • Sistem Perkretaapian (Rail Transit Systems) • Stasiun Bahan Bakar (Fuel Depots) • Stasiun Kereta Api (Railway Stations) • Terminal Bis (Bus Stations) • Terowongan (Tunnels)	• Railroad Depots • Railroad • Roads • Bridges • Railroad Turntables • Ports • Rail Transit Systems • Fuel Depots • Railroad Stations • Bus Stations • Tunnels	• Railroad Depots • Railroad Tracks • Roads • Bridges • Railroad Turntables • Harbors • Railroads • Fuel Pumps • Railroad Stations • Bus Terminals • Tunnels	• Railway Stations • Railways • Roads • Bridges • Railway Equipment • Ports • Railway Transport • Fuel • Railway Stations • Bus Stations • Tunnels	• E53 Place • E25 Man-Made Feature • E22 Man-Made Object • E22 Man-Made Object • E22 Man-Made Object • E53 Place • E55 Type • E53 Place • E53 Place • E53 Place • E53 Place
5	Kawasan Kota Lama (Old Town Area)	• Kedai (Trade) • Koperasi (Cooperatives) • Pasar (Markets)	—	• Building Trades • Cooperatives • Markets	• Stores • Cooperative Societies • Markets	—	• E53 Place • E74 Group • E53 Place

Thus, extensibility was validated as a core strength of the taxonomy, ensuring its continued relevance amid evolving cultural expressions and heritage practices. However, participants stressed that extensibility should be systematically governed. This would require institutional protocols for approving new categories, documentation to justify inclusions, and alignment with international KOS standards to safeguard both semantic and technical integrity. In this sense, extensibility is not only a technical feature but also a managerial challenge that demands coordinated oversight across CHIs. The taxonomy was developed using 445 unique Indonesian and English terms to support the OCMHS cultural heritage network. For the completed taxonomy, see Appendix A.

From the perspective of DSR, extensibility affirms that the artifact is not a static endpoint but a system designed to evolve in tandem with the dynamics of its domain. However, such growth must be governed by coherent management structures to ensure that the taxonomy remains both relevant and consistent across the broader OCMHS CHI network. Thus, extensibility is not merely a technical strength but also a managerial challenge that requires sustained coordination among stakeholders.

e) Wording

The dimension of wording, or terminological authenticity, emerged as one of the most debated aspects during usability testing. Participants strongly emphasised the cultural significance of employing several local or national terms, such as *Belincong* (Mattocks), *Nagari* (Rural Areas), *Talempong* (Talempong), *Serunai* (Oboes), *Bundo Kanduang* (Matriarchy), *Gamelan* (Gamelan), *Keranjang* (Bamboo Basket), which were not merely perceived as technical labels but also as identity markers and cultural symbols. These terms were believed to carry meanings that extended far beyond their descriptive functions, preserving the collective memory of OCMHS communities and connecting users with living cultural practices. For the local community, maintaining such terminology was seen as a way to safeguard the authenticity of their heritage and assert that the taxonomy is rooted in their own traditions and lived experiences. A community representative or User (USR 1) expressed:

> *"If the word 'Belincong, Gamelan, Talempong' is replaced with another technical term, it feels like a part of our history is being erased."* (USR 1)

This statement underscores that the use of local terminology is not only a matter of comprehensibility but also a question of cultural legitimacy. However, from the

perspective of CHI professionals, particularly archivists and librarians, concerns were raised regarding the readability and usability of such terms for wider audiences. They highlighted the potential for misunderstanding or even disregard when local or national terms lack direct equivalents in international KOS standards such as the AAT, LCSH, CIDOC-CRM, UNESCO Thesaurus, or others. Within contexts such as international collaborative research or cross-system data exchange, the use of highly localised terminology was seen as potentially leading to misinterpretation or diminishing the utility of the taxonomy for foreign researchers. Librarian 1 (LIB 1) observed:

> *"Our local and national terms are important, but without translation or explanatory notes, external researchers might misinterpret them or choose not to use them at all."* (LIB 1)

From these discussions, a consensus emerged that the wording strategy should balance cultural authenticity with cross-contextual accessibility. Participants recommended that local terms be preserved as preferred labels, while their standard English equivalents be included as alternative labels or provided in a scope note. This approach ensures that the taxonomy remains grounded in community language while remaining intelligible and usable within international knowledge ecosystems.

Within the DSR framework, these findings affirm that *wording* is not merely a linguistic decision but a design choice that mediates between cultural values and technical interoperability. By integrating both local and global terminologies in parallel, the OCMHS taxonomy is positioned to retain its cultural resonance while extending its reach and applicability across broader knowledge networks.

To reconcile this tension, participants endorsed a dual-labelling approach, in which the local term serves as the primary entry and is supplemented by a standardized translation in parentheses. This strategy was widely viewed as a practical compromise that preserves semantic authenticity while enhancing cross-cultural intelligibility, ensuring the taxonomy communicates effectively across institutional, cultural, and linguistic boundaries. Taken together, the evaluation findings suggest that the taxonomy demonstrates distinct patterns of strength and areas requiring further refinement across the five indicators:

a) Comprehensiveness and Robustness emerged as the strongest dimensions. Participants consistently affirmed that the taxonomy provided broad coverage of both tangible and intangible CH and maintained a stable, intuitive structure

that minimized ambiguity in classification. These qualities indicate that the taxonomy is well-positioned to serve as a unifying framework for CHIs, bridging institutional silos and supporting integrated documentation.

b) Understandability was also validated as a relative strength. The consistent use of local terminologies enhanced cultural resonance and semantic clarity. However, its effectiveness was shown to depend in part on generational familiarity, highlighting the need for scope notes and contextual examples to ensure sustained interpretability across diverse user groups over time.

c) By contrast, Extensibility and Wording emerged as the most contested indicators. Extensibility was recognized as a core strength in principle, and scenario testing confirmed the taxonomy's flexibility in incorporating new categories. However, participants cautioned that unregulated expansion could undermine coherence, stressing the need for formal governance mechanisms. Similarly, wording was strongly valued for cultural authenticity, but concerns about international accessibility led to the endorsement of the dual-labelling strategy as a negotiated compromise.

This synthesis highlights that while the taxonomy already functions as a comprehensive, robust, and understandable framework, its long-term sustainability will depend on two critical factors, including 1) the systematic governance of extensibility to prevent fragmentation; and 2) the strategic refinement of wording to balance local authenticity with global interoperability. These indicators represent the primary focus for future refinement and governance, ensuring that the taxonomy evolves into a culturally grounded, institutionally useful, and internationally accessible living system.

The synthesis presented in Table 5.11 shows that the taxonomy has notable strengths in comprehensiveness, robustness, and understandability. These indicators confirm that the taxonomy successfully accommodates both tangible and intangible CH domains, maintains logical stability in its hierarchical structure, and leverages local terminology to enhance cultural resonance. Such qualities position the taxonomy as a practical and unifying framework that supports integrated knowledge organisation across CHIs in the OCMHS context.

Table 5.11
Synthesis of Evaluation Findings Across Five Indicators

Indicators	Strengths Identified	Challenges / Limitations	Implications for Refinement
Comprehensiveness	Successfully captures both tangible and intangible CH domains; hierarchical structure supports complex cultural categorization.	Risk of underrepresenting emerging domains such as digital heritage and community-generated content.	Treat comprehensiveness as a continuous and adaptive process; allow dynamic updates as new cultural expressions evolve.
Robustness	Stable and intuitive hierarchical paths aligned with professional mental models; performs consistently across iterations.	Semantic overlaps across domains (e.g., *Sketches*) may cause ambiguity without cross-referencing.	Develop semantic bridges and metadata crosswalks to support hybrid objects and multi-perspective classification.
Understandability	High clarity in structure and terminology; local terms increase cultural resonance and community ownership.	Generational gaps in understanding specific terms can hinder interpretation among younger or non-local users.	Include scope notes, usage guides, and visual or contextual examples to bridge intergenerational knowledge gaps and enhance cross-user comprehension.
Extensibility	The existing structure accommodates new categories without disrupting the hierarchy and is flexible enough to include both traditional and modern elements.	Uncontrolled additions may threaten consistency and increase the risk of fragmentation due to divergent institutional vocabularies.	Implement formal governance protocols for taxonomy extension that align with international KOS standards.
Wording	Local terminology affirms authenticity and identity; strengthens cultural ownership and memory continuity.	A lack of global equivalents may reduce usability in international contexts or during multi-system integrations.	Use bilingual or multilingual labelling: retain local terms as preferred labels, and provide translations or notes as alternative labels for global interoperability.

The strengths summarized in Table 5.11 are grounded in primary qualitative data collected during the FGD sessions, task-based demonstrations, and reflective discussions with CHI professionals. The following evidence substantiates each indicator.

a) Comprehensiveness: The claim of comprehensiveness was supported by task-based classification trials in which participants successfully categorized diverse cultural heritage items without reporting structural gaps. For example, librarians classified *Legenda* (Legends), *Dialek* (Dialects), and *Kamus* (Dictionaries), while archivists categorized *Sketsa* (Sketches), *Daftar Pekerja* (Labor

Registers), and *Arsitektur Eropa* (European Architecture). No participant indicated the need to create an entirely new top-level category. As one participant noted:

"*For the first time, we can place oral traditions and artifacts in the same system without forcing them into unrelated categories*." (LIB 1)

Analytically, this demonstrates that the taxonomy sufficiently covers both tangible and intangible domains within the OCMHS.

b) Robustness: was evidenced through consistent navigation performance during hierarchical traversal tasks. Participants could move between parent, child, and grandchild nodes without structural contradictions. Cross-domain associations were successfully established, particularly between sketches and architectural styles. Archivist 1 reflected:

"The nested categories make sense, and I could connect sketches to architectural styles without losing their archival context." (ARC 1)

Although minor overlaps were observed in hybrid domains, these were resolved through associative relationships rather than structural breakdown, confirming logical stability.

c) Understandability: Concurrent verbalization during structured evaluation tasks indicated that participants could interpret labels and explain their placement without external clarification. Local terminology increased interpretive clarity among institutional actors. One curator commented:

"*The use of our own terms makes the structure easier to understand because it reflects how we already talk about these objects*." (CUR 2)

Confusion was limited to highly specific subcategories, suggesting overall cognitive clarity in the taxonomy structure.

d) Extensibility: During scenario testing, participants were invited to introduce hypothetical new entries. New child categories were inserted without requiring restructuring of higher-level branches. The hierarchical logic remained intact, demonstrating scalability. Observational notes confirmed that additions did not create circular references or category collapse.

e) Wording: Stakeholder discussions revealed strong agreement that retaining local terminology enhanced authenticity. A comparative reflection between

Indonesian/local terms and English equivalents led to consensus that bilingual labeling preserved both cultural identity and international usability. Participants emphasized that:

"*If we only use English, the cultural meaning disappears*." (CHE 1)

This evidence confirms that wording functions not merely as a linguistic choice but as a cultural preservation mechanism.

By contrast, extensibility and wording emerged as the most contested indicators, revealing areas that require careful refinement. Extensibility, while validated as a structural strength, carries the risk of uncontrolled expansion that could undermine coherence unless supported by clear governance mechanisms. Similarly, the wording highlighted the tension between cultural authenticity and global accessibility, necessitating a dual-labelling strategy to balance local identity with international interoperability.

From a practical perspective, the evaluation confirmed that taxonomy provides direct, tangible benefits for CHIs. Stakeholders consistently reported that the hierarchical structuring reduced descriptive ambiguity and improved the efficiency of cataloguing tasks, particularly for staff with limited training in metadata standards. By aligning with international KOS standards, the taxonomy also enhanced interoperability, enabling smoother integration into broader heritage information systems and future linked data initiatives.

Equally important, the inclusion of local terminologies and cultural expressions was perceived as a form of heritage legitimacy, giving CHIs and communities a stronger sense of ownership over their collections. Taken together, these outcomes demonstrate that taxonomy is not merely a theoretical construct but a practical tool that improves daily workflows, strengthens interoperability, and ensures that local and national cultural identity is preserved within digital heritage infrastructures.

The comprehensive evaluation across five key indicators demonstrates that the taxonomy has a solid foundation for use across diverse CHIs. The taxonomy not only captures the multidimensional nature of the CH domain, ranging from material artifacts to intangible expressions, but also presents a structurally coherent and semantically resonant classification system. Participants validated its intuitive navigation paths, culturally embedded terminology, and capacity to accommodate new and hybrid entities.

However, the findings also underscore several critical challenges, including the need for adaptive scalability, semantic bridging across overlapping domains, intergenerational comprehension support, and the formulation of robust governance mechanisms to prevent structural fragmentation. In particular, the tension between local authenticity and global interoperability reveals that taxonomy design must balance preserving cultural identity with ensuring technical relevance within wider knowledge networks.

Within the framework of DSR, the taxonomy is not a static artifact but a living system, one that must evolve alongside shifting cultural narratives, technological transformations, and user expectations. Thus, future refinement must be guided by both community participation and institutional alignment to ensure that the taxonomy remains usable, sustainable, and meaningful in an ever-changing CH landscape.

While the evaluation phase provided valuable insights into the usability, cultural resonance, and technical robustness of the OCMHS taxonomy, several methodological limitations must be acknowledged to contextualize the findings. These limitations primarily concern sample size, scope, and generalizability:

a) Sample Size: The evaluation involved a purposively selected but relatively limited number of participants, representing curators, archivists, librarians, registrars, heritage experts, CHI directors, and community users. Although this interdisciplinary composition was sufficient to capture a range of professional and community perspectives, the modest sample size restricts the ability to draw statistically generalizable conclusions. As a result, the usability metrics should be interpreted as indicative trends rather than definitive measures. Expanding future studies with larger and more stratified participant groups across institutional levels, professional experience, and user backgrounds would strengthen the robustness of the evaluation.

b) Scope: The evaluation was conducted within the context of CHIs in Sawahlunto Municipality and focused primarily on scenario-based tasks using the digital repository prototype. While this context-specific focus ensured cultural and institutional relevance, it inevitably limited the evaluation's ecological breadth. Not all potential workflows were tested, and the study did not extend beyond local institutional

boundaries. Broader application across national-level CHIs and more diverse task scenarios would provide a fuller picture of the taxonomy's operational capacity.

c) Generalizability: The evaluation findings are deeply embedded within the socio-cultural and institutional characteristics of the OCMHS, which is itself a distinct form of industrial heritage with strong intangible dimensions. Consequently, the degree to which the taxonomy framework can be directly generalized to other contexts, such as natural heritage sites, religious heritage, or intangible heritage systems in different cultural settings, remains uncertain. Cross-site validation in other UNESCO World Heritage sites contexts is therefore necessary to assess adaptability, scalability, and the balance between contextual specificity and universal applicability.

These limitations suggest that the present evaluation should be regarded as a contextually valid but locally bounded validation exercise. While the taxonomy demonstrates clear promise as a comprehensive, robust, and culturally resonant framework, further studies incorporating larger participant pools, broader institutional scopes, and cross-site comparative analyses will be required to establish its wider applicability and long-term sustainability.

The findings of this study are not intended to produce statistical generalization in the positivist sense. Rather, consistent with case study logic (Yin, 2018) and Design Science Research (Peffers et al., 2007), the contribution lies in analytical generalization. The taxonomy and digital repository prototype were developed in response to empirically identified conditions within the OCMHS ecosystem; however, the underlying design principles extend beyond this single case.

Three elements demonstrate transferability. First, the identified structural tensions—namely the misalignment between universal classification standards and localized cultural semantics, the gap between analog practices and digital transformation, and the persistence of institutional silos—are not unique to OCMHS but are recurrent challenges documented across CHIs globally. Second, the participatory DSR process model, incorporating multi-actor validation and iterative refinement, provides a replicable methodological pathway for developing contextualized taxonomies in other heritage clusters. Third, the hybrid design principle

combining hierarchical structuring, cultural embeddedness, and interoperability mechanisms offers a conceptual template adaptable to diverse CH environments.

However, certain components remain context-dependent. The specific taxonomic categories, vernacular terminologies, and sociohistorical references embedded in the OCMHS taxonomy reflect localized epistemologies and cannot be directly transplanted without contextual adaptation. Therefore, what is generalizable is not the taxonomic content itself, but rather the design logic, the participatory validation approach, and the socio-technical integration framework. Accordingly, this study advances a transferable convergence-oriented taxonomy model for CHIs confronting fragmentation, while acknowledging that successful implementation in other contexts requires domain analysis and stakeholder co-creation tailored to local heritage ecologies.

5.5 Phase F – Communication of Taxonomy

The Communication Phase represents the culminating stage of the DSR methodology, where the validated artifact and its associated insights are systematically disseminated to diverse audiences. As emphasized by Peffers et al. (2007), this phase is critical to ensuring that an artifact is not only theoretically rigorous but also practically accessible and transferable across academic, professional, and community domains. In this study, the Communication Phase is particularly significant, as it extends the value of the developed taxonomy for the CHIs of OCMHS beyond the research process.

The purpose of this phase is twofold. First, it contributes to scholarly discourse by advancing knowledge within the intersecting fields of KO, cultural heritage management, and DSR. By developing a contextualized taxonomy tailored to OCMHS, the study situates its contributions within broader debates on taxonomy design, interoperability, and digital heritage, thereby enhancing conceptual clarity and methodological rigor in KO scholarship.

Second, the Communication Phase targets professional and community stakeholders, including curators, archivists, registrars, librarians, policymakers, and local communities who serve as custodians of collective memory. For these groups, the taxonomy provides a tested and validated framework that improves classification, retrieval, and interpretation of CH resources. Its integration into the digital repository prototype demonstrates that the taxonomy is not merely a theoretical construct but a

practical tool that strengthens institutional workflows, enhances interoperability, and enriches cultural interpretation practices.

In this way, the Communication Phase functions as a bridge between research and practice. It translates theoretical contributions into actionable guidelines, digital tools, and institutional processes that foster long-term adaptability and resilience. Simultaneously, it reinforces the artifact's academic legitimacy by embedding it in peer-reviewed publications, scholarly conferences, and professional reports. This dual orientation ensures that the taxonomy achieves both scholarly visibility and practical impact within CHIs and their communities.

Furthermore, this phase underscores the central principle of DSR that artifacts should not remain confined to research outputs but must be actively transferred to the communities for whom they are designed. The communication of the taxonomy, therefore, closes the iterative loop of design, evaluation, and societal application, ensuring that it emerges not only as a validated KOS but also as a living framework that supports cultural sustainability, institutional innovation, and scholarly advancement.

5.5.1 Communication to Academic Audiences

The dissemination of research outputs to academic audiences was carried out in accordance with established scholarly conventions to ensure visibility, credibility, and intellectual impact. Central to this process was the preparation of peer-reviewed publications, including journal articles and book chapters, submitted to reputable academic outlets. Each publication targeted different dimensions of the research: the methodological framework underpinning taxonomy development, the comparative evaluation of KO practices across CHIs, and the implementation of the digital repository prototype as a model for institutional and digital convergence. By embedding these findings within established discourses in KO and CH studies, the study offered original perspectives that enriched theoretical debates and advanced methodological practices in these fields.

In addition to written dissemination, the study also engaged academic audiences through international webinar presentations. These forums enabled direct dialogue with scholars and professionals from diverse disciplines, including LIS, heritage studies, and the digital humanities. The interactive nature of these events fostered opportunities for intellectual exchange and constructive critique, further validating the taxonomy by

situating the OCMHS case study within broader global discussions on CH management and the application of DSR approaches.

Moreover, these activities ensured that the research outputs reached diverse scholarly audiences and contributed substantively to interdisciplinary dialogue. The combination of peer-reviewed publications and academic presentations reinforced the scientific legitimacy of the taxonomy while positioning it as both a theoretical contribution and a methodological exemplar. Through these academic communication channels, the study strengthened its resonance within the wider fields of LIS, heritage studies, and digital humanities, ensuring long-term scholarly relevance and impact.

5.5.2 Communication to Professional and Community Audiences

Beyond academic dissemination, targeted efforts were made to communicate the research outputs to professional stakeholders and community audiences, thereby ensuring both practical adoption and cultural relevance. For CHI professionals and subject matter experts, the taxonomy and its digital repository prototype were translated into operational resources that could be directly embedded into daily workflows. A quick-reference operational manual was prepared to distil the technical design into accessible and actionable guidance. This manual emphasized key procedures such as classification, metadata assignment, and retrieval, enabling CHI staff to integrate the taxonomy effectively while reducing reliance on specialist expertise.

For broader community stakeholders, dissemination was expanded by providing an open digital preview of the taxonomy prototype. Hosted on the CollectiveAccess (CA) platform, this preview provided dual access: CHI professionals could test its technical functionality, while educators, historians, and community members could engage directly with the taxonomy as a cultural resource. Such accessibility promoted transparency, inclusivity, and local ownership, positioning the prototype not only as a technical tool but also as a participatory platform for cultural engagement.

Through these professional and community-oriented communication channels, the taxonomy moved beyond its immediate research context to become a scalable, shareable knowledge infrastructure. At the professional level, the availability of operational guidelines supported institutional adoption and sustainable implementation. At the community level, the open-access preview fostered cultural inclusivity, ensuring that the taxonomy resonated with the lived realities of its intended users.

Taken together, these activities underscored the study's dual commitment: advancing methodological innovation in taxonomy design while addressing the practical needs of CHI professionals and the cultural priorities of local communities. In doing so, the Communication Phase not only disseminated the artifact outwardly but also consolidated its cultural legitimacy and societal impact, demonstrating how a contextualized taxonomy can bridge scholarly innovation and cultural sustainability.

5.5.3 Communication through Policy and Institutional Network

In addition to academic and community-oriented dissemination, the research outputs were also communicated through policy and institutional networks, ensuring that the taxonomy could inform decision-making processes and support heritage governance at broader scales. This channel of communication was particularly important for bridging the gap between localized CH practices in Sawahlunto Municipality and national and international frameworks for cultural heritage management.

At the national level, presentations and policy briefs were prepared for cultural heritage agencies, municipal authorities, and professional associations within the fields of library, archives, and museums. These communications emphasized the taxonomy's capacity to standardize classification practices, strengthen interoperability across CHIs, and support the objectives of national heritage digitization initiatives. By framing the taxonomy as both a technical infrastructure and a policy-enabling tool, the study positioned it as a practical reference for policymakers seeking to improve CH documentation and governance in Indonesia.

At the international level, the study aligned its communication efforts with CH networks and standards bodies, highlighting the compatibility of the taxonomy with established frameworks such as UNESCO CH domains, metadata, and KOS standards. By engaging with international conferences, professional workshops, and heritage consortia, the research underscored the potential of the taxonomy to serve as a replicable model for other industrial heritage contexts beyond OCMHS. This strategic communication reinforced the artifact's relevance within global discourses on cultural sustainability, digital preservation, and knowledge interoperability.

Moreover, communication through policy and institutional networks elevated the taxonomy from a localized artifact into a strategically recognized knowledge

framework, capable of informing both national CH strategies and international collaborative practices. In this way, the study ensured that the taxonomy was not only academically validated and culturally embedded but also institutionally acknowledged as a reference point for long-term CH management and policy innovation.

Taken together, the three channels of communication, academic dissemination, professional and community engagement, and policy and institutional networking demonstrate the multi-layered strategy adopted to maximize the taxonomy's visibility, legitimacy, and long-term impact. At the academic level, peer-reviewed publications and scholarly forums reinforced the artifact's scientific credibility and positioned it as a methodological contribution to LIS, heritage studies, and digital humanities scholarship. At the professional and community level, operational guidelines and open-access prototypes facilitated practical adoption and participatory engagement, ensuring that the taxonomy resonated with both institutional workflows and local cultural realities. Additionally, through policy and institutional networks, the taxonomy was elevated into a strategic reference point for heritage governance, aligning local practices with national initiatives and international standards.

By weaving together these three strands, the Communication Phase fulfilled the DSR principle that artifacts must extend beyond research outputs to become living frameworks embedded in scholarly, institutional, and community contexts. The OCMHS taxonomy thus emerges not only as a validated KOS but also as a scalable and transferable infrastructure for cultural sustainability, institutional innovation, and global interoperability. This integrated communication approach ensures that the artifact's contributions will endure, shaping both theoretical debates and practical CH management for years to come.

Furthermore, the development and evaluation of the OCMHS taxonomy highlight a dual contribution that addresses both scholarly and institutional needs. Theoretically, the study advances the literature on taxonomy development by embedding participatory validation and iterative stakeholder feedback within the DSR process, thus extending existing models with a culturally sensitive, empirically grounded approach. Practically, the study delivers an artifact that demonstrably enhances cataloguing efficiency, facilitates semantic interoperability, and strengthens cultural representation across diverse CHIs in Sawahlunto Municipality. This dual impact underscores the significance of the taxonomy not simply as a refined technical product, but as a research-through-design contribution that advances KO theory and

addresses the pressing needs of CHIs. The broader implications of these contributions are further synthesized in Chapter 6, where the study's theoretical, methodological, and practical significance is articulated.

5.6 Chapter Summary

The development, demonstration, and evaluation of the taxonomy in this chapter are supported by systematically collected qualitative evidence, including coded interview data, stakeholder validation sessions, task-based demonstrations, and iterative feedback cycles. The findings presented are therefore not conceptual projections but empirically substantiated outcomes of applied design interventions within authentic CHI environments. This evidentiary grounding reinforces the credibility and transferability of the proposed taxonomy framework. This chapter has presented the final stages of the DSR process, including design and development, demonstration, evaluation, and communication. In Phase C (Design and Development), the focus was on translating conceptual requirements into a structured, semantically coherent, and culturally contextualized taxonomy tailored to the OCMHS context. In Phase D (Demonstration), the taxonomy was applied across diverse CHI domains through scenario-based tasks involving both tangible and intangible CH. These demonstrations validated its semantic consistency and its capacity to bridge institutional workflows, while also revealing areas for refinement, such as integrating local terminologies, enabling associative linking, and supporting hybrid CH categories.

The Evaluation Phase (Phase E) systematically assessed the taxonomy's performance against five indicators, including comprehensiveness, robustness, understandability, extensibility, and wording. The findings confirmed its strengths in semantic clarity and structural stability, while also highlighting challenges related to hybrid classification, generational knowledge gaps, and multilingual representation. These insights informed iterative refinements, including the incorporation of contextual glossaries, interface enhancements, and configurable views adapted to institutional needs, thereby reinforcing both robustness and cultural alignment.

Additionally, the Communication Phase (Phase F) ensured the systematic dissemination of outcomes to academic, professional, and community audiences. Scholarly contributions were advanced through peer-reviewed publications and international presentations, while operational guidelines and the deployment of a digital

repository prototype supported professional adoption. At the community level, the open-access preview promoted inclusivity and participatory engagement, reinforcing the taxonomy's role as both a scholarly and cultural resource.

Furthermore, these phases underscore the taxonomy's dual value, serving as both a theoretical contribution to KO scholarship and a practical tool for sustaining OCMHS. By synthesizing all DSR phases, this chapter demonstrated that the taxonomy functions effectively in real-world CHI contexts and resonates across cultural, institutional, and academic dimensions. The next chapter builds upon these findings to present the overall discussion and conclusions of the study.

CHAPTER 6
DISCUSSION AND CONCLUSION

6.1 Chapter Overview

This section provides an integrative interpretation of the findings by explicitly linking the empirical evidence, the iterative design process, and the relevant theoretical foundations. Rather than reiterating the results presented in Chapters 4 and 5, the discussion focuses on explaining what the findings mean and why they are significant within the broader discourse of Knowledge Organization (KO) and Design Science Research (DSR). The synthesis is structured according to the four research objectives, demonstrating how each objective contributes to a coherent theoretical and practical advancement.

The findings related to the first research objective (RO1) reveal that the fragmentation of knowledge organization practices across CHIs in the Sawahlunto Municipality is not merely a technical incompatibility between standards such as MARC, ISAD(G), and museum-based cataloguing practices. Instead, fragmentation reflects deeper epistemic and disciplinary boundaries embedded within institutional traditions. Library prioritize subject access and bibliographic control, archives emphasize provenance and original order, and museums privilege object-centered and narrative-rich documentation.

While each approach is internally coherent, their coexistence without a shared semantic framework results in structural disconnection and limited interoperability. This finding advances existing KO discourse by demonstrating that fragmentation in industrial heritage contexts is fundamentally socio-epistemic rather than purely technical. Consequently, resolving such fragmentation requires more than metadata harmonization; it requires developing an integrative semantic infrastructure capable of bridging disciplinary logics.

In addition, the empirical evidence confirms that intangible cultural heritage (ICH) remains systematically underrepresented within institutional knowledge systems. This underrepresentation is not simply a matter of oversight but is structurally embedded within artifact-centric classification models that privilege tangible objects and documentary records. Existing international KOS standards were originally

developed within bibliographic and archival traditions that do not easily accommodate oral traditions, rituals, social practices, and community-based narratives. The significance of this finding lies in demonstrating that representational silences are often produced by system design rather than by institutional intention. Thus, the inclusion of intangible cultural heritage within the proposed taxonomy represents not merely an expansion of categories but a structural rebalancing of the epistemic priorities within the KO framework.

The second research objective (RO2) identified four critical conditions shaping taxonomy development in the OCMHS context: cultural embeddedness, stakeholder participation, interoperability with international standards, and usability. These factors should not be understood as optional design preferences but as necessary conditions for the maturity and legitimacy of taxonomies in cultural heritage environments.

Cultural embeddedness ensures epistemic inclusivity by recognizing vernacular terminologies and lived practices. Stakeholder participation secures social legitimacy and institutional ownership. Interoperability guarantees technical viability and global visibility. Usability ensures sustainability within everyday professional workflows. The analytical contribution of this study lies in conceptualizing these four elements as interdependent design imperatives rather than independent attributes. Together, they form a socio-technical validation framework that extends traditional models for taxonomy development.

With respect to the third research objective (RO3), the development of the contextualized taxonomy demonstrates the feasibility of constructing a hybrid KO framework that simultaneously satisfies cultural authenticity and international interoperability. The taxonomy functions as a multi-level hierarchical structure that integrates tangible and intangible domains while employing dual-labelling and semantic crosswalk strategies to align local terminologies with international KOS standards. The theoretical implication of this outcome is significant: interoperability does not require homogenization. Instead, it can be achieved through structured semantic negotiation that preserves local meaning while enabling global connectivity. This finding challenges the assumption that universal standards inevitably marginalize local knowledge and instead demonstrates that careful design can reconcile these tensions.

The evaluation phase associated with the fourth research objective (RO4) further confirms that artifact maturity in cultural heritage contexts must be assessed across multiple dimensions. The taxonomy demonstrated structural coherence, improved

classification consistency, and enhanced retrieval clarity during scenario-based tasks. More importantly, it achieved cultural resonance through stakeholder validation and community acceptance. These findings suggest that logical validity alone is insufficient as a criterion for taxonomy evaluation in socially embedded domains. Instead, artifact maturity must encompass structural validity, operational usability, and cultural legitimacy. This multidimensional evaluation framework contributes to DSR scholarship by extending artifact evaluation beyond technical functionality to encompass social and epistemic acceptance.

Taken together, the integrative discussion demonstrates that the findings of this study are not isolated observations but components of a coherent theoretical advancement. Fragmentation in CHIs is revealed as an epistemic disconnection; the exclusion of intangible heritage is shown to be structurally embedded; taxonomy maturity is reframed as socio-technical legitimacy; interoperability is reconceptualized as negotiated alignment; and evaluation is expanded into a multidimensional validation process. Through these interpretations, the study moves beyond descriptive analysis. It positions its findings as substantive contributions to the evolving discourse of Knowledge Organization and Design Science Research within cultural heritage environments.

6.2 Limitations, Challenges, and Opportunities in Knowledge Organization Reform

This section clarifies the analytical distinction between limitations, challenges, and opportunities identified throughout the study. While these terms are often used interchangeably, they serve different conceptual functions in interpreting the findings. Limitations refer to structural deficiencies embedded within existing KO systems. Challenges denote tensions or constraints encountered during the design and implementation of reform. Opportunities indicate enabling conditions that make transformation feasible. Distinguishing these categories provides greater analytical precision and strengthens the interpretation of the study’s contribution.

6.2.1 Structural Limitations in Existing Knowledge Organization Practices

The limitations identified in the OCMHS context are structural. They arise from entrenched institutional traditions and legacy systems rather than from isolated operational weaknesses. The most critical limitation concerns the systematic underrepresentation of intangible cultural heritage. Existing KO practices across library, archives, and museums remain predominantly artifact-centric. Bibliographic systems privilege published materials, archival standards prioritize documentary provenance, and museum cataloguing centers on tangible objects. As a result, oral traditions, rituals, mining-related practices, and community narratives are rarely integrated into formal knowledge systems.

This limitation is significant because it reveals how classification systems can inadvertently shape cultural memory. When intangible elements are excluded from institutional documentation, they become invisible within searchable and preservable infrastructures. The consequence is not merely descriptive imbalance but epistemic marginalization. The findings therefore demonstrate that limitations in KO are not purely technical; they shape which knowledge is formally recognized and sustained.

A second structural limitation is the absence of a shared semantic framework across CHIs. Each institution relies on internally coherent but externally disconnected systems. Library employ MARC and DDC; archives operate under ISAD(G); museums use object-centered vocabularies. While these systems are professionally valid within their own domains, they do not provide cross-institutional semantic alignment. The absence of a unifying taxonomy restricts interoperability and inhibits integrated heritage narratives. This fragmentation limits collaborative interpretation, reduces discoverability, and weakens the collective visibility of OCMHS within broader heritage infrastructures.

6.2.2 Socio-Technical Challenges in Taxonomy Development

Beyond structural limitations, the study encountered several challenges during the development and implementation of the contextualized taxonomy. Unlike limitations, which describe existing deficiencies, challenges refer to tensions that must be negotiated during reform.

The most prominent challenge concerns the balance between local authenticity and international interoperability. CHI professionals emphasized the need to align with international KOS standards to ensure global visibility and technical integration. However, stakeholders expressed concern that excessive reliance on external vocabularies might dilute or replace vernacular terms central to OCMHS's identity. This tension reflects a broader debate in KO theory between universality and contextual specificity.

The study addressed this challenge through dual-labelling and semantic crosswalk strategies. Nevertheless, the negotiation itself underscores that the development of taxonomy in cultural heritage contexts is inherently political and epistemic. Decisions about labeling and categorization are not neutral; they reflect choices about representation and authority. The challenge, therefore, is not only technical compatibility but epistemic balance.

A second challenge relates to institutional capacity and workflow adaptation. Even a well-designed taxonomy risks rejection if it increases cataloguing complexity or disrupts established routines. CHI professionals repeatedly stressed that usability determines adoption. This underscores a central insight of the study: technical sophistication must be matched by operational feasibility. Taxonomy reform must function within real-world constraints of staffing, time, and technical expertise. The challenge lies in ensuring that reform enhances efficiency rather than imposing additional burdens.

6.2.3 Transformative Opportunities for Integrated Knowledge Infrastructure

Despite these limitations and challenges, the study identified substantial opportunities that make KO reform viable within OCMHS. Opportunities differ from challenges in that they represent enabling conditions rather than constraints.

First, there is strong institutional awareness of fragmentation and a willingness among CHI professionals to pursue integration. Stakeholders acknowledged the shortcomings of existing systems and demonstrated openness to collaborative solutions. This institutional readiness significantly increases the feasibility of implementing a shared taxonomy.

Second, OCMHS possesses rich cultural resources, including well-documented industrial heritage and vibrant community traditions. These resources provide a strong

empirical foundation for building a contextualized taxonomy. Rather than constructing categories abstractly, the taxonomy could be grounded in lived practices and documented heritage assets. This depth of cultural material supports sustainable refinement and expansion.

Third, the presence of a digital repository prototype provides technological infrastructure for implementation. The integration of the taxonomy within the CollectiveAccess platform demonstrates that the solution is not merely conceptual but operationally feasible. The existence of a working digital environment transforms theoretical design into practical application, reinforcing institutional confidence.

Together, these opportunities indicate that reform is not aspirational but achievable. Fragmentation, while entrenched, exists alongside institutional motivation, cultural richness, and technological readiness. The convergence of these enabling conditions strengthens the study's conclusion that contextualized taxonomy development is both necessary and feasible within the OCMHS environment.

6.3 Discussion of Findings in Relation to Research Objectives

This section synthesizes the principal findings in direct relation to the four research objectives. Rather than restating the results presented in earlier chapters, the discussion interprets the findings, explains why they matter, and how they contribute to knowledge organization (KO) theory and Design Science Research (DSR). The aim is to demonstrate coherence between empirical evidence, design processes, and theoretical positioning.

6.3.1 Addressing Fragmented Knowledge Organization (RO1)

The first research objective sought to explore existing KO processes and challenges within CHIs of the Sawahlunto Municipality. The findings confirmed that fragmentation was not accidental but structurally embedded in institutional traditions. Library, archives, and museums operated under distinct descriptive paradigms, each professionally legitimate yet semantically isolated.

The significance of this finding lies in reframing fragmentation as a systemic condition rather than an operational flaw. The absence of a shared semantic infrastructure prevented the formation of an integrated narrative of industrial heritage.

Moreover, the marginalization of intangible cultural heritage revealed that fragmentation also operates at a representational level. When institutions privilege documentary and object-centered logics, cultural practices become peripheral to formal knowledge systems.

Theoretically, this finding reinforces and extends domain-analytic critiques of disciplinary silos in KO. However, it contributes a contextual refinement by demonstrating that in industrial heritage environments—where tangible and intangible elements are inherently intertwined—fragmentation has amplified consequences. It does not merely affect retrieval efficiency; it shapes the construction of collective memory. Thus, RO1 establishes the intellectual necessity of a contextualized integrative framework.

6.3.2 Identifying Critical Design Factors (RO2)

The second research objective aimed to identify critical factors shaping taxonomy development in the OCMHS context. The findings converged on four interdependent principles, including cultural embeddedness, stakeholder participation, interoperability with international standards, and usability.

The analytical importance of these factors lies in their interdependence. Cultural embeddedness without interoperability risks isolation; interoperability without cultural grounding risks homogenization. Participation without usability risks, symbolic inclusion without practical adoption. These principles, therefore, function not as isolated design preferences but as structural conditions for artifact maturity in culturally embedded environments.

This insight advances KO theory by positioning taxonomy not solely as a classificatory structure but as a socio-technical mediator. It also extends taxonomy development frameworks by demonstrating that participatory validation and workflow feasibility are not optional enhancements but core maturity conditions. The contribution of RO2, therefore, is conceptual: it defines the necessary conditions under which a taxonomy can be both technically robust and socially legitimate.

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6.3.3 Evaluating the Implemented Taxonomy (RO3 and RO4)

The third and fourth research objectives concerned the design, development, and evaluation of the contextualized taxonomy. The evaluation findings demonstrate that the implemented solution achieved effectiveness across three dimensions: structural coherence, operational usability, and cultural resonance.

First, structurally, the taxonomy provided a unified hierarchical framework that reduced semantic ambiguity and improved classification consistency. Second, operationally, usability testing confirmed that CHI professionals could integrate the taxonomy into daily workflows with clarity and reduced hesitation. Third, culturally, the inclusion of vernacular terminology and intangible categories was positively validated by community participants.

The analytical implication of these findings is that artifact quality in DSR must be assessed across multiple dimensions. A taxonomy cannot be considered successful solely because it is logically sound or interoperable. It must demonstrate functional viability and stakeholder acceptance. The study, therefore, reframes artifact evaluation in KO as the convergence of structural validity, empirical usability, and cultural legitimacy.

This multidimensional evaluation contributes to DSR discourse by operationalizing participatory validation as an artifact-ending condition. Iteration was not merely a technical refinement but an epistemic negotiation between institutional standards and community semantics. The implemented solution thus represents a mature DSR artifact because it is empirically grounded, socially embedded, and technically interoperable.

Taken together, the discussion demonstrates a coherent progression across objectives. RO1 established the structural and representational fragmentation of KO practices. RO2 identified the non-negotiable conditions required to address this fragmentation. RO3 translated these conditions into a contextualized taxonomy design. RO4 empirically validated the artifact in institutional and community settings.

The broader implication is that taxonomy development in cultural heritage contexts must reconcile three dialectics, including 1) Universality and locality; 2) Technical rigor and practical usability; and 3) Institutional standards and community epistemologies. By resolving these dialectics through iterative and participatory design, the study advances both KO scholarship and DSR methodology. The findings confirm

that knowledge organization reform in heritage contexts is not purely classificatory; it is infrastructural, cultural, and institutional.

6.4 Contributions of the Study

This section articulates the principal contributions of the study in a focused and integrative manner. Rather than reiterating empirical findings, the emphasis here is placed on explaining how the research advances theory, methodology, and professional practice within knowledge organization (KO) and cultural heritage (CH) studies. The contributions are structured across three dimensions, including theoretical, methodological, and practical, as shown in Table 6.1.

Table 6.1
Alignment of Research Objectives, Key Interpretations, and Contributions

Research Objective (RO)	Core Interpretive Insight	Theoretical Contribution	Methodological Contribution	Practical Significance
RO1: Explore current KO processes and challenges within CHIs	Fragmentation is socio-epistemic, not merely technical; ICH exclusion is structurally embedded in artifact-centric KOS.	Extends KO theory by reframing fragmentation as epistemic disconnection in hybrid industrial heritage contexts. Demonstrates that representational silences are system-produced.	Validates the use of embedded multiple case studies as a rigorous approach to diagnosing cross-institutional KO fragmentation.	Establishes the necessity of an integrative semantic infrastructure to bridge institutional silos and restore representational balance.
RO2: Identify critical factors shaping taxonomy development	Cultural embeddedness, participation, interoperability, and usability function as interdependent maturity conditions.	Reconceptualizes the legitimacy of taxonomy as socio-technical rather than purely structural—advances in artifact maturity theory in KO.	Extends taxonomy development models (Nickerson et al., 2013; Kundisch et al., 2021) by integrating participatory validation and workflow feasibility as core design imperatives.	Provides a structured design framework for CHIs to balance local authenticity with global interoperability.
RO3: Design and develop a contextualized taxonomy for OCMHS	Interoperability can be achieved through negotiated semantic alignment (dual-labelling), not homogenization.	Challenges the assumption that universal standards marginalize local knowledge; proposes hybrid KO frameworks.	Demonstrates operationalization of DSR in culturally embedded domains through iterative co-constructive refinement.	Delivers a functional, multi-level taxonomy integrating tangible and intangible CH domains within a digital repository prototype.
RO4: Evaluate the taxonomy in practice	Artifact maturity requires structural validity, usability, and cultural legitimacy.	Expands DSR evaluation discourse by positioning participatory validation	Integrates scenario-based testing and concurrent verbal	Confirms operational feasibility, institutional

	and usability as artifact-ending conditions.	protocol analysis into taxonomy evaluation methodology.	adoption potential, and cross-institutional semantic alignment.

6.4.1 Theoretical Contributions

The study advances KO theory by reconceptualizing taxonomy as a socio-technical and culturally embedded infrastructure rather than a neutral classificatory tool. Traditional KO frameworks have prioritized structural coherence, universality, and compliance with international standards. While these remain essential, the findings demonstrate that in cultural heritage contexts—particularly industrial heritage environments—structural validity alone is insufficient. Taxonomies must also embed vernacular semantics, intangible practices, and community epistemologies to achieve cultural legitimacy.

This theoretical contribution lies in redefining artifact maturity within KO. The study proposes that a taxonomy is considered mature only when three conditions converge, including logical coherence, empirical usability, and cultural acceptance. This multidimensional model extends existing taxonomy evaluation frameworks by incorporating participatory validation and contextual resonance as core criteria rather than peripheral considerations.

Furthermore, the study contributes to DSR theory by demonstrating that iterative refinement in culturally embedded systems is epistemic rather than purely structural. Each iteration represented negotiation between institutional standards and local knowledge systems. By embedding stakeholder validation within each design cycle, the research broadens the understanding of iteration as co-constructive knowledge development. This extends DSR discourse beyond technical optimization toward socio-technical integration. In sum, the theoretical contribution of this study is twofold: it advances KO by embedding cultural epistemology within taxonomy design, and it refines DSR by operationalizing participatory validation as a criterion of artifact maturity.

6.4.2 Methodological Contributions

Methodologically, the study demonstrates how DSR can be rigorously applied in complex, culturally embedded environments through integration with an embedded multiple-case study strategy. By grounding artifact design in empirical exploration across library archives and museums, the research addresses longstanding critiques that DSR may lack contextual depth.

The methodological innovation lies in three areas. First, it provides a structured roadmap for contextualized taxonomy development in CHIs, aligning problem identification, design principles, iterative refinement, and empirical validation within a coherent DSR framework. Second, it adapts usability evaluation techniques—such as focus group discussions, scenario-based tasks, and concurrent verbal protocol analysis—to evaluate taxonomic artifacts. This expands the methodological toolkit available to KO researchers by demonstrating that user-centered evaluation can be systematically embedded in taxonomy validation. Third, the study clarifies how qualitative evaluation in DSR can generate transferable design knowledge rather than remaining artifact-bound. By addressing concerns regarding contextual grounding, evaluation rigor, and knowledge contribution in DSR, the research strengthens the methodological legitimacy of applying DSR in cultural heritage domains.

6.4.3 Practical Contributions

In practice, the study presents a functional, contextualized taxonomy and a digital repository prototype that serve as a unified semantic framework for OCMHS CHIs. The implemented solution addresses fragmentation, improves cross-institutional alignment, and enhances representational inclusivity by formally incorporating intangible cultural heritage into knowledge systems.

The practical significance extends beyond OCMHS. The dual-labelling and semantic crosswalk strategy provides a replicable model for other heritage sites seeking to reconcile local authenticity with international interoperability. By demonstrating operational feasibility within a digital repository environment, the study moves beyond conceptual recommendation to practical implementation.

Moreover, the participatory development process fosters institutional ownership and increases the likelihood of long-term adoption. This illustrates that sustainable KO

reform depends not only on technical robustness but also on stakeholder legitimacy and workflow integration. Thus, the practical contribution of the study lies in offering both a tangible artifact and a transferable design model capable of supporting sustainable, inclusive, and interoperable heritage management.

Collectively, these contributions establish the doctoral significance of the study. The research does not merely document fragmentation or propose a classificatory scheme; it provides a theoretically grounded, methodologically rigorous, and empirically validated model for developing contextualized taxonomies in cultural heritage institutions.

By integrating structural validity, usability, and cultural legitimacy within a unified framework, the study advances knowledge organization beyond technical classification toward socio-technical infrastructure design. In doing so, it strengthens both KO scholarship and DSR methodology while offering actionable solutions for heritage institutions operating in complex, culturally sensitive environments.

6.5 Delimitations, Limitations, and Recommendations for Future Research

6.5.1 Delimitations

This study was conducted within a specific set of boundaries deliberately established to ensure methodological focus and coherence. These delimitations reflect conscious choices made by the researcher in scoping the inquiry, thereby shaping the direction and applicability of the findings. First, the study was geographically delimited to CHIs within the Sawahlunto Municipality, which represents Area A of the OCMHS. This core zone encompasses the principal industrial and social sites recognized by UNESCO for their outstanding universal value (OUV). While other areas associated with OCMHS are located beyond Sawahlunto Municipality, the research was restricted to this primary zone to capture the most representative and institutionally concentrated context for CH management. As Yin (2018) emphasizes, such scoping is a necessary feature of case study research to ensure the depth of inquiry within clearly defined boundaries.

Second, the study used DSR as the guiding methodological framework, thereby excluding alternative approaches, such as grounded theory or ethnographic methods, for developing the taxonomy. This decision was made to align the research with its

central aim of producing a purposeful artifact: a contextualized taxonomy, developed through a structured, iterative design process (Peffers et al., 2007; Gregor & Hevner, 2013). While grounded theory might have offered insights into emergent conceptual categories, the DSR approach was more suited to the study's problem-solving orientation, enabling the systematic design, evaluation, and refinement of the taxonomy as an artifact.

Third, the scope of the study was restricted to the design and evaluation of the taxonomy as an artifact, rather than full-scale system deployment across institutional infrastructures. The taxonomy was implemented in a digital repository prototype as a proof of concept. However, long-term integration into institutional workflows, governance frameworks, and national heritage networks was beyond the scope of this study. Such a focus ensured that the study remained feasible within its temporal and resource constraints while still generating a rigorously designed and validated artifact. As Gregor and Hevner (2013) argue, the primary contribution of DSR lies in the development and evaluation of artifacts rather than in their institutional adoption, which typically requires broader organizational and policy-level engagement.

These delimitations were necessary to maintain clarity, methodological rigor, and feasibility in conducting the research. However, they also point to potential avenues for future studies that may expand the geographic coverage, apply complementary methodological approaches, or pursue large-scale deployment of the taxonomy within wider heritage infrastructures.

6.5.2 Limitations

While this study provides important contributions to the field of KO and CH studies, it is not without limitations. These limitations primarily relate to methodological choices, contextual boundaries, and participant representation, and they should be acknowledged when interpreting the findings and their broader applicability.

First, the evaluation of the taxonomy was primarily qualitative, relying on FGDs, concurrent verbal protocol analysis, and scenario-based usability testing to validate its clarity, usability, and cultural resonance. Although these approaches provided rich, contextually grounded insights, the study used only limited quantitative measures, such as task success rate or time-on-task, due to resource and time constraints. As Creswell (2014) notes, qualitative methods are effective for exploring

processes, meanings, and experiences, but they are less suited for producing generalizable statistical evidence. The absence of comprehensive quantitative usability metrics limits the ability to compare the taxonomy's performance with other KOSs systematically.

Second, the study focused on a single heritage cluster, namely Area A of the OCMHS, in Sawahlunto Municipality. While this area is significant as the UNESCO-designated core zone, the findings are context-dependent. They may not be directly generalizable to other World Heritage Site contexts with different socio-cultural characteristics. As Yin (2018) emphasizes in case study methodology, the strength of this approach lies in producing in-depth insights within bounded contexts. However, caution is required when extending findings beyond the immediate setting. The contextual specificity of OCMHS means that adaptation would be necessary for application in broader or different CH domains.

Third, although the study emphasized participatory engagement and achieved strong stakeholder involvement from CHI professionals or subject matter experts, namely curators, librarians, archivists, registrars, and CH heritage experts, the broader community representation was limited, particularly among groups such as youth, educators, tourists, and other end-user communities. These groups are important stakeholders in the consumption and interpretation of digital heritage, but were not fully represented due to time and logistical constraints during data collection. As Chaudhry and Tan (2005), Dahlgren and Hansson (2020), Hendrawan et al. (2025b), and Ledinek-Lozej (2019) argue, inclusive participation is critical in CH initiatives to ensure representational equity and sustainability. The absence of these perspectives may have limited the inclusivity of the taxonomy's validation process, although the strong involvement of institutional stakeholders provided a reliable foundation for taxonomy development.

In acknowledging these limitations, the study maintains transparency in its scope and methodology. At the same time, these boundaries highlight opportunities for future research to incorporate mixed-method evaluations with stronger quantitative components, extend the application of the taxonomy to other heritage clusters or sites, and broaden community participation to capture more diverse user perspectives.

6.5.3 Recommendations for Future Research

Considering the delimitations and limitations identified in this study, several avenues for future research are recommended to strengthen, expand, and further validate the contributions of the contextualized taxonomy developed for the OCMHS CHI. These recommendations emphasize integrating additional methodological approaches, broadening application across contexts, and adopting emerging technologies to enhance the sustainability and scalability of taxonomy-based solutions for CHIs.

First, it is recommended to extend the evaluation of the taxonomy using quantitative usability metrics and comparative retrieval studies. While this study employed qualitative methods such as focus group discussions, concurrent verbal protocol analysis, and scenario-based testing, future research could incorporate quantitative indicators such as task success rate, error rate, time-on-task, and satisfaction scores to provide a more robust and systematic assessment of taxonomy performance. Comparative studies between the developed taxonomy and existing classification or metadata schemes could also highlight specific areas of improvement and further validate its effectiveness. Usability evaluations that combine qualitative and quantitative measures yield more comprehensive insights into system or artifact performance and user experience.

Second, the contextualized taxonomy developed for OCMHS also offers concrete opportunities for expanding to other UNESCO World Heritage sites. The dual-labeling strategy (using vernacular terms alongside international KOS standards) provides a replicable model for balancing cultural specificity with international compatibility. This approach can be adapted to various heritage contexts, whether industrial, natural, or intangible, allowing each site to preserve authenticity while enabling cross-site comparisons. Additionally, the participatory and iterative development process integrating expert knowledge, community input, and usability testing can serve as a methodological template for other UNESCO World Heritage sites. This ensures that taxonomies stay sensitive to their context while sharing best practices.

Furthermore, the digital infrastructure demonstrated in CollectiveAccess can be customized for other sites, facilitating cost-effective implementation and collaboration across institutions. This paves the way for creating interconnected networks of heritage taxonomies, linking OCMHS with other world heritage digital repositories. Moreover, the model aligns with UNESCO's global priorities of sustainability, inclusivity, and

digital access. By scaling this framework, UNESCO World Heritage sites could collectively contribute to a global heritage knowledge graph, supporting richer interpretation, comparative research, and long-term preservation across cultural and geographic boundaries.

Third, the study can significantly strengthen the development and sustainability of contextualized taxonomies for CHIs by leveraging emerging digital technologies, particularly artificial intelligence (AI), linked data, and semantic web frameworks. These technologies not only extend the methodological capabilities for constructing taxonomies but also ensure adaptability, interoperability, and global visibility.

AI, especially machine learning and natural language processing (NLP), can support semi-automated taxonomy refinement. NLP-based term extraction can identify candidate concepts from archival documents, oral history transcripts, or museum catalogues, thereby reducing reliance on manual indexing. Clustering and topic modeling techniques can suggest new categories or relationships between terms that may not be immediately visible to human experts. Moreover, AI can facilitate multilingual alignment, ensuring that vernacular or indigenous terms are appropriately linked to international KOS standards. This dynamic enrichment process would transform the taxonomy into a living framework that evolves with cultural change and community usage.

The application of linked open data (LOD) principles offers opportunities to embed contextualized taxonomies into broader heritage information ecosystems. Publishing taxonomy terms as LOD and mapping them to existing international KOS standards would enable semantic interoperability across institutions and regions. This would allow OCMHS and similar heritage sites to connect their unique narratives to global digital heritage networks, thereby increasing discoverability, facilitating cross-institutional collaboration, and enhancing cultural exchange.

Furthermore, Semantic Web standards such as the Simple Knowledge Organization System (SKOS), the Resource Description Framework (RDF), and the Web Ontology Language (OWL) can formalize taxonomic structures, enabling more precise representation of hierarchical and associative relationships. Encoding the taxonomy in SKOS, for example, would allow for multilingual labeling, inferencing, and richer query capabilities through SPARQL protocol and RDF query language (SPARQL) endpoints. This would transform the taxonomy from a static classification system into a flexible semantic infrastructure that supports advanced retrieval, resource

discovery, and long-term digital preservation within global knowledge graphs.

6.6 Conclusion

This study set out to address a persistent, structurally embedded problem within the cultural heritage institutions (CHIs) of the Sawahlunto Municipality, including fragmented knowledge-organization practices, limited interoperability, and the systematic underrepresentation of intangible cultural heritage. Using the Design Science Research (DSR) methodology, the research was designed, developed, and sempirically validated a contextualized taxonomy that serves as a unified semantic infrastructure across library, archives, and museums within the OCMHS.

The principal conclusion of this study is that the development of taxonomy in cultural heritage contexts is not merely a classificatory exercise but a socio-technical intervention. Fragmentation in OCMHS was not simply the result of incompatible standards; it reflected deeper epistemic divides between institutional traditions and community knowledge. By embedding cultural semantics, vernacular terminology, and intangible practices within a structurally coherent, interoperable framework, the study demonstrates that it is possible to reconcile local authenticity with international standardization without subordinating one to the other.

The research further concludes that artifact maturity in taxonomy design must be understood in a multidimensional way. Structural coherence and compliance with international KOS standards are necessary but insufficient conditions. A taxonomy achieves maturity only when it demonstrates empirical usability within institutional workflows and cultural legitimacy among stakeholders. By operationalizing participatory validation and usability testing as explicit evaluation criteria, this study extends both KO and DSR discourse, positioning evaluation as a convergence of logical validity, functional viability, and social embeddedness.

Another central conclusion concerns iteration. The iterative cycles of design were not limited to incremental structural refinement; they functioned as processes of epistemic negotiation between global standards and local meanings. This co-constructive dynamic affirms that in culturally embedded systems, iteration must integrate stakeholder knowledge rather than operate solely as technical optimization. In this sense, the study contributes to refining DSR methodology for application in complex heritage environments.

The implemented solution, validated through scenario-based testing and participatory evaluation, proved effective in enhancing classification clarity, supporting cross-institutional alignment, and improving representational inclusivity. While future quantitative benchmarking and broader deployment would strengthen comparative validation, the evidence confirms that the taxonomy is structurally robust, operationally feasible, interoperable with international frameworks, and contextually legitimate within OCMHS.

The accumulated wisdom of this research lies in demonstrating that knowledge organization reform in heritage contexts requires balancing rigor with relevance, universality with locality, and technical precision with lived cultural experience. Taxonomies must function simultaneously as semantic systems, institutional tools, and cultural mediators. When these dimensions converge, taxonomy transcends classification and becomes an infrastructure that supports preservation, interpretation, collaboration, and collective memory.

In conclusion, this dissertation advances knowledge organization scholarship by proposing a culturally embedded, participatory, and interoperable model of taxonomy development. It strengthens DSR methodology by integrating contextual grounding, multidimensional evaluation, and epistemic iteration. Practically, it provides CHIs in Sawahlunto Municipality with a sustainable semantic framework and a proof-of-concept digital implementation that can serve as a transferable model for other heritage contexts facing similar fragmentation and representational challenges.

Through these contributions, the study affirms the vital role of knowledge organization in safeguarding cultural heritage. It demonstrates that carefully designed taxonomies can serve not only as tools of classification but as mechanisms of cultural continuity and institutional integration.

6.7 Chapter Summary

This chapter has provided a comprehensive synthesis of the findings of the study, situating them within the framework of the research objectives and questions. It demonstrated how the study systematically addressed the fragmentation of KO practices across CHIs in the Area A OCMHS (Sawahlunto Municipality) and how the developed taxonomy addressed these challenges. The discussion highlighted that the taxonomy not only provided a unified semantic framework for institutional use but also embedded

local cultural narratives, thereby reinforcing both interoperability and cultural authenticity.

The chapter further elaborated on the contributions of the study at three distinct levels. From a theoretical perspective, it extended KO scholarship by positioning taxonomies as both technical artifacts and cultural constructs. From a methodological perspective, it refined the application of DSR in the CH domain by incorporating participatory validation and usability testing as evaluative criteria. From a practical perspective, it delivered a functional, scalable taxonomy artifact integrated into a digital repository prototype, thereby offering CHIs in Sawahlunto Municipality a sustainable solution for collection management and enhanced access to heritage information.

Additionally, the chapter acknowledged the delimitations and limitations of the research, including its geographic focus, methodological scope, and participant representation, while proposing recommendations for future studies. These included expanding evaluation through quantitative usability metrics, testing the framework in other UNESCO World Heritage Site contexts, exploring semantic web integration, and leveraging artificial intelligence to refine the taxonomy. Such recommendations provide pathways for extending the contributions of this thesis beyond its immediate context.

Moreover, this chapter reaffirmed the central contribution of the study, including the development and evaluation of a contextualized, interoperable, and culturally embedded taxonomy for OCMHS CHIs. This artifact represents a significant advancement in KO theory, methodology, and practice, offering both a scholarly framework and a practical infrastructure for the CH context. By bridging local heritage knowledge with the global CH network, the study underscores the potential of taxonomy design to enhance access to heritage information and institutional collaboration, community engagement, and the long-term preservation of collective memory.

REFERENCES

Acierno, M., Cursi, S., Simeone, D., & Fiorani, D. (2017). Architectural heritage knowledge modelling: An ontology-based framework for conservation process. *Journal of Cultural Heritage*, *24*, 124–133.

Adler, M. (2017). The (De-) Universalization of the United States: Inscribing Ma¯ori History in the Library of Congress Classification. In Andersen, J., & Skouvig, L. (Eds.), *The Organization of Knowledge: Caught Between Global Structures and Local Meaning (pp. 33–50).* UK: Emerald Publishing Limited.

Agathos, M., Tsiouprou, K., Kalogeros, E. & Gergatsoulis, M. (2025). Modeling styles of vernacular architecture using CIDOC CRM. *In J. Doe & A. Smith (Ed.), Intelligence and equity: Shaping the future of knowledge, pp. 203–217*. USA: Springer.

Alivizatou, M. (2021). *Intangible heritage and Participation: Encounters with Safeguarding practices*. UK: Routledge.

Altenhöner, R., Blümel, I., Boehm, F., Bove, J., Bicher, K., Bracht, C., ... & Wiermann, B. (2020). NFDI4Culture-Consortium for research data on material and immaterial cultural heritage. *Research Ideas and Outcomes*, (6).

Amiri, S. M. H. (2025). The evolution of book classification: Principles, systems, and practices. *Academia*, 2025.

Aria, M., & Cuccurullo, C. (2017). Bibliometrix: An R-tool for comprehensive science mapping analysis. *Journal of Informetrics 11*(4): 959–975.

Asoka, A, Samry, W., Zulqayyim, & Saputra, Y. (2016). *Sawahlunto Dulu, Kini, dan Esok: Menjadi Kota Wisata Tambang yang Berbudaya*. Padang: Minangkabau Press.

Barnum, C. M. (2011). *Usability testing essentials: ready, set...test!* USA: Morgan Kaufmann.

Biagetti, M. T. (2021). Ontologies as knowledge organization systems. *Knowledge Organization* 48, no. 2: 152–176.

Binding, C., & Tudhope, D. (2016). Improving interoperability using vocabulary-linked data. *International Journal on Digital Libraries 17*, 5–21.

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, *3*(2), 77–101.

Broughton, V. (2015). *Essential classification*. UK: Facet Publishing.

Camagni, R., Capello, R., Cerisola, S., & Panzera, E. (2020). The Cultural Heritage-Territorial Capital nexus: theory and empirics/Il nesso tra Patrimonio Culturale e Capitale Territoriale: teoria ed evidenza empirica. *Il capitale culturale. Studies on the Value of Cultural Heritage*, 33–59.

Chairu, T., Hamdani, M., Suryandi, A., & Muzakir, M. A. I. (2025). Cultural Advancement Strategy: Realities, Paradigms, and Policy Orientations in Managing UNESCO Cultural Heritage. *The Journal of Academic Science*, *2*(8), 2020-2030.

Chakrabarti, M., & Chakrabarti, G. (2025). Intangible Cultural Heritage in a Globalized World. *Intangible Cultural Heritage in a Globalized World*, *5*, 349.

Chansanam, W., Nguyen, L. T., Li, C., & Guan, C. K. S. (2025). Semantic Knowledge Graphs for Intercultural and Ethnographic Diversity in the Greater Mekong Subregion. *Journal of Intercultural Communication*, *25*(3), 11–24.

Chaudhry, A. S., & Tan, P. J. (2005). Enhancing access to digital information resources on heritage: A case of development of a taxonomy at the integrated museum and archives system in Singapore. *Journal of Documentation, 61*(6), 751–776.

Chen, S. S. J. (2021). Methodological considerations for developing the Art & Architecture Thesaurus in the Chinese language and its applications. *Knowledge Organization, 48*(4), 267–281.

Chiodi, C. A. M., De Lucia, R., Giunchi, C., & Molinari, P. (2025). Looking for a Balance Between Memories, Patrimonialization, and Tourism: Sustainable Approaches to Industrial Heritage Regeneration in Northwestern Italy. *Sustainability*, *17*(3), 905.

Corujo, L., Revez, J., da Silva, C. G., & de Macedo, L. A. (2025). Preservation and Digital Repositories: Connections, Possibilities, and Needs. In Holland, B. J. (Ed.), *Handbook of Trends and Innovations Concerning Library and Information Science: A Multidisciplinary Approach, (111–134).*

Costa, E., Soares, A. L., & de Sousa, J. P. (2016). Situating case studies within the design science research paradigm: An instantiation for collaborative networks. In Afsarmanesh, H., Camarinha-Matos, L. M., & Soares, A. L., (Eds.), *Collaboration in a Hyperconnected World: 17th IFIP WG 5.5 Working Conference on Virtual Enterprises, PRO-VE 2016, Porto, Portugal, October 3-5, 2016 (pp. 531–544)*. Switzerland: Springer.

Creswell, J. W. (2014). *Research design: Quantitative, Qualitative, and Mixed methods*

approaches, 4th ed. USA: Sage.

Crockett, M. (2015). *The no-nonsense guide to archives and recordkeeping*. UK: Facet Publishing.

Currás, E. (2010). *Ontologies, taxonomies, and thesauri in systems science and systematics*. UK: Chandos Publishing.

Dahlgren, A., & Hansson, K. (2020). The Diversity Paradox: Conflicting Demands on Metadata Production in Cultural Heritage Collections. *Digital Culture & Society*, *6*(2), 239–256.

Derre, B., De Bruyckere, P., & Weggeman, M. (2025). The Entrepreneurial Educational Method: A DSR Artifact to Support Educators in Designing Entrepreneurial Education. In Derre, B. & Baggen, Y. (Eds.), *Empowering the Next Generation of Entrepreneurial Change Agents: A Design Science Approach to Transforming Entrepreneurial Education (pp. 101–152).* Switzerland: Springer.

Di Giulio, R., Boeri, A., Longo, D., Gianfrate, V., Boulanger, S. O., & Mariotti, C. (2021). ICTs for accessing, understanding, and safeguarding cultural heritage: the experience of INCEPTION and ROCK H2020 projects. *International Journal of Architectural Heritage*, *15*(6), 825–843.

Douet, J. (2016). *Industrial heritage re-tooled: The TICCIH guide to industrial heritage conservation*. UK: Routledge.

Drechsler, A., & Hevner, A. R. (2018). Utilizing, producing, and contributing design knowledge in DSR projects. In Chatterjee, S., Dutta, K., & Sundarraj, R. P. (Eds.), *International Conference on Design Science Research in Information Systems and Technology (pp. 82–97).* Switzerland: Springer.

Dresch, A., Lacerda, D. P., & Miguel, P. A. C. (2015). A distinctive analysis of case study, action research, and design science research. *Revista de Administração de Empresas, 17*(5), 1116–1133.

Duff, W., Carter, J., Cherry, J., MacNeil, H., & Howarth, L. (2013). From coexistence to convergence: Studying partnerships and collaboration among LAMs. *Information Research, 18*(3), 588.

Dunn, S., Earl, G., Foka, A., Wooton, W. (2019). Spatial Narratives in Museums and Online: The Birth of the Digital Object Itinerary. In Giannini, T., Bowen, J. (Eds.), *Museums and Digital Culture: Springer Series on Cultural Computing (pp. 253–271).* Switzerland: Springer.

Duranti, L. (2020). Documentary heritage in the Cloud. In Edmondson, R., Jordan, L.,

& Prodan, A. C. (Eds.), *The UNESCO Memory of the World Programme (pp. 191–201)*. Switzerland: Springer.

Eisenhardt, K. M. (1989). Building theories from case study research. *Academy of Management Review, 14*(4), 532–550.

Emely, G., & Gebert, V. (2020). *Sawahlunto: Towards a Sustainable and Attractive Place to Live, Work, and Recreate*. Netherland: Rijksdienst voor het Cultureel Erfgoed.

Erman, E. (2005). *Membaranya Batu Bara Konflik Kelas dan Etnik, Ombilin Sawahlunto1892–1996*. Depok: Kajian Perempuan Desantara.

Ferrero, M., Friel, M., Meneghin, E., & Lavanga, M. (2024). Industrial Heritage and Citizen Participation: The UNESCO World Heritage Site of Ivrea, Italy. *Urban Planning*, *9*.

Franks, P. C. (2018). *Records and Information Management* (2nd ed.). USA: ALA Neal-Schuman.

Franks, P. C., & Bernier, A. (2018). *The international directory of national archives*. UK: Bloomsbury Publishing PLC.

Gaitanou, P., Andreou, I., Sicilia, M. A., & Garoufallou, E. (2024). Linked data for libraries: Creating a global knowledge space, a systematic literature review. *Journal of Information Science*, *50*(1), 204–244.

Galletta, A. (2013). *Mastering the semi-structured interview and beyond: From research design to analysis and publication*. USA: NYU Press.

García-Gutiérrez, A. (2014). Declassifying Knowledge Organization. *Knowledge Organization, 41*(5), 393–409.

Germanakos, P., & Fichte, L. (2020). EUREKATAX: A Taxonomy for the Representation and Analysis of Qualitative Usability Test Data. *Multimodal Technologies and Interaction, 4*(2), 22. https://doi.org/10.3390/mti4020022

Getty Research Institute. (2024). *Art & Architecture Thesaurus (AAT)*. Retrieved May 19, 2024, from https://www.getty.edu/research/tools/vocabularies/aat/index.html

Giannoulakis, S., Tsapatsoulis, N., & Grammalidis, N. (2018). Metadata for Intangible Cultural Heritage – The Case of Folk Dances. In Telea, A., Kerren, A. & Braz, J. (Eds.), *Proceedings of the 13th International Joint Conference on Computer Vision, Imaging and Computer Graphics Theory and Applications (VISAPP 2018), Volume 5: VCEA, (pp. 634–645)*. Madeira: Science and Technology

Publications.

Gilliland, A. J. (2014). *Conceptualizing 21st-Century Archives*. USA: Society of American Archivists.

Gioia, D. A., Corley, K. G., & Hamilton, A. L. (2013). Seeking qualitative rigor in inductive research: Notes on the Gioia methodology. *Organizational Research Methods*, *16*(1), 15–31.

Given, L. M. (2016). *100 Questions (and Answers) About Qualitative Research*. USA: Sage.

Gnoli, C. (2020). *Introduction to knowledge organization*. UK: Facet Publishing.

Golub, K., & Liu, Y. H. (2021). *Information and knowledge organisation in digital humanities*. UK: Routledge.

Government of West Sumatra and Ministry of Education and Culture of the Republic of Indonesia. (2018). *Ombilin Coal Mining Heritage of Sawahlunto Nomination Dossier Annex 1: Maps.* Jakarta: Government of West Sumatra and Ministry of Education and Culture of the Republic of Indonesia.

Gregor, S., & Hevner, A. R. (2013). Positioning and presenting design science research for maximum impact. *MIS Quarterly***,** 37(2), 337–355.

Guba, E. G., & Lincoln, Y. S. (1994). Competing paradigms in qualitative research. In *Handbook of qualitative research*, *2*(163-194), p. 105.

Halkias, D., Neubert, M., Thurman, P. W., & Harkiolakis, N. (2022). *The multiple case study design: Methodology and application for management education*. UK: Routledge.

Harrison, R. (2013). *Heritage: Critical approaches*. UK: Routledge.

Haynes, D. (2018). *Metadata for Information Management and Retrieval: Understanding metadata and its use*. UK: Facet Publishing.

Hedden, H. (2022). *The Accidental Taxonomist 3rd Ed*. USA: Information Today, Inc.

Hendrawan, M. R. & Bafadhal, A. S. (2022). *Virtual Museum*. In Buhalis, D. (Ed.), *Encyclopedia of Tourism Management and Marketing*. UK: Edward Elgar Publishing.

Hendrawan, M. R., & Sulistyo-Basuki. (2026). Knowledge organization system: Knowledge taxonomy. In V. Ratten (Ed.), *International encyclopedia of business management* (1st ed., pp. 640–644). USA: Elsevier.

Hendrawan, M. R., Ariyani, L. P. S., & Bafadhal, A. S. (2024c). *The library and information science perspective on knowledge management*. In Helge, K., &

Rookey, C. A. (Eds.), *Creating and sustaining an information governance program (pp. 308–324)*. USA: IGI Global.

Hendrawan, M. R., Isa, A. M., & Samsudin, A. Z. H. (2024a). Initiating memory institutions convergence through digital convergence in Indonesian World Heritage Sites. In Holland, B. J., & Sinha, K. (Eds.), *Advances in Library and Information Science: Multidisciplinary Approach to Information Technology in Library and Information Science (pp. 231–251)*. USA: IGI Global.

Hendrawan, M. R., Isa, A. M., & Samsudin, A. Z. H. (2024b). Metadata Interoperability for Cultural Heritage Digital Repositories: A Case Study in Indonesian World Heritage Site Memory Institutions. *International Journal of Academic Research in Business and Social Sciences*, *14*(8), 545–561.

Hendrawan, M. R., Isa, A. M., & Samsudin, A. Z. H. (2025a). Evolving taxonomies: Fifty years of taxonomy development in library and information science. *Journal of Librarianship and Information Science 58*(1), 1–22.

Hendrawan, M. R., Isa, A. M., & Samsudin, A. Z. H. (2025b). Developing a cultural heritage taxonomy for an Indonesian World Heritage site. *Journal of Documentation 81*(5–6), 1200–1217.

Hevner, A. R., March, S. T., Park, J., & Ram, S. (2004). Design science in information systems research. *MIS Quarterly*, *28*(1), 75–105.

Hitchcock, M., King, V. T., & Parnwell, M. J. (2010). Heritage tourism in Southeast Asia. *Heritage tourism in Southeast Asia*. Copenhagen: NIAS Press.

Hjørland, B. (2007). Semantics and Knowledge Organization. *Annual Review of Information Science and Technology*, 367–405.

Hjørland, B. (2016). Knowledge organization (KO). *KO Knowledge Organization, 43*(6), 475–484.

Hjørland, B. (2017a). Domain analysis. In J. D. McDonald & M. Levine-Clark (Eds.), *Encyclopedia of Library and Information Sciences 4th ed. (pp. 1473–1484)*. USA: CRC Press.

Hjørland, B. (2017b). Theories are knowledge organizing systems (KOS). *Knowledge Organization*, 42(2), 113–128.

Hjørland, B. (2021). Information retrieval and knowledge organization: A perspective from the philosophy of science. *Information, 12*(3), 135.

Hlava, M. (2022a). *The Taxobook: History, Theories, and Concepts of Knowledge Organization, Part 1 of a Part-3 Series*. USA: Springer.

Hlava, M. (2022b). *The Taxobook: Principles and Practices of Building Taxonomies, part 2 of a 3-part series*. USA: Springer.

Hosseini, M., Nijimbere, V., Dabbagh, N., & Thelwall, M. (2023). Evolution and adoption of contributor role ontologies and taxonomies. *Learned Publishing, 36*(2), 164-176

Hou, Y., Kenderdine, S., Picca, D., Egloff, M., & Adamou, A. (2022). Digitizing intangible cultural heritage embodied: State of the art. *Journal on Computing and Cultural Heritage (JOCCH)*, *15*(3), 1–20.

International Council on Museums. (2016). *The CIDOC Conceptual Reference Model (CRM) Version 6.2.2*. Retrieved May 17, 2024, from http://cidoc.ics.forth.gr/official_release_cidoc.html

International Organization for Standardization & International Electrotechnical Commission (ISO/IEC). (2015). *Information technology — Vocabulary* (ISO/IEC Standard No. 2382:2015). Switzerland: International Organization for Standardization.

International Organization for Standardization (ISO). (2011). *Information and documentation — Thesauri and interoperability with other vocabularies: Part 1, Thesauri for information retrieval* (ISO Standard No. 25964-1:2011). Switzerland: International Organization for Standardization.

International Organization for Standardization (ISO). (2017). *Information and documentation — Foundation and vocabulary* (ISO Standard No. 5127:2017). Switzerland: International Organization for Standardization.

Joudrey, D. N., & Taylor, A. G. (2018). *The organization of information*. USA: Libraries Unlimited.

Kamal, A. M., & Golub, K. (2025). Subject matters: Metadata standards and subject access for library and museum catalogues. In Hanssen, J. M. & Furuseth, S. (Eds.), *The Hermeneutics of Bibliographic Data and Cultural Metadata (pp. 204–239).* Norway: National Library of Norway.

Kementerian Pekerjaan Umum dan Perumahan Rakyat Republik Indonesia. (2021). *Peratuan Menteri Pekerjaan Umum dan Perumahan Rakyat Republik Indonesia Nomor 19 Tahun 2021 tentang Pedoman Teknis Penyelenggaraan Bangunan Gedung Cagar Budaya yang Dilestarikan.* Jakarta: Pemerintah Republik Indonesia.

Kementerian Pendidikan dan Kebudayaan Republik Indonesia. (2014). *Keputusan*

Menteri Pendidikan dan Kebudayaan Republik Indonesia Nomor 345/M/2014 tentang Penetapan Satuan Ruang Geografis Kota Lama Tambang Batubara Sawahlunto sebagai Kawasan Cagar Budaya Peringkat Nasional. Jakarta: Pemerintah Republik Indonesia.

Kumar, G. T. K. & Ramesha. (2020). Metadata Standardization in Cultural Heritage Imaging: A Semantic Annotation Approach. In Dodamani, A. M., Ramesha, B., Keshava, & Akhilesh, K. S. Y. (Eds.). *Reimagining LIS Education: Integrating Indian Knowledge Systems with NEP 2020*. New Delhi: Taran Publication.

Kumar, G. T. K. & Nair, R. R. (2022). Conserving knowledge heritage: Opportunities and challenges in conceptualizing a cultural heritage information system (CHIS) in the Indian context. *Global Knowledge, Memory and Communication, 71*(6-7), 564–583.

Kumar, G. T. K. (2024). Valorization of intangible cultural heritage through documentation: An Indian scenario. *Library Hi Tech News, 41*(8), 10–14.

Kundisch, D., Muntermann, J., Oberländer, A., Rau, D., Röglinger, M., Schoormann, T., & Szopinski, D. (2022). An Update for Taxonomy Designers. *Business & Information Systems Engineering, 64,* 421–439. https://doi.org/10.1007/s12599-021-00723-x

Kushwaha, R. K., Yadav, K., Yadap, P. K., & Yadap, M. K. (2024). *Ethical Frameworks in Special Education: A Guide for Researchers*. UK: Bluerose Publishers.

Kwiecien, K., Chansanam, W., & Tuamsuk, K. (2025). Digital Cultural Heritage in Southeast Asia: Knowledge Structures and Resourcesin GLAM Institutions. *Informatics 12*, 96. https://doi.org/10.3390/informatics12030096

Lambe, P. (2014). *Organising knowledge: Taxonomies, knowledge and organisational effectiveness (2nd ed.).* UK: Chandos Publishing.

Ledinek-Lozej, Š. (2019). Collaborative Inventory—A Participatory Approach to Cultural Heritage Collections. In Nared, J., & Bole, D. (Eds.), *Participatory research and Planning in practice (pp. 121-131)*. Switzerland: Springer.

Lewi, H., Smith, W., Vom Lehn, D., & Cooke, S. (2020). *The Routledge international handbook of new digital practices in galleries, libraries, archives, museums and heritage sites*. UK: Routledge.

Lewis, J. R. (2012). Usability testing. In Salvendy, G. (Ed.), *Handbook of human factors and ergonomics*, *(pp. 1267–1312)*. USA: John Wiley & Sons.

Lian, Y., & Xie, J. (2024). The Evolution of Digital Cultural Heritage Research: Identifying Key Trends, Hotspots, and Challenges through Bibliometric Analysis. *Sustainability*, *16*(16), 7125.

Library of Congress. (2024). *Library of Congress Subject Headings (LCSH) 46th ed*. USA: Library of Congress. Retrieved May 19, 2024, from https://www.loc.gov/aba/publications/FreeLCSH/freelcsh.html

Lincoln, Y. S., & Guba, E. G. (1985). *Naturalistic inquiry*. USA: Sage.

Lindayanti, R.A.F., Efendi, H., Rahman, F., Saputra, Y., Yulia, A., Mega, Y. & Elvira, M. (2017). *Kota Sawahlunto, Jalur Kereta Api dan teluk Bayur: Tiga Serangkai dalam Sejarah Pertambangan Batubara Ombilin di Sumatera Barat*. Padang: Minangkabau Press.

Lindayanti, R.A.F., Yulia, A., Bahren, E., Harry, S., Yoni, M., Yuristya, Z., Zaiyardam, & Zulqayyim. (2016). *Pertambangan dan Pengangkutan Batubara Ombilin Sawahlunto pada Masa Kolonial*. Padang: Minangkabau Press.

Liu, F., Hindmarch, J., & Hess, M. (2023). A review of the cultural heritage linked open data ontologies and models. In Tucci, G., Balletti, C., Bonora, V., Fassi, F., Spanò, A., Parisi, E. I., Previtali, M., & Sammartano, G. (Eds.), *The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences, XLVIII-M-2*, *(pp. 943–950).* Hannover: ISPRS.

Liu, S., & Jia, J. (2025). A quantitative study of vocabulary categorization and reuse in the LIS field linked data. *Online Information Review*, *49*(2), 246–268.

Longo, D., Boeri, A., Turillazzi, B., & Orlandi, S. (2020). Cultural heritage and interoperable open platforms: strategies for knowledge, accessibility, enhancement, and networking. *WIT Transactions on Ecology and the Environment*, *241*, 371–382.

Mai, J. E. (2011). The modernity of classification. *Journal of Documentation*, *67*(4), 710–730.

Martínez-Ávila, D., & Beak, J. (2016). Methods, theoretical frameworks, and hope for knowledge organization. *Knowledge organization*, *43*(5).

Martínez-González, M. M., & Alvite-Díez, M. L. (2020). A semantic web methodological framework to evaluate the support of integrity in thesaurus tools. *Journal of Information Science*, *46*(3), 378–391.

McHugh, M. L. (2012). Interrater reliability: The kappa statistic. *Biochemia Medica*, *22*(3), 276–282.

McKelvey, B. (2022). *Organizational systematics: Taxonomy, evolution, classification (1st ed.)*. USA: University of California Press.

Miller, D. K. (2005). *Measurement by the physical educator: Why and how, 4th ed*. USA: McGraw-Hill.

Milton, N. J. & Lambe, P. (2020). *The Knowledge Manager's Handbook: A Step-by-step Guide to Embedding Effective Knowledge Management in Your Organization, 2nd ed*. USA: Kogan Page.

Mohammed, M. A., Ahmed, H., Sultan, G. A., & Abdelghani, A. A. A. (2024). Mamluk Cultural Heritage and Sustainable Tourism: The Interplay of Heritage Value, Cultural Identity, and Behavioral Intentions in Promoting Roots Tourism. *Cultural Arts Research and Development*, *4*(2), 50–62.

Nabukenya, J. (2012). Combining case study, design science and action research methods for effective collaboration engineering research efforts. In *Proceedings of the 47th Hawaii International Conference on System Sciences, Maui, Hawaii, USA, 2012, (pp. 343–352)*. USA: IEEE.

Naeem, M., Ozuem, W., Howell, K., & Ranfagni, S. (2023). A Step-by-Step Process of Thematic Analysis to Develop a Conceptual Model in Qualitative Research. *International Journal of Qualitative Methods*, *22*.

Nappi, M. L., Buono, M., Chivăran, C., & Giusto, R. M. (2024). Models and tools for the digital organisation of knowledge: accessible and adaptive narratives for cultural heritage. *Heritage Science*, *12*(1), 112.

Navarrete, T. (2021). Libraries, archives, and museums of the future. *Economic Considerations for Libraries, Archives and Museums*, 91.

Negri, M. (2025). Unlocking industrial heritage meanings and legacies for the post-industrial generations. In McColl, M., Brown, P., Delaney, M., Murr, K. B., & Zipsane, H. (Eds.), *The Routledge Handbook of Museum and Heritage Education (pp. 14–27)*. UK: Routledge.

Neuendorf, K. A. (2017). *The content analysis guidebook, 2nd ed*. USA: Sage.

Nickerson, R. C., Varshney, U. & Muntermann, J. (2013). A method for taxonomy development and its application in information systems. *European Journal of Information Systems*, *22*(3), 336–359.

O'Neill, B., & Stapleton, L. (2022). Digital cultural heritage standards: from silo to semantic web. *AI & society*, *37*(3), 891–903.

Oberländer, A. M., Lösser, B., & Rau, D. (2019). Taxonomy research in information

systems: A systematic assessment. In vom Brocke, Jan., Gregor, S., & Müller, O. (Eds.), *27th European Conference on Information Systems - Information Systems for a Sharing Society, ECIS 2019, Stockholm and Uppsala, Sweden, June 8-14, 2019*.

Page, M. J, McKenzie, J. E, Bossuyt, & P. M. (2021). The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. *International Journal of Surgery 88*: 105906.

Patton, M. Q. (2015). *Qualitative research and evaluation methods (4th ed.).* USA: Sage.

Pavlinov, I. Y. (2026). *The hierarchies in biological systematics: A conceptual perspective*. USA: CRC Press.

Peffers, K., Tuunanen, T., Rothenberger, M. A., & Chatterjee, S. (2007). A design science research methodology for information systems research. *Journal of Management Information Systems*, 24(3), 45–77.

Poveda-Villalón, M., Espinoza-Arias, P., Garijo, D., & Corcho, O. (2020). Coming to terms with FAIR ontologies. In *International Conference on Knowledge Engineering and Knowledge Management* (pp. 255–270). Switzerland: Springer.

Qin, J., & Zeng, M. L. (2020). *Metadata*. USA: American Library Association.

Raemy, J. A. (2025). Linked Open Usable Data for Cultural Heritage: Community building and semantic interoperability in practice, in the 17th Semantic Web in Libraries Conference (SWIB25). https://doi.org/10.48620/92261

Ranjgar, B., Sadeghi-Niaraki, A., Shakeri, M., Rahimi, F., & Choi, S. M. (2024). Cultural heritage information retrieval: past, present, and future trends. *IEEE Access*, *12*, 42992–43026.

Rasmussen, C. H., & Hjørland, B. (2022). Libraries, archives, and museums (LAMs): Conceptual issues with focus on their convergence. *Knowledge Organization, 49*(8).

Republik Indonesia. (2007). *Undang-Undang Republik Indonesia Nomor 43 Tahun 2007 tentang Perpustakaan*. Jakarta: Pemerintah Republik Indonesia.

Republik Indonesia. (2009). *Undang-Undang Republik Indonesia Nomor 43 Tahun 2009 tentang Kearsipan*. Jakarta: Pemerintah Republik Indonesia.

Republik Indonesia. (2010). *Undang-Undang Republik Indonesia Nomor 11 Tahun 2010 tentang Cagar Budaya*. Jakarta: Pemerintah Republik Indonesia.

Rhodes, M. A., II, & Hannum, K. L. (2024). UNESCO, mining heritage, and the scalar sustainability of tourism geographies at industrial World Heritage Sites. *Journal of Tourism Futures*.

Roussos, K., & Stamatoudi, I. (2022). Management issues for cultural heritage institutions. In Stamatoudi, I. (Ed.), *Research Handbook on Intellectual Property and Cultural Heritage (pp. 413-438)*. UK: Edward Elgar Publishing.

Rubin, J., & Chisnell, D. (2008). *Handbook of usability testing: How to plan, design, and conduct effective tests* 2*nd Ed*. USA: John Wiley & Sons.

Ruhanen, L., & Whitford, M. (2021). Cultural heritage and Indigenous tourism. In Whitford, M., & Ruhanen, L. (Eds.), *Indigenous heritage* (pp. 1–13). UK: Routledge.

Ruthven, I., & Chowdhury, G. G. (2015). *Cultural heritage information: Access and management (Vol. 1)*. UK: Facet Publishing.

Sabiescu, A., Calvi, L., & Vermeeren, A. (2025). Introduction: Transformative Museum Experiences at a Time of Transformation. In Calvi, L., Vermeeren, A., & Sabiescu, A. (Eds.), *Transformative Museum Experiences (pp. 1–23).* Switzerland: Springer.

Salaba, A., & Chan, L. M. (2023). *Cataloging and classification: an introduction*. USA: Rowman & Littlefield.

Sandy, H., & Bossaller, J. (2017). Providing cognitively just subject access to indigenous knowledge through knowledge organization systems. *Cataloging & Classification Quarterly*, *55*(3), 129–152.

Saputra, Y. (2012). *Jejak de Greve dalam Kenangan Sawahlunto.* Yogyakarta: Penerbit Ombak.

Saunders, M. N. K, Lewis, P., & Thornhill, A. (2023). *Research methods for business students (9th ed.)*. UK: Pearson.

Silva, A. L., & Terra, A. L. (2024). Cultural heritage on the semantic web: the Europeana data model. *IFLA journal*, *50*(1), 93–107.

Smiraglia, R. P. (2014a). *The Elements of Knowledge Organization.* USA: Springer.

Smiraglia, R. P. (2014b). *Cultural Synergy in Information Institutions*. USA: Springer.

Smiraglia, R. P. (2015). *Domain Analysis for Knowledge Organization: Tools for Ontology Extraction*. UK: Chandos Publishing.

Smith, L., & Waterton, E. (2013). *Heritage, Communities and Archaeology.* UK: Bloomsbury Academic.

Southeast Asia Museum Services (SEAMS). (2022). *Survei Dasar untuk Pengembangan Strategi Interpretasi Situs Warisan Dunia Tambang Batubara Ombilin Sawahlunto*. Jakarta: UNESCO, SEAMS, and Pemerintah Kota Sawahlunto.

Stauffer, S. M. (2021). *Libraries, Archives, and Museums: An introduction to cultural heritage institutions through the ages*. UK: Bloomsbury Publishing PLC.

Stylianidis, E. (2025). Recording and Documenting Cultural Heritage. In Stylianidis, E. (Ed.), *Exploring the Ethical Dimension in Recording and Documenting Cultural Heritage* (pp. 25-46). Switzerland: Springer.

Sullivan, A.T. (2016). Cultural Heritage & New Media: A Future for the Past, 15 J. Marshall Rev. Intell. Prop. L. 604. *John Marshall Review of Intellectual Property Law*, 15, 11.

Syafrini, D., Nurdin, M. F., Sugandi, Y. S., & Miko, A. (2020). Re/constructing collective memory: coal-mining Heritage Museums in Sawahlunto, Indonesia. *The International Journal of Intangible Heritage*, *15*, 166–178.

Szopinski, D., Schoormann, T., & Kundisch, D. (2019). Because your taxonomy is worth it: Towards a framework for taxonomy evaluation. In Johannesson, P., Ågerfalk, P., & Helms, R. (Eds.), *Proceedings of the 27th European Conference on Information Systems (ECIS), Stockholm & Uppsala, Sweden, June 8-14, 2019* (pp. 1–19).

Szopinski, D., Schoormann, T., & Kundisch, D. (2020). Criteria as a prelude for guiding taxonomy evaluation. In Bui, T. (Ed.), *Proceedings of the 53rd Hawaii International Conference on System Sciences (HICSS)*. USA: Hawaii International Conference on System Sciences.

The United Nations Educational, Scientific, and Cultural Organization (UNESCO). (2003). *Convention for the Safeguarding of the Intangible Cultural Heritage*. Paris: UNESCO.

The United Nations Educational, Scientific, and Cultural Organization (UNESCO). (2019). *Ombilin Coal Mining Heritage of Sawahlunto*. Retrieved June 17, 2023, from https://whc.unesco.org/en/list/1610

The United Nations Educational, Scientific, and Cultural Organization (UNESCO). (2021). *Memory of the World in the digital age: Guidelines for preservation and access*. Paris: The United Nations Educational, Scientific, and Cultural Organization.

The United Nations Educational, Scientific, and Cultural Organization (UNESCO). (2025). *World Heritage List*. Retrieved July 29, 2025, from https://whc.unesco.org/en/list.

The United Nations Educational, Scientific, and Cultural Organization (UNESCO). (2024). *UNESCO Thesaurus*. Retrieved May 19, 2024, from https://vocabularies.unesco.org/browser/thesaurus/en/

The United Nations Educational, Scientific, and Cultural Organization World Heritage Centre. (2025). *Operational Guidelines for the Implementation of the World Heritage Convention* (WHC.25/01). Paris: The United Nations Educational, Scientific, and Cultural Organization.

Thekkum Kara, G. K. (2021). Developing a sustainable cultural heritage information system. *Library Hi Tech News*, *38*(6), 17–20.

Ubertazzi, B. (2022). Intangible cultural heritage. In *Intangible Cultural Heritage, Sustainable Development and Intellectual Property: International and European Perspectives* (pp. 11–65). Switzerland: Springer.

van der Merwe, A., Gerber, A., & Smuts, H. (2017). Mapping a design science research cycle to the postgraduate research report. *Communications in Computer and Information Science*, 730, 293–308.

Veldpaus, L. (2016). Heritage Taxonomy: Towards a common language? In Amoêda, R., Sérgio Lira, S., & Pinheiro, C. (Eds.), *HERITAGE 2016–5th International Conference on Heritage and Sustainable Development (pp. 193–202)*. Barcelos: Green Lines Institute for Sustainable Development.

Venable, J., Pries-Heje, J., & Baskerville, R. (2016). *FEDS: A framework for evaluation in design science research*. *European Journal of Information Systems, 25*(1), 77–89.

Vogt, L., Strömert, P., Matentzoglu, N., Karam, N., Konrad, M., Prinz, M., & Baum, R. (2025). Suggestions for extending the FAIR Principles based on a linguistic perspective on semantic interoperability. *Scientific Data*, *12*(1), 688.

Walikota Sawahlunto. (2005). *Peraturan Walikota Sawahlunto Nomor 8 tahun 2005 tentang Pembentukan Organisasi dan Tata Kerja Unit Pelaksana Teknis (UPTD) Perpustakaan*. Kota Sawahlunto: Pemerintah Kota Sawahlunto.

Walikota Sawahlunto. (2008). *Peraturan Walikota Sawahlunto Nomor 13 tahun 2008 tentang Pembentukan Organisasi dan Tata Kerja Unit Pelaksana Teknis (UPTD) Kearsipan.* Kota Sawahlunto: Pemerintah Kota Sawahlunto.

Walikota Sawahlunto. (2013). *Peraturan Daerah Kota Sawahlunto Nomor 3 Tahun 2013 tentang Pembentukan Organisasi dan Tata Kerja Kantor Arsip dan Perpustakaan Daerah.* Kota Sawahlunto: Pemerintah Kota Sawahlunto.

Walikota Sawahlunto. (2016). *Peraturan Walikota Sawahlunto Nomor 31 Tahun 2016 tentang Susunan Organisasi Tugas, Fungsi serta Tata Kerja Organisasi Perangkat Daerah Kota Sawahlunto serta Peraturan Pemerintah Nomor 18 tahun 72016 tentang Perangkat Daerah*. Kota Sawahlunto: Pemerintah Kota Sawahlunto.

Walikota Sawahlunto. (2021). *Peraturan Walikota Sawahlunto Nomor 85 Tahun 2021 tentang Kedudukan, Susunan Organisasi, Tugas dan Fungsi serta Tata Kerja Dinas Perpustakaan dan Kearsipan*. Kota Sawahlunto: Pemerintah Kota Sawahlunto.

Wang, G., Khalid, Y. I. A. M., Abdullah, N., Xu, Y.-S., & Yuan, Y. (2025). Tradition meets innovation: Research trends in libraries, archives, and museums convergence from a digital humanities perspective. *Knowledge Organization, 5*2(4), 395–414. https://doi.org/10.31083/KO39514

Whirl-i-Gig. (2023). *CollectiveAccess Setup and Use*. Retrieved December 19, 2023, from https://manual.collectiveaccess.org/

Wilkinson, M. D., Dumontier, M., Aalbersberg, I., Appleton, G., Axton, M., Baak, A., Blomberg, N., et al. (2016). The FAIR Guiding Principles for scientific data management and stewardship. *Scientific Data, 3*, Article 160018.

Williamson, K. (2018). Questionnaires, individual interviews, and focus group interviews, in Williamson, K. & Johanson, G. (Ed.). *Research Methods: Information, Systems, and Context*. UK: Chandos Publishing.

Ye, J., Qin, Y., & Wu, H. (2024). Cultural heritage and sustainable tourism: unveiling the positive correlations and economic impacts. *Current Psychology*, *43*(47), 36393-36415.

Ye, P., & Zhou, Y. (2013). The framework of Chinese intangible cultural heritage metadata standards. In Tan, H., & Wang, T. (Eds.), *Proceedings of the 2013 International Workshop on Computer Science in Sports* (pp. 221–225). The Netherlands: Atlantis Press.

Yin, R. K. (2018). *Case Study Research and Applications: Design and Methods, 6th ed*. USA: Sage.

Yuan, J., Zhai, K., Li, H., & Yuan, M. (2025). Research on the construction and

mapping model of a knowledge organization system driven by standards. *Computer Standards & Interfaces*, *92*, 103905.

Zeng, M. L., & Mayr, P. (2019). Knowledge Organization Systems (KOS) in the Semantic Web: a multi-dimensional review. *International Journal on Digital Libraries, 20*(3), 209–230.

Zhang, R., Peng, F., & Gwilt, I. (2024). Exploring the role of immersive technology in digitally representing contemporary crafts within hybrid museum exhibitions: a scoping review. *Digital Creativity*, *35*(4), 355–377.

Zlodi, G. (2023). Information and Documentation Perspective to Intangible Cultural Heritage in the Context of Digital Humanities Research. *Studia ethnologica Croatica*, (35), 115–148.

Zorich, D. M., Waibel, G., & Erway, R. (2008). *Beyond the silos of the LAMs: Collaboration among libraries, archives, and museums*. USA: OCLC Research.

Zou, H., Wang, X., & Guo, D. (2025). Architectures of Knowledge: Archival Spaces at the Intersection of Library Science and Heritage Design–A Documentary Case Study Series. *African Journal of Library, Archives and Information Science*, *35*(1).

APPENDICES

APPENDIX 1

OCMHS Taxonomy

Level 1	Level 2	Level 3	Level 4	AAT	LCSH	UNESCO	CIDOC CRM
ADAT ISTIADAT MASYARAKAT, RITUS DAN PERAYAAN-PERAYAAN (SOCIAL PRACTICES, RITUALS, AND FESTIVE EVENTS)	**Hukum adat (Customary law)**	***Sistem hukum (Legal systems)***	Hubungan rumah tangga (Domestic relations)	Domestic relations	Domestic relations	Family law	E30 Right
			Hukum dagang (Law merchant)	Commercial law	Law merchant	Commercial law	E30 Right
			Hukum Islam (Islamic law)	Islamic law	Islamic law	Islamic law	E30 Right
			Hukum perkawinan (Marriage law)	Marriage law	Marriage law	Marriage	E30 Right
			Hukum pidana (Criminal law)	Criminal law	Criminal law	Criminal law	E30 Right
			Hukum warisan (Inheritance)	Inheritance law	Inheritance	Inheritance	E30 Right
			Konsensus hukum (Consensus)	Consensus (law)	Consensus (Social science)	Consensus	E30 Right
			Penguasaan tanah (Land tenure)	Land tenure	Land tenure	Land tenure	E30 Right
			Proses peradilan (Judicial process)	Judicial process	Judicial process	Judicial system	E7 Activity
			Tata cara hukum (Law procedure)	Legal procedure	Law procedure	Legal procedure	E7 Activity
	Ritual dan upacara (Rites and	*Adat berkabung (Mourning customs)*		Mourning customs	Mourning customs	Funeral rites	E5 Event (subclass of E7 Activity)
		Adat dan ritual pernikahan (Marriage		Marriage customs	Marriage customs and rites	Marriage	E5 Event (subclass of E7 Activity)
		Adat dan ritual politik (Political customs and		N/A	Political customs and rites	N/A	E7 Activity
		Objek upacara (Ceremonial objects)	Asesoris (Ceremonial accessories)	Accessories (costume	Ceremonial objects	Ceremonial accessories	E22 Man-Made Object
			Peralatan (Ritual tools)	Tools (instrumental	Ceremonial equipment	Ritual tools	E22 Man-Made Object
			Sesaji (Ceremonial offerings)	Offerings	Ritual objects	Ceremonial	E22 Man-Made
		Upacara dan ritual peringatan (Memorial rites and ceremonies)		N/A	Memorial rites and ceremonies	N/A	E22 Man-Made Object
		Upacara kota (Municipal ceremonial)		N/A	Municipal ceremonial	Funeral rites	E5 Event
		Upacara mendatangkan hujan (Rain-making rites)		N/A	Rain-making rites	N/A	E5 Event

	Upacara pemberian nama (Naming		Naming ceremonies	Naming ceremonies	N/A	E5 Event
	Upacara penanaman (Planting rites)		N/A	Planting rites	N/A	E5 Event
	Upacara penandatanganan		N/A	Signing ceremonies	N/A	E5 Event
	Upacara pubertas (Puberty rites)		Rites of passage	Puberty rites	Puberty	E5 Event (subclass of E7 Activity)
Sistem ekonomi tradisional (Traditional economic	***Cara pembayaran (Payment)***	Barter (Barter)	Barter	Barter	Barter	E5 Event
		Hasil panen (Agricultural products)	Harvesting	Agricultural products	Agricultural products	E19 Physical Object
		Hasil tangkapan (Fishing products)	Fishing	Fishery products	Fishery products	E19 Physical Object
	Pasar (Markets)		Markets (retail)	Markets	Markets	E5 Event
Sistem kekerabatan tradisional (Family relatives)	***Jenis Kekerabatan (Kinship)***	Matrilineal (Matrilineal kinship)	Kinship	Matrilineal kinship	Kinship	E74 Group
		Parental (Parent and child)	Kinship	Parent and child	Kinship	E74 Group
		Patrilineal (Patrilineal kinship)	Kinship	Patrilineal kinship	Kinship	E74 Group
	Sistem kekerabatan (Consanguinity)	Ayah dan anak (Father and child)	Family relationships	Father and child	Family	E74 Group
		Ibu dan anak (Mother and child)	Family	Mother and child	Family	E74 Group
		Menantu dan mertua (In-laws)	Extended families	In-laws	Family	E74 Group
		Paman dan kemenakan (Collateral relatives)	Collateral relatives	Collateral relatives	Kinship	E74 Group
Struktur sosial (Social structure)	***Jenis pekerjaan (Occupations)***	Arsiparis (Archivists)	Archivists	Archivists	Archivists	E39 Actor
		Budayawan (Cultural workers)	Cultural workers	Cultural workers	Cultural workers	E39 Actor
		Buruh (Laborers)	Laborers	Laborers	Labour	E21 Person
		Demang (Village headmen)	Village heads	Village headmen	Local government officials	E39 Actor
		Dokter / Mantri (Health personnel)	Paramedical personnel	Paramedical personnel	Health personnel	E39 Actor
		Fotografer (Photographers)	Photographers	Photographers	Photographers	E39 Actor

	Guru (Teachers)	Teachers	Teachers	Teachers	E39 Actor
	Insinyur (Engineers)	Engineers	Engineers	Engineers	E39 Actor
	Kepala tambang (Technical personnel)	Technical personnel	Technical personnel	Technical personnel	E39 Actor
	Koki (Chefs)	Chefs	Chefs	Chefs	E39 Actor
	Kontrolir (Managers)	Managers	Managers	Managers	E39 Actor
	Kurator (Museum curators)	Museum curators	Museum curators	Museum curators	E39 Actor
	Masinis (Machinists)	Machinists	Machinists	Machinists	E39 Actor
	Pedagang (Merchants)	Merchants	Merchants	Merchants	E39 Actor
	Pembantu rumah tangga (Domestic workers)	Domestic workers	Domestic workers	Domestic workers	E39 Actor
	Penambang (Miners)	Miners	Miners	Miners	E39 Actor
	Penari (Dancers)	Dancers	Dancers	Dancers	E39 Actor
	Pengacara (Lawyers)	Lawyers	Lawyers	Lawyers	E39 Actor
	Penghulu (Elders)	N/A	N/A	N/A	E39 Actor
	Penulis (Authors)	N/A	N/A	Authors	E39 Actor
	Petani (Farmers)	N/A	N/A	Farmers	E39 Actor
	Polisi (Police)	N/A	N/A	N/A	E39 Actor
	Residen (Colonial administrators)	N/A	N/A	N/A	E39 Actor
	Sejarawan (Historians)	N/A	N/A	N/A	E39 Actor
	Seniman (Artists)	N/A	N/A	N/A	E39 Actor
	Tukang kayu (Carpenters)	N/A	N/A	N/A	E39 Actor
Tokoh Publik (Public figures)	Tokoh adat (Indigenous leaders)	Indigenous leaders	Indigenous leaders	Indigenous leaders	E39 Actor
	Tokoh agama (Religious leaders)	Religious leaders	Religious leaders	Religious leaders	E39 Actor
	Tokoh kolonial (Colonial administrators)	Colonial administrators	Colonial administrators	Colonial administrators	E39 Actor
	Pahlawan nasional (National heroes)	National heroes	National heroes	National heroes	E39 Actor
	Penambang (Labor leaders)	Labor leaders	Labor leaders	Labor leaders	E39 Actor
	Jurnalis (Journalists)	Journalists	Journalists	Journalists	E39 Actor

			Politisi (Politicians)	Politicians	Politicians	Politicians	E39 Actor
			Tionghoa (Chinese)	Chinese people	Chinese	Chinese	E74 Group
		Wilayah organisasi sosial (Social organization territory)	Koloni (Colonies)	Colonies	Colonies	Colonies	E74 Group
			Nagari (Rural areas)	Rural areas	Rural areas	Rural areas	E74 Group
		Jenis organisasi (Organization type)	Organisasi buruh (Labour union)	Labor unions	Labor unions	Labor unions	E74 Group
			Partai politik (Political parties)	Political parties	Political parties	Political parties	E74 Group
BAHAN DOKUMENTER (DOCUMENTS)	**Dokumen resmi (Official documents)**	*Cetak biru (Blueprints)*	Sketsa (Sketches)	Sketches	Sketches	Sketches	E22 Man-Made Object
		Dokumen kependudukan (Civil	Akta kelahiran (Birth certificates)	Birth certificates	Birth certificates	Birth certificates	E31 Document
			Buku nikah (Marriage certificates)	Marriage certificates	Marriage certificates	Documents	E31 Document
			Kartu identitas (Identification cards)	Identity cards	Identification cards	Personal identity	E42 Identifier
			Kartu keluarga (Family registers)	Family registers	Family registers	Family	E31 Document
			Surat izin mengemudi (Driver's licenses)	Driver's licenses	Driver's licenses	Documents	E42 Identifier
		Dokumen kesehatan (Medical records)		Medical records	Health records / Medical	Health documentation	E31 Document
		Dokumen ketenagakerjaan dan komersial (Employement and	Daftar pekerja (Labor registers)	Employment records	Labor registers	Employment	E31 Document
			Kartu ransum (Ration cards)	Ration cards	Ration cards	Rationing	E42 Identifier
			Kontrak (Contract)	Contracts	Contracts	Contracts	E31 Document
			Kwitansi (Receipts)	Receipts (Acknowledgments	Receipts (Acknowledgments	Receipts	E31 Document
			Lisensi (Licences)	Licenses (Legal documents)	Licenses	Licenses	E31 Document
			Perbankan (Banking)	Banking	Banking	Banking	E7 Activity
			Piagam dan sertifikat (Certificates)	Certificates	Certificates	Certificates	E31 Document

		Slip gaji (Pay slips)	Pay slips	Pay slips	Wages	E31 Document
	Dokumen perjalanan (Travel documents)	Paspor (Passports)	Passports	Passports	Passports	E31 Document
		Tiket (Tickets)	Tickets	Tickets	Tickets	E31 Document
	Dokumen pos (Postal document)	Kartu pos (Postcards)	Postcards	Postcards	Postcards	E31 Document
		Perangko (Postage stamps)	Postage stamps	Postage stamps	Postage stamps	E31 Document
		Surat (Letters)	Letters	Letters	Letters	E31 Document
	Mata uang (Currency)	Masa kolonialisme (Colonial currency)	Colonial currency	Colonial currency	Colonial currency	E22 Man-Made Object
		Masa kemerdekaan (National currency)	National currency	National currency	National currency	E22 Man-Made Object
Hasil tambang (Mining products)	*Batu pasir (Sandstone)*		Sandstone	Sandstone	Sandstone	E57 Material
	Batuan fosil (Fossil rock)		Fossil rock	Fossils	Fossils	E57 Material
	Batuan lempung		Claystone	Claystone	Claystone	E57 Material
	Batubara (Coal)	Batubara antrasit (Anthracite)	Anthracite (coal)	Anthracite	Anthracite	E57 Material
		Batubara bituminous (Bituminous coal)	Bituminous coal	Bituminous coal	Bituminous coal	E57 Material
		Batubara lignit (Lignite)	Lignite (coal)	Lignite	Lignite	E57 Material
		Batubara subbituminous coal (Subbituminous coal)	Subbituminous coal	Subbituminous coal	Subbituminous coal	E57 Material
Literatur dan terbitan (Literature and publications)	***Kartografi (Cartographic materials)***	Globe (Globes)	Globes (cartographic artifacts)	Globes	Globes	E22 Man-Made Object
		Peta (Maps)	Maps (documents)	Maps	Maps	E31 Document
	Monograf (Monographs)	Fiksi (Fiction)	Fiction (literary	Fiction	Fiction	E73 Information
		Non Fiksi (Nonfiction)	Nonfiction (literary	Nonfiction	Nonfiction	E73 Information
	Referensi (Reference materials)	Almanak (Almanacs)	Almanacs (reference works)	Almanacs	Almanacs	E31 Document
		Biografi (Biographies)	Biographies	Biographies	Biographies	E73 Information
		Direktori (Directories)	Directories (reference works)	Directories	Directories	E31 Document
		Ensiklopedia (Encyclopedias)	Encyclopedias (reference works)	Encyclopedias	Encyclopedias	E31 Document

			Kamus (Dictionaries)	Dictionaries (reference works)	Dictionaries	Dictionaries	E31 Document
			Terbitan pemerintah (Government publications)	Government publications	Government publications	Government publications	E31 Document
		Terbitan berkala (Periodicals)	Jurnal (Journals)	Journals (periodicals)	Periodicals	Academic periodicals	E33 Linguistic Object
			Koran (Newspapers)	Newspapers	Newspapers	Newspapers	E31 Document
			Majalah (Magazines)	Magazines	Magazines	Magazines	E31 Document
KAWASAN KOTA LAMA (OLD TOWN AREA)	**Area komersial (Commercial**	*Bank (Banks and banking)*		Banks (institutions)	Banks and banking	Banks	E74 Group
		Gedung teater dan bioskop (Cinema)		Theaters	Motion picture	Cinema	E22 Man-Made Object
		Hotel dan Penginapan (Hotels)		Hotels	Hotels	Hotels	E22 Man-Made Object
		Kantor perusahaan tambang (Office		Administration buildings	Office buildings	Office services	E22 Man-Made Object
		Kedai (Trade)		Building trades	Stores, Retail	Trade	E22 Man-Made
		Koperasi (Cooperatives)		Cooperatives	Cooperative	Cooperatives	E74 Group
		Pasar (Markets)		Markets (buildings)	Markets	Markets	E22 Man-Made
		Pegadaian (Pawnshops)		Pawnshops (built	Pawnshops	Pawnshops	E22 Man-Made
	Fasilitas kesehatan (Healthcare facilities)	*Apotek (Pharmacies)*		Pharmacies (buildings)	Pharmacies	Pharmacies	E22 Man-Made Object
		Klinik (Clinics)		Clinics (buildings)	Clinics	Clinics	E22 Man-Made
		Rumah sakit (Hospitals)		Hospitals	Hospitals	Hospitals	E22 Man-Made
	Fasilitas pendukung (Support facilities)	*Dapur umum (Community kitchens)*		Kitchen houses	Cummunity kitchens	N/A	E22 Man-Made Object
		Gedung pertemuan (Assembly halls)		Assembly halls	Assembly halls	Assembly halls	E22 Man-Made Object
		Gudang senjata		Arsenals	Arsenals	Arsenals	E22 Man-Made
		Insitusi memori (Memory Institutions)	Arsip (Archives)	Archives	Archives	Archives	E78 Collection
			Museum (Museums)	Museums	Museums	Museums	E74 Group
			Perpustakaan (Libraries)	Libraries	Libraries	Libraries	E74 Group
		Insitusi pendidikan (Educational	Sekolah keagamaan (Religious schools)	Religious schools	Religious schools	Religious schools	E74 Group

		Sekolah rakyat (Public schools)	Public schools	Public schools	Public schools	E74 Group
		Sekolah tambang (Vocational schools)	Vocational schools	Vocational schools	Vocational schools	E74 Group
	Kantor berita (News agencies)		News agencies	News agencies	News agencies	E74 Group
	Kantor polisi (Police stations)		Police stations	Police stations	Police stations	E22 Man-Made Object
	Kesusteran		Monasteries	Monasteries	Monasteries	E74 Group
	Penjara (Prisons)		Prisons	Prisons	Prisons	E22 Man-Made
	Rumah potong hewan (Slaughterhouses)		Slaughterhouses	Slaughterhouses	Slaughterhouses	E22 Man-Made Object
	Tanah lapang (Open		Open spaces	Open spaces	Open spaces	E53 Place
	Tempat ibadah (Religious buildings)	Gereja (Churches)	Churches	Churches	Churches	E22 Man-Made Object
		Masjid (Mosques)	Mosques	Mosques	Mosques	E22 Man-Made
		Surau (Prayer rooms)	Prayer rooms	Prayer rooms	Prayer rooms	E22 Man-Made Object
Kompleks industri pertambangan (Mining complexes)	*Fasilitas pengolahan (Ore-treatment plants)*		Ore processing facilities	Ore-treatment plants	Ore processing	E22 Man-Made Object
	Fasilitas penyimpanan hasil (Coal washeries)		Coal washeries	Coal storage	Coal storage	E22 Man-Made Object
	Fasilitas transportasi (Transportation	Depo lokomotif (Railroad depots)	Railroad depots	Railroad depots	Railway stations	E22 Man-Made Object
		Jalur kereta api (Railway tracks)	Railroad	Railroad tracks	Railways	E53 Place
		Jalan raya (Roads)	Roads	Roads	Roads	E53 Place
		Jembatan (Bridges)	Bridges	Bridges	Bridges	E22 Man-Made
		Meja putar lokomotif (Railroad turntables)	Railroad turntables	Railroad turntables	Railway equipment	E22 Man-Made Object
		Pelabuhan (Harbors)	Ports (harbors)	Harbors	Ports	E53 Place
		Sistem perkretaapian (Rail transit systems)	Rail transit systems	Railroads	Railway transport	E74 Group
		Stasiun bahan bakar (Fuel depots)	Fuel depots	Fuel pumps	Fuel	E22 Man-Made Object

			Stasiun kereta api (Railway stations)	Railroad stations	Railroad stations	Railway stations	E22 Man-Made Object
			Terminal Bis (Bus stations)	Bus stations	Bus terminals	Bus stations	E22 Man-Made
			Terowongan (Tunnels)	Tunnels	Tunnels	Tunnels	E53 Place
		Tambang permukaan (Coal mining)		Mining	Coal mines and mining	Coal mining	E53 Place
		Kompresor udara (Air compressor)		Compressors	Air compressors	Compressor buildings	E22 Man-Made Object
		Lubang tambang (Mine shafts)		Mine shafts	Mines and mineral resources	Mining pits	E53 Place
		Pembangkit listrik (Power plant buildings)		Power plant buildings	Electric power-plants	Power plants	E22 Man-Made Object
		Stasiun pompa air (Pumping stations)		Water pump facilities	Pumping stations	Pumps	E22 Man-Made Object
	Monumen	*Makam (Cemeteries)*		Cemeteries	Cemeteries	Cemeteries	E53 Place
		Menara (Towers)		Towers	Towers	Towers	E22 Man-Made
		Patung (Statues)		Statues	Statues	Statues	E22 Man-Made
	Tempat tinggal (Residential districts)	*Barak pekerja (Barracks)*		Barracks	Barracks	Barracks	E22 Man-Made Object
		Perumahan kolonial (Official residences)		Dwellings	Official residences	Housing	E24 Physical Man-Made Thing
KEMAHIRAN KERAJINAN TRADISIONAL (TRADITIONAL CRAFTSMANSHIP)	**Gaya arsitektur (Architectural styles)**	*Arsitektur arab (Islamic architecture)*		N/A	Islamic architecture	N/A	E25 Man-Made Feature
		Arsitektur eropa (European architecture)	Art Deco	Art Deco	Art Deco	Art Deco	E25 Man-Made Feature
			Arsitektur Belanda (Dutch colonial)	Dutch colonial	Dutch	Dutch	E25 Man-Made Feature
			Arsitektur Mediterania (Mediterranean)	Mediterranean	Mediterranean	Mediterranean	E25 Man-Made Feature
		Arsitektur pribumi (Indigenous	Arsitektur Batak (Batak architecture)				
			Arsitektur Jawa (Javanese architecture)	Folk architecture	Domestic Architecture	Traditional architecture	E25 Man-Made Feature
			Arsitektur Melayu (Malay architecture)	Folk architecture	Domestic Architecture	Traditional architecture	E25 Man-Made Feature

		Arsitektur Minangkabau (Minangkabau architecture)	Folk architecture	Domestic Architecture	Traditional architecture	E25 Man-Made Feature
	Arsitektur Tiongkok (Chinese architecture		Chinese architecture styles	Architecture, Chinese	Traditional architecture	E25 Man-Made Feature
Kerajinan tradisional (Handicrafts)	*Gerabah (Traditional pottery)*		Earthenware	Traditional pottery	Ceramic crafts	E22 Man-Made Object
	Kain (Ethnographic		Woven cloth /	Ethnographic	Traditional	E22 Man-Made
	Kriya (Handicrafts)		Handicrafts	Artisan crafts	Traditional craftsmanship	E22 Man-Made Object
	Sulam (Decorative embroidery)		Embroidery (technique)	Decorative embroidery	Textile embellishment	E22 Man-Made Object
	Ukir (Carving techniques)		Carving	Wood / stone	Carving	E22 Man-Made
	Pengrajin (Artisans)	Pengrajin batubara (Carves)	Art weavers	Carves	Artists	E21 Person
		Pengrajin rotan (Woodworkers)	Art weavers	Woodworkers	Artists	E21 Person
		Pengrajin tenun songket (Weavers)	Weavers	Weavers	Artists	E21 Person
	Teknik pengerjaan (Art techniques)	Anyam (Braid)	Plait	Braid	Weaving methods	E55 Type
		Rajut (Knitting)	Knitting	Knitting	N/A	E55 Type
		Tempa (Forging)	Forging	Forging (metalworking)	N/A	E55 Type
		Tenun (Weaving)	Weaving	Weaving	Textile arts	E55 Type
		Ukir (Carving techniques)	Carving techniques	Carving	Wood carving	E55 Type
Kuliner tradisional (Traditional cuisine)	***Bahan makanan (Ingredients)***	Hewani (Animal food products)	Animal-based food ingredients	Animal food products	Animal-derived ingredients	E57 Material
		Nabati (Vegetable food products)	Plant-based food ingredients	Vegetable food products	Plant-derived ingredients	E57 Material
	Media penyajian (Serving vessels)	Dedaunan (Leaf wrappers)	Leaf wrappers	Food presentation	Traditional food presentation	E22 Man-Made Object
		Gerabah (Earthenware)	Earthenware	Earthenware dishes	Traditional serving vessels	E22 Man-Made Object
		Kaca (Glassware)	Glassware	Glass dishes	Glass serving	E22 Man-Made
		Keramik (Ceramic ware)	Ceramic ware	Ceramic tableware	Ceramic vessels	E22 Man-Made
		Tempurung (Coconut shell)	Coconut shell	Coconut shell	Natural food	E22 Man-Made

	Proses masak (Cooking)	Bakar (Grilling)	Grilling (cooking technique)	Grilling (Cooking)	Traditional cooking methods	E55 Type
		Goreng (Frying)	Frying (cooking method)	Frying (Cooking)	Traditional food preparation	E55 Type
		Kukus (Steaming)	Steaming (cooking)	Steaming	Steam cooking	E55 Type
	Tata cara penyajian (Food service)	Makanan inti (Main courses)	Main Courses	Entrées	Primary dishes	E55 Type
		Makanan pembuka (Appetizers)	Appetizers	Starters (Meals)	Hors d'oeuvre /	E55 Type
Pakaian tradisional (Ethnic costume)	***Aksesoris terkait (Dress accessories)***	Penutup kepala (Headdresses)	Headdresses	Headgear	Traditional headwear	E22 Man-Made Object
		Perhiasan (Jewelry)	Jewelry	Jewelry	Ornaments	E22 Man-Made
		Sarung (Sarongs)	Sarongs	Sarongs	Traditional	E22 Man-Made
		Selendang (Shawls)	Shawls	Shawls	Cultural dress accessories	E22 Man-Made Object
	Status pemakai (Social conditions)	Bundo kanduang (Matriarchy)	Matriarchs	Matriarchy	N/A	E21 Person
		Hulubalang (Warlords)	Warlords	Military	N/A	E21 Person
		Menteri (Cabinet officers)	Cabinet officers	Cabinet officers	Political figures	E21 Person
		Tokoh agama (Religious leaders)	Religious leaders	Religious leaders	Spiritual figures	E21 Person
		Penghulu (Elders)	Tribal chiefs	Elders	Customary	E21 Person
Senjata tradisional (Traditional weapons)	*Bahan baku senjata (Materials handling)*	Bambu (Bamboo)	Bamboo (plant material)	Bamboo crafts	Traditional weapon materials	E57 Material
		Kayu (Wood)	Wood (plant	Woodwork	Wooden weapons	E57 Material
		Logam (Metalworking)	Metal (material)	Metal-work	Metal weaponry	E57 Material
	Sistem senjata (Weapon systems)	Dakwah (Religious tools)	Weapons in ritual or religious	Religious tools / Ritual accessories	Sacred object function	E55 Type
		Keamanan (Protection tools)	Weapons for self-	Weapons –	Protection tools	E55 Type
		Kesaktian (Spiritual function)	Magical or spiritual weapons	Mystical weapons	Spiritual function – objects	E55 Type
		Kewibawaan (Symbols of leadership)	Ceremonial authority symbols	Weapons as status symbols	Symbols of leadership	E55 Type

PENGETAHUAN DAN KEBIASAAN PERILAKU MENGENAI ALAM SEMESTA (KNOWLEDGE AND PRACTICES CONCERNING NATURE AND THE UNIVERSE)	**Kearifan lokal (Local wisdom)**	*Konservasi ekologi (Ecological conservation)*		Ecological conservation	Conservation of natural resources	Ecological knowledge	E55 Type
		Mitigasi bencana (Disaster prevention)		Disaster prevention	Disaster relief	Disaster mitigation	E55 Type
		Toleransi (Tolerance)		Tolerance (social	Tolerance	Cultural values	E28 Conceptual
	Masakan tradisional (Local cuisine)	*Masakan Batak (Bataknese cuisine)*		Bataknese cuisine	Traditional food – Batak	Ethnic culinary heritage – Batak	E28 Conceptual Object
		Masakan Bugis (Bugis cuisine)		Bugis cuisine	Traditional food – Bugis	Ethnic culinary heritage – Bugis	E28 Conceptual Object
		Masakan Jawa (Javanese cuisine)		Javanese cuisine	Traditional food – Java	Ethnic culinary heritage –	E28 Conceptual Object
		Masakan Madura (Madurese cuisine)		Madurese cuisine	Traditional food – Madura	Ethnic culinary heritage –	E28 Conceptual Object
		Masakan Minangkabau (Minangkabau cuisine)		Minangkabau cuisine	Traditional food – Minangkabau	Ethnic culinary heritage –	E28 Conceptual Object
	Pengetahuan mengenai alam	*Makrokosmos (Cosmology)*		Cosmology	Cosmology, Indigenous	Cosmology	E28 Conceptual Object
		Mikrokosmos (Microcosm)		Microcosm	Microcosm and macrocosm	Symbolic ecology	E28 Conceptual Object
		Pengolahan alam (Resource management)		Resource management	Natural resource management	Traditional environmental knowledge	E55 Type
	Pengobatan tradisional	*Bahan pengobatan (Herbal medicine*		Medicinal plant ingredients	Herbal medicine ingredients	Traditional medicinal	E57 Material
		Etiologi penyakit (Traditional disease		Traditional disease classification	Indigenous explanations of	Ethnomedical etiology	E28 Conceptual Object
		Metode pengobatan (Traditional healing methods)		Traditional healing methods	Health improvement techniques –	Cultural healing systems	E55 Type
PERALATAN DAN PERLENGKAPAN (TOOLS AND EQUIPMENT)	**Alat komunikasi (Communication**	*Kamera film (Film cameras)*		Motion-picture cameras	Cameras	Film cameras	E22 Man-Made Object
		Kentongan (Slit drums)		Slit drums	Drums	Communication equipment	E22 Man-Made Object

	Lonceng (Bells)	Bells (indicating devices)	Bells	Communication equipment	E22 Man-Made Object
	Mikrofilm (Microforms)	Microforms	Microforms	Microform	E22 Man-Made
	Papan pengumuman (Bulletin board)	Bulletin boards	Notice boards	Information displays	E22 Man-Made Object
	Peluit (Whistles)	Whistles	Whistles	Manual sound signaling	E22 Man-Made Object
	Pengeras suara (Loudspeakers)	Loudspeakers	Sound--Recording and reproducing	Communication equipment	E22 Man-Made Object
	Proyektor (Projectors)	Motion picture projectors	Motion picture projectors	Projectors	E22 Man-Made Object
	Radio (Radios)	Radios	Radio	Radio	E22 Man-Made
	Semafor (Semaphore signals)	Semaphore signals	Signals and signaling	Communication equipment	E22 Man-Made Object
	Telegram (Telegraphs)	telegraphs (communication equipment)	Telegraph	Telecommunication equipment	E22 Man-Made Object
	Telepon (Telephones)	Telephones	Telephone	Telecommunication equipment	E22 Man-Made Object
Alat makan	*Garpu (Forks)*	Forks	Forks	Food preparation	E22 Man-Made
	Gelas (Drinking cups)	Cups	Drinking cups	Food preparation	E22 Man-Made
	Mangkuk (Bowls)	Soup bowls	Bowls	Food preparation	E22 Man-Made
	Nampan (Trays)	tray racks	Trays	Food preparation	E22 Man-Made
	Tempat kue (Cake	Cake stands	Cake stands	Food preparation	E22 Man-Made
	Sendok (Spoons)	Spoons	Spoons	Food preparation	E22 Man-Made
	Sumpit (Chopsticks)	Chopsticks	Chopsticks	Food preparation	E22 Man-Made
	Tempat telur (Eggcups)	Eggcups	Eggcups	Food preparation	E22 Man-Made
	Tempat madu (Honey	Honeypots	Honey pots	Food preparation	E22 Man-Made
	Tempat pisau (Knife	Knife rests	Knife rests	Food preparation	E22 Man-Made
	Piring (Plates)	Cup plates	Plates	Food preparation	E22 Man-Made
	Pisau (Knives)	Knives	Knives	Food preparation	E22 Man-Made
	Tempat garam	Saltcellars	Saltcellars	Food preparation	E22 Man-Made
	Rak roti (Toast racks)	Toast racks	Toast racks	Food preparation	E22 Man-Made
Alat masak	*Cetakan kue (Molds)*	Cake molds	Molds	Food preparation	E22 Man-Made

	Kuali (Cauldrons)		Cauldrons	Kettles	Food preparation	E22 Man-Made
	Loyang (Baking pans)		Bread pans	Baking pans	Food preparation	E22 Man-Made
	Panci (Pots)		Cookie jars	Pots	Food preparation	E22 Man-Made
	Pemotong kue (Cookie cutters)		Cookie cutters	Cookie cutters	Food preparation	E22 Man-Made Object
	Penghangat makanan (Food warmers)		Food warmers	Food warmers	Food preparation	E22 Man-Made Object
	Pengukus makanan (Food steamers)		Steamers	Food steamers	Food preparation	E22 Man-Made Object
	Periuk (Kettles)		Kettles	Kettles	Food preparation	E22 Man-Made
	Tungku (Stoves)		Stoves (hearths)	Stoves	Food preparation	E22 Man-Made
	Wajan (Frying pans)		Frying pans	Frying pans	Food preparation	E22 Man-Made
Alat pertambangan (Mining tools)	***Mesin pertambangan (Mining machinery)***	Buldoser (Bulldozers)	Bulldozers	Bulldozers	Earth-moving equipment	E22 Man-Made Object
		Kereta tambang/lori (Mine carts)	Mine carts	Mining cars	Mining transport	E22 Man-Made Object
		Loader (Loaders)	Loaders	Front-end loaders	Mining loaders	E22 Man-Made
		Mesin bor tambang (Drilling rigs)	Drilling rigs	Drilling and boring machinery	Drilling equipment	E22 Man-Made Object
		Mesin giling uap (Steam rollers)	Steam rollers	Steam-engines	Industrial	E22 Man-Made
		Mesin penghancur batu (Rock crushers)	Crushing machinery	Rock crushers	Crushing equipment	E22 Man-Made Object
		Mesin penyangga atap (Roof supports)	Roof supports	Mining supports	Mine safety equipment	E22 Man-Made Object
		Sistem ban berjalan (Belt conveyors)	Belt conveyors	Conveying machinery	Conveyor belts	E22 Man-Made Object
	Alat tambang tradisional (Hand tools)	Ayakan (Shieves)	Sieves	Sieves	N/A	E22 Man-Made Object
		Belincong (Mattocks)	Mattocks	Mattocks	N/A	E22 Man-Made
		Cangkul tambang (Hoes)	Hoes	Hoers	N/A	E22 Man-Made
		Drum air (Water containers)	Water drums	Water containers	N/A	E22 Man-Made
		Ember (Buckets)	Buckets	Buckets	N/A	E22 Man-Made
		Gergaji (Saws)	Saws	Saws	N/A	E22 Man-Made
		Gunting (Scissors)	Scissors	Scissors	N/A	E22 Man-Made

		Kapak (Axes)	Axes	Axes	N/A	E22 Man-Made
		Katrol (Pulleys)	Pulleys	Hoisting	N/A	E22 Man-Made
		Keranjang (Bamboo baskets)	Basketry	Bamboo baskets	Handicrafts	E22 Man-Made
		Linggis (Crowbars)	Crowbars	Crowbars	N/A	E22 Man-Made
		Pahat (Chisels)	Chisels	Chisels	N/A	E22 Man-Made
		Palu (Hammers)	Hammers	Hammers	N/A	E22 Man-Made
		Parang (Machetes)	Machetes	Machetes	N/A	E22 Man-Made
		Peyangga kayu (Mine timbering)	Timbering	Mine timbering	N/A	E22 Man-Made
		Sekop (Shovels)	Shovels	Shovels	N/A	E22 Man-Made
		Tang (Cutting pliers)	Cutting pliers	Cutting tools	N/A	E22 Man-Made
		Tangga (Stepladders)	Stepladders	Ladders	N/A	E22 Man-Made
Alat transportasi (Transportation)	***Transportasi Air (Water transport)***	Kapal layar (Sailing ships)	Sailing ships	Sailing ships	Water transport	E22 Man-Made Object
		Kapal perang (Warships)	Warships	Warships	Ships	E22 Man-Made
		Kapal uap (Steamships)	Steamships	Steam-navigation	Ships	E22 Man-Made
		Perahu (Boats)	Boats	Boats and boating	Ships	E22 Man-Made
	Transportasi darat (Land transport)	Bis (Buses)	Buses	Buses	Vehicles	E22 Man-Made Object
		Kereta api (Trains)	Locomotives	Railroads	Trains	E22 Man-Made
		Kereta dan gerobak (Carriages and carts)	Carts	Carriages and carts	Vehicles	E22 Man-Made Object
		Mobil van (Vans)	Vans (vehicles)	Vans (Vehicles)	Motor vehicles	E22 Man-Made
		Sepeda (Bicycles)	Bicycles	Bicycles	Bicycles	E22 Man-Made
		Sepeda motor (Motorcycles)	Motorcycles	Motorcycles	Motor vehicles	E22 Man-Made
		Truk (Trucks)	Trucks	Trucks	Vehicles	E22 Man-Made
Alat ukur (Measuring instruments)	*Alat hitung daya listrik (Electric meters)*		Electric meters	Electric meters	Measuring instruments	E22 Man-Made Object
	Alat ukur arus listrik (Ammeters)		Ammeters	Ammeters	Measuring instruments	E22 Man-Made Object
	Alat ukur daya listrik (Wattmeters)		Wattmeters	Electric power consumption—Measurement	Measuring instruments	E22 Man-Made Object

	Alat ukur hambatan listrik (Ohmmeters)		Ohmmeters	Ohmmeters	Measuring instruments	E22 Man-Made Object
	Alat ukur tanah		Theodolites	Theodolites	Measuring	E22 Man-Made
	Alat ukur tegangan listrik (Voltmeters)		Voltmeters	Voltmeters	Measuring instruments	E22 Man-Made Object
	Timbangan debu (Air samplers)		Air samplers	Air sampling apparatus	Measuring instruments	E22 Man-Made Object
Peralatan listrik (Electrical	*Gramafon (Phonographs)*		Phonographs	Phonograph	Phonograms	E22 Man-Made Object
	Kipas angin (Electric		Electric fans	Electric fans	Air conditioning	E22 Man-Made
	Komputer (Computers)		Computers	Computers	Computers	E22 Man-Made
	Lampu (Lamps)	Lampu keselamatan (Safety lamp)	Safety lamps	Lamps—Safety	Light	E22 Man-Made Object
		Lampu sinyal (Signal lamps)	Signal lamps	Signal lights	Light	E22 Man-Made
		Lampu sorot (Spotlights)	Spotlights	Searchlights	Light	E22 Man-Made
		Lampu wesel (Railroad signals)	Railway signal	Railroad signals	Light	E22 Man-Made
		Lampu wolf (Safety lamps)	Wolf safety lamps	Safety lamps	Light	E22 Man-Made
		Senter kepala (Headlamps)	Headlamps	Headlamps	Light	E22 Man-Made
	Televisi (Television sets)		Television sets	Television	Television	E22 Man-Made
Seragam tambang (Uniforms)	*Baju tambang (Work clothes)*		Cloth	Work clothes	Clothing	E22 Man-Made Object
	Celana (Trousers)		Trousers	Pants	Clothing	E22 Man-Made
	Helm (Protective		Protective helmets	Mining safety	Clothing	E22 Man-Made
	Kacamata pelindung (Protective eyeglasses)		Eye glasses	Protective eyeglasses	Safety devices	E22 Man-Made Object
	Respirator (Breathing apparatus)		Respirators	Breathing apparatus	Safety devices	E22 Man-Made Object
	Sarung tangan (Work		Protective gloves	Work gloves	Clothing	E22 Man-Made
	Sepatu tambang (Safety shoes)		Safety shoes	Shoes	Clothing	E22 Man-Made Object
	Seragam kantor (Office attire)		Office uniforms	Office attire	Clothing	E22 Man-Made Object
	Topi (Headwear)		Hats	Headwear	Clothing	E22 Man-Made

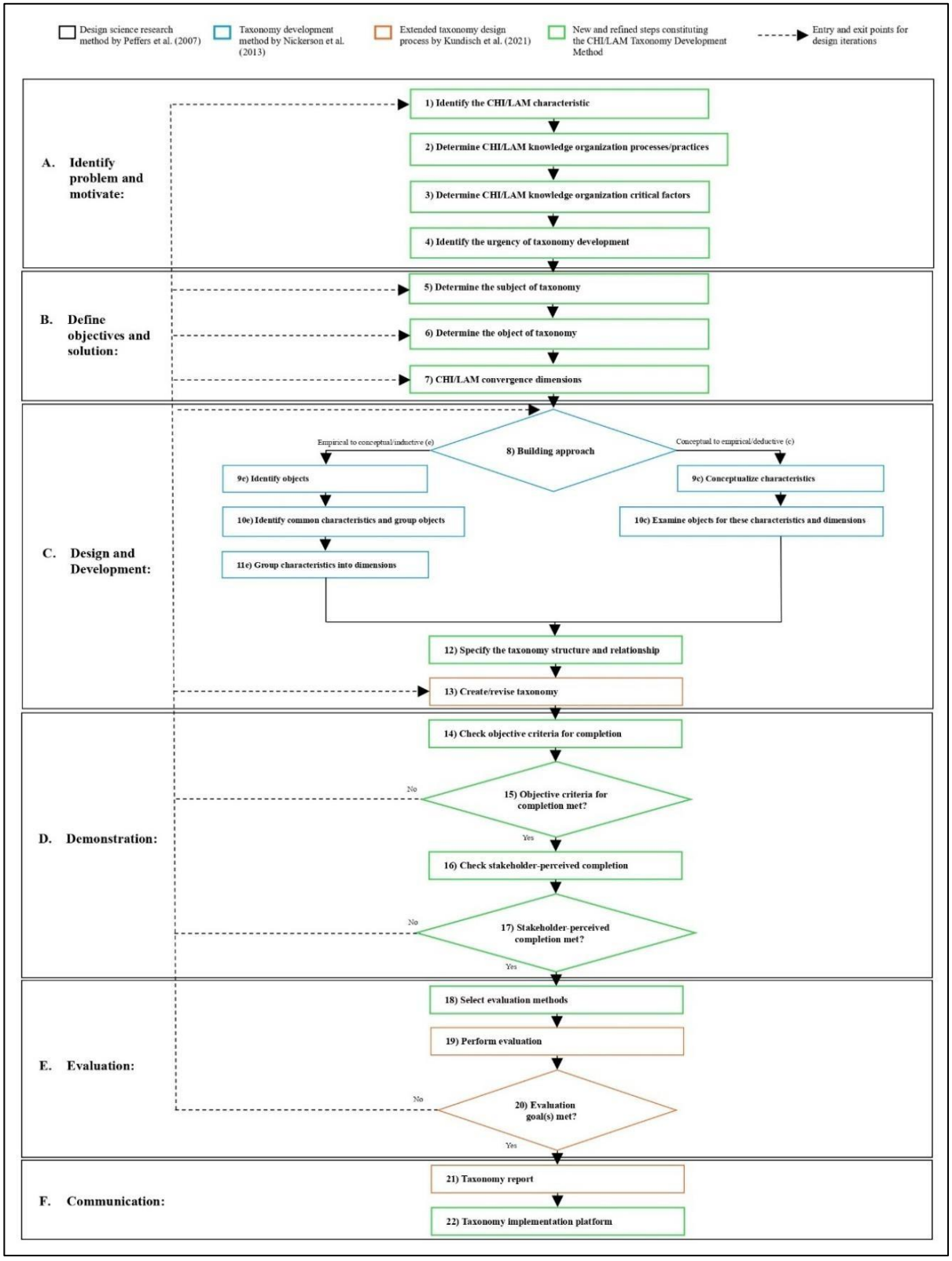


SENI PERTUNJUKAN (PERFORMING ARTS)	**Seni gerak (Movement art)**	***Olahraga dan permainan rakyat (Traditional sports and games)***	Berkuda (Horse riding)	Horseback riding	Horse riding	Sport	E7 Activity
			Layang-layang (Toy kites)	Toy kites	Kites	Play	E7 Activity
			Sepak bola (Football)	Football	Football	Football	E7 Activity
		Seni akrobat (Acrobatics)		Acrobatics	Acrobatic performances	Acrobatics	E7 Activity
		Seni bela diri (Martial arts)		Martial arts	Martial arts	Combat-based performance arts	E7 Activity
	Seni musik (Musical art)	***Alat musik (Musical instruments)***	Gamelan (Gamelan)	Musical instruments	Gamelan	Musical instruments	E22 Man-Made Object
			Harmonika (Harmonica)	Harmonicas	Harmonica	Musical	E22 Man-Made
			Saluang (Flute)	Bamboo flutes	Flute	Musical	E22 Man-Made
			Serunai (Oboes)	Double reed	Oboes	Musical	E22 Man-Made
			Talempong (Talempong)	Gong chimes	Talempong	Musical	E22 Man-Made
			Ukulele (Ukulele)	Ukuleles	Ukulele	Musical	E22 Man-Made
	Seni suara (Vocal			Vocal music	Singing	Vocal music	E5 Event
	Seni tari (Dance)			Dance	Dance	Dance	E5 Event
TRADISI LISAN (ORAL TRADITION)	**Bahasa daerah (Mother tongue)**	*Dialek (Dialects)*		Dialects	Regional dialects	Dialects	E33 Linguistic Object
		Tata bahasa (Grammar)		Grammar – oral tradition	Grammar – indigenous	Grammar	E33 Linguistic Object
	Cerita rakyat (Folklore)	*Cerita jenaka (Humorous stories)*		Humorous stories	Humorous stories	Humour	E33 Linguistic Object
		Cerita pendek (Short		Short stories	Short fictional	Short stories	E33 Linguistic Object
		Epos (Epic)		Epic stories	Traditional epics	Epic	E33 Linguistic Object
		Fabel (Fables)		Fables	Fables	Moral stories – animal	E33 Linguistic Object
		Legenda (Legends)		Legends	Heroic and place-based legends	(Legends	E33 Linguistic Object
		Novel (Novels)		Traditional novels	Extended narrative fiction	Novels	E33 Linguistic Object
		Mitos (Mythology)		Mythology	Mythology	Mythology	E33 Linguistic Object
		Peribahasa (Proverbs)		Proverbs	Proverbs	Proverbs	E33 Linguistic Object

	Doa (Prayers)		Prayers	Prayers	Prayer	E33 Linguistic Object
	Mantra (incantations)		Incantations	Incantations	Incantations	E33 Linguistic Object
	Musik tradisional (Traditional music)		Music	Folk music	Traditional music	E33 Linguistic Object
	Naskah kuno		Manuscripts	Manuscripts,	Manuscripts	E84 Information
	Nyanyian rakyat		Folk songs	Folksongs	Traditional music	E33 Linguistic Object
	Pertunjukan dramatik (Drama)		Drama (Performing arts)	Drama	Drama	E5 Event
	Puisi (Poetry)		Poetry	Poetry	Poetry	E33 Linguistic Object
	Teka-teki rakyat		Riddles	Rebuses	Riddles	E33 Linguistic Object

APPENDIX 2

Empirical CHI/LAM Taxonomy Development Method



APPENDIX 3

Face and Content Validity Interview Guide Review

EXPERT 1

Dear **Heather Hedden**
Northern Light LLC Taxonomy Manager, USA / American Society for Indexing Member

This interview guide review form contains 18 researchers' questions in the research titled *"Enhancing Access to Heritage Information in Indonesia through the Development of Knowledge Taxonomy: A Case Study of the Ombilin Coal Mining Heritage of Sawahlunto"*. The interview guide was designed to address the research objectives regarding the existing condition of the knowledge organization process and critical factors justifying knowledge taxonomy development at the Ombilin Coal Mining Heritage of Sawahlunto (OCMHS), a UNESCO World Heritage Site located in West Sumatra Province, Republic of Indonesia. This research proposes addressing persistent conditions and critical factors in cross-domain resource discovery within memory institutions (libraries, archives, and museums) in the cultural heritage sector. The target informants for this research have the following characteristics:

1. The OCMHS/ The Sawahlunto Municipality Library and Archives, Office of Library and Archives: Director (1 Informant)
2. The OCMHS/ The Sawahlunto Municipality Museums, Office of Culture: Director (1 Informant)
3. The OCMHS/ The Sawahlunto Municipality Library, Office of Library and Archives: Librarians (2 Informants)
4. The OCMHS/ The Sawahlunto Municipality Archives, Office of Library and Archives: Archivists (2 Informants)
5. The OCMHS/ The Sawahlunto Municipality Museums, Office of Culture: Registrars (2 Informants)
6. The OCMHS/ The Sawahlunto Municipality Museums, Office of Culture: Curators (2 Informants)
7. The OCMHS Representatives: Cultural Heritage Expert (2 Informants)
8. The OCMHS/ The Sawahlunto Municipality Communities: Library User (1 Informant)
9. The OCMHS/ The Sawahlunto Municipality Communities: Archives User (1 Informant)
10. The OCMHS/ The Sawahlunto Municipality Communities: Museums User (1 Informant)

We seek your expert judgment on the degree of clarity (face validity) and relevance (content validity) of each item concerning the measured research objectives. This review includes definitions and relevant terminology of the research. Please be as objective and constructive as possible in your review and use the following rating scales. Kindly select the appropriate answer for each question by ticking the checkbox (✓) and provide comments if any.

Degree of Clarity:
1 = The item is not clear or understandable
2 = The item is somewhat clear and understandable
3 = The item is clear and understandable

Degree of Relevance:
1 = The item is not relevant to the measured concept
2 = The item is somewhat relevant to the measured concept
3 = The item is relevant to the measured concept

Shah Alam, December 25, 2023

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1. EXISTING CONDITION OF KNOWLEDGE ORGANIZATION PROCESS

The *existing condition of knowledge organization processes* at OCMHS refers to the current practices, systems, and institutional approaches used to categorize, describe, and manage cultural heritage resources across memory institutions. It encompasses the degree of standardization and contextual relevance in organizing and providing access to both tangible and intangible heritage collections.

Items	Degree of Clarity			Degree of Relevance			Comments
	1	2	3	1	2	3	
A. Questions for Directors							
What is the role and involvement of museums/libraries and archives in Sawahlunto Municipality in developing knowledge organization practices related to OCMHS cultural heritage today?			✓			✓	All questions for directors were rated very good in terms of clarity and relevance. Questions focused on the role of the institution, internal policies, the level of effectiveness of KO practices, adoption of standard systems, use of digital technology, and involvement of experts. None needed to be revised. Several questions explicitly support the direction of taxonomy development because they discuss systemic and professional involvement in KO. These questions illustrate a strategic understanding from the institutional side regarding the existing conditions of the KO process.
Are there any internal policies or regulations specifically governing the organization of OCMHS cultural heritage collections within the museums/libraries and archives in Sawahlunto Municipality?			✓			✓	
In your opinion, how effective are the current knowledge organization practices implemented in the museums/libraries and archives of Sawahlunto Municipality in supporting access to OCMHS cultural heritage information?		✓				✓	
Have the museums/libraries and archives in Sawahlunto Municipality adopted standardized knowledge organization systems to support access to OCMHS cultural heritage information?			✓			✓	
To what extent is digital technology utilized in the knowledge organization practices of museums/libraries and archives in Sawahlunto Municipality to support access to OCMHS cultural heritage information?			✓			✓	
Have the museums/libraries and archives in Sawahlunto Municipality engaged professional experts in the knowledge organization practices related to OCMHS cultural heritage?			✓			✓	
B. Questions for curators/registrars/librarians/archivists							
What are your primary responsibilities as a curator/registrar/librarian/archivist in the museums/library/archives of Sawahlunto Municipality, particularly in relation to the knowledge organization practices of collections associated with OCMHS cultural heritage?			✓			✓	Questions included descriptions of daily roles, workflows, classification systems used, methods of approach, digitization, and application of standards. All questions were rated as very clear and relevant. They were designed to capture
In your daily routines, how does the workflow in the museums/library/archives of Sawahlunto Municipality proceed in the context of knowledge organization or collection related to OCMHS cultural heritage?			✓			✓	

Are you aware whether the knowledge organization practices for OCMHS cultural heritage collections in Sawahlunto's cultural heritage institutions adhere to any specific national or international standards?			✓			✓	
D. Questions for Library/Archives/Museums User							
Based on your experience as a resident/user of Sawahlunto Municipality's museums/library/archives, how would you see the way OCMHS cultural heritage collections are categorized and made accessible to the general public?			✓			✓	Questions explored user perceptions of how collections are categorized, experiences in accessing information, ease of understanding the KO system, and use of the digital platform. All questions were deemed clear and relevant, except for one question regarding user interaction with the KOS, which needs to be revised. Further exploration of user identification and technical barriers to the system is recommended. Overall, this section provides important information from the user perspective that will enrich the understanding of the real conditions of the KO process from the public's perspective.
When you or your community search for information related to the OCMHS cultural heritage in Sawahlunto Municipality's museums/library/archives, have you ever encountered any difficulties?			✓			✓	
In your view, as a resident/user, do you think the current collections in Sawahlunto Municipality's museums/library/archives adequately reflect the cultural identity of the local OCMHS community?		✓				✓	
Do you think the current knowledge organization system used in Sawahlunto Municipality's museums/library/archives is easy for the public to understand?			✓			✓	
Have you ever tried to access the collections through the digital platform provided by Sawahlunto Municipality's museums/library/archives?			✓			✓	
In your opinion, as a resident/user, are local OCMHS terms already being used in the knowledge organization systems of Sawahlunto Municipality's museums/library/archives?			✓			✓	
Have you ever provided suggestions or feedback to the Sawahlunto Municipality's museums/library/archives on how the OCMHS cultural heritage information should be categorized?			✓		✓		
Do you find that the information or narratives provided in the Sawahlunto Municipality's museums/library/archives, either physical or digital, help you understand the OCMHS cultural heritage from your perspective as a resident/user?			✓			✓	

2. KNOWLEDGE ORGANIZATION CRITICAL FACTORS TO TAXONOMY DEVELOPMENT

Knowledge organization critical factors at OCMHS refer to the essential limitations, challenges, and opportunities relevant to organizing cultural heritage resources in memory institutions. These critical factors are vital for developing an integrated knowledge taxonomy of OCMHS and serve as the initial convergence point for aligning practices, systems, and standards across memory institutions within the OCMHS cultural heritage network.

Could you describe the current system used in the museums/library/archives of Sawahlunto Municipality for knowledge organization pertaining to OCMHS cultural heritage?			✓			✓	the factual conditions, daily practices, and understanding of technical staff regarding the organization of OCMHS cultural collections. Data from this section will help map the actual conditions of the KO process, especially the KO system, and the extent to which the system is oriented to local context and standardization.
What methods or approaches are commonly employed by the museums/library/archives of Sawahlunto Municipality in classifying or categorizing collections related to OCMHS cultural heritage?			✓			✓	
Have the knowledge organization practices related to OCMHS cultural heritage in the museums/library/archives of Sawahlunto Municipality been digitized?			✓			✓	
Does the current knowledge organization system for OCMHS cultural heritage in Sawahlunto Municipality museums/library/archives follow specific national or international standards? How effective is its implementation in practice?			✓		✓		
Are local terminologies or contextual elements of OCMHS cultural heritage accommodated within the current knowledge organization systems used in the museums/library/archives of Sawahlunto Municipality? If not, what are the main constraints?			✓			✓	
Has there been any involvement of subject-matter experts or professionals in the practice and development of knowledge organization systems in the museums/library/archives of Sawahlunto Municipality for OCMHS cultural heritage?		✓				✓	
C. Questions for Cultural Heritage Expert							
Could you explain your main responsibilities as a member of the Cultural Heritage Expert Team in supporting the knowledge organization practice of OCMHS cultural heritage within the cultural heritage institutions of Sawahlunto Municipality?			✓			✓	The questions focused on the role of the Cultural Heritage Expert Team in supporting and evaluating the KO process in cultural heritage institutions. The evaluation showed that all questions were clear and relevant. They helped explore the extent to which there is coordination, critical evaluation, and expert assessment of the ongoing KO process, and how the unique characteristics of OCMHS are accommodated in the current KO system.
To what extent has the Cultural Heritage Expert Team been involved in decision-making or providing assistance related to the knowledge organization of OCMHS cultural heritage in the cultural heritage institutions of Sawahlunto Municipality?			✓			✓	
Is there any space for coordination or dialogue between the Cultural Heritage Expert Team and the cultural heritage institutions of Sawahlunto Municipality regarding knowledge organization practices?		✓				✓	
How do you assess the current state of knowledge organization practices related to OCMHS cultural heritage implemented in the cultural heritage institutions of Sawahlunto Municipality?			✓			✓	
Do the current knowledge organization practices used in the cultural heritage institutions of Sawahlunto Municipality adequately represent the unique characteristics of the OCMHS cultural heritage?			✓		✓		

Items	Degree of Clarity			Degree of Relevance			Comment
	1	2	3	1	2	3	
A. Question for Directors							
What are the main limitations or challenges faced by the museums/libraries and archives in Sawahlunto Municipality in carrying out knowledge organization practices related to OCMHS cultural heritage?			✓			✓	All questions cover strategic issues, such as key challenges in KO, relevance of current standards, potential for contextual system development, system integration plans, and forms of support needed. All are very clear and relevant. These questions directly target key institutional and policy factors that are the foundation for supporting or inhibiting the development of cross-institutional taxonomies.
In your opinion, to what extent are the current systems and standards or guidelines used in knowledge organization relevant to the context of OCMHS cultural heritage in the museums/libraries, and archives of Sawahlunto Municipality?		✓				✓	
In your view, what strategic potentials or opportunities do the museums/libraries and archives of Sawahlunto Municipality possess to develop contextual knowledge organization systems related to OCMHS cultural heritage, such as taxonomies?			✓		✓		
Do the museums/libraries and archives in Sawahlunto Municipality have any strategic plans to promote the integration of knowledge organization systems related to OCMHS cultural heritage, such as taxonomies?			✓			✓	
What forms of support do you believe are most needed by the museums/libraries and archives in Sawahlunto Municipality to strengthen the practices and development of knowledge organization systems related to OCMHS cultural heritage, especially in the form of taxonomies?			✓			✓	
B. Question for curators/registrars/librarians/archivists							
What are the primary limitations or challenges faced by the museums/library/archives of Sawahlunto Municipality in knowledge organization related to OCMHS cultural heritage?			✓			✓	Questions examined technical and operational barriers, aspects most affected by limitations, aspects most affected by limitations, the relationship between the KO process and local characteristics, comparative practices, contextual plans, and cross-sector collaboration. All questions were considered very appropriate to capture critical factors from the technical and field side that greatly influence the development of a practice-based taxonomy. Questions on basic principles and
Which aspect of the knowledge organization practices related to OCMHS cultural heritage do you perceive to be most affected by the current limitations in the museums/library/archives of Sawahlunto Municipality?			✓			✓	
In your view, to what extent is the current knowledge organization system used in the museums/library/archives of Sawahlunto Municipality relevant to the specific characteristics of OCMHS cultural heritage? Do you find the system too generic or lacking in contextual specificity?		✓				✓	
Have you observed or studied practices from other museums, domestically or internationally, that could serve as exemplary models for developing knowledge organization systems such as taxonomy in the museums/library/archives of Sawahlunto Municipality?			✓		✓		

Are there any current strategic plans or initiatives in place within the museums/library/archives of Sawahlunto Municipality aimed at developing a more contextual or participatory knowledge organization system such as taxonomy for OCMHS cultural heritage?			✓			✓	forms of support needed also strengthen the direction of developing a sustainable and inclusive KO system.
In your view, what fundamental principles should be considered by the museums/library/archives of Sawahlunto Municipality in developing an effective and sustainable knowledge organization system such as taxonomy for OCMHS cultural heritage?		✓				✓	
What forms of support are most needed by the museums/library/archives of Sawahlunto Municipality in developing knowledge organization systems such as taxonomy for OCMHS cultural heritage?			✓			✓	
What is your perspective on the importance of cross-sector collaboration for the museums/library/archives of Sawahlunto Municipality in developing an inclusive and integrated knowledge organization system such as taxonomy for OCMHS cultural heritage?			✓		✓		
C. Question for Cultural Heritage Expert							
From your perspective as a Cultural Heritage Expert Team member, what are the main limitations you have identified in the knowledge organization practices of OCMHS cultural heritage in Sawahlunto Municipality's heritage institutions?			✓			✓	The questions have at least focused on identifying the obstacles and challenges faced, strategic opportunities for the development of KO systems, such as taxonomies, examples of best practices, important principles to consider, and forms of support for the development of such systems. All were considered very good in terms of clarity and relevance. Input from this group is important for understanding the conceptual and theoretical perspectives in building a KO system based on cultural heritage.
What are the key challenges you have identified in knowledge organization practices of OCMHS-related cultural heritage in these institutions?			✓			✓	
In your opinion, to what extent is there a strategic opportunity to develop a knowledge organization system, such as a taxonomy, within the heritage institutions of Sawahlunto Municipality?		✓				✓	
Are there any examples of knowledge organization practices, either nationally or internationally, that you believe are relevant and could be adapted by the heritage institutions in Sawahlunto Municipality?			✓		✓		
What essential principles do you think should be taken into consideration by the heritage institutions of Sawahlunto Municipality when developing a knowledge organization system, such as a taxonomy for organizing OCMHS cultural heritage?			✓			✓	
What forms of support are most needed by the museums in Sawahlunto Municipality in implementing and further developing their knowledge organization systems related to OCMHS cultural heritage?			✓			✓	

D. Question for Library/Archives/Museums User							
What are the main limitations or challenges that you think make it difficult to access information about the OCMHS cultural heritage in the Sawahlunto Municipality's museums/library/archives?			✓			✓	Questions explored public perceptions of access limitations, the impact of these limitations, whether the system reflects the richness of cultural heritage, inspiration from other practices, initial suggestions for improvement, public engagement, and expectations for collaboration. All questions were evaluated as highly appropriate for describing community expectations. Incorporating user voice is an important component of a participatory approach to building a socially and culturally relevant taxonomy system.
Based on your experience as a resident/user, which aspects are most affected by the current limitations in the knowledge organization system used by the Sawahlunto Municipality's museums/library/archives?			✓			✓	
Do you think the current knowledge organization system in Sawahlunto Municipality's museums/library/archives accurately reflects the richness of OCMHS cultural heritage?			✓			✓	
Have you ever seen examples of good practices elsewhere that you think could inspire Sawahlunto Municipality's museums/library/archives?		✓				✓	
In your opinion, what is the first thing that the Sawahlunto Municipality's museums/library/archives need to improve so that the public can more easily access and understand information about the OCMHS cultural heritage?			✓			✓	
Do you think the Sawahlunto Municipality's museums/library/archives should involve residents/users in the process of developing the knowledge organization system for OCMHS cultural heritage?			✓		✓		
What are your hopes as a resident/user for the Sawahlunto Municipality's museums/library/archives in providing OCMHS cultural heritage information that better reflects the perspectives of the user/community?			✓			✓	
What is your view on the potential collaboration between residents/users and Sawahlunto Municipality's museums/library/archives in developing a knowledge organization system that is contextual and user-friendly for all?		✓				✓	

Thank you for reviewing this interview guide and your constructive suggestions.

Additional Comments:

(January 5, 2024)

Dear Hendra,

I looked at your interview guide for your dissertation proposal, and I have some feedback, since I have done much scholarly research myself. (I did an M.A. thesis in 1990). I know what is expected for research techniques and methodology. By the way, on the Literature Review slide, I am pleased that you include my book, and I recognize some of the others. Hlava is correct. Also I am not aware of a book or article of hers published in 2022. Her Taxobook 3-volume series was first published in 2015.

As for the Research Interview Guide, the questions are mostly good. They might need to be refined after interviewing starts.
Questions: "Could you please share examples of how users or visitors interact with the KOS at OCMHS?"
This is interesting, but typical interactions would not be *examples*. I suggest replacing this with two questions:
Could you please explain how users or visitors interact with the KOS at OCMHS (including searching, lookup, browsing, filtering, etc.)?
Could you please provide examples of what users use to KOS at OCMHS for in their research?

I also suggest adding a question:
Who are the users or visitors of cultural heritage information at OCMHS who would use the KOS?

And there probably needs to be a question about technology, which you might ask differently than my suggestion:
Are there software system features or limitations that impact the KOS?

That's all I have time for.
Good luck!

Kind regards,
Heather

EXPERT 2

Dear **Dr. Luh Putu Sri Ariyani, M, Hum.**
Department of Library Science, Universitas Pendidikan Ganesha, Indonesia

This interview guide review form contains 18 researchers' questions in the research titled *"Enhancing Access to Heritage Information in Indonesia through the Development of Knowledge Taxonomy: A Case Study of the Ombilin Coal Mining Heritage of Sawahlunto"*. The interview guide was designed to address the research objectives regarding the existing condition of the knowledge organization process and critical factors justifying knowledge taxonomy development at the Ombilin Coal Mining Heritage of Sawahlunto (OCMHS), a UNESCO World Heritage Site located in West Sumatra Province, Republic of Indonesia. This research proposes addressing persistent conditions and critical factors in cross-domain resource discovery within memory institutions (libraries, archives, and museums) in the cultural heritage sector. The target informants for this research have the following characteristics:

1. The OCMHS/ The Sawahlunto Municipality Library and Archives, Office of Library and Archives: Director (1 Informant)
2. The OCMHS/ The Sawahlunto Municipality Museums, Office of Culture: Director (1 Informant)
3. The OCMHS/ The Sawahlunto Municipality Library, Office of Library and Archives: Librarians (2 Informants)
4. The OCMHS/ The Sawahlunto Municipality Archives, Office of Library and Archives: Archivists (2 Informants)
5. The OCMHS/ The Sawahlunto Municipality Museums, Office of Culture: Registrars (2 Informants)
6. The OCMHS/ The Sawahlunto Municipality Museums, Office of Culture: Curators (2 Informants)
7. The OCMHS Representatives: Cultural Heritage Expert (2 Informants)
8. The OCMHS/ The Sawahlunto Municipality Communities: Library User (1 Informant)
9. The OCMHS/ The Sawahlunto Municipality Communities: Archives User (1 Informant)
10. The OCMHS/ The Sawahlunto Municipality Communities: Museums User (1 Informant)

We seek your expert judgment on the degree of clarity (face validity) and relevance (content validity) of each item concerning the measured research objectives. This review includes definitions and relevant terminology of the research. Please be as objective and constructive as possible in your review and use the following rating scales. Kindly select the appropriate answer for each question by ticking the checkbox (✓) and provide comments if any.

Degree of Clarity:
1 = The item is not clear or understandable
2 = The item is somewhat clear and understandable
3 = The item is clear and understandable

Degree of Relevance:
1 = The item is not relevant to the measured concept
2 = The item is somewhat relevant to the measured concept
3 = The item is relevant to the measured concept

Shah Alam, December 25, 2023

Muhammad Rosyihan Hendrawan
Ph.D. Candidate
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Supervisor
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Assoc. Prof. Dr. Ahmad Zam Hariro Samsudin

1. EXISTING CONDITION OF KNOWLEDGE ORGANIZATION PROCESS

The *existing condition of knowledge organization processes* at OCMHS refers to the current practices, systems, and institutional approaches used to categorize, describe, and manage cultural heritage resources across memory institutions. It encompasses the degree of standardization and contextual relevance in organizing and providing access to both tangible and intangible heritage collections.

Items	Degree of Clarity			Degree of Relevance			Comment
	1	2	3	1	2	3	
A. Questions for Directors							
What is the role and involvement of museums/libraries and archives in Sawahlunto Municipality in developing knowledge organization practices related to OCMHS cultural heritage today?			✓			✓	All questions in this section are clear and relevant. No substantive changes are needed. The questions have been able to explore the understanding of the role of institutions and internal policies in supporting knowledge organizing practices. However, some terms, such as standardized system or digital utilization, can be explained with operational terms in field practice, but do not interfere with overall clarity.
Are there any internal policies or regulations specifically governing the organization of OCMHS cultural heritage collections within the museums/libraries and archives in Sawahlunto Municipality?			✓			✓	
In your opinion, how effective are the current knowledge organization practices implemented in the museums/libraries and archives of Sawahlunto Municipality in supporting access to OCMHS cultural heritage information?			✓		✓		
Have the museums/libraries and archives in Sawahlunto Municipality adopted standardized knowledge organization systems to support access to OCMHS cultural heritage information?			✓			✓	
To what extent is digital technology utilized in the knowledge organization practices of museums/libraries and archives in Sawahlunto Municipality to support access to OCMHS cultural heritage information?			✓			✓	
Have the museums/libraries and archives in Sawahlunto Municipality engaged professional experts in the knowledge organization practices related to OCMHS cultural heritage?			✓			✓	
B. Questions for curators/registrars/librarians/archivists							
What are your primary responsibilities as a curator/registrar/librarian/archivist in the museums/library/archives of Sawahlunto Municipality, particularly in relation to the knowledge organization practices of collections associated with OCMHS cultural heritage?			✓			✓	Questions for technical informants (curators, registrars, librarians, and archivists) have covered job descriptions, daily workflows, systems used, and classification methods. All questions were considered clear and relevant. They provide a detailed picture of how the organization of cultural heritage collections is carried out at the
In your daily routines, how does the workflow in the museums/library/archives of Sawahlunto Municipality proceed in the context of knowledge organization or collection related to OCMHS cultural heritage?		✓				✓	
Could you describe the current system used in the museums/library/archives of Sawahlunto Municipality for knowledge organization pertaining to OCMHS cultural heritage?			✓			✓	

What methods or approaches are commonly employed by the museums/library/archives of Sawahlunto Municipality in classifying or categorizing collections related to OCMHS cultural heritage?			✓			✓	technical implementation level. Although some terms may need language adjustments for ease of understanding in the field, the structure of the questions is appropriate.
Have the knowledge organization practices related to OCMHS cultural heritage in the museums/library/archives of Sawahlunto Municipality been digitized?			✓			✓	
Does the current knowledge organization system for OCMHS cultural heritage in Sawahlunto Municipality museums/library/archives follow specific national or international standards? How effective is its implementation in practice?			✓			✓	
Are local terminologies or contextual elements of OCMHS cultural heritage accommodated within the current knowledge organization systems used in the museums/library/archives of Sawahlunto Municipality? If not, what are the main constraints?			✓			✓	
Has there been any involvement of subject-matter experts or professionals in the practice and development of knowledge organization systems in the museums/library/archives of Sawahlunto Municipality for OCMHS cultural heritage?			✓		✓		
C. Questions for Cultural Heritage Expert							
Could you explain your main responsibilities as a member of the Cultural Heritage Expert Team in supporting the knowledge organization practice of OCMHS cultural heritage within the cultural heritage institutions of Sawahlunto Municipality?			✓			✓	This question is quite focused on the assessment and involvement of the Cultural Heritage Expert Team in the process of organizing knowledge. All questions are considered clear and relevant, covering aspects of involvement in decision-making, coordination space with institutions, and evaluation of knowledge representation of the characteristics of the OCMHS heritage. No significant changes are needed because the questions are in accordance with the level of knowledge and strategic position of this informant.
To what extent has the Cultural Heritage Expert Team been involved in decision-making or providing assistance related to the knowledge organization of OCMHS cultural heritage in the cultural heritage institutions of Sawahlunto Municipality?			✓			✓	
Is there any space for coordination or dialogue between the Cultural Heritage Expert Team and the cultural heritage institutions of Sawahlunto Municipality regarding knowledge organization practices?			✓			✓	
How do you assess the current state of knowledge organization practices related to OCMHS cultural heritage implemented in the cultural heritage institutions of Sawahlunto Municipality?			✓			✓	
Do the current knowledge organization practices used in the cultural heritage institutions of Sawahlunto Municipality adequately represent the unique characteristics of the OCMHS cultural heritage?			✓			✓	
Are you aware whether the knowledge organization practices for OCMHS cultural heritage collections in Sawahlunto's cultural		✓				✓	

heritage institutions adhere to any specific national or international standards?							
D. Questions for Library/Archives/Museums User							
Based on your experience as a resident/user of Sawahlunto Municipality's museums/library/archives, how would you see the way OCMHS cultural heritage collections are categorized and made accessible to the general public?			✓			✓	Most questions for public collection users were deemed clear and relevant.
When you or your community search for information related to the OCMHS cultural heritage in Sawahlunto Municipality's museums/library/archives, have you ever encountered any difficulties?			✓			✓	
In your view, as a resident/user, do you think the current collections in Sawahlunto Municipality's museums/library/archives adequately reflect the cultural identity of the local OCMHS community?			✓			✓	
Do you think the current knowledge organization system used in Sawahlunto Municipality's museums/library/archives is easy for the public to understand?			✓			✓	
Have you ever tried to access the collections through the digital platform provided by Sawahlunto Municipality's museums/library/archives?			✓			✓	
In your opinion, as a resident/user, are local OCMHS terms already being used in the knowledge organization systems of Sawahlunto Municipality's museums/library/archives?			✓		✓		
Have you ever provided suggestions or feedback to the Sawahlunto Municipality's museums/library/archives on how the OCMHS cultural heritage information should be categorized?			✓			✓	
Do you find that the information or narratives provided in the Sawahlunto Municipality's museums/library/archives, either physical or digital, help you understand the OCMHS cultural heritage from your perspective as a resident/user?			✓			✓	

2. KNOWLEDGE ORGANIZATION CRITICAL FACTORS TO TAXONOMY DEVELOPMENT

Knowledge organization critical factors at OCMHS refer to the essential limitations, challenges, and opportunities relevant to organizing cultural heritage resources in memory institutions. These critical factors are vital for developing an integrated knowledge taxonomy of OCMHS and serve as the initial convergence point for aligning practices, systems, and standards across memory institutions within the OCMHS cultural heritage network.

Items	Degree of Clarity			Degree of Relevance			Comment
	1	2	3	1	2	3	
A. Question for Directors							
What are the main limitations or challenges faced by the museums/libraries and archives in Sawahlunto Municipality in carrying out knowledge organization practices related to OCMHS cultural heritage?			✓			✓	All in this section have been assessed as clear and relevant, especially in identifying strategic challenges and institutional support. Questions such as system integration plans, contextual KO system development opportunities, and forms of institutional support are essential to understanding the justification for developing a taxonomy. Although terms such as "strategic potentials" and "taxonomy" can be simplified in practice, academically, the questions are still on target.
In your opinion, to what extent are the current systems and standards or guidelines used in knowledge organization relevant to the context of OCMHS cultural heritage in the museums/libraries, and archives of Sawahlunto Municipality?			✓			✓	
In your view, what strategic potentials or opportunities do the museums/libraries and archives of Sawahlunto Municipality possess to develop contextual knowledge organization systems related to OCMHS cultural heritage, such as taxonomies?			✓			✓	
Do the museums/libraries and archives in Sawahlunto Municipality have any strategic plans to promote the integration of knowledge organization systems related to OCMHS cultural heritage, such as taxonomies?			✓			✓	
What forms of support do you believe are most needed by the museums/libraries and archives in Sawahlunto Municipality to strengthen the practices and development of knowledge organization systems related to OCMHS cultural heritage, especially in the form of taxonomies?			✓			✓	
B. Question for curators/registrars/librarians/archivists							
What are the primary limitations or challenges faced by the museums/library/archives of Sawahlunto Municipality in knowledge organization related to OCMHS cultural heritage?			✓			✓	The questions for technical implementers adequately reflect real-world obstacles, perceptions of the current system, and experiences with good practices from other institutions. All questions were deemed clear and relevant. They explore factors important for the design of a sustainable and participatory taxonomy system. Simplifying terms such as "contextual specificity" and "fundamental principles" would
Which aspect of the knowledge organization practices related to OCMHS cultural heritage do you perceive to be most affected by the current limitations in the museums/library/archives of Sawahlunto Municipality?			✓			✓	
In your view, to what extent is the current knowledge organization system used in the museums/library/archives of Sawahlunto Municipality relevant to the specific characteristics of OCMHS cultural heritage? Do you find the system too generic or lacking in contextual specificity?			✓			✓	
Have you observed or studied practices from other museums, domestically or internationally, that could serve as exemplary models for developing knowledge organization systems such as			✓			✓	

taxonomy in the museums/library/archives of Sawahlunto Municipality?							make them easier to understand in the field, without changing the essence of the questions.
Are there any current strategic plans or initiatives in place within the museums/library/archives of Sawahlunto Municipality aimed at developing a more contextual or participatory knowledge organization system such as taxonomy for OCMHS cultural heritage?			✓			✓	
In your view, what fundamental principles should be considered by the museums/library/archives of Sawahlunto Municipality in developing an effective and sustainable knowledge organization system such as taxonomy for OCMHS cultural heritage?			✓		✓		
What forms of support are most needed by the museums/library/archives of Sawahlunto Municipality in developing knowledge organization systems such as taxonomy for OCMHS cultural heritage?			✓			✓	
What is your perspective on the importance of cross-sector collaboration for the museums/library/archives of Sawahlunto Municipality in developing an inclusive and integrated knowledge organization system such as taxonomy for OCMHS cultural heritage?			✓			✓	
C. Question for Cultural Heritage Expert							
From your perspective as a Cultural Heritage Expert Team member, what are the main limitations you have identified in the knowledge organization practices of OCMHS cultural heritage in Sawahlunto Municipality's heritage institutions?			✓			✓	Questions to the expert team have at least focused on evaluating the current KO process and the strategic potential of taxonomy development. All questions were considered clear and relevant. They were asked to identify limitations and assess examples of national and international good practices. The language of the questions can be maintained for informants with a high academic or professional background.
What are the key challenges you have identified in knowledge organization practices of OCMHS-related cultural heritage in these institutions?			✓			✓	
In your opinion, to what extent is there a strategic opportunity to develop a knowledge organization system, such as a taxonomy, within the heritage institutions of Sawahlunto Municipality?			✓		✓		
Are there any examples of knowledge organization practices, either nationally or internationally, that you believe are relevant and could be adapted by the heritage institutions in Sawahlunto Municipality?			✓			✓	
What essential principles do you think should be taken into consideration by the heritage institutions of Sawahlunto Municipality when developing a knowledge organization system, such as a taxonomy for organizing OCMHS cultural heritage?			✓			✓	
What forms of support are most needed by the museums in Sawahlunto Municipality in implementing and further developing			✓			✓	

their knowledge organization systems related to OCMHS cultural heritage?							
D. Question for Library/Archives/Museums User							
What are the main limitations or challenges that you think make it difficult to access information about the OCMHS cultural heritage in the Sawahlunto Municipality's museums/library/archives?			✓			✓	Questions to service users focused on barriers to accessing information, perceptions of heritage representation, and views on community engagement. All questions were deemed clear and relevant, noting that technical terms such as "knowledge organization system" could be simplified to "the way in which collections or information are organized or categorized." Questions about community engagement were essential to guiding an inclusive and participatory approach to the taxonomy.
Based on your experience as a resident/user, which aspects are most affected by the current limitations in the knowledge organization system used by the Sawahlunto Municipality's museums/library/archives?			✓			✓	
Do you think the current knowledge organization system in Sawahlunto Municipality's museums/library/archives accurately reflects the richness of OCMHS cultural heritage?			✓			✓	
Have you ever seen examples of good practices elsewhere that you think could inspire Sawahlunto Municipality's museums/library/archives?			✓			✓	
In your opinion, what is the first thing that the Sawahlunto Municipality's museums/library/archives need to improve so that the public can more easily access and understand information about the OCMHS cultural heritage?		✓				✓	
Do you think the Sawahlunto Municipality's museums/library/archives should involve residents/users in the process of developing the knowledge organization system for OCMHS cultural heritage?			✓			✓	
What are your hopes as a resident/user for the Sawahlunto Municipality's museums/library/archives in providing OCMHS cultural heritage information that better reflects the perspectives of the user/community?			✓		✓		
What is your view on the potential collaboration between residents/users and Sawahlunto Municipality's museums/library/archives in developing a knowledge organization system that is contextual and user-friendly for all?			✓			✓	

Thank you for reviewing this interview guide and your constructive suggestions.

Additional Comments:

(January 5, 2024)

Dear Mr. Hendrawan. I am sending some research question suggestions that might help dig up data in the field.

Researcher needs to simplify research questions addressed to informants. For example, questions about knowledge organization systems might be asked in general terms such as How do you organize, store, and provide access to information in various knowledge domains? This also applies to other research questions. Dig up information without making it difficult for informants to understand academic terms that may not be familiar to them.

Sometimes we don't know exactly what our weaknesses are, so informants need to be asked more practical questions, such as "how does your superior support you in managing and disseminating cultural heritage information?"

When going into the field, look for equivalent words from the knowledge taxonomy that make it easier for informants to explain their daily work. Maybe it would be better understood if the question was: "Explain how OCMHS cultural sites are grouped? What are the grouping categories?"
This applies to all questions.

Sincerely,
Luh Putu S. A.

APPENDIX 4

Observation Logbook

April 2024

A. OBSERVATION, APRIL 1–13

Activity Focus:

The first and second weeks were dedicated to preliminary observation, focusing on mapping the organizational structure and conducting an initial exploration of cultural heritage type or categories (tangible and intangible) and knowledge organization (KO) processes across four museums in Sawahlunto Municipality, or known as Area A of Ombilin Coal Mining Heritage of Sawahlunto (OCMHS), all of which are under the coordination or management of the Sawahlunto Municipality Office of Culture. These museums include the Goedang Ransoem Museum, the Railway Museum, the Soero Coal Mine Pit Site Museum, and the Coal Mining Museum. This phase also served as the foundation for understanding how local narratives and cultural values are treated within the museum collection classification practices.

Institutions Visited:

- Office of Culture, Sawahlunto Municipality
- The Goedang Ransoem Museum
- The Railway Museum
- The Soero Coal Mine Pit Site Museum
- The Coal Mining Museum

Field Activities:

- Audience and in-depth interviews with the Head of the Office of Culture (DIR1), along with four key museum technical staff, consisting of two curators (CUR1, CUR2) and two registrars (REG1, REG2).
- Direct observation of daily museum work processes related to collection classification, labeling, artifact documentation, and the narrative approach employed by the curators.
- Review of manual recording systems used by registrars, and exploration of work

documents related to collection classification and inventory (***Manual Dependency***). The information gathered reflects an ongoing reliance on manual processes for collection, classification, documentation, and management.

- Photographing selected collections, registration books, and storage/display spaces of artifacts.

Key Findings:

1. **Documents Identified:**
    - Museum Collection Inventory Book (in Excel or spreadsheet format), containing basic information such as inventory numbers, object name, origin, and physical condition.
    - New Collection Registration Form, filled out manually and used as the basis for digital entry (when equipment is available) (***Accessioning Process, Manual Dependency***). This indicates a continuing dependency on manual methods for collection, classification, and management.
    - A Mayor's Decree of Sawahlunto concerning the designation of specific collections as part of the OCMHS (some collections have been proposed as Cultural Heritage Objects).
    - An internal draft for local sub-category structuring (not yet formalized), listing terms (***Local Terminology***).
2. **Visual and Narrative Materials:**
    - Visual documentation, which is attached to some display cases, indicating early efforts to insert social context into object presentations (though not yet standardized) (***Narrative Description***). This descriptive approach emphasizes the story or socio-cultural background of the collection, beyond mere technical or administrative data.
    - Several unique tangible and intangible CH, such as mining tools and equipment from mining periods, rites, ceremonies, and traditions, remain undocumented with formal narrative descriptions.
    - Collection items present strong potential for categorization based on tangible and intangible CH.
3. **Additional Field Notes:**
    - Archives of correspondence with national agencies, including the Ministry of Education and Culture, and the Centre for the Conservation of Cultural Properties of the Republic of Indonesia, exist but are not yet

- integrated into the museum's collection system.
- Curators maintain personal documentation from local historical research, including interview transcripts with former miners, which have not been archived institutionally.
- Informal discussions indicate a desire to digitize the collections (***Digitization Preparedness***), but efforts are hindered by a lack of equipment (***Infrastructure Constraints***), budget limitations, and technical training needs (***Capacity Development***). This reflects institutional and technical readiness challenges in initiating or continuing digitization efforts, including overcoming human resource and infrastructure limitations.
- Accessioning is still conducted manually and is not yet fully digitized; this points to challenges in standardizing and automating the accessioning process across the institution.

Researcher's Notes:

The initial stage of observation indicated that knowledge organization (KO) processes are still in a transitional phase between formal systems based on national regulations and the need to accommodate local specificities. The four museums in Sawahlunto Municipality have served as central repositories for physical artifacts but have yet to fully manage the narrative and social value aspects of the collections or resources, including tangible and intangible CH (***Collection Stewardship***). This highlights that while cultural institutions function as custodians of collections, they continue to face challenges in expanding stewardship toward social and thematic narratives. There exists a vast potential for cultural narratives, particularly related to community identity, mining administration, through tangible and intangible CH. However, the absence of an integrated digital system and weak data interoperability result in dispersed and non-thematic information. Nonetheless, the museum teams have shown enthusiasm and initiative in developing more contextual local sub-categories as a foundation for constructing a contextualized taxonomy for OCMHS CHI.

B. Observation, April 22–27, 2024

Activity Focus:

During the third week of April, field activities focused on deepening cross-actor

perspectives, particularly from the Cultural Heritage Expert Team and users of the museum, library, and archives. The objective was to obtain a comprehensive view from the perspective of users and external stakeholders regarding the existing knowledge organization system. The observations aimed to understand how local values, social contexts, and community narratives are currently represented in classification and documentation systems.

Institutions and Informants Targeted:

- OCMHS representatives or Cultural Heritage Expert Team of Sawahlunto Municipality (CHE1, CHE2)
- OCMHS Community or users of cultural heritage institutions of Sawahlunto Municipality, such as museums, libraries, and archives (USR1, USR2, USR3)

Activities Conducted:

- Interviews with two OCMHS representatives who are also active members of the Cultural Heritage Expert Team. Discussions focused on their role in preserving collective memory and their involvement in collection classification or digitization practices.
- Interviews with service users (USR1, USR2, USR3) regarding their experiences in accessing OCMHS-related collection information through museums, libraries, and archives.
- Passive observation in the library reading room and archive service area to observe user interaction with available classification and cataloging systems
- Collection of secondary documentation from informants, such as personal writings, community activity photographs, and internal documents containing recommendations from the Cultural Heritage Expert Team.

Key Findings:

1. **Contextual Representation Gaps:**
    - Cultural heritage experts emphasized that current organizational systems do not fully reflect the richness of the local context. Museum, archive, and library collections remain administratively and separately classified, thus failing to form a cohesive cultural narrative.
    - Numerous artifacts, documents, and historical mining books are only

- recorded under formal categories (***Subject Analysis***, ***Sociohistorical Reference***). This reflects a lack of effort to contextualize the objects/documents with relevant social and historical dimensions.
- Intangible CH practices such as oral traditions, folksongs, community rites and ceremonies are not yet represented in the current classification systems, even though they are frequently requested by users (***Intangible Cultural Heritage***).

2. **User Perspectives:**
    - A representative Museum user (USR3) and library user (USR1) noted that the classification systems are too technical and not intuitive for general users (***System Accessibility***). This indicates a need for user-friendly access to collection information through classification or digital platforms. Users reported difficulty retrieving information on items such as tools and equipment and oral tradition due to the absence of local terms in the metadata (***User Based***).
    - Museum access remains highly dependent on staff assistance due to the absence of a digital catalog that supports independent searching (***System Accessibility, Retrieval Structure***). This points to the need for accessible systems that facilitate collection discovery and research. In contrast, the library already provides an online catalog (***Digital Platform***), reflecting responsiveness to user needs and greater user involvement in system development.
    - Archive user (USR2) reported that archive access also heavily depends on staff, with no available digital catalog for independent search (***Open Access***). This slows access and reduces public engagement. The issue highlights the importance of public access to collection information and self-service information retrieval systems.
    - Both users emphasized the importance of integrating local terminology and thematic approaches into classification systems to make collections more comprehensible to non-expert audiences.
3. **Documents and Information Found:**
    - A draft recommendation from the Cultural Heritage Expert Team concerning cultural heritage preservation at OCMHS, including the proposal for additional narrative categories in museum classification.

- Field notes from CHE2 discussing technocratic approaches in museum collection classification and the need to integrate social narratives into KO systems.
- Clippings of local newspapers and mining community history books that are substantively valuable yet lack narrative metadata entries (***Metadata Description***, ***Metadata Platform***). This reflects the need to construct descriptive metadata that meaningfully represents the content of the collection.

4. **Limitations and Challenges:**
    - Lack of inter-institutional coordination has led to fragmented collections without systemic interconnectivity ***(Fragmented Sources***).This indicates the continued separation of information sources and collections among institutions without an integrated system.
    - Bureaucratic procedures and sectoral egos among museums, archives, and libraries further exacerbate data fragmentation and the absence of permanent coordination forums.
    - Insufficient technical training has resulted in documentation systems focusing too heavily on the physical aspects of collections rather than their value, meaning, and narrative (***Capacity Development***). This highlights the need to enhance staff capacity through technical training and skill development.
    - Existing metadata is generic and does not accommodate narrative descriptions or local terminology, which are crucial for enhancing public access and cultural contextualization.
5. **Strategic Opportunities:**
    - Cultural Heritage Experts and users strongly support the development of a participatory and locally grounded or contextualized taxonomy (***Knowledge Mediation***). This approach aims to bridge information in ways that can be accessed and interpreted by users from diverse backgrounds.
    - It is recommended that taxonomy development involve cultural practitioners, local historians, and community members to ensure inclusive and sustainable outcomes.
    - It is hoped to establish a collaborative cross-institutional forum to

- connect the KO process of museums, archives, and libraries through a collective OCMHS narrative.
- Several initiatives, such as narrative labels, thematic shelf markers, and local taxonomies, indicate an ongoing process of mediating knowledge from formal structures to more meaningful and participatory systems.

Researcher's Notes:

The third and fourth weeks of April reinforced the understanding that the greatest challenges in knowledge organization at OCMHS are not only technical, but also systemic and cultural. The current classification system has yet to reach the dimension of cultural meaning and does not engage the user community as active agents (***Contextual Customization***). This reflects the need to adapt classification systems or taxonomies based on local values, terminology, and context. A growing critical awareness from heritage experts and the perspectives of users further highlights the urgency for a contextual, inclusive, and collaborative classification system. This process must begin by creating participatory spaces, training cross-sectoral human resources, and building system interoperability that can weave fragmented histories into a living and relevant knowledge structure.

C. OBSERVATION, APRIL 29-30, 2024

Activity Focus:

During the fourth week of April was the consolidation of field observation results through a cross-institutional evaluation of the initial contextualized taxonomy prototype was provided and demonstrated. Additionally, this week included the preparation and execution of the first Focus Group Discussion (FGD) to gather systemic feedback from all stakeholders and assess institutional readiness for the adoption of the contextual taxonomy.

Institutions and Participants Involved, representative of:

- Information professionals or Subject Matter Expert: librarian, curator, registrar, and archivist
- Cultural Heritage Expert Team
- Researchers, moderators, and FGD facilitators

Activities Conducted:

- FGD Preparation: refinement of the initial taxonomy framework, development of visualizations of the first hierarchical structure (based on social and thematic domains), and drafting of participatory discussion guidelines.
- FGD was held on April 30, 2024, with 8 participants from various institutions (***Taxonomy Co-Creation***).
- In-depth discussion on the technical, social, and organizational aspects of preliminary taxonomy development through DSR phase C principles (design and development).
- Collection of both verbal and written feedback from FGD participants regarding revisions to category structures, label formats, and digital system requirements.
- Conclusion of the field observation phase through a reflective session involving the three core institutions to summarize strategic opportunities, challenges, and readiness for the next stage (design of a taxonomy-based integrated digital system).

Key Findings:

1. **Response to the Taxonomy Prototype:**
    - Participants stated that the proposed taxonomy structure based on their CH collection or resources categories was far more representative than the current administrative classification system (***Classification Growth***).
    - Curators and librarians agreed that this approach allows for connectivity across museums, libraries, and archives collections resources that were previously fragmented and unlinked (***Convergence, Schema Alignment, Sociohistorical Reference, Scheme Integration***). This highlights the need to align classification schemes or metadata systems across institutions to achieve interoperability. It also reflects efforts and recommendations to use the social and historical background of an object or document, including events, social structures, or political dynamics, as reference components. Additionally, it underscores the need to integrate or merge various classification schemes from different institutions.
        - Some participants proposed terminology adjustments to make the taxonomy more understandable to the public without losing its original

- cultural meaning (***Controlled Vocabulary***). This reflects the need for a standardized (including local) controlled vocabulary to enhance consistency in knowledge organization.

2. **Critical Feedback and Necessary Revisions:**
   - A periodic and open revision mechanism is needed to update terms and category structures in line with collection developments and social contexts.
   - The category of tangible and intangible CH needs to be strengthened and granted more space within the taxonomy structure (***Intangible Cultural Heritage***).
   - Users requested that the final system feature a simple digital interface that supports thematic and narrative searches (***User Based, Open Access, System Accessibility, Retrieval Structure***). This highlights the importance of addressing user needs, enhancing the information access experience, and fostering user involvement in system development. There is also a clear need for public access to collection information and for search systems that enable independent discovery.
   - Cross-institutional integration (museum, library, archive) within the contextualized taxonomy is necessary (***Convergence***).
3. **Institutional Challenges and Readiness:**
   - The main challenges remain digital infrastructure and human resources: no central server is yet available, collection management systems are not interoperable, and staff skills vary widely (***Infrastructure Constraints***).
   - However, all institutions expressed commitment and initial readiness to continue developing the taxonomy as a joint project (***Taxonomy Co-Creation***). This shows the initiation of collaboration among actors (curators, librarians, archivists, users, experts) in participatory taxonomy development.
   - It was agreed that the Sawahlunto Municipality cultural heritage institutions will act as the initial coordinators in formulating a roadmap for taxonomy development.
4. **Documents and Artifacts from the Discussion:**
   - Complete minutes of the FGD, including a synthesis of participant comments by institution.

- Revised visualization of the initial taxonomy hierarchy, including domain level (main categories), parent level (sub-categories), child level (specific categories), grandchild levels (contextualized entries) (***Practice Benchmarking, Vocabulary Hierarchy***). This indicates a hierarchical structure of terms or concepts used within the classification or taxonomy system.
- A list of local terms resulting from the discussion, including local terms
- (***Local Terminology***).
- A map outlining institutional roles within the OCMHS knowledge organization ecosystem.

Researcher's Note:

The fourth week of April concluded the entire field observation process on a positive, critical, and collaborative note. The interviews and first FGD activities demonstrated that, despite critical factors that justify taxonomy development, including challenges, limitations, and opportunities in KO. There is significant institutional potential and social readiness to build a localized taxonomy. This process also revealed that the success of a knowledge organization system does not solely rely on advanced technologies or compliance with formal standards, but rather on the extent to which it reflects the identity, values, and collective stories of the OCMHS community. Moving forward, the results of this first FGD and field notes will serve as the foundation for the final design of the contextualized taxonomy.

May 2024

A. Observation, May 1–11, 2024

Activity Focus:

In the first and second weeks of May, field activities shifted their focus to the Office of the Library and Archives in Sawahlunto Municipality. The observations aimed to understand the knowledge organization process in both the library and archival sectors, particularly concerning collections relevant to OCMHS based on tangible and intangible CH. Activities also included interviews with the Director of the Library and Archives Office, librarians, and archivists.

Institutions Visited:

- Sawahlunto Municipality Office of Library and Archives

Activities Conducted:

- In-depth interviews with two technical librarians (LIB1 and LIB2) and two archivists (ARC1 and ARC2).
- Discussion with the Head of the Office of Library and Archives (DIR2) about the institution's strategies in building a historical knowledge system based on local heritage.
- Direct observation of the library's collection classification using the DDC and cataloging based on RDA.
- Inspection of archival rooms and the static record management system from local government agencies, and identification of challenges in managing heritage-based archives.
- Tracing local collections such as historical mining documents and documentation of mining community activities of Sawahlunto Municipality.
- Identification of priority collections for digitization and thematic grouping efforts based on local social and cultural issues.

Key Findings:

1. **Knowledge Organization Systems and Practices:**
   - The library uses the DDC system for classification (***Classification Scheme***) and RDA for bibliographic description (***Metadata Standard***). The automation system used is InLISLite Version 3, provided by the National Library of the Republic of Indonesia, but access is limited due to internet disruptions and equipment constraints (***Digital Platform***). This reflects the application of digital systems for managing, storing, and accessing digital collections.
   - OCMHS-related collections are often placed under general classifications such as "959.8 – Indonesian History" without specific local or thematic indicators (***Fragmented Sources***). This reflects the rigidity of formal classification systems, which are not yet responsive to local contexts, social narratives, or cultural expressions.
   - Archives are still managed manually (***Manual Dependency***), indicating continued reliance on non-digital processes in classification,

- documentation, or collection management.
- The archival classification system follows Ministry of Home Affairs Regulation No. 83/2022 and the National Archives of the Republic of Indonesia (ANRI) Regulation No. 6/2012, which are administrative and functionally oriented (***Classification Scheme, Standard Documentation***). This indicates reliance on formal documents and institutional standards, including national regulations.
- Archival collections containing historical and cultural value, such as colonial-era documents related to mining, have not yet been classified as cultural or social entities (***Subject Analysis***).

2. **Documents and Informational Materials Found:**
    - Master Library Collection Book and digital catalog data from InLISLite
    - Version 3 (***Limited Access***).
    - A manually maintained spreadsheet for local collection documentation with entries (***Manual Dependency***), reflecting continued reliance on manual processes.
    - Archival management forms, internal memos, and archive identification sheets showing groupings based on Sawahlunto Municipal government agency functions rather than cultural content.
    - Physical documents such as colonial-era documents or archives of miners from the New Order era, all of which are yet to be digitized (***Accessioning Process***).
3. **Limitations and Challenges:**
    - Classification rigidity: Locally nuanced collections are difficult to map using standardized national classification systems (***Classification Rigidity***).
    - Limited infrastructure: Digitization tools are restricted to a single scanner unit, and there is no long-term storage server (***Infrastructure Constraints***).
    - Human resource limitations: Most staff lack technical training in contextual metadata, narrative description, or digital integration (***Capacity Building***).
    - System fragmentation: There is no integration between library, archival, and museum collections to map a comprehensive local narrative

- (***Schema Alignment, Fragmented Sources***). This highlights the absence of inter-institutional integration and the need to align classification schemes and metadata systems across institutions.
- Superficial subject analysis: Collections are classified in a shallow manner, without considering their cultural meaning or local narratives (***Classification Rigidity***).

4. **Strategic Opportunities:**
    - One librarian (LIB2) presented an informal draft of a local terminology list, proposed as part of a community-based taxonomy initiative (***Controlled Vocabulary, Vocabulary Compliance, Local Terminology***). This reflects the need for a controlled vocabulary standard or a local one to ensure consistency in knowledge organization. There is early discourse in developing a thematic digital collection platform to display cultural collections in visual and narrative formats, although this is still hindered by institutional policies and system limitations.
    - There is high enthusiasm for metadata training and inter-agency integration efforts (***Capacity Development***), with the aspiration that the library can serve as an open and inclusive center of knowledge.

Researcher's Notes:

The first week of May revealed the complexity of managing local knowledge, which has yet to be fully integrated into the regional library and archival information systems. Knowledge organization process remains dominated by administrative approaches and generic classifications, without accommodating the narrative depth and socio-cultural richness of OCMHS based on tangible and intangible CH (***Contextual Adaptation***). This reflects the need to adapt classification systems to local culture, social context, and community narratives. Key collections related to mining history, community practices, and local expressions are still scattered and lack thematic documentation (***Collection Stewardship***). Nevertheless, interviews with librarians and archivists revealed critical awareness and an emerging initiative to develop more contextual and collaborative classification systems. This indicates that cultural institutions are serving as collection stewards but still face challenges in expanding stewardship toward social and thematic narratives. Overall, this observation phase provides a concrete picture of the "gap

between formal structures and local realities." Strategic interventions are needed in the form of cross-sector training, development of local taxonomies, and the establishment of an integrated digital platform to enhance access and preserve cultural heritage knowledge.

B. Observation, May 13–18, 2024

Focus of Activities:

In mid-May, the focus of observation shifted to a deeper exploration of thematic classification systems and the potential for inter-institutional integration among the cultural heritage institutions (museums, libraries, archives) of Sawahlunto Municipality. The activities aimed to uncover adaptive internal practices within each cultural heritage institution, while also facilitating informal cross-agency discussions around a contextual classification system rooted in mining locality.

Institutions Involved:

- Office of Library and Archives
- Cultural Heritage Expert Team
- Office of Culture

Activities Conducted:

- Small group discussions with curators, librarians, and archivists regarding efforts to adapt classification systems to local narratives.
- Observation of documentation and labeling processes of museum collections that began to include informal narrative elements of OCMHS (Intangible Cultural Heritage, Local Terminology, Narrative Description, Sociohistorical Reference).
- Cross-institutional document comparison studies to trace overlapping collections through Sawahlunto Municipality CHI or beyond (Practice Benchmarking). This indicates efforts to compare and evaluate classification or knowledge organization processes as a basis for further development.
- Mapping of local terminology found in collections, including artifacts, documents, and library resources (Intangible Cultural Heritage, Local Terminology, Narrative Description, Sociohistorical Reference).
- Trial of narrative-based collection categorization with museum curators and

- librarians (Classification Growth, Taxonomy Co-Creation, Contextual Adaptation).

Key Findings:

1. **Adaptive Practices in Institutions:**
   - Museum curators have started composing informal narratives (***Contextual Adaptation***) posted near collections to bridge the limitations of formal classification systems (***Narrative Description***) (***Fragmented Sources***). This indicates ongoing rigidity in formal classification systems that are unresponsive to local context, social narratives, or cultural expressions. The descriptive approach centers on stories or the socio-cultural background of collections rather than merely technical or administrative data, reflecting adaptation to cultural and social contexts.
   - Librarians created special shelf markers labeled "OCMHS Collection" (***Knowledge Mediation***) as a thematic category even though it is not part of the official DDC classification (***Contextual Adaptation***). This effort demonstrates an attempt to bridge information in ways that are accessible and meaningful to diverse user backgrounds.
   - Archivists began sorting documents based on narrative content types, such as mining archives containing interviews or community social records.
   - Initiatives like narrative labeling, thematic shelf markers, and library classification demonstrate a shift in knowledge mediation from formal frameworks to more meaningful and participatory systems.
2. **Cross-Institutional Discussions:**
   - Informal discussions among librarians, curators, and archivists revealed a collective awareness of the need for a cross-institutional taxonomy system (***Taxonomy Co-Creation***) (***Convergence***) (***Schema Alignment***) (***Scheme Integration***). This indicates collaborative initiatives among actors (curators, librarians, archivists, users, experts) to co-develop taxonomies, as well as efforts toward cross-institutional integration in the KO process and KOSs. It also reflects the need to align classification schemes or metadata systems across institutions for interoperability.
   - All parties expressed difficulty connecting collections due to

- inconsistent metadata and the absence of a shared information platform (***Fragmented Sources***). This highlights the continued separation of information sources or collections between institutions without system integration.
- There is a growing desire to develop a cultural narrative concept map connecting artifacts, archives, and library materials through social themes and collective memory.

3. **Supporting Documents and Materials:**
    - An initial draft of a mining narrative map collaboratively prepared by curators and librarians (not yet formalized), illustrating relationships among mining tools, labor practices, social conditions, and cultural expressions.
    - Internal minutes from the Office of Culture highlighting the need for a thematic classification system across institutions as part of a cultural preservation strategy.
    - Photo documentation of collections or CH resources with narrative content of OCMHS.
4. **Limitations and Challenges:**
    - The absence of a digital system capable of linking collection metadata across institutions.
    - Lack of local regulations or standard operating procedures (SOPs) that permit formal improvisation within the national classification scheme (Standard Documentation). This indicates no use or reference to formal documents and institutional standards, including local regulations.
    - Technical staff lack guidelines or training in narrative or context-based classification methods.
5. **Strategic Opportunities:**
    - Mental and cultural readiness among field staff to trial more adaptive and participatory classification models.
    - The potential to form a cross-agency task force to develop a thematic classification scheme that can serve as the foundation for the contextualized taxonomy for OCMHS CHI.
    - Informal support from the heads of the Office of Culture and the
    - Library and Archives to pilot the new system.

Researcher's Notes:

The second of May marks a significant transition from descriptive observation to an interpretive phase. During this period, a negotiation space emerged on the ground, indicating institutional readiness to experiment with more dynamic and representative alternative classification systems. Ideal conditions are not yet in place in terms of infrastructure, digital systems, or formal regulations. Nevertheless, intensive discussions and modest practices such as narrative labeling, thematic shelf markers, and inter-collection mapping signal the emergence of institutional awareness toward a KOS that reflects local context and cultural identity. The next step will focus on drafting the initial framework of a narrative taxonomy based on mining stories as a conceptual tool to support cross-institutional information system integration.

C. OBSERVATION, MAY 20–25, 2024

Focus of Activities:

The focus during the third week of May was on the second trial of the taxonomy structure that had been conceptually developed during the previous week. This observation phase aimed to test the implementation of a participatory taxonomy concept through prototype tagging, local label testing, and institutional responses to the potential integration of contextual classification systems. This activity marked the transition from passive observation to active participation in the development of practice-based solutions.

Institutions and Participants Involved:

- Office of Culture (curators and registrars)
- Office of Library and Archives (librarians and archivists)
- Cultural Heritage Expert Team (external observers)

Activities Conducted:

- Simulated application of local narrative labels on selected physical collections in museums and libraries, using terms developed during previous observations.
- Technical discussions with librarians and curators regarding the alignment of these labels with current classification systems (DDC, Permendikbudristek).
- Review of metadata entries in the library automation systems (InLISLite Version 3) and Excel-based Museum inventory to assess the possibility of integrating contextual labels.

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- Collection of feedback from technical staff on the narrative taxonomy concept covering ease of understanding, term relevance, and potential for long-term adoption.
- Initial adjustments to the taxonomy structure based on the feedback: re-grouping several labels according to social domains (tools, rites, labor, identity, and mining locations) (Classification Growth) (Vocabulary Hierarchy). This refers to the development of classification structures through category expansion, term enrichment, and system integration. Additionally, it involves efforts to build a hierarchical structure of terms or concepts for use in a classification scheme or taxonomy.

Key Findings:

1. **Positive Response to the Taxonomy Prototype:**
    - Most museum and library staff stated that narrative labels were more "meaningful" than formal classification codes, which often fail to reflect the social context of collections (Contextual Customization, Narrative Description). This descriptive approach is seen as an effort focused on the story or socio-cultural background of the collection, rather than merely technical or administrative information. It also demonstrates the adjustment of classification or taxonomy systems based on values, terminology, and local context (mining narratives, community culture, local terms).
    - Curators appreciated the narrative labels' ability to revive the stories behind objects, especially those previously tagged only with inventory numbers and no narrative (Narrative Description).
    - Librarians believed that contextual labels could enrich users' search results, although integration into Metadata systems as subject headings or local tags is still needed (Metadata Description, Metadata Platform). This shows an ongoing process of composing descriptive metadata to represent and explain the content of collections.

2. **Technical Challenges and Feedback:**
    - InLISLite, as the library automation system, currently lacks features for

- hierarchical taxonomy or narrative tagging (Digital Platform). This points to the need for workaround approaches.
- Most museum and archive collections are still managed in local spreadsheet systems without adequate metadata standards (Metadata Platform, Metadata Standard), resulting in manual system integration (Manual Dependency). This indicates ongoing reliance on manual processes in classification, documentation, or collection management, despite efforts to use metadata systems to describe, classify, and connect information.
- Additional training is required to avoid misinterpretation of taxonomy concepts (Capacity Development), particularly in distinguishing between categories, labels, and descriptive entities. This highlights the need for technical skills-building and staff capacity development.
- Existing metadata is generic and does not yet accommodate narrative descriptions and local terminology, which are crucial for enhancing public access and cultural contextualization.

3. **Documents and Artifacts Tested with Labels:**
    - Museum: Knowledge and practices concerning nature and the universe, tools and equipment, and the old town area.
    - Library: oral tradition, social practices, rituals, and festive events, literature, and publications.
    - Archives: Historical documents or archives.

4. **Strategic Opportunities:**
    - There is enthusiasm for creating a glossary of local terms as a foundation for further taxonomy development (***Controlled Vocabulary, Vocabulary Compliance***). This demonstrates the need for using standardized or locally regulated term lists to increase consistency in the knowledge organization process.
    - Curators proposed integrating narrative labels into museum educational activities, such as thematic tours and story-based exhibitions (***Sociohistorical Reference***). This indicates the effort to reference the social and historical background of an object or document, including events, societal structures, or political dynamics.
    - Archivists welcomed the thematic approach for grouping social.

- collections, which had previously been classified only by the administrative functions of the Sawahlunto Municipal Government Agencies.

Researcher's Notes:

This period marked an important milestone in the initial validation that locally grounded narrative taxonomy is not only feasible but enthusiastically embraced by field practitioners. The simple pilot showed that narrative labels can overcome the rigidity of formal classification systems while strengthening the role of institutions as stewards of community stories (***Fragmented Sources***). This condition indicates persistent inflexibility in formal classification systems that do not respond to local context, social narratives, or cultural expressions, which are known based on tangible and intangible CH. However, technical challenges remain significant, particularly regarding digital systems that do not yet support complex taxonomy structures and contextual metadata integration. There is also a need for training strategies and the development of technical guidelines to ensure a gradual and structured transition to the new system. This week's findings will serve as a foundation for developing a narrative domain-based taxonomy model, which will later be evaluated across institutions during the focus group discussion phase at the end of May.

D. OBSERVATION, MAY 27–31, 2024

Focus of Activities:

The primary focus during the fourth week of May was the consolidation of field observation results through a cross-institutional evaluation of the initial contextualized taxonomy prototype for OCMHS CHI, previously tested. Additionally, this week included the preparation and execution of the second Focus Group Discussion (FGD) to gather systemic feedback from all stakeholders and assess institutional readiness for the adoption of the contextual taxonomy.

Institutions and Participants Involved:

- Office of Culture, Sawahlunto Municipality
- Office of Library and Archives, Sawahlunto Municipality
- Information professionals or Subject Matter Experts: librarians, curators, registrars, and archivists

- Cultural Heritage Expert Team
- The Office of Communications and Information representative
- The Office of Tourism representative
- Office of Education representative
- User representatives
- Researchers, moderators, and FGD facilitators

Activities Conducted:

- FGD Preparation: refinement of the initial taxonomy framework, development of visualizations of the hierarchical structure (based on social and thematic domains), and drafting of participatory discussion guidelines.
- FGD was held on May 28, 2024, with 15 participants from various institutions
- (Taxonomy Co-Creation).
- In-depth discussion on the technical, social, and organizational aspects of taxonomy implementation, including an evaluation of usability principles, institutional acceptance, and system sustainability.
- Collection of both verbal and written feedback from FGD participants regarding revisions to category structures, label formats, training needs, and digital system requirements.
- Conclusion of the field observation phase through a reflective session involving the three core institutions to summarize strategic opportunities, challenges, and readiness for the next stage (design of a contextualized taxonomy).

Key Findings:

1. **Response to the Taxonomy Prototype:**
    - Participants stated that the proposed taxonomy structure (based on mining narratives and socio-cultural categories) was far more representative than the current administrative classification system (Classification Growth).
    - Curators and librarians agreed that this approach allows for connectivity across museums, libraries, and archives collections resources that were previously fragmented and unlinked (Convergence, Schema Alignment, Sociohistorical Reference, Scheme Integration). This highlights the need to align classification schemes or metadata systems across institutions to achieve interoperability. It also reflects efforts and recommendations to use the social and historical background of an object or document, including

events, social structures, or political dynamics, as reference components. Additionally, it underscores the need to integrate or merge various classification schemes from different institutions.

- Some participants proposed terminology adjustments to make the taxonomy more understandable to the public without losing its original cultural meaning (Controlled Vocabulary). This reflects the need for a standardized (including local) controlled vocabulary to enhance consistency in taxonomy.

2. **Critical Feedback and Necessary Revisions:**
    - A periodic and open revision mechanism is needed to update terms and category structures in line with collection developments and social contexts.
    - The category of intangible heritage (such as traditional music, language, oral tradition, and social rites) needs to be strengthened and granted more space within the taxonomy structure (***Intangible Cultural Heritage***).
    - Users requested that the final system feature a simple digital interface that supports thematic and narrative searches (User Based, Open Access, System Accessibility, Retrieval Structure). This highlights the importance of addressing user needs, enhancing the information access experience, and fostering user involvement in system development. There is also a clear need for public access to collection information and for search systems that enable independent discovery.
    - Cross-institutional integration (museum, library, archive) within the knowledge organization system is necessary (***Convergence***).
3. **Institutional Challenges and Readiness:**
    - The main challenges remain digital infrastructure and human resources: no central server is yet available, collection management systems are not interoperable, and staff skills vary widely (***Infrastructure Constraints***).
    - However, all institutions expressed commitment and initial readiness to continue developing the taxonomy as a joint project (***Taxonomy Co-Creation***). This shows the initiation of collaboration among actors (curators, librarians, archivists, users, experts) in participatory taxonomy development.

- It was agreed that the Sawahlunto Municipality cultural heritage institutions will act as the initial coordinators in formulating a roadmap for taxonomy development.

4. **Documents and Artifacts from the Discussion:**
    - Complete minutes of the FGD, including a synthesis of participant comments by institution.
    - Revised visualization of the refined taxonomy hierarchy through domain level (main categories), parent level (sub-categories), child level (specific categories), grandchild levels (contextualized entries) (***Practice Benchmarking, Vocabulary Hierarchy***). This indicates a hierarchical structure of terms or concepts used within the classification or taxonomy system.
    - A list of local terms resulting from the discussion, including new terms (***Local Terminology***).
    - A map outlining institutional roles within the OCMHS knowledge organization ecosystem.

Researcher's Note:

The fourth week of May concluded the entire field observation process on a positive, critical, and collaborative note. The FGD activities demonstrated that despite limitations in infrastructure and policy, there is significant institutional potential and social readiness to build a localized taxonomy. This process also revealed that the success of a knowledge organization system does not solely rely on advanced technologies or compliance with formal standards, but rather on the extent to which it reflects the identity, values, and collective stories of the OCMHS community. Moving forward, the results of this FGD and field notes will serve as the foundation for the final contextualized taxonomy development.

APPENDIX 5

Sample of FGD feedback from OCMHS subject matter experts

Formulir Umpan Balik Pengujian Kegunaan Taksonomi Warisan Budaya "Pusako Ombilin"

Informasi Partisipan:

- Nama Lengkap: YURISTYA MEGA
- Lembaga/Organisasi: Dinas Kebudayaan
- Peran/Posisi: Kurator Museum
- Tahun Mulai Mengabdi/Terlibat di WTBOS/Lembaga saat ini: 2005
- No.Telepon/Email: 081374011162 / yuristyamega@gmail.com
- Tandatangan:

Yuristya Mega, S-S

Uji Coba Pencarian Informasi:

- Telusuri informasi bangunan cagar budaya di WTBOS.
- Temukan informasi tentang artefak atau koleksi museum tertentu yang ada di WTBOS
- Temukan informasi tentang tradisi lisan masyarakat (Carito dari Ombilin) di WTBOS
- Temukan informasi tentang warisan budaya tak benda di WTBOS
- Temukan informasi foto-foto bersejarah terkait WTBOS
- Telusuri informasi koleksi jenis musik pop terkait WTBOS
- Telusuri informasi koleksi buku atau bahan pustaka terkait WTBOS.
- Temukan informasi koleksi dokumen atau arsip peta terkait WTBOS
- Temukan informasi koleksi arsip koran (surat kabar) terkait WTBOS
- Telusuri informasi tentang hal lainnya yang anda inginkan (tuliskan):

Pertanyaan Umpan Balik

1. **Kemudahan Penggunaan:**
   - Bagaimana Anda menilai kemudahan penggunaan Taksonomi Warisan Budaya "Pusako Ombilin" tersebut untuk mencari informasi warisan budaya WTBOS?
     - (•) Sangat mudah
     - Mudah
     - Netral
     - Sulit
     - Sangat sulit
   - Pada Taksonomi Warisan Budaya "Pusako Ombilin" tersebut, aspek apa yang menurut Anda mudah atau sulit digunakan dan mengapa? **Sesuaikan dengan pilihan poin di atas sebelumnya (sulit / mudah)*
     - Jawaban:

Pada taksonomi warisan budaya "Pusako Ombilih" pencarian informasi warisan budaya bisa dicari melalui beberapa kata saja dan menekan tombol search. Selain itu juga terdapat link - link yg terkoneksi dgn kata yg dicari.

2. **Kepuasan Pengguna**:
   - Secara keseluruhan, seberapa puaskah Anda dengan pengalaman Anda menggunakan Taksonomi Warisan Budaya "Pusako Ombilin" tersebut?
     - (•) Sangat puas
     - Puas
     - Netral
     - Tidak puas
     - Sangat tidak puas

   - Aspek bagian Taksonomi Warisan Budaya "Pusako Ombilin" apa yang menurut Anda paling memuaskan atau tidak memuaskan? *"Sesuiakan dengan pilihan poin di atas sebelumnya (puas / tidak puas)*
     - Jawaban:

Pada taksonomi ini juga bisa melihat data / informasi dan artip dan letdin yang lamak sebali memuat data tsb sesuahlunto.
Diharapkan kedepannya taksonomi ini bisa mengalin kerjasama dgn pusat" informasi lainnya spt leiden University Kitly, Arsip, Propen Museum, Volkenkunde, dll, sehingga taksonomi Pusako Ombilin bisa kaya akan informasi.

3. **Persepsi Kegunaan**:
   - Seberapa berguna Taksonomi Warisan Budaya "Pusako Ombilin" tersebut menurut Anda dalam membantu mencapai tujuan akses informasi warisan budaya WTBOS?
     - (•) Sangat berguna
     - Berguna
     - Netral
     - Tidak berguna
     - Saangat tidak berguna

   - Menurut Anda apakah taksonomi Taksonomi Warisan Budaya "Pusako Ombilin" tersebut memberikan informasi yang relevan dan berharga untuk kebutuhan informasi warisan budaya bagi Anda?
     - Jawaban:

Iya, bisa pada taksonomi Pusako Ombilin ini akan menghimpun seluruh warisan budaya yang ada di sawahlunto. Baik itu warisan budaya benda maupun warisan budaya tak bendanya.

4. **Saran untuk Perbaikan:**
   - Apakah Anda mempunyai saran untuk meningktakan kualitas/perbaikan taksonomi Taksonomi Warisan Budaya "Pusako Ombilin" agar semakin dapat memenuhi kebutuhan atau preferensi Anda?
     - Jawaban:

       Agar diuraikan tata cara mencari ~~dan menambah~~ data dan cara menambah informasi pada taksonomi warisan budaya Pusako Ombilin.

   - Apakah ada fitur, fungsi, atau bagian tertentu pada Taksonomi Warisan Budaya "Pusako Ombilin" yang Anda rasa penting ditambahkan atau tingkatkan?
     - Jawaban:

       Ditambahkan Kontak Person Dinas se sawahlunto museum - museum se sawahlunto, ~~dan tiu~~, dll

5. **Ulasan Tambahan:**
   - Silakan sampaikan komentar, hasil pengamatan, atau umpan balik tambahan apa pun terkait pengalaman Anda menggunakan Taksonomi Warisan Budaya "Pusako Ombilin" tersebut.
     - Jawaban:

Terima kasih banyak

Formulir Umpan Balik Pengujian Kegunaan
Taksonomi Warisan Budaya "Pusako Ombilin"

Informasi Partisipan:

- Nama Lengkap: Erni Sasmita
- Lembaga/Organisasi: Dinas Perpustakaan dan Kearsipan
- Peran/Posisi: Arsiparis
- Tahun Mulai Mengabdi/Terlibat di WTBOS/Lembaga saat ini: 2021
- No.Telepon/Email: 0852 7453 5701 / ernio407sasmita@gmail.com
- Tandatangan:

Uji Coba Pencarian Informasi:

- Telusuri informasi bangunan cagar budaya di WTBOS.
- Temukan informasi tentang artefak atau koleksi museum tertentu yang ada di WTBOS
- Temukan informasi tentang tradisi lisan masyarakat (Carito dari Ombilin) di WTBOS
- Temukan informasi tentang warisan budaya tak benda di WTBOS
- Temukan informasi foto-foto bersejarah terkait WTBOS
- Telusuri informasi koleksi jenis musik pop terkait WTBOS
- Telusuri informasi koleksi buku atau bahan pustaka terkait WTBOS.
- Temukan informasi koleksi dokumen atau arsip peta terkait WTBOS
- Temukan informasi koleksi arsip koran (surat kabar) terkait WTBOS
- Telusuri informasi tentang hal lainnya yang anda inginkan (tuliskan):

Pertanyaan Umpan Balik

1. **Kemudahan Penggunaan:**
   - Bagaimana Anda menilai kemudahan penggunaan Taksonomi Warisan Budaya "Pusako Ombilin" tersebut untuk mencari informasi warisan budaya WTBOS?
     - Sangat mudah
     - [x] Mudah
     - [x] Netral
     - Sulit
     - Sangat sulit
   - Pada Taksonomi Warisan Budaya "Pusako Ombilin" tersebut, aspek apa yang menurut Anda mudah atau sulit digunakan dan mengapa? **Sesuiakan dengan pilihan poin di atas sebelumnya (sulit / mudah)*
     - Jawaban:

       Mudah krena mudah u/ sekian akses informasi yaa, umumnya untuk berupa tekstulasi berkelanjutan seperti ini. Mudah ini akan sulit berkaitan dan sesuatu.

2. **Kepuasan Pengguna**:
   - Secara keseluruhan, seberapa puaskah Anda dengan pengalaman Anda menggunakan Taksonomi Warisan Budaya "Pusako Ombilin" tersebut?
     - Sangat puas
     - [x] Puas
     - Netral
     - Tidak puas
     - Sangat tidak puas

   - Aspek bagian Taksonomi Warisan Budaya "Pusako Ombilin" apa yang menurut Anda paling memuaskan atau tidak memuaskan? **Sesuaikan dengan pilihan poin di atas sebelumnya (puas / tidak puas)*
     - Jawaban:

       Cukup ini dalam penyajian ini sudah memuaskan secara pribadi saya puas menggunakan ini.

3. **Persepsi Kegunaan**:
   - Seberapa berguna Taksonomi Warisan Budaya "Pusako Ombilin" tersebut menurut Anda dalam membantu mencapai tujuan akses informasi warisan budaya WTBOS?
     - [x] Sangat berguna
     - Berguna
     - Netral
     - Tidak berguna
     - Saangat tidak berguna

   - Menurut Anda apakah taksonomi Taksonomi Warisan Budaya "Pusako Ombilin" tersebut memberikan informasi yang relevan dan berharga untuk kebutuhan informasi warisan budaya bagi Anda?
     - Jawaban:

       Ini sangat berguna u/ kemajuan pengetahuan ke depan, karena yang menjadi warisan penyimpanannya memang ini. Tidak lupa juga untuk pengetahuan generasi dari bangsa - sebelum itu lebih banyak tambahannya.

4. **Saran untuk Perbaikan**:
   - Apakah Anda mempunyai saran untuk meningktakan kualitas/perbaikan taksonomi Taksonomi Warisan Budaya "Pusako Ombilin" agar semakin dapat memenuhi kebutuhan atau preferensi Anda?
     - Jawaban:

       Secara ini menurut saya ini sudah sangat baik dalam tampilan yang menarik. untuk ke depan mungkin ini bisa berkembang sesuai perkembangan zaman dengan teknologi.

   - Apakah ada fitur, fungsi, atau bagian tertentu pada Taksonomi Warisan Budaya "Pusako Ombilin" yang Anda rasa penting ditambahkan atau tingkatkan?
     - Jawaban:

       untuk kedepannya mungkin bisa ditambahkan lagi supaya datanya lebih luas dan semua kalangan

5. **Ulasan Tambahan**:
   - Silakan sampaikan komentar, hasil pengamatan, atau umpan balik tambahan apa pun terkait pengalaman Anda menggunakan Taksonomi Warisan Budaya "Pusako Ombilin" tersebut.
     - Jawaban:

       good job

Terima kasih banyak

Formulir Umpan Balik Pengujian Kegunaan
Taksonomi Warisan Budaya "Pusako Ombilin"

Informasi Partisipan:

- Nama Lengkap: FIKI DWI AFRIYANTI, S.IIP
- Lembaga/Organisasi: Dinas Perpustakaan & Kearsipan Kota Sawahlunto
- Peran/Posisi: Pustakawan
- Tahun Mulai Mengabdi/Terlibat di WTBOS/Lembaga saat ini: .....
- No.Telepon/Email: 082238982689 / fikidwiafriyanti@gmail.com
- Tandatangan:

Uji Coba Pencarian Informasi:

- Telusuri informasi bangunan cagar budaya di WTBOS.
- Temukan informasi tentang artefak atau koleksi museum tertentu yang ada di WTBOS
- Temukan informasi tentang tradisi lisan masyarakat (Carito dari Ombilin) di WTBOS
- Temukan informasi tentang warisan budaya tak benda di WTBOS
- Temukan informasi foto-foto bersejarah terkait WTBOS
- Telusuri informasi koleksi jenis musik pop terkait WTBOS
- Telusuri informasi koleksi buku atau bahan pustaka terkait WTBOS.
- Temukan informasi koleksi dokumen atau arsip peta terkait WTBOS
- Temukan informasi koleksi arsip koran (surat kabar) terkait WTBOS
- Telusuri informasi tentang hal lainnya yang anda inginkan (tuliskan):

.....

Pertanyaan Umpan Balik

1. **Kemudahan Penggunaan:**
   - Bagaimana Anda menilai kemudahan penggunaan Taksonomi Warisan Budaya "Pusako Ombilin" tersebut untuk mencari informasi warisan budaya WTBOS?
     - Sangat mudah
     - ✓ Mudah
     - Netral
     - Sulit
     - Sangat sulit
   - Pada Taksonomi Warisan Budaya "Pusako Ombilin" tersebut, aspek apa yang menurut Anda mudah atau sulit digunakan dan mengapa? **Sesuaikan dengan pilihan poin di atas sebelumnya (sulit / mudah)*
     - Jawaban:

Secara aspek yg tersedia pada Taksonomi Warisan Budaya mudah & sangat berguna untuk digunakan Memudahkan pencarian informasi lebih luas terkait WTBOS yang ada di Kota Sawahlunto.

2. **Kepuasan Pengguna**:
   - Secara keseluruhan, seberapa puaskah Anda dengan pengalaman Anda menggunakan Taksonomi Warisan Budaya "Pusako Ombilin" tersebut?
     - ✓ Sangat puas
     - ~~Puas~~
     - Netral
     - Tidak puas
     - Sangat tidak puas

   - Aspek bagian Taksonomi Warisan Budaya "Pusako Ombilin" apa yang menurut Anda paling memuaskan atau tidak memuaskan? **Sesuaikan dengan pilihan poin di atas sebelumnya (puas / tidak puas)*
     - Jawaban:

Sangat puas terhadap fitur" yang ada sangat bermanfaat selain pengetahuan teknologi yg saat ini, namun ini begitu juga ~~bisa~~ menyamakan kata sambutan tahunnya saya

3. **Persepsi Kegunaan**:
   - Seberapa berguna Taksonomi Warisan Budaya "Pusako Ombilin" tersebut menurut Anda dalam membantu mencapai tujuan akses informasi warisan budaya WTBOS?
     - ✓ Sangat berguna
     - Berguna
     - Netral
     - Tidak berguna
     - Saangat tidak berguna

   - Menurut Anda apakah taksonomi Taksonomi Warisan Budaya "Pusako Ombilin" tersebut memberikan informasi yang relevan dan berharga untuk kebutuhan informasi warisan budaya bagi Anda?
     - Jawaban:

Sangat berguna, namun ~~kita~~ mendapatkan informasi tentang WTBOS yg ~~bisa~~ dimanfaatkan oleh siapun. Cukup sangat baik sesuai dengan penjelasan, namun apa saja yg ada di ~~sini~~ sini dan yg dapat kalau oleh orang luar akan lebih bermanfaat

4. **Saran untuk Perbaikan**:
   - Apakah Anda mempunyai saran untuk meningktakan kualitas/perbaikan taksonomi Taksonomi Warisan Budaya "Pusako Ombilin" agar semakin dapat memenuhi kebutuhan atau preferensi Anda?
     - Jawaban:

       Semoga nantinya taksonomi WTBOs ini bisa lebih lengkap dan dapat digunakan untuk literasi ke generasi muda tentang WTBOs dan juga lebih terhubung antar OPD yg terkait.

   - Apakah ada fitur, fungsi, atau bagian tertentu pada Taksonomi Warisan Budaya "Pusako Ombilin" yang Anda rasa penting ditambahkan atau tingkatkan?
     - Jawaban:

       Sejauh ini sangat lengkap dan jelas.

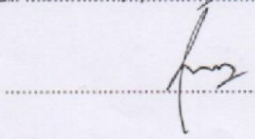
5. **Ulasan Tambahan**:
   - Silakan sampaikan komentar, hasil pengamatan, atau umpan balik tambahan apa pun terkait pengalaman Anda menggunakan Taksonomi Warisan Budaya "Pusako Ombilin" tersebut.
     - Jawaban:

Terima kasih banyak

Formulir Umpan Balik Pengujian Kegunaan
Taksonomi Warisan Budaya "Pusako Ombilin"

Informasi Partisipan:

- Nama Lengkap: ROSITA CAHYANI S.Sos
- Lembaga/Organisasi: DINAS KEBUDAYAAN
- Peran/Posisi: Registar
- Tahun Mulai Mengabdi/Terlibat di WTBOS/Lembaga saat ini: 2005
- No.Telepon/Email: 082175622951 / cumah3anakpadik@gmail.com
- Tandatangan:



Uji Coba Pencarian Informasi:

- Telusuri informasi bangunan cagar budaya di WTBOS.
- Temukan informasi tentang artefak atau koleksi museum tertentu yang ada di WTBOS
- Temukan informasi tentang tradisi lisan masyarakat (Carito dari Ombilin) di WTBOS
- Temukan informasi tentang warisan budaya tak benda di WTBOS
- Temukan informasi foto-foto bersejarah terkait WTBOS
- Telusuri informasi koleksi jenis musik pop terkait WTBOS
- Telusuri informasi koleksi buku atau bahan pustaka terkait WTBOS.
- Temukan informasi koleksi dokumen atau arsip peta terkait WTBOS
- Temukan informasi koleksi arsip koran (surat kabar) terkait WTBOS
- Telusuri informasi tentang hal lainnya yang anda inginkan (tuliskan):

.....

Pertanyaan Umpan Balik

1. **Kemudahan Penggunaan:**
   - Bagaimana Anda menilai kemudahan penggunaan Taksonomi Warisan Budaya "Pusako Ombilin" tersebut untuk mencari informasi warisan budaya WTBOS?
     - (•) Sangat mudah
     - Mudah
     - Netral
     - Sulit
     - Sangat sulit
   - Pada Taksonomi Warisan Budaya "Pusako Ombilin" tersebut, aspek apa yang menurut Anda mudah atau sulit digunakan dan mengapa? **Sesuaikan dengan pilihan poin di atas sebelumnya (sulit / mudah)*
     - Jawaban:

       Kare bisa diakses secara bebas dan pengelompokan yang sangat jelas.

2. **Kepuasan Pengguna**:
   - Secara keseluruhan, seberapa puaskah Anda dengan pengalaman Anda menggunakan Taksonomi Warisan Budaya "Pusako Ombilin" tersebut?
     - (•) Sangat puas
     - Puas
     - Netral
     - Tidak puas
     - Sangat tidak puas

   - Aspek bagian Taksonomi Warisan Budaya "Pusako Ombilin" apa yang menurut Anda paling memuaskan atau tidak memuaskan? **Sesuaikan dengan pilihan poin di atas sebelumnya (puas / tidak puas)*
     - Jawaban:

       Karena memudahkan dalam pencarian data sehingga hemat waktu tenaga dan biaya karena data yg disediakan telah dikelompokan.....

3. **Persepsi Kegunaan**:
   - Seberapa berguna Taksonomi Warisan Budaya "Pusako Ombilin" tersebut menurut Anda dalam membantu mencapai tujuan akses informasi warisan budaya WTBOS?
     - (•) Sangat berguna
     - Berguna
     - Netral
     - Tidak berguna
     - Saangat tidak berguna

   - Menurut Anda apakah taksonomi Taksonomi Warisan Budaya "Pusako Ombilin" tersebut memberikan informasi yang relevan dan berharga untuk kebutuhan informasi warisan budaya bagi Anda?
     - Jawaban:

       ya, dengan adanya Taksonomi ini dapat menjadi media publikasi dan komunikasi WTBOS kepada masyarakat secara luas.....

4. **Saran untuk Perbaikan**:
   - Apakah Anda mempunyai saran untuk meningktakan kualitas/perbaikan taksonomi Taksonomi Warisan Budaya "Pusako Ombilin" agar semakin dapat memenuhi kebutuhan atau preferensi Anda?
     - Jawaban:

       Agar lebih memperbanyak bahan dan data terkait WTBOs.

   - Apakah ada fitur, fungsi, atau bagian tertentu pada Taksonomi Warisan Budaya "Pusako Ombilin" yang Anda rasa penting ditambahkan atau tingkatkan?
     - Jawaban:

       Menghubungkan informasi yg ada di tempilkan.

5. **Ulasan Tambahan**:
   - Silakan sampaikan komentar, hasil pengamatan, atau umpan balik tambahan apa pun terkait pengalaman Anda menggunakan Taksonomi Warisan Budaya "Pusako Ombilin" tersebut.
     - Jawaban:

       Semoga menjadi Basis data bagi WTBOs

Terima kasih banyak

APPENDIX 6

Research Interview Guide

RESEARCH INTERVIEW GUIDE:
DIRECTOR OF CULTURAL HERITAGE INSTITUTIONS

Title of Research Project : *Tajuk Penyelidikan :*	Enhancing Access to Heritage Information in Indonesia through the Development of Knowledge Taxonomy: A Case Study of the Ombilin Coal Mining Heritage of Sawahlunto
Name of Researcher* : *Nama Penyelidik*:*	Muhammad Rosyihan Hendrawan
Name of Supervisor : *Nama Penyelia:*	Prof. Dr. Azman Mat Isa Assoc. Prof. Dr. Ahmad Zam Hariro Samsudin
Address of Department/ Hospital/ Institute : *Alamat Jabatan/ Hospital/ Institut:*	Faculty of Information Science, UiTM Cawangan Selangor Kampus Puncak Perdana, Seksyen U10, 40150 Shah Alam, Selangor.
Contact No/ Email : *No.Telefon/ Emel :*	+62 821 3429 2240 / 2023394187@student.uitm.edu.my

Introduction:

The researcher will open the interview section and be thankful to the participants for their time and interest in contributing to the research. The researcher will provide an overview of the study's purpose, emphasizing the development of a knowledge taxonomy for the Ombilin Coal Mining Heritage Site of Sawahlunto (OCMHS) to enhance access to cultural heritage information.

- The researcher will introduce himself and the purpose of the interview.
- The researcher will explain the importance of their insights in developing a knowledge taxonomy for OCMHS.

Participant Information:

- Name:
  ……
- Role/Position:
  ……..
- Affiliation/Organization:
  ……..
- Contact Information:
  ……

Confidentiality Statement: The researcher will ensure participants the confidentiality of their responses and the use of anonymized data in research findings.

Section 1: Existing Conditions of Knowledge Organization Processes

1. What is the role and involvement of museums/libraries and archives in Sawahlunto Municipality in developing knowledge organization practices related to OCMHS cultural heritage today?
2. Are there any internal policies or regulations specifically governing the organization of OCMHS cultural heritage collections within the museums/libraries and archives in Sawahlunto Municipality?
3. In your opinion, how effective are the current knowledge organization practices implemented in the museums/libraries and archives of Sawahlunto Municipality in supporting access to OCMHS cultural heritage information?
4. Have the museums/libraries and archives in Sawahlunto Municipality adopted standardized knowledge organization systems to support access to OCMHS cultural heritage information?
5. To what extent is digital technology utilized in the knowledge organization practices of museums/libraries and archives in Sawahlunto Municipality to support access to OCMHS cultural heritage information?
6. Have the museums/libraries and archives in Sawahlunto Municipality engaged professional experts in the knowledge organization practices related to OCMHS cultural heritage?

Section 2: Critical Factors Justifying the Taxonomy Development

1. What are the main limitations or challenges faced by the museums/libraries and archives in Sawahlunto Municipality in carrying out knowledge organization practices related to OCMHS cultural heritage?
2. In your opinion, to what extent are the current systems and standards or guidelines used in knowledge organization relevant to the context of OCMHS cultural heritage in the museums/libraries, and archives of Sawahlunto Municipality?
3. In your view, what strategic potentials or opportunities do the museums/libraries and archives of Sawahlunto Municipality possess to develop contextual knowledge organization systems related to OCMHS cultural heritage, such as taxonomies?
4. Do the museums/libraries and archives in Sawahlunto Municipality have any strategic plans to promote the integration of knowledge organization systems related to OCMHS cultural heritage, such as taxonomies?
5. What forms of support do you believe are most needed by the museums/libraries and archives in Sawahlunto Municipality to strengthen the practices and development of knowledge organization systems related to OCMHS cultural heritage, especially in the form of taxonomies?

Reference:

Gnoli, C. (2020). *Introduction to Knowledge Organization*. UK: Facet Publishing.

Hjørland, B. (2007). Semantics and Knowledge Organization. *Annual Review of Information Science and Technology*, 367-405.

Hjørland, B. (2017a). Domain analysis. In J. D. McDonald & M. Levine-Clark (Eds.), *Encyclopedia of Library and Information Sciences (4th ed., pp. 1473–1484)*. USA: CRC Press.
Hjørland, B. (2017b). Theories are knowledge organizing systems (KOS). *Knowledge Organization, 42*(2), 113–128.
Hjørland, B. (2021). Information retrieval and knowledge organization: A perspective from the philosophy of science. *Information, 12*(3), 135.
Hlava, M. (2014b). *The Taxobook: Principles and Practices of Building Taxonomies, Part 2 of a 3-Part Series*. USA: Springer.
Smiraglia, R. P. (2014a). *The Elements of Knowledge Organization.* USA: Springer.
Smiraglia, R. P. (2014b). *Cultural Synergy in Information Institutions.* USA: Springer.
Smiraglia, R. P. (2015). *Domain Analysis for Knowledge Organization: Tools for Ontology Extraction*. UK: Chandos Publishing.

RESEARCH INTERVIEW GUIDE:
CURATORS/ REGISTRARS/LIBRARIANS/ARCHIVISTS

Title of Research Project : *Tajuk Penyelidikan :*	Enhancing Access to Heritage Information in Indonesia through the Development of Knowledge Taxonomy: A Case Study of the Ombilin Coal Mining Heritage of Sawahlunto
Name of Researcher* : *Nama Penyelidik*:*	Muhammad Rosyihan Hendrawan
Name of Supervisor : *Nama Penyelia:*	Prof. Dr. Azman Mat Isa Assoc. Prof. Dr. Ahmad Zam Hariro Samsudin
Address of Department/ Hospital/ Institute : *Alamat Jabatan/ Hospital/ Institut:*	Faculty of Information Science, UiTM Cawangan Selangor Kampus Puncak Perdana, Seksyen U10, 40150 Shah Alam, Selangor.
Contact No/ Email : *No.Telefon/ Emel :*	+62 821 3429 2240 / 2023394187@student.uitm.edu.my

Introduction:

The researcher will open the interview section and be thankful to the participants for their time and interest in contributing to the research. The researcher will provide an overview of the study's purpose, emphasizing the development of a knowledge taxonomy for the Ombilin Coal Mining Heritage Site of Sawahlunto (OCMHS) to enhance access to cultural heritage information.

- The researcher will introduce himself and the purpose of the interview.
- The researcher will explain the importance of their insights in developing a knowledge taxonomy for OCMHS.

Participant Information:

- Name:
  ……
- Role/Position:
  ……..
- Affiliation/Organization:
  ……..
- Contact Information:
  ……

Confidentiality Statement: The researcher will ensure participants the confidentiality of their responses and the use of anonymized data in research findings.

Section 1: Existing Conditions of Knowledge Organization Processes

1. What are your primary responsibilities as a curator/registrar/librarian/archivist in the museums/library/archives of Sawahlunto Municipality, particularly in relation to the knowledge organization practices of collections associated with OCMHS (Ombilin Coal Mining Heritage of Sawahlunto) cultural heritage?
2. In your daily routines, how does the workflow in the museums/library/archives of Sawahlunto Municipality proceed in the context of knowledge organization or collection related to OCMHS cultural heritage?
3. Could you describe the current system used in the museums/library/archives of Sawahlunto Municipality for knowledge organization about OCMHS cultural heritage?
4. What methods or approaches are commonly employed by the museums/library/archives of Sawahlunto Municipality in classifying or categorizing collections related to OCMHS cultural heritage?
5. Have the knowledge organization practices related to OCMHS cultural heritage in the museums/library/archives of Sawahlunto Municipality been digitized?
6. Does the current knowledge organization system for OCMHS cultural heritage in Sawahlunto Municipality museums/library/archives follow specific national or international standards? How effective is its implementation in practice?
7. Are local terminologies or contextual elements of OCMHS cultural heritage accommodated within the current knowledge organization systems used in the museums/library/archives of Sawahlunto Municipality? If not, what are the main constraints?
8. Has there been any involvement of subject-matter experts or professionals in the practice and development of knowledge organization systems in the museums/library/archives of Sawahlunto Municipality for OCMHS cultural heritage?

Section 2: Critical Factors Justifying the Taxonomy Development

1. What are the primary limitations or challenges faced by the museums/library/archives of Sawahlunto Municipality in knowledge organization related to OCMHS cultural heritage?
2. Which aspect of the knowledge organization practices related to OCMHS cultural heritage do you perceive to be most affected by the current limitations in the museums/library/archives of Sawahlunto Municipality?
3. In your view, to what extent is the current knowledge organization system used in the museums/library/archives of Sawahlunto Municipality relevant to the specific characteristics of OCMHS cultural heritage? Do you find the system too generic or lacking in contextual specificity?
4. Have you observed or studied practices from other museums, domestically or internationally, that could serve as exemplary models for developing knowledge organization systems, such as taxonomy in the museums/library/archives of Sawahlunto Municipality?

5. Are there any current strategic plans or initiatives in place within the museums/library/archives of Sawahlunto Municipality aimed at developing a more contextual or participatory knowledge organization system, such as a taxonomy for OCMHS cultural heritage?
6. In your view, what fundamental principles should be considered by the museums/library/archives of Sawahlunto Municipality in developing an effective and sustainable knowledge organization system such as a taxonomy for OCMHS cultural heritage?
7. What forms of support are most needed by the museums/library/archives of Sawahlunto Municipality in developing knowledge organization systems such as taxonomy for OCMHS cultural heritage?
8. What is your perspective on the importance of cross-sector collaboration for the museums/library/archives of Sawahlunto Municipality in developing an inclusive and integrated knowledge organization system, such as a taxonomy for OCMHS cultural heritage?

Reference:

Gnoli, C. (2020). *Introduction to Knowledge Organization*. UK: Facet Publishing.

Hjørland, B. (2007). Semantics and Knowledge Organization. *Annual Review of Information Science and Technology*, 367-405.

Hjørland, B. (2017a). Domain analysis. In J. D. McDonald & M. Levine-Clark (Eds.), *Encyclopedia of Library and Information Sciences (4th ed., pp. 1473–1484)*. USA: CRC Press.

Hjørland, B. (2017b). Theories are knowledge organizing systems (KOS). *Knowledge Organization, 42*(2), 113–128.

Hjørland, B. (2021). Information retrieval and knowledge organization: A perspective from the philosophy of science. *Information, 12*(3), 135.

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Smiraglia, R. P. (2014b). *Cultural Synergy in Information Institutions.* USA: Springer.

Smiraglia, R. P. (2015). *Domain Analysis for Knowledge Organization: Tools for Ontology Extraction*. UK: Chandos Publishing.

RESEARCH INTERVIEW GUIDE:
CULTURAL HERITAGE EXPERTS

Title of Research Project : *Tajuk Penyelidikan :*	Enhancing Access to Heritage Information in Indonesia through the Development of Knowledge Taxonomy: A Case Study of the Ombilin Coal Mining Heritage of Sawahlunto
Name of Researcher* : *Nama Penyelidik*:*	Muhammad Rosyihan Hendrawan
Name of Supervisor : *Nama Penyelia*:	Prof. Dr. Azman Mat Isa Assoc. Prof. Dr. Ahmad Zam Hariro Samsudin
Address of Department/ Hospital/ Institute : *Alamat Jabatan/ Hospital/ Institut:*	Faculty of Information Science, UiTM Cawangan Selangor Kampus Puncak Perdana, Seksyen U10, 40150 Shah Alam, Selangor.
Contact No/ Email : *No.Telefon/ Emel :*	+62 821 3429 2240 / 2023394187@student.uitm.edu.my

Introduction:

The researcher will open the interview section and be thankful to the participants for their time and interest in contributing to the research. The researcher will provide an overview of the study's purpose, emphasizing the development of a knowledge taxonomy for the Ombilin Coal Mining Heritage Site of Sawahlunto (OCMHS) to enhance access to cultural heritage information.

- The researcher will introduce himself and the purpose of the interview.
- The researcher will explain the importance of their insights in developing a knowledge taxonomy for OCMHS.

Participant Information:

- Name:
  ……
- Role/Position:
  ……..
- Affiliation/Organization:
  ……..
- Contact Information:
  ……..

Confidentiality Statement: The researcher will ensure participants the confidentiality of their responses and the use of anonymized data in research findings.

Section 1: Existing Conditions of Knowledge Organization Processes

1. Could you explain your main responsibilities as a member of the Cultural Heritage Expert Team in supporting the knowledge organization practice of OCMHS cultural heritage within the cultural heritage institutions of Sawahlunto Municipality?
2. To what extent has the Cultural Heritage Expert Team been involved in decision-making or providing assistance related to the knowledge organization of OCMHS cultural heritage in the cultural heritage institutions of Sawahlunto Municipality?
3. Is there any space for coordination or dialogue between the Cultural Heritage Expert Team and the cultural heritage institutions of Sawahlunto Municipality regarding knowledge organization practices?
4. How do you assess the current state of knowledge organization practices related to OCMHS cultural heritage implemented in the cultural heritage institutions of Sawahlunto Municipality?
5. Do the current knowledge organization practices used in the cultural heritage institutions of Sawahlunto Municipality adequately represent the unique characteristics of the OCMHS cultural heritage?
6. Are you aware whether the knowledge organization practices for OCMHS cultural heritage collections in Sawahlunto's cultural heritage institutions adhere to any specific national or international standards?

Section 2: Critical Factors Justifying the Taxonomy Development

1. From your perspective as a Cultural Heritage Expert Team member, what are the main limitations you have identified in the knowledge organization practices of OCMHS cultural heritage in Sawahlunto Municipality's heritage institutions?
2. What are the key challenges you have identified in knowledge organization practices of OCMHS-related cultural heritage in these institutions?
3. In your opinion, to what extent is there a strategic opportunity to develop a knowledge organization system, such as a taxonomy, within the heritage institutions of Sawahlunto Municipality?
4. Are there any examples of knowledge organization practices, either nationally or internationally, that you believe are relevant and could be adapted by the heritage institutions in Sawahlunto Municipality?
5. What essential principles do you think should be taken into consideration by the heritage institutions of Sawahlunto Municipality when developing a knowledge organization system, such as a taxonomy for organizing OCMHS cultural heritage?

6. What forms of support are most needed by the museums in Sawahlunto Municipality in implementing and further developing their knowledge organization systems related to OCMHS cultural heritage?

Reference:

Gnoli, C. (2020). *Introduction to Knowledge Organization*. UK: Facet Publishing.

Hjørland, B. (2007). Semantics and Knowledge Organization. *Annual Review of Information Science and Technology*, 367-405.

Hjørland, B. (2017a). Domain analysis. In J. D. McDonald & M. Levine-Clark (Eds.), *Encyclopedia of Library and Information Sciences (4th ed., pp. 1473–1484)*. USA: CRC Press.

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Hjørland, B. (2021). Information retrieval and knowledge organization: A perspective from the philosophy of science. *Information, 12*(3), 135.

Hlava, M. (2014b). *The Taxobook: Principles and Practices of Building Taxonomies, Part 2 of a 3-Part Series*. USA: Springer.

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Smiraglia, R. P. (2014b). *Cultural Synergy in Information Institutions.* USA: Springer.

Smiraglia, R. P. (2015). *Domain Analysis for Knowledge Organization: Tools for Ontology Extraction*. UK: Chandos Publishing.

RESEARCH INTERVIEW GUIDE:
USERS/COMMUNITIES

Title of Research Project : *Tajuk Penyelidikan :*	Enhancing Access to Heritage Information in Indonesia through the Development of Knowledge Taxonomy: A Case Study of the Ombilin Coal Mining Heritage of Sawahlunto
Name of Researcher* : *Nama Penyelidik*:*	Muhammad Rosyihan Hendrawan
Name of Supervisor : *Nama Penyelia*:	Prof. Dr. Azman Mat Isa Assoc. Prof. Dr. Ahmad Zam Hariro Samsudin
Address of Department/ Hospital/ Institute : *Alamat Jabatan/ Hospital/ Institut:*	Faculty of Information Science, UiTM Cawangan Selangor Kampus Puncak Perdana, Seksyen U10, 40150 Shah Alam, Selangor.
Contact No/ Email : *No.Telefon/ Emel :*	+62 821 3429 2240 / 2023394187@student.uitm.edu.my

Introduction:

The researcher will open the interview section and be thankful to the participants for their time and interest in contributing to the research. The researcher will provide an overview of the study's purpose, emphasizing the development of a knowledge taxonomy for the Ombilin Coal Mining Heritage Site of Sawahlunto (OCMHS) to enhance access to cultural heritage information.

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Participant Information:

- Name:
  ……
- Role/Position:
  ……..
- Affiliation/Organization:
  ……..
- Contact Information:
  …….

Confidentiality Statement: The researcher will ensure participants the confidentiality of their responses and the use of anonymized data in research findings.

Section 1: Existing Conditions of Knowledge Organization Processes

1. Based on your experience as a resident/user of Sawahlunto Municipality's museums/library/archives, how would you see the way OCMHS cultural heritage collections are categorized and made accessible to the general public?
2. When you or your community search for information related to the OCMHS cultural heritage in Sawahlunto Municipality's museums/library/archives, have you ever encountered any difficulties?
3. In your view, as a resident/user, do you think the current collections in Sawahlunto Municipality's museums/library/archives adequately reflect the cultural identity of the local OCMHS community?
4. Do you think the current knowledge organization system used in Sawahlunto Municipality's museums/library/archives is easy for the public to understand?
5. Have you ever tried to access the collections through the digital platform provided by Sawahlunto Municipality's museums/library/archives?
6. In your opinion, as a resident/user, are local OCMHS terms already being used in the knowledge organization systems of Sawahlunto Municipality's museums/library/archives?
7. Have you ever provided suggestions or feedback to the Sawahlunto Municipality's museums/library/archives on how the OCMHS cultural heritage information should be categorized?
8. Do you find that the information or narratives provided in the Sawahlunto Municipality's museums/library/archives, either physical or digital, help you understand the OCMHS cultural heritage from your perspective as a resident/user?

Section 2: Critical Factors Justifying the Taxonomy Development

1. What are the main limitations or challenges that you think make it difficult to access information about the OCMHS cultural heritage in the Sawahlunto Municipality's museums/library/archives?
2. Based on your experience as a resident/user, which aspects are most affected by the current limitations in the knowledge organization system used by the Sawahlunto Municipality's museums/library/archives?
3. Do you think the current knowledge organization system in Sawahlunto Municipality's museums/library/archives accurately reflects the richness of OCMHS cultural heritage?
4. Have you ever seen examples of good practices elsewhere that you think could inspire Sawahlunto Municipality's museums/library/archives?
5. In your opinion, what is the first thing that the Sawahlunto Municipality's museums/library/archives need to improve so that the public can more easily access and understand information about the OCMHS cultural heritage?

6. Do you think the Sawahlunto Municipality's museums/library/archives should involve residents/users in the process of developing the knowledge organization system for OCMHS cultural heritage?
7. What are your hopes as a resident/user for the Sawahlunto Municipality's museums/library/archives in providing OCMHS cultural heritage information that better reflects the perspectives of the user/community?
8. What is your view on the potential collaboration between residents/users and Sawahlunto Municipality's museums/library/archives in developing a knowledge organization system that is contextual and user-friendly for all?

Reference:

Gnoli, C. (2020). *Introduction to Knowledge Organization*. UK: Facet Publishing.

Hjørland, B. (2007). Semantics and Knowledge Organization. *Annual Review of Information Science and Technology*, 367-405.

Hjørland, B. (2017a). Domain analysis. In J. D. McDonald & M. Levine-Clark (Eds.), *Encyclopedia of Library and Information Sciences (4th ed., pp. 1473–1484)*. USA: CRC Press.

Hjørland, B. (2017b). Theories are knowledge organizing systems (KOS). *Knowledge Organization, 42*(2), 113–128.

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Hlava, M. (2014b). *The Taxobook: Principles and Practices of Building Taxonomies, Part 2 of a 3-Part Series*. USA: Springer.

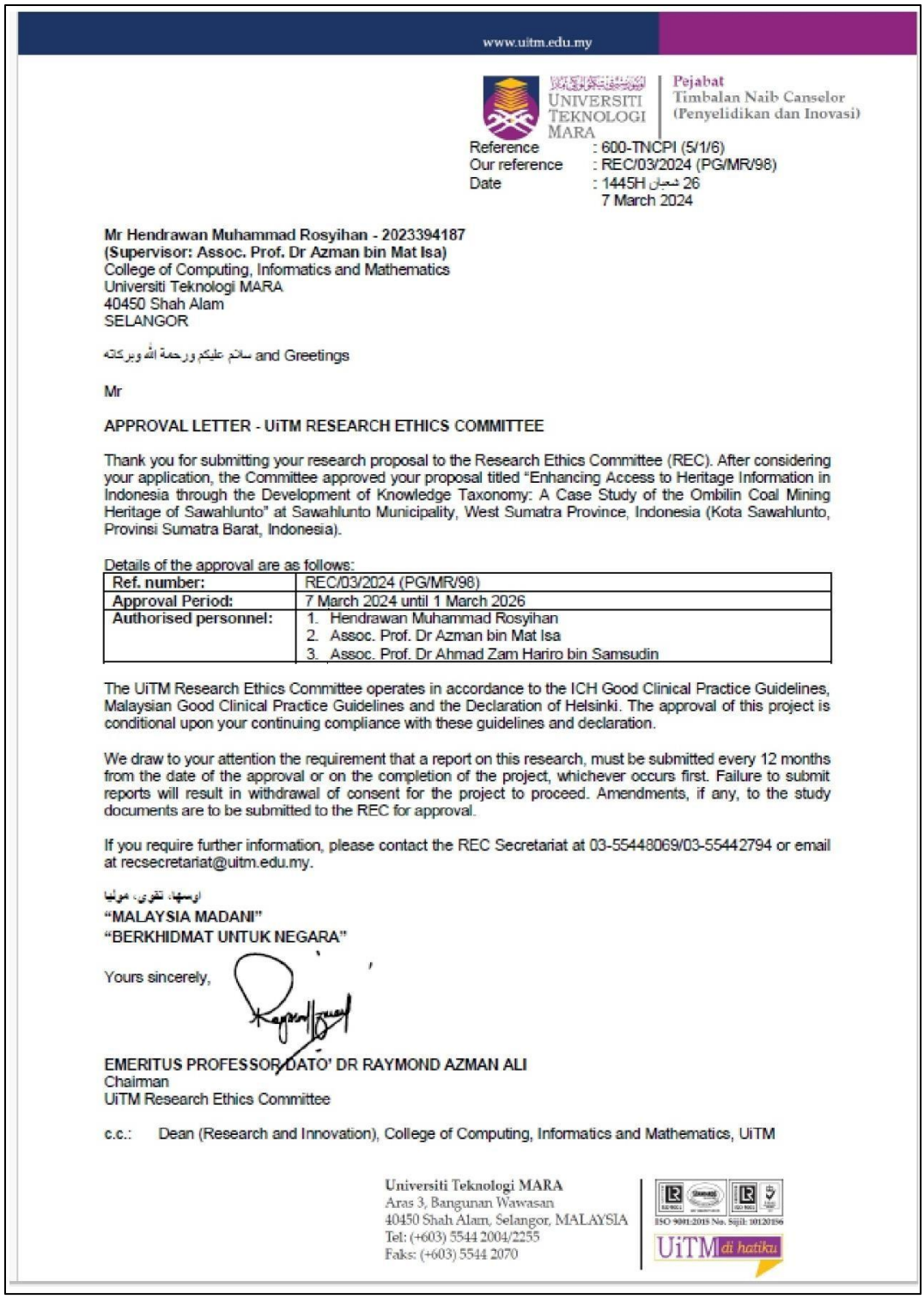
Smiraglia, R. P. (2014a). *The Elements of Knowledge Organization.* USA: Springer.

Smiraglia, R. P. (2014b). *Cultural Synergy in Information Institutions.* USA: Springer.

Smiraglia, R. P. (2015). *Domain Analysis for Knowledge Organization: Tools for Ontology Extraction*. UK: Chandos Publishin.

APPENDIX 7

Approval Letter UiTM Research Ethics Commite



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UNIVERSITI TEKNOLOGI MARA

Pejabat
Timbalan Naib Canselor
(Penyelidikan dan Inovasi)

Reference : 600-TNCPI (5/1/6)
Our reference : REC/03/2024 (PG/MR/98)
Date : 1445H 26 شعبان
7 March 2024

Mr Hendrawan Muhammad Rosyihan - 2023394187
(Supervisor: Assoc. Prof. Dr Azman bin Mat Isa)
College of Computing, Informatics and Mathematics
Universiti Teknologi MARA
40450 Shah Alam
SELANGOR

سلام عليكم ورحمة الله وبركاته and Greetings

Mr

APPROVAL LETTER - UiTM RESEARCH ETHICS COMMITTEE

Thank you for submitting your research proposal to the Research Ethics Committee (REC). After considering your application, the Committee approved your proposal titled "Enhancing Access to Heritage Information in Indonesia through the Development of Knowledge Taxonomy: A Case Study of the Ombilin Coal Mining Heritage of Sawahlunto" at Sawahlunto Municipality, West Sumatra Province, Indonesia (Kota Sawahlunto, Provinsi Sumatra Barat, Indonesia).

Details of the approval are as follows:

Ref. number:	REC/03/2024 (PG/MR/98)
Approval Period:	7 March 2024 until 1 March 2026
Authorised personnel:	1. Hendrawan Muhammad Rosyihan 2. Assoc. Prof. Dr Azman bin Mat Isa 3. Assoc. Prof. Dr Ahmad Zam Hariro bin Samsudin

The UiTM Research Ethics Committee operates in accordance to the ICH Good Clinical Practice Guidelines, Malaysian Good Clinical Practice Guidelines and the Declaration of Helsinki. The approval of this project is conditional upon your continuing compliance with these guidelines and declaration.

We draw to your attention the requirement that a report on this research, must be submitted every 12 months from the date of the approval or on the completion of the project, whichever occurs first. Failure to submit reports will result in withdrawal of consent for the project to proceed. Amendments, if any, to the study documents are to be submitted to the REC for approval.

If you require further information, please contact the REC Secretariat at 03-55448069/03-55442794 or email at recsecretariat@uitm.edu.my.

اوسهها، تقوى، مولیا
"MALAYSIA MADANI"
"BERKHIDMAT UNTUK NEGARA"

Yours sincerely,

EMERITUS PROFESSOR DATO' DR RAYMOND AZMAN ALI
Chairman
UiTM Research Ethics Committee

c.c.: Dean (Research and Innovation), College of Computing, Informatics and Mathematics, UiTM

Universiti Teknologi MARA
Aras 3, Bangunan Wawasan
40450 Shah Alam, Selangor, MALAYSIA
Tel: (+603) 5544 2004/2255
Faks: (+603) 5544 2070

ISO 9001:2015 No. Sijil: 10120156

UiTM di hatiku

APPENDIX 8

Permission to Conduct Research

PEMERINTAH KOTA SAWAHLUNTO
DINAS PENANAMAN MODAL PELAYANAN
TERPADU SATU PINTU DAN TENAGA KERJA
Jl. Lintas Sumatera Desa Muaro Kalaban Kec. Silungkang Telp/Fax: (0754) 62167 Kode Pos 27435

SURAT KETERANGAN PENELITIAN
Nomor : 503/ 42 /DPMPTSPNaker-SWL/2024

Sehubungan dengan Surat dari Penyelia Utama Pengajian Pengkomputeran, Informatik dan Matematik Universiti Teknologi Mara Nomor : 600-KPPIM (AKA-5/3 Perihal Izin Penelitian, dengan ini kami Kepala Dinas Penanaman Modal Pelayanan Terpadu Satu Pintu dan Tenaga Kerja Kota Sawahlunto menyatakan tidak keberatan atas maksud pelaksanaan Penelitian yang dilakukan oleh :

Nama	:	Muhammad Rosyihan Hendrawan
Tempat / Tanggal Lahir	:	Selong / 4 Desember 1987
Pekerjaan	:	Dosen
NIM/BP	:	2023394187
Alamat	:	Kelurahan Landungsari, Kecamatan Dau, Kab. Malang
Tujuan Penelitian	:	Data Penelitian
Bidang Penelitian	:	Manajemen Informasi Warisan Budaya
Lama Penelitian	:	1 April 2024 s/d 31 Juli 2024
Judul	:	Enhancing Access to Heritage Information in Indonesia through the Development of Knowledge Taxonomy: A Case Study of the Ombilin Coal Mining Heritage of Sawahlunto
Lokasi / Tempat Penelitian	:	Museum Goedang Ransoem Kota Sawahlunto, Museum Situs Lubang Tambang Mbah Soero Kota Sawahlunto, Museum Kereta Api Kota Sawahlunto, Museum Tambang Kota Sawahlunto, Dinas Perpustakaan dan Arsip Kota Sawahlunto.

Dengan ketentuan sebagai berikut :

1. Tidak boleh menyimpang dari kerangka serta tujuan penelitian/ survey yang akan dilaksanakan.
2. Memberitahukan kedatangan dan maksud penelitian yang akan dilaksanakan dengan menunjukan surat-surat keterangan yang berhubungan dengan itu serta melaporkan diri sebelum meninggalkan daerah/lokasi penelitian kepada Pemerintah Daerah Setempat.
3. Mematuhi semua peraturan yang berlaku dan menghormati adat istiadat serta kebiasaan masyarakat setempat.
4. Karena Pelaksanaan Penelitian pada Era *New Normal*, maka tetap menerapkan Protokol Kesehatan.
5. Menyampaikan laporan hasil penelitian sebanyak 1 (satu) eksemplar kepada Walikota Sawahlunto Cq. Dinas Penanaman Modal Pelayanan Terpadu Satu Pintu dan Tenaga Kerja Kota Sawahlunto.
6. Bila terjadi penyimpangan / pelanggaran terhadap ketentuan tersebut diatas, maka surat rekomendasi ini akan dicabut kembali.

Demikianlah rekomendasi izin kegiatan Penelitian/Survey ini kami sampaikan, untuk suksesnya kegiatan dimaksud diharapkan bantuan saudara seperlunya, terima kasih.

Sawahlunto, 21 Maret 2024



KEPALA DINAS PENANAMAN MODAL, PELAYANAN TERPADU SATU PINTU DAN TENAGA KERJA
Dwi Darmawati, S.H.
Pembina Utama Muda, IV/c
NIP. 19740522 199803 2 003

Tembusan : disampaikan kepada Yth.
1. Bapak Pj Walikota Sawahlunto (Sebagai Laporan);

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UNIVERSITI TEKNOLOGI MARA | Kolej Pengajian Pengkomputeran, Informatik dan Matematik

Rujukan kami: 600-KPPIM (AKA-5/3)
Tarikh : 1445H 10 رمضان
21 Mac 2024

Kepala Dinas Penanaman Modal,
Pelayanan Terpadu Satu Pintu
dan Tenaga Kerja Kota Sawahlunto
Jalan Lintas Sumatera Desa Muaro
Kalaban, Kecamatan Silungkang,
Kota Sawahlunto 27435
INDONESIA

السلام عليكم ورحمة هللا وبركاته
YBhg. Tuan/Puan

MEMOHON KEBENARAN MENEMU BUAL BAGI PENYELIDIKAN PENINGKATAN AKSES KEPADA MAKLUMAT WARISAN BUDAYA DALAM KONTEKS PEMBINAAN TAKSONOMI PENGETAHUAN DI PERINGKAT PENGURUSAN SITUS WARISAN TAMBANG BATUBARA OMBILIN SAWAHLUNTO

Dengan hormatnya perkara di atas dirujuk.

2. Saya dengan ini memohon jasa baik dan kesudian YBhg. Tuan/Puan untuk menjadi informan dalam proses pengumpulan data secara kualitatif oleh calon Ph.D seperti butiran berikut:

NAMA	:	MUHAMMAD ROSYIHAN HENDRAWAN
ID PELAJAR	:	2023394187
TAJUK KAJIAN	:	ENHANCING ACCESS TO HERITAGE INFORMATION IN INDONESIA THROUGH THE DEVELOPMENT OF KNOWLEDGE TAXONOMY: A CASE STUDY OF THE OMBILIN COAL MINING HERITAGE OF SAWAHLUNTO

3. Penyelidikan ini bertujuan mengkaji secara menyeluruh peningkatan akses kepada maklumat warisan budaya (*heritage information*) dalam konteks pembinaan taksonomi pengetahuan di peringkat pengurusan Situs Warisan Tambang Batubara Ombilin Sawahlunto (*The Ombilin Coal Mining Heritage of Sawahlunto*). Penyelidikan ini akan membangun sebuah kerangka tadbir urus maklumat untuk warisan budaya yang boleh diguna pakai oleh lembaga museum, arsip, dan perpustakaan pada Situs Warisan Tambang Batubara Ombilin Sawahlunto bagi penambahbaikan kualiti keputusan strategik. Ia secara tidak langsung meningkatkan prestasi, tahap akauntabiliti dan ketelusan sesebuah situs warisan dunia.

4. Kerjasama dan perhatian Tuan/Puan amat dihargai dan didahului dengan ucapan ribuan terima kasih. Besar harapan saya agar mendapat maklum balas dengan kadar segera daripada pihak YBhg. Tuan/Puan.

Sekian.

وسهلا تقوى، مولیا

'MALAYSIA MADANI"
"BERKHIDMAT UNTUK NEGARA"

Saya yang menjalankan amanah,

PROF MADYA DR AZMAN BIN MAT ISA
Penyelia Utama

Kompleks Al-Khawarizmi
Universiti Teknologi MARA
40450 Shah Alam, Selangor Darul Ehsan
MALAYSIA
Tel: (+603) 5543 5329 / 5307 / 4860
Faks: (+603) 5543 5501

2. Kepala Badan Kesbangpol Kota Sawahlunto;
3. Kepala Dinas Kebudayaan Kota Sawahlunto;
4. Kepala Dinas Pariwisata Kota Sawahlunto;
5. Kepala Dinas Perpustakaan dan Arsip Kota Sawahlunto.

Jenis Perizinan : Tidak Berbayar

Dokumen ini ditandatangani secara elektronik menggunakan Sertifikat Elektronik yang diterbitkan oleh Balai Sertifikasi Elektronik (BSrE), Badan Siber dan Sandi Negara (BSSN)

APPENDIX 9

On-Site Data Collections



Fig. 1. Warm welcome from the Mayor of Sawahlunto Municipality



Fig. 2. A corner of the archives collection room



Fig. 3. One of the Coal Mining Museum outdoor collections



Fig. 4. One of the collection rooms at the Railway Museum



Fig. 5. Greetings after an interview session



Fig. 6. Session in the first FGD



Fig. 7. Some photos of *Orang Rantai*



Fig. 8. One of evidence of colonialism



Fig. 9. Greetings before an interview session



Fig. 10. With the descendants of *Orang Rantai*



Fig. 11. One of the ongoing interview session



Fig. 12. Closing after the second FGD

APPENDIX 10

SLR and BA Paper

Check for updates

Article

Journal of Librarianship and Information Science
1–22
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DOI: 10.1177/09610006251334372
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Sage

Evolving taxonomies: Fifty years of taxonomy development in Library and Information Science

Muhammad Rosyihan Hendrawan
Universiti Teknologi MARA, Malaysia
Universitas Brawijaya, Indonesia

Azman Mat Isa
Universiti Teknologi MARA, Malaysia

Ahmad Zam Hariro Samsudin
Universiti Teknologi MARA, Malaysia

Abstract

This study provides a comprehensive bibliometric analysis of taxonomy development in Library and Information Science (LIS), covering 50 years (1974–2024) and examining 268 articles indexed in Scopus. It identifies three phases of research evolution: an early stage with limited output, a growth phase marked by methodological expansion, and a mature phase characterized by interdisciplinary and technology-driven approaches. The results show important contributors like Nickerson and Varshney, showing a change from basic classification systems to taxonomies that are based on consensus, are human-centered, and use artificial intelligence. Emerging themes include knowledge modeling, ontologies, and applications in business and information systems. By combining bibliometric mapping with systematic review techniques, this study charts the intellectual and thematic landscape of taxonomy research in LIS. The results emphasize the need for adaptable, user-centric taxonomies that align with modern digital infrastructures. These insights inform both theoretical refinement and practical innovation in taxonomy design, providing a foundation for future research across diverse knowledge domains.

Keywords

Bibliometric analysis, co-citation network, library and information science, research trends, taxonomy development

Introduction

Taxonomy is critical in Library and Information Science (LIS) because it facilitates knowledge organization and information retrieval in both traditional and digital contexts. Dos Santos Maculan and Aganette (2018) define a taxonomy as a hierarchical classification structure that serves as a foundational element in the development of ontologies and thesauri, essential data structures in LIS. The process of developing a taxonomy involves designing a classification system tailored to the objects of interest (Omair and Alturki, 2020). People often use terms like "taxonomy development" (Nickerson et al., 2013), "taxonomy building" (Sia and Al-Hawamdeh, 2003), and "taxonomy design" (Kundisch et al., 2022) interchangeably to describe this process.

Linnaeus (1735) hierarchical classification system in Systema Naturae, which used binomial nomenclature to organize species, marked the beginning of taxonomy development. Bloom's (1956) Taxonomy later adapted this system to education, hierarchically structuring educational objectives to classify and assess learning goals. Over time, the taxonomy development has expanded to various fields. Today, they are employed in industries such as government and business management (Ko and

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Gillani, 2020; Mohamad et al., 2024; Niu et al., 2015; Samsudin et al., 2015), technologies (Usman et al., 2017; Yang and Varshney, 2022), and sustainability (Pérez and Costa, 2018; Pradani et al., 2022). Additionally, Yazgan (2018), Berger et al. (2020), and Stanton et al. (2023) utilize taxonomies to address risk and safety issues. In LIS research, Vickery (1960) was the first to define taxonomies as tools for structuring domain-specific entities, a concept further developed by researchers including Nickerson et al. (2013), Beydoun et al. (2013), Lund and Ørnager (2016), Omair and Alturki (2020), and Kundisch et al. (2022). This broad application underscores the versatility of taxonomies and their relevance across diverse domains.

Despite its importance, the taxonomy development process in LIS research often lacks clarity, and the evaluation of taxonomies remains infrequent (Kundisch et al., 2022; Oberländer et al., 2019; Omair and Alturki, 2020). Irfan et al. (2019) conducted a comprehensive review of taxonomy development research, while Oberländer et al. (2019) focused on leading information systems journals from 2013 to 2018. However, there is a notable gap in research that specifically addresses the application of bibliometrics in taxonomy development research.

According to Sillet (2013), Blakeman (2018), and Curtis (2023), bibliometrics is a way to measure academic output, research performance, and the impact of scientific work. It gives information about publication trends, authorship patterns, and how academic fields have changed over time. Despite criticisms for insufficiently linking outputs to theoretical and practical advancements, bibliometrics remains instrumental in tracking emerging trends and advancing research, particularly in areas like taxonomy development within LIS (Lyu et al., 2023; Mukherjee et al., 2022). This study covers five decades (1974–2024) and utilizes bibliometric analysis techniques, to explore publication trends, and reveal interesting patterns and themes in the taxonomy development context. A bibliometric analysis was conducted of 268 articles that highlighted the topics of taxonomy development. This study addresses the following research objectives:

(a) To identify the annual scientific publication overview and determine the periodic progression of taxonomy development research.
(b) To identify the most relevant and most cited sources in taxonomy development.
(c) To identify the most prolific and prominent authors in the taxonomy development field of study.
(d) To identify the most influential work in taxonomy development.
(e) To identify the most frequently used words and keywords, trending topics, and keyword co-occurrence in taxonomy development research.
(f) To identify the patterns of collaboration, co-citation, co-authorship, and bibliographic coupling among authors, we aim to obtain the intellectual structure of research in the taxonomy development area.
(g) To identify the basic, motor, niche, and declining or emerging theme of research being conducted by researchers in taxonomy development.

This article is structured as follows. Section 2 discusses the study's conceptual background, and Section 3 outlines the methodology used in this review. Section 4 illustrates and discusses the findings, including bibliometric analysis results. Section 5 provides key findings and future research. Section 6 has theoretical and practical implications, and finally, section 7 states the conclusion and limitations of this study.

Conceptual background

The conceptual background serves as the foundation of this study, exploring the evolution, methodologies, and significance of taxonomy development within the Library and Information Science (LIS) domain and beyond. This section delves into how taxonomies provide structural frameworks for organizing knowledge, the methodologies involved in their development, and the technological advancements that are reshaping their applications in diverse fields. By examining these aspects, the section establishes the theoretical basis for understanding the trends and innovations in taxonomy research.

Taxonomies emerge as essential building blocks, providing a hierarchical structure for organizing, and classifying information. Taxonomies categorize concepts into broader categories and subcategories, establishing a framework that reflects the inherent structure of knowledge domains. By delineating relationships between concepts, taxonomies enable users to navigate complex information landscapes, guiding them toward relevant resources and insights. The process of taxonomy development in LIS involves several methodological approaches, ranging from manual classification techniques to automated and semi-automated methods.

Beyond LIS, taxonomy development has seen significant applications in adjacent fields such as business, technology, and sustainability. Business increasingly uses taxonomies to structure knowledge management systems, thereby enhancing decision-making processes and strategic planning (Ko and Gillani, 2020). Recent studies have emphasized the importance of dynamic and adaptable taxonomies in response to the evolving information landscape. More flexible systems that can accommodate the rapid changes in digital information are replacing the traditional static taxonomies, which were primarily hierarchical and rigid (Pérez and Costa, 2018). Dynamic taxonomies, also known as faceted taxonomies, allow for multi-dimensional

categorization, providing users with a more nuanced approach to information retrieval (Gnoli, 2020). These taxonomies are particularly effective in digital environments, where information is vast, unstructured, and constantly changing.

Artificial intelligence (AI) and machine learning have become pivotal in the development and maintenance of modern taxonomies by enabling adaptability and efficiency. AI-driven taxonomies automatically categorize, and update classifications based on new data, while machine learning algorithms facilitate the creation of predictive models that anticipate changes in information needs, allowing taxonomies to evolve alongside user requirements (Usman et al., 2017; Yang and Varshney, 2022). Additionally, the integration of taxonomies with business analytics and decision support systems has enhanced organizational efficiency, with research emphasizing iterative refinement methods through empirical analysis (Nickerson et al., 2013). This approach has been widely adopted in various fields, including LIS, to create taxonomies that are comprehensive, responsive, and adaptable to dynamic information landscapes.

Taxonomies manage complex information systems in the technology sector, particularly in software engineering and mobile health (Yang and Varshney, 2022). For instance, taxonomies in software engineering facilitate the development and maintenance of large-scale software projects by categorizing and standardizing components (Batista et al., 2022). Similarly, in mobile health, taxonomies help organize diverse health-related data, improving the accuracy and efficiency of health informatics systems. Sia and Al-Hawamdeh (2003) investigated tools for taxonomy building, highlighting the importance of user-centered design and the integration of expert knowledge. Their study emphasized the need for taxonomies to be flexible and scalable, allowing for continuous updates as new information becomes available. Kundisch et al. (2022) further expanded on this approach by providing methodological guidance for taxonomy designers, particularly in the context of business and information systems research. The field of sustainability has also benefited from the application of taxonomies, particularly in environmental data management and risk assessment. Research has focused on developing taxonomies that classify and prioritize sustainability initiatives, helping organizations better align their practices with global environmental standards (Pérez and Costa, 2018). These taxonomies are critical in guiding policy decisions and fostering sustainable practices across various industries.

In summary, this conceptual background highlights the pivotal role of taxonomies as tools for organizing and navigating complex information landscapes. It underscores the transformative impact of technological advancements, such as artificial intelligence and dynamic systems, on taxonomy development. These insights not only deepen our understanding of taxonomy methodologies but also set the stage for addressing the research objectives of this study, which aim to uncover the evolving patterns, challenges, and future directions in taxonomy development.

Methodology

This study employs a robust methodological approach to conduct a comprehensive bibliometric analysis of taxonomy development research spanning five decades or 50 years (1974–2024). The methodology is designed to systematically identify, screen, and analyze relevant academic contributions to understand publication trends, key contributors, thematic shifts, and intellectual structures in the field. By leveraging bibliometric tools and techniques, this research provides valuable insights into the evolution of taxonomy development and identifies emerging research priorities. The subsequent sections detail the research design, data collection, and analytical methods used to achieve the study's objectives.

Research design

This review adopts a dual-method strategy, integrating bibliometric analysis with the R package program to investigate publication trends and uncover key patterns and themes in taxonomy development, design, and building. The study follows the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 framework, as illustrated in Figure 1. PRISMA serves as a structured guide for reporting, reflecting advancements in methodologies for identifying, selecting, appraising, and synthesizing research. This approach aims to provide a comprehensive overview of the current state of knowledge in the field, identify emerging research priorities, and contribute to the development or evaluation of theories explaining various phenomena (Page et al., 2021).

Data collection

Identification source. The objective of this study was to perform a detailed bibliometric analysis using Scopus to map current research, identify core topics, and pinpoint research opportunities related to taxonomy development. The analysis includes research from leading publishers such as IEEE, Taylor & Francis, Elsevier, Emerald, Springer, and Wiley. Scopus was chosen for its reliable and extensive bibliometric data, providing comprehensive author and institution profiles that are ideal for large-scale research evaluations and policy assessments (Baas et al., 2020). Furthermore, Scopus has the advantage as a single database in bibliometric analysis because its coverage is wider than other databases such as Web of Science and Microsoft Academic, and it provides sophisticated analysis tools and high-quality data (Yang and Meho, 2006; Visser et al., 2021). Since

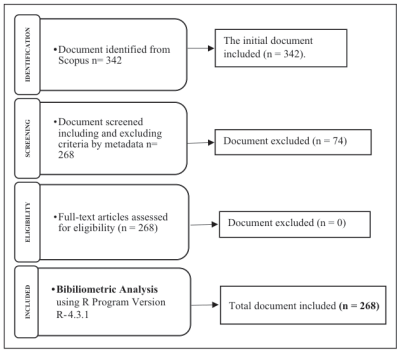


Figure 1. PRISMA 2020 review methodology flow-chart.

taxonomy development research is a continually evolving field, no specific time limit was imposed on data extraction. Therefore, the review included all relevant papers up to the extraction date of July 25, 2024, covering a span of 50 years (1974–2024).

To identify pertinent literature, we utilized boolean operators to refine our keyword search within the Scopus database. Search strings such as "taxonomy development" OR "taxonomy building" OR "taxonomy design" OR "taxonomy construction" OR "taxonomy generation" were applied to titles, keywords, and abstracts. This search strategy yielded a total of 342 publications for subsequent analysis.

Screening criteria. Additionally, this study applied specific inclusion and exclusion criteria based on Scopus metadata:

(a) Only papers published in English were included.

(b) Only journal articles and conference papers were considered; short reports, news articles, books, and dissertations were excluded.

(c) The sources were restricted to journals and conference proceedings.

(d) Only final publication stages were included.

Following the screening process using Scopus metadata, 74 papers were excluded, resulting in a total of 268 papers that met the criteria for further analysis.

Eligibility criteria. At this stage, a thorough review of full-text articles was conducted to ensure their relevance to taxonomy development, design, and building. The eligibility criteria applied were:

1. Exclusion of studies that were not available in full text.
2. Exclusion of articles still in press.

Following the application of these criteria, the data analysis included a total of 268 papers.

Data analysis

Scholars employ bibliometric analysis to achieve various objectives, such as identifying emerging trends in publication performance, collaboration patterns, research topics, and the intellectual structure of specific research areas (Donthu et al., 2021). In this study, we used *Bibliometrix*, an open-source tool based on R programing, to visualize and analyze bibliographic data. *Bibliometrix* is a robust and versatile tool designed for comprehensive bibliometric analysis (Aria and Cuccurullo, 2017). *Bibliometrix* offers a suite of functions for importing, cleaning, analyzing, and visualizing bibliographic data from major academic databases, including Scopus, Web of Science, and Dimensions. It supports a wide range of analytical techniques such as descriptive analysis, co-word analysis, co-citation and bibliographic coupling, thematic evolution, and collaboration mapping. The tool is particularly suitable for longitudinal studies, as it enables the exploration of intellectual, conceptual, and social structures within a given field over time.

For this study, version 4.3.1 of the R programing language was used alongside *Bibliometrix* to process and visualize the dataset, generate performance indicators, and construct network graphs. Integrating *Bibliometrix* enhances transparency, reproducibility, and methodological rigor, making it a valuable resource for large-scale bibliometric investigations in Library and Information Science (LIS).

The analysis utilized data from 268 papers on taxonomy development, sourced from the Scopus database. This data was exported in.csv file format and imported into R version 4.3.1 for bibliometric mapping. The R package provides detailed statistics and graphical representations across four metric levels (overview, source, author, and document) and three knowledge structures (conceptual, intellectual, and social).

Result

Overview and publication trend analysis

Main information. The main information from bibliometric data, as shown in Table 1, covers publications from 1974 to 2024, including 268 documents across 220 sources, with an average annual growth rate of 5.1%. The average document age is 8.79 years, and each document receives an average of 20.13 citations, indicating a moderate impact.

Table 1. Main information.

Description	Results
Main information about the data	
Timespan	1974:2024
Sources (Journals, Books, etc.)	220
Documents	268
Annual growth rate %	5.1
Document average age	8.79
Average citations per doc	20.13
References	11,705
Document contents	
Keywords plus (ID)	1817
Author's keywords (DE)	803
Authors	
Authors	859
Authors of single-authored docs	21
Authors collaboration	
Single-authored docs	24
Co-authors per doc	3.56
International co-authorships%	22.39
Document types	
Article	149
Conference paper	119

The dataset features 1817 Keywords Plus and 803 author-provided keywords, reflecting the core research themes. The total number of references across the documents is 11,705, demonstrating extensive engagement with existing literature.

Collaboration is prevalent, with 859 authors contributing to the dataset, though only 21 authored single papers. The average number of co-authors per document is 3.56, and 22.39% of documents involve international co-authorship. The majority of publications are journal articles (149), with 119 conference papers also included. This data highlights a growing, collaborative field with moderate global engagement, showing room for increased international partnerships and impact among scholars in the area of taxonomy development research.

Annual publication trend. The publication trend graph, illustrating annual total citations per year from 1974 to 2024 (see Figure 2), reveals a marked increase in research output on taxonomy development. The number of publications grew exponentially, rising from a single article in 1974 to 12 articles in 2024, accumulating a total of 268 articles over the period. This analysis identifies three distinct phases of productivity throughout the timeframe.

The development of taxonomy research can be divided into three distinct phases, each reflecting the field's growth and transformation over time. First, the early development phase, from 1974 to 1996, was characterized by a limited number of publications and a gradual expansion of interest. During this period, taxonomy research was in its formative years, with only 12 articles published in total. Between 1974 and 1990, there were no recorded articles, which suggests the field was still nascent and received little attention compared to other emerging research areas. However, from 1991 to 1996, there was a noticeable increase in activity, peaking at five articles in 1995. This increase in publications likely marks the beginning of a growing interest in taxonomy, possibly spurred by advancements in methodology or the establishment of dedicated research groups.

The second phase, referred to as growth and expansion, occurred between 1997 and 2014. During this period, there was a steady increase in the number of published articles, with the field showing substantial growth and expansion. The total number of articles increased significantly to 80. Between 1997 and 2004, the research output continued to rise consistently, peaking at seven articles in 2005. From 2005 to 2014, the field reached several peaks in output, with the highest being 21 articles in 2017, indicating a robust and expanding research area. This stability and the successive peaks suggest that taxonomy research has gained significant traction, benefiting from increased funding, technological advancements, and a growing academic community dedicated to the field.

The third phase, maturation, and current trends, spans from 2015 to 2024 and reflects the maturation of taxonomy as a field, with high publication rates and occasional fluctuations. The research output during this period was substantial, with a total of 176 articles published. Despite some variability in recent years, the field remains active and relevant, particularly in 2020 and 2021, which saw peaks in publications likely influenced by the increased focus on biological diversity during the pandemic. Although there has been a slight decline in the number of articles published in 2022 and 2023, the field remains vibrant and well-supported, indicating that taxonomy continues to be a crucial area of study in contemporary research.

The analysis of publication trends highlights three distinct phases in the evolution of taxonomy development research: early development (1974–1996), growth and expansion (1997–2014), and maturation (2015–2024). The early development phase was characterized by limited activity, with only 12 articles published, reflecting the foundational efforts to establish taxonomy as a research area. The growth and expansion phase saw a steady rise in publications, with diversification into advanced methods like cluster analysis and decision-making frameworks, as well as applications in fields such as information systems and artificial intelligence. During the maturation phase, the field experienced significant productivity, publishing 176 articles and emphasizing practical, human-centric approaches like knowledge management, business models, and ontology. Peaks in 2020 and 2021, potentially driven by the digital transformation accelerated by the

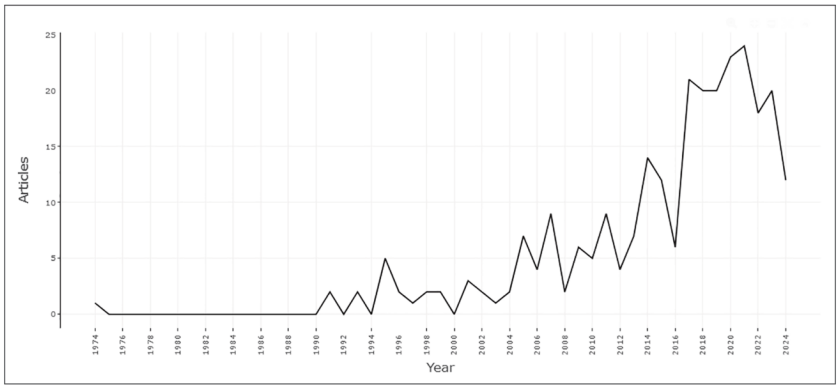


Figure 2. Annual publication trend.

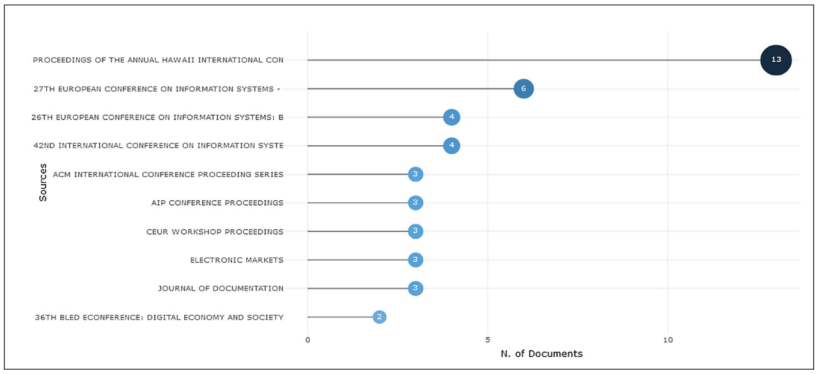


Figure 3. Most relevant sources.

COVID-19 pandemic, further underscore the field's dynamic adaptability and its growing importance in addressing contemporary challenges. These phases collectively reflect the field's progression and underscore its interdisciplinary and evolving nature.

Sources analysis

Most relevant sources. Figure 3 lists the top 10 sources related to taxonomy development research. The most prolific source, in terms of number of publications, the Proceedings of the Annual Hawaii International Conference on System Sciences is the leading source for taxonomy development research, with 13 articles, reflecting its prominence in the field. Significant contributions also come from the 27th European Conference on Information Systems (ECIS 2019) and the 42nd International Conference on Information Systems (ICIS 2021), with six and four articles, respectively, indicating their focus on socio-technical aspects of taxonomy development. The 26th European Conference on Information Systems (ECIS 2018) and ACM International Conference Proceeding Series further contribute with four and three articles, showing their relevance in information systems and computing contexts. Other notable sources include AIP Conference Proceedings, CEUR Workshop Proceedings, and the Journal of Documentation, each with three articles,

Table 2. Most prominent authors.

Authors (by citation)	Total citation	*h*-Index	Number papers
Muntermann J.	1045	7	7
Nickerson R. C.	1113	6	6
Varshney U.	958	5	7
Schoormann T.	158	4	4
Chaudhry A. S.	40	3	3
Hanelt A.	306	3	3
Kolbe L. M.	292	3	3
Kundisch D.	114	3	4
Liu X.	150	3	3
Szopinski D.	114	3	3

reflecting diverse yet valuable insights into taxonomy development research. In summary, conference proceedings dominate the publication landscape for taxonomy development research, with 36 articles compared to just 6 articles from journals. This indicates a higher volume of recent, diverse research contributions from conferences, while journals offer more comprehensive, peer-reviewed studies.

Author analysis

Most prominent authors. Table 2 presents the most prolific and prominent authors in taxonomy development research, as determined by citation metrics, *h*-index, and number of publications, respectively. Muntermann J., Nickerson R. C., and Varshney U. are the leading authors in taxonomy development research, distinguished by their impressive bibliometric metrics. Muntermann J. has an *h*-index of 7 and a *g*-index of 7, with 1045 total citations and seven published articles since 2009, indicating both high productivity and substantial research impact. Nickerson R. C., with an *h*-index and *g*-index of 6 each, has achieved 1113 citations from six articles, also starting in 2009, showcasing significant influence and a robust research output. Although Varshney U has a slightly lower *h*-index (5), it has a high *g*-index of 7 and a total of 958 citations from seven articles, demonstrating strong research performance.

Moreover, Schoormann T., Kundisch D., and Szopinski D. exhibit notable citation efficiency and potential despite having fewer publications. Schoormann T, with an *h*-index of 4 and a *g*-index of 4, has a high *m*-index of 0.571, reflecting effective citation growth from four articles published since 2018. Kundisch D, who began publishing in 2020, has a high *m*-index of 0.6 from four articles, indicating significant future potential in his research impact. Similarly, Szopinski D, with three articles and an *m*-index of 0.6, also demonstrates a strong potential for increased influence.

In contrast, Chaudhry A. S., Hanelt A., and Kolbe L. M. show moderate overall impact and citation efficiency. Chaudhry A. S., with three articles and a total of only 40 citations, has a low *m*-index of 0.15, indicating a limited impact. Hanelt A., with three articles, has 306 citations and an *m*-index of 0.3, indicating moderate citation efficiency. Kolbe L. M., with a similar publication count and m-index of 0.15, has 292 citations, demonstrating a more niche but still relevant contribution to taxonomy development research.

Document analysis

Most prominent document. Table 3 ranks the top 10 cited articles on taxonomy development research. The most influential document, Nickerson et al. (2013), boasts 91 local citations and 821 global citations, yielding a Local to Global Citations Ratio of 11.08%. The high citation count and normalization values (7.00 for local and 6.63 for global) underscore its substantial impact and broad recognition in the field. Following closely, Kundisch et al. (2022) made a notable impact with 5 local citations and 66 global citations, achieving a Local to Global Citations Ratio of 7.58%, with normalized values of 18.00 for local and 5.50 for global citations, indicating its emerging influence.

Other notable documents include Fteimi and Lehner (2018), which has a high Local to Global Citations Ratio of 36.36%, reflecting strong local relevance despite a modest global reach. Raza et al. (2018) show a high ratio of 50.00%, indicating a significant local impact. A conference paper from Fruhwirth et al. (2020) has a 5.71% ratio, but it has a notable global impact. An article from Posey et al. (2017) has a balanced impact with a 6.06% ratio and a stronger global presence. A paper from Strasser (2017) demonstrates varied influences with significant global impacts. An article from Bashshur et al. (2011) in Telemedicine and e-Health has a low 0.85% ratio but substantial global recognition. A conference paper from Wang et al. (2011) indicates equal local and global impact but minimal overall influence.

The terms Local Citation or Local Cited References and Global Citations are bibliometric indicators that help assess the impact and relevance of research documents. Local Citation refers to the number of times a document has been cited within the specific dataset used for this study, highlighting its influence within this research domain (Aria and Cuccurullo, 2017). In contrast, Global Citations represent the total number of times a document has been cited across all sources indexed in the Scopus database, reflecting its broader academic impact across multiple disciplines (Donthu et al., 2021).

Most frequent words. Analyzing the keywords used in papers is an important method for determining emerging subjects and the authors' focus on the topic (Agbo et al., 2021). Figure 4 shows a tree map of the most frequent words based on the authors' keyword usage. The

Table 3. Most prominent document.

Document	Global citations	Local cited references
Nickerson et al. (2013)	821	91
Kundisch et al. (2022)	66	5
Fteimi and Lehner (2018)	11	4
Raza et al. (2018)	6	3
Fruhwirth et al. (2020)	35	2
Posey et al. (2017)	33	2
Strasser (2017)	37	2
Bashshur et al. (2011)	236	2
Wang et al. (2011)	2	2

bibliometric analysis reveals critical insights into the core themes of taxonomy development research through the analysis of 1817 Keywords Plus and 803 author-provided keywords. The term "taxonomies" appears most frequently, with 122 occurrences, signifying its pivotal role in the field. 47 times, "Human" places a significant emphasis on human-centric elements or taxonomy-related applications. The presence of "information systems" (44 occurrences) and "information use" (38 occurrences) indicates a strong emphasis on taxonomy integration and application within broader information systems contexts. "Classification," mentioned 24 times, underscores its importance in organizing and categorizing information. The terms "female" and "adult," each appearing 24 and 20 times respectively, suggest an exploration of gender and age factors in taxonomy research. Finally, the term "taxonomy," with 20 occurrences, complements "taxonomies," reinforcing its fundamental relevance. This distribution of terms illustrates the predominant research themes and areas of interest within the taxonomy development field.

Keywords trending topic. Figure 5 displays the current trending topics in this area. The analysis of the topics in taxonomy development research reveals several distinct keyword trends over time, indicating how the field has evolved and what areas are currently gaining prominence. Several phases divide the critical overview of taxonomy development research, each highlighting different trends and advancements in the field. The early foundation's phase, spanning from 1993 to 2005, reveals that key topics such as "nursing" (7 occurrences), "nursing diagnosis" (6 occurrences), and "standard" (6 occurrences) played a crucial role in establishing the basic frameworks and classifications relevant to specific fields. During this period, there was also an emerging interest in "information analysis" and "learning systems," reflecting the beginning of efforts to understand and organize information within systems.

The expansion and methodological development phase, from 2006 to 2015, represents a significant broadening of the scope of taxonomy research. During this period, topics like "classification" (24 occurrences) and "cluster analysis" (16 occurrences) reflect a growing focus on advanced methods for organizing and categorizing information. This phase also saw an increasing emphasis on practical applications, with the rise of topics like "information management" (7 occurrences) and "decision making" (9 occurrences), highlighting the impact of taxonomies in various decision-making processes. Moreover, growing interest in "information systems" (44 occurrences) underscores a shift toward more structured and complex approaches to managing and retrieving information. The latter part of this phase saw the introduction of "artificial intelligence" in 2008, marking the start of integrating advanced technological concepts into taxonomy development research.

In the contemporary trends and specialization phase from 2016 to the present, research has become increasingly specialized and refined. Topics such as "taxonomies"

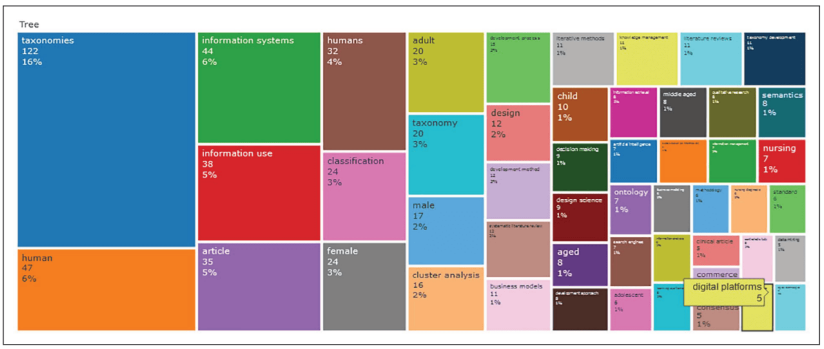


Figure 4. Tree map of most frequent words.

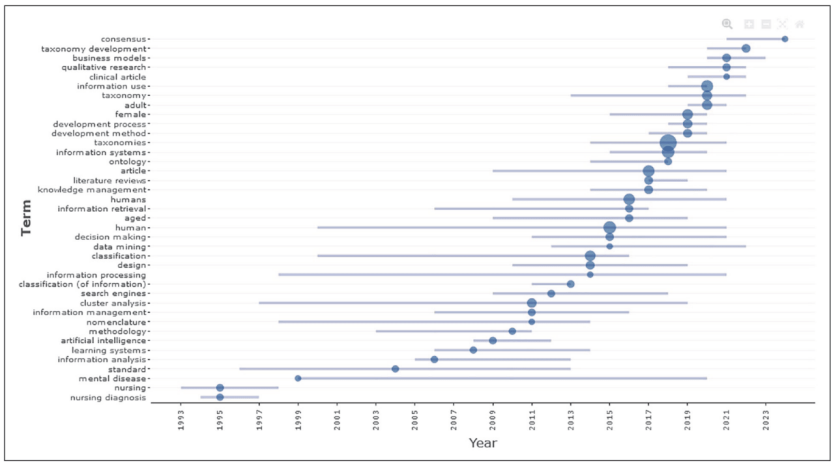


Figure 5. Keywords trending topic.

(122 occurrences) and "taxonomy development" (11 occurrences) have become central, reflecting the field's focus on advancing taxonomy systems themselves. The emergence of terms like "information use" (38 occurrences) and "knowledge management" (11 occurrences) indicates a growing interest in the practical application of taxonomies and their role in knowledge management. Additionally, the rise of topics like "business models" (11 occurrences), "ontology" (7 occurrences), and "qualitative research" (8 occurrences) demonstrates an integration of taxonomies with business applications and more qualitative approaches to research. The appearance of terms like "consensus" (5 occurrences) and "development process" (15 occurrences) highlights a shift toward collaborative and procedural aspects of taxonomy development. The concept of "consensus" has gained particular significance, emphasizing the importance of establishing standardized frameworks or classifications that require expert agreement. Achieving consensus is critical for ensuring that taxonomies are universally accepted and effectively applicable across diverse contexts, while also meeting the evolving needs and expectations of their users.

Network approach analysis

Keyword co-occurrence network. Co-word analysis uses a word co-occurrence network to map and group terms from keywords, titles, or abstracts in a bibliographic dataset, enabling the creation of a conceptual framework (Aria and Cuccurullo, 2017). This type of analysis focuses on keywords to reveal the thematic structures emphasized in the research, particularly regarding the application of taxonomy development. Figure 6 illustrates how this network reflects the key themes and their interconnections in this field. The co-word network reflects key themes and their interconnections within the field of taxonomy development, with each cluster showing distinct research focuses and varying levels of influence.

Cluster 1, represented by the red node, revolves around the core concept of taxonomy development, which holds the highest centrality and PageRank values. This suggests that taxonomy development is the most central and influential theme within the cluster. Furthermore, the cluster interconnects less central supporting themes such as knowledge management, digital transformation, and content analysis with taxonomy development. These connections highlight a broader thematic structure where the methodology and framework of taxonomy development play a crucial role in advancing research across digital transformation and content management areas.

The green node in Cluster 2 illustrates the shift in focus toward the practical applications of taxonomy in fields like software engineering, cloud computing, and classification. While taxonomy remains at the core, this cluster illustrates its integration into technical and applied contexts. The themes of XBRL and crowdsourcing underscore the application of taxonomy in addressing practical technological issues, showcasing its significance in industries that depend on effective data structuring and classification techniques.

Moreover, cluster 3, marked by the blue node, focuses on specialized topics like classification schemes and

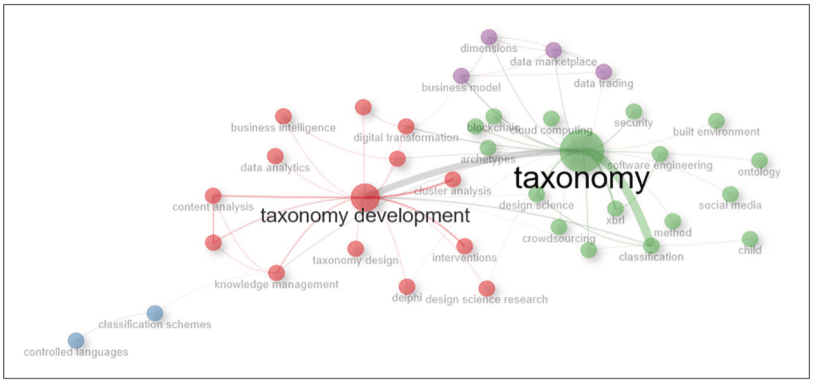


Figure 6. Keyword co-occurrence network.

controlled languages. Although it is less central compared to other clusters, this group likely represents a more niche area of research focused on the formal structuring and organization of data, especially within fields like information systems or linguistic classification. The connections within this cluster suggest that while these topics are important, they are somewhat isolated from the broader themes of taxonomy development and application.

Finally, Cluster 4, represented by the purple node, centers around business-related themes such as dimensions, business models, data trading, and data marketplaces. This cluster reflects an emerging emphasis on data commercialization and the underlying frameworks that support data-driven economies. Although it has a smaller presence in terms of centrality, the business-oriented topics in this cluster indicate a growing interest in how taxonomy and data management are evolving in the context of digital transactions and business models.

Hence, the co-word network reveals that taxonomy development is the most prominent theme, especially in Cluster 1, where it connects with theoretical and methodological topics like knowledge management and digital transformation. In contrast, Cluster 2 focuses on applying taxonomy in technical fields, while Cluster 3 delves into specialized research on classification schemes and controlled languages. Cluster 4, though less central, highlights the increasing role of taxonomy in business models and data marketplaces, reflecting the evolving impact of taxonomies in the data economy.

Intellectual structure analysis

Co-citation network. Kumar (2015) explained that co-citation arises when a single paper references two different documents within its list of citations. Co-citation is a valuable method for assessing the contextual similarity between two documents (Surwase et al., 2011). Figure 7 illustrates the use of co-citation analysis to identify the leading researchers in the field of taxonomy development. The co-citation network map reveals distinct clusters of research, each represented by different color nodes, highlighting specific authors and their roles within the field of taxonomy development. By examining the frequency of citations between two documents, co-citation analysis reveals the intellectual structure of a field and provides insight into their contextual similarity.

In Cluster 1, represented by red nodes, Nickerson et al. (2013) emerge as the central figure. His work is a major reference point for other researchers in this cluster, such as Täuscher and Laudien (2018) and Bakos (1998), though these scholars have less central roles. This suggests that Nickerson's research in taxonomy development is foundational, serving as a key anchor for subsequent studies. The less central authors in this cluster contribute to the theme, but their work revolves around Nickerson's influential research, indicating a high degree of contextual similarity in how their work intersects.

Cluster 2, marked by blue nodes, features Zott et al. (2011) and Teece (2010) as the main connectors between different research themes within the taxonomy development field. Although other researchers, such as Osterwalder and Pigneur (2011) and Al-Debei and Avison (2010), are present, they hold less influential positions. The contextual similarity here lies in the shared interest in business models and how taxonomy informs strategic decision-making within these models. Zott and Teece's significant role demonstrates their critical contributions to understanding the integration of taxonomies in business research.

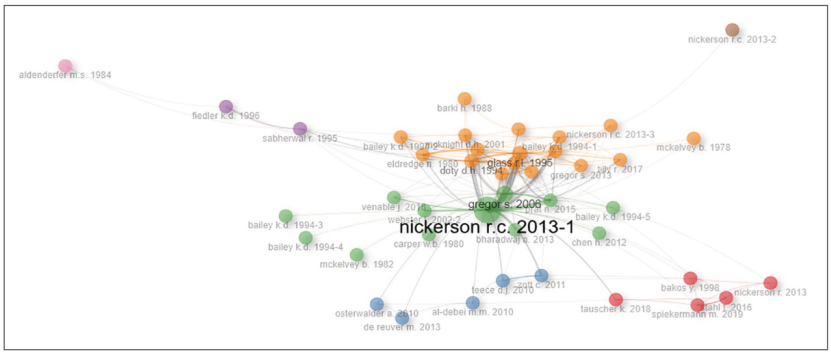


Figure 7. Co-citation network.

Cluster 3, represented by green nodes, again highlights Nickerson et al. (2013) as a leading figure, similar to his role in Cluster 1. In this cluster, other important contributors such as Gregor (2006) and Prat et al. (2015) add depth, though Nickerson remains the key influence. This suggests a thematic continuation of Nickerson's work in taxonomy development, with contributions from Gregor and Prat further elaborating on the theoretical frameworks he established.

Cluster 4, represented by purple nodes, shows Fiedler et al. (1996) as a central connector, with Sabherwal and King (1995) making significant contributions, though with less centrality. This cluster appears to concentrate on the application of taxonomy in information systems, with Fiedler's work offering foundational concepts that others, such as Sabherwal, expand upon.

Cluster 5, represented by orange nodes, stands out for its high degree of interconnectedness. Glass and Vessey (1995) is a particularly influential figure within this cluster, suggesting a focus on empirical studies and methodological advances in taxonomy. The high number of co-citation links in this cluster shows that the studies are very connected. Methods or approaches that are commonly used are often cited together, showing a strong contextual similarity.

Cluster 6, represented by a brown node, features Nickerson et al. (2013) in a more peripheral role compared to his central positions in other clusters. This suggests that while Nickerson's work remains relevant, it is less critical to the themes explored in this particular cluster, which may focus on a more specialized or tangential aspect of taxonomy development.

Finally, Cluster 7, represented by pink nodes, highlights Aldenderfer and Blashfield (1984), who play a modest role in connecting research but are less influential than the central figures in the other clusters. This cluster likely focuses on earlier taxonomy work or foundational studies, with Aldenderfer and Blashfield contributing important early insights, though the cluster itself is not as tightly interconnected as others.

In conclusion, the co-citation network reveals Nickerson et al. (2013) as the most influential figure, especially in Clusters 1 and 3, where his work serves as a key link between diverse research areas. Clusters 2 and 5 also feature important figures like Zott et al. (2011), Teece (2010), and Glass and Vessey (1995), who play significant roles in shaping research themes. The network demonstrates a high degree of contextual similarity within clusters, particularly in terms of shared methodologies, theoretical frameworks, and applications of taxonomy development. Clusters 4, 6, and 7, although less central, still contribute important foundational or specialized insights to the field. Overall, Nickerson's centrality underscores his pivotal influence, while other researchers also contribute to the network's interconnectedness.

Social Structure Analysis

Co-authorship. A scientific collaboration network maps authors as nodes and their co-authorships as links, serving as an established method for documenting collaborative research efforts (Aria and Cuccurullo, 2017). Analyzing these co-authorship connections is a powerful way to evaluate collaboration trends and identify influential contributors (Fonseca et al., 2016). Figure 8 illustrates the co-authorship relationships among researchers in virtual tourism, focusing on those who have collaborated on at least one research paper. These collaborations enhance both the quantity and quality of scientific publications, as researchers bring together diverse perspectives and expertise to achieve common objectives. The research analysis classified a total of 50 authors into 13 distinct clusters, visually distinguishing each cluster node with a different color.

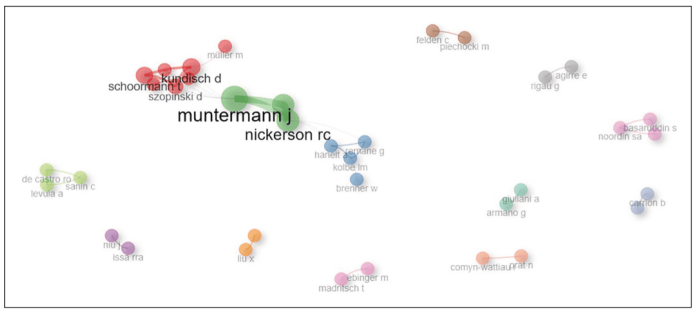


Figure 8. Co-authorship.

Cluster 3, represented by green nodes, is the most robust and central in the co-authorship network, with key authors such as Muntermann, J., and Nickerson, R. C. These authors have high centrality, meaning they have collaborated extensively across different groups and play a significant role in influencing and shaping the overall research landscape of taxonomy development. Their position in the network suggests that they act as bridges, fostering collaboration between various researchers and driving the field forward through their broad collaborative reach. The focus in this cluster appears to be on advancing taxonomy development methodologies and frameworks, particularly integrating technologies and digital systems into the research domain.

Clusters 1 and 2, marked by red and blue nodes, respectively, are complementary to Cluster 3, bridging diverse research areas and contributing to the overall cohesiveness of the network. In Cluster 1, Kundisch, D. stands out as a critical link between Cluster 1 and Cluster 3. Although less central than the key figures in Cluster 3, Kundisch, D. plays an essential role in facilitating collaboration across clusters, linking different research domains related to taxonomy development. The collaboration trends in Cluster 1 indicate a focus on decision-making frameworks, digital platforms, and data-driven approaches, which connect well with the taxonomy-centric work in Cluster 3.

Similarly, blue nodes visually represent Kolbe, L. M. as a central figure in Cluster 2. Kolbe's contributions help bridge the gap between Cluster 3 and the broader research community, creating interconnections that enhance the collective knowledge base of taxonomy development. Cluster 2 likely emphasizes research on information systems and digital infrastructures, making Kolbe's role critical in linking these topics with the core work in taxonomy and digital transformation explored in Cluster 3.

Clusters 4 through 13, represented by various color nodes such as purple (Cluster 4) and orange (Cluster 5), exhibit strong internal cohesion but are less influential in connecting with other clusters. For instance, Issa, R. R. A. in Cluster 4 shows considerable internal collaboration within the group but does not act as a significant bridge to other clusters. This suggests that the research within these clusters is more specialized and insular, focused on niche aspects of taxonomy development, perhaps exploring specific applications or sub-fields that do not yet interact broadly with the larger research community. Cluster 5, with Liu, X., as a key contributor, shows a similar pattern, where internal collaborations are strong but the cluster remains more isolated from the broader co-authorship network. These clusters likely explore more focused topics such as specific data models, technical frameworks, or domain-specific applications of taxonomy development.

The co-authorship analysis reveals several important trends. First, Cluster 3 stands out for its extensive collaborations across the field, demonstrating the network's high interconnectedness at its core. The centrality of authors such as Nickerson, R. C., and Muntermann, J. underscores their influence in both the quantity and quality of collaborative research, contributing to the development of widely applicable taxonomy methodologies. Additionally, Clusters 1 and 2 show the importance of intermediary figures like Kundisch, D., and Kolbe, L. M., who bridge various research domains and link them with the central cluster, enhancing the cross-pollination of ideas. Meanwhile, Clusters 4 through 13 demonstrate a focus on internal collaboration and niche research areas, contributing valuable insights to the field but with less impact on connecting disparate research themes. Together, all these clusters illustrate a vibrant and interconnected research ecosystem, with certain clusters and key contributors playing pivotal roles in advancing the field of taxonomy development.

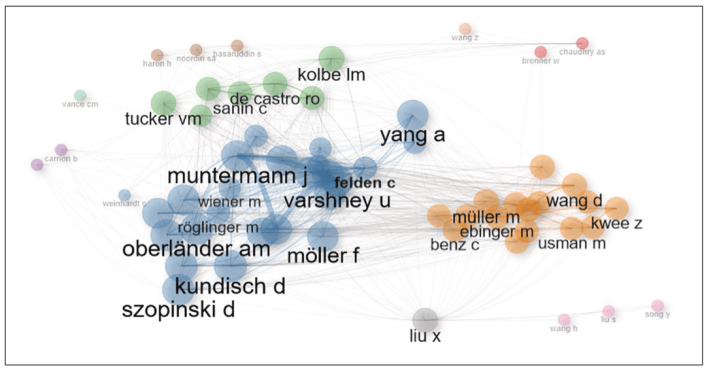


Figure 9. Bibliographic coupling.

Intellectual structure analysis

Bibliographic coupling. Two articles are considered bibliographically coupled if they share at least one common reference in their bibliographies or reference lists. The strength of this coupling increases with the number of shared references between the articles. The method of bibliographic coupling groups publications with similar themes into clusters, aiding in the identification of related research areas (Aria and Cuccurullo, 2017). Figure 9 shows that the groups of authors' bibliographic coupling, which are shown by different colored nodes, include authors, keyword research topics, and coupling levels.

Cluster 1, represented by the red node, includes authors Chaudhry A. S. and Brenner W. and focuses on topics such as classification schemes (60%), controlled languages (50%), and Singapore (66.7%). This cluster demonstrates moderate coupling, reflecting a thematic connection around classification schemes and controlled languages, with a particular emphasis on regional research centered in Singapore. This cluster's relatively localized nature suggests a specific but narrower scope in terms of academic reach.

Cluster 2, the blue node, contains influential authors such as Remane G, Hanelt A, Röginger M, Schoormann T, Nickerson RC, Szopinski D, Oberländer AM, Rau D, Muntermann J, Kundisch D, Varshney U, Breitner MH, Zschech P, Weinhardt C, Wiener M, Felden C, Piechocki M, Strasser A, Pringle J, Hill S, Gimpel H, Möller F, Teuteberg F, Yang A, Werth O. This cluster is highly central and well-coupled within the academic space, focusing on taxonomy development (75.5%), taxonomy (53.4%), and design science research (100%). The strong presence of established authors and the high coupling level indicates a significant impact on the development of taxonomies and design science methodologies. Cluster 2, with its methodological focus, stands out as a key area in this academic network.

The green node, representing Cluster 3, leads authors such as Kolbe LM, Fteimi N, De Castro RO, and Tucker VM. The cluster's research centers on taxonomy development (24.5%), classification schemes (100%), and content analysis (100%), showing high connectivity around these themes. The focus on taxonomy and classification systems, alongside qualitative content analysis, positions this cluster as another critical area in the field, particularly with its strong theoretical underpinnings.

Cluster 4, marked by the purple node, includes authors like Carrion B and Onorati T and revolves around topics such as knowledge modeling (100%), big data (100%), and taxonomy design (18.2%). The coupling in this cluster is strong around knowledge modeling and big data, although the lower focus on taxonomy design points toward a more specialized, potentially emerging area of study. The cluster's emphasis on big data and knowledge modeling signals its relevance in the context of technological advancements.

In Cluster 5, represented by the orange node, authors such as Ebel P, Vom Brocke J, Issa RRA, Niu J, Kwee Z, Van De Ven M, Comyn-Wattiau I, Prat N, Usman M, Benz C, Smith S, Ebinger M, Madritsch T, Wang B, Wang D., and Müller M. contribute to research on taxonomy (44.8%), data marketplaces (100%), and XBRL (55.6%). This cluster has a high coupling, particularly in financial technology contexts like XBRL and data marketplaces. The strong links between taxonomy development and financial information systems underline taxonomy's practical applications in technology-driven sectors.

Cluster 6, represented by the brown node, contains authors such as Basaruddin S, Haron H, and Noordin SA.

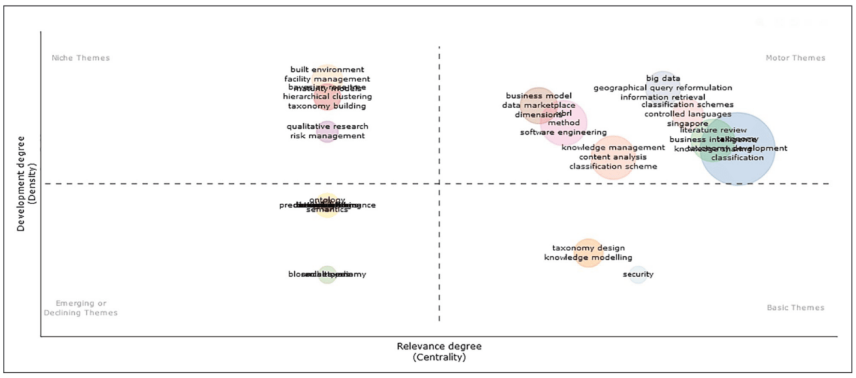


Figure 10. Thematic mapping.

Knowledge management accounts for 37.5% of this cluster's focus, and its moderate coupling makes it less connected than other clusters. Its narrower focus suggests it may be exploring a specific niche within the broader academic discourse on knowledge management, potentially positioning itself at the periphery of more central research topics.

Cluster 7, symbolized by the pink node, involves authors such as Liu S, Song Y, and Wang H and focuses on Bayesian rose trees (75%), hierarchical clustering (75%), and taxonomy building (75%). The cluster's strong coupling within computational approaches, particularly Bayesian and hierarchical clustering, reflects its focus on applying advanced machine learning techniques to taxonomy development. This makes the cluster relevant in computational research, where it intersects traditional taxonomy with modern technological methods.

Cluster 8, identified by the gray node, features Liu X and centers on Bayesian rose trees (25%), hierarchical clustering (25%), and taxonomy (1.7%). With weak coupling, this cluster appears to be on the fringe of the research network, possibly representing a nascent area of study in computational taxonomy. Although its current academic reach may be limited, the cluster could have potential for growth as interest in computational methods expands.

Cluster 9, represented by the tosca node, features Vance CM and revolves around knowledge sharing (50%). It has moderate coupling and focuses on the dynamics of knowledge-sharing, likely within organizational or collaborative settings. Although less central than other clusters, this research area remains relevant, especially in the context of increasing interest in organizational knowledge management.

Finally, Cluster 10, marked by the peach node, includes Wang Z and focuses on classification schemes (20%), controlled languages (25%), and Singapore (33.3%). This cluster, like Cluster 1, has a regional focus with lower coupling levels. Its emphasis on Singapore and controlled language environments points to a more localized application of classification schemes, with limited global relevance.

In conclusion, the analysis reveals that clusters like Cluster 2 and Cluster 3 dominate the research landscape with their strong centrality and wide coupling across taxonomy development and classification systems. Clusters such as Cluster 5 and Cluster 7, while more specialized, play important roles in specific sectors like financial technology and computational methods. Meanwhile, clusters like Cluster 1 and Cluster 10, with their regional focus, and Cluster 6 and Cluster 8, with their narrower academic reach, offer valuable yet more specialized contributions to the broader research network.

Conceptual structure analysis

Figure 10 shows a thematic map of research on virtual tourism. It shows how taxonomy development is changing over time by using density and centrality indices to see how different issues are changing and how important they are. This map, which divides research themes into four quadrants, showcases the foundational, dominant, niche, and emerging or declining themes in the field. The circle sizes represent the frequency of articles using specific terms, allowing for a clearer understanding of how each theme contributes to the broader research area. The thematic map divides the research landscape of taxonomy development into four quadrants, each representing different research themes based on their density (development degree) and centrality (relevance). These quadrants provide key insights into the significance and progress of various topics within taxonomy research.

In the lower-right quadrant, representing basic themes, we observe topics that are central but less developed. Themes such as taxonomy design, knowledge modeling, and security are fundamental to the field, yet they have not reached the same level of maturity as motor themes. Their presence in this quadrant suggests that they form the foundation of taxonomy development research, but further exploration and refinement are required to achieve broader significance.

Furthermore, the upper-right quadrant, representing motor themes, highlighted the central and well-developed topic in taxonomy research areas. Here, topics such as big data, geographical query reformulation, information retrieval, controlled language, literature review, business intelligence, knowledge development, classification, knowledge management, content analysis, and classification schemes are highly relevant and extensively developed. These themes drive the research forward by connecting to various other topics in taxonomy development, indicating that they are the backbone of ongoing studies. Additionally, research areas like business models, XBRL, software engineering, and data marketplaces demonstrate the increasing integration of taxonomy with technological advancements and data-driven applications.

The upper-left quadrant, known as niche themes, includes specialized but well-developed topics like built environment, facility management, hierarchical clustering, and taxonomy building. These research themes have high development but lower centrality, indicating that they are critical in their respective fields but do not connect widely to the rest of the research landscape. Niche topics such as qualitative research and risk management are also in this quadrant, showcasing their specialized role in taxonomy research.

Lastly, the lower-left quadrant, highlighting emerging or declining themes, contains topics like ontology, predicted intelligence, and semantics. These areas represent the emergence of new research fields that are still in their early stages of development. Interestingly, biomedical taxonomy and Bloom's taxonomy also fall within this quadrant, indicating its declining relevance in the current taxonomy research landscape.

Discussion and future research directions

This study presents novel contributions that exceed previous works by delivering the first bibliometric analysis of taxonomy development within the context of Library and Information Science (LIS) over the past 50 years (1974–2024). This contrasts with earlier research that primarily utilized systematic literature reviews in Information Systems (Irfan et al., 2019; Oberländer et al., 2019) or concentrated on design science research methodologies for constructing and evaluating taxonomies (Kundisch et al., 2022; Omair and Alturki, 2020). While these studies enhanced methodological guidance and theoretical frameworks for taxonomy construction, none have systematically mapped the current states, including periodic progression, key sources and authors, influential works, thematic trends, keyword patterns, collaboration networks, and the intellectual structure of taxonomy development, particularly within the context of LIS, using quantitative bibliometric tools. This study identifies key focus areas, gaps, and future directions in taxonomy development, including domain expansion, under-researched domains, domain analysis, information standardization and ethics, taxonomy archetypes and structure, benchmarking and consensus-building, monetization strategies, methodological guidance, and the use of semantic and open-linked data. In summary, this work contributes by:

(a) Providing the first bibliometric analysis of the current state of taxonomy development in LIS over the past 50 years, revealing its intellectual and thematic evolution;

(b) Identifying key gaps and future directions to promote the development of a more user-centric, applicable, and solution-oriented taxonomy method within the LIS field.

The results of this bibliometric analysis offer a comprehensive overview of the current state of taxonomy development research in the LIS field. First, the annual publication trend analysis reveals three distinct phases in taxonomy development research from 1974 to 2024. The early development phase, from 1974 to 1996, saw only 12 articles published, followed by a growth and expansion phase between 1997 and 2014, peaking in 2017 with 21 articles. The maturation phase, spanning from 2015 to 2024, included 176 articles, with notable peaks in 2020 and 2021, indicating increased research activity. These findings align with Kundisch et al. (2022), who observed that taxonomy development research has grown in both scope and rigor over the past decade. Similarly, Oberländer et al. (2019) noted that the increase in taxonomy articles outpaces overall publication trends, reflecting the growing significance of taxonomy research in the LIS field, although their numbers are fewer compared to related disciplines such as the natural and social sciences (Nickerson et al., 2013). The findings of Oberländer et al. (2019) also support this study's identification of the maturation phase (2015–2024) in taxonomy development, particularly through their distinction between established phenomena—well-researched topics prior to or around the millenium—and emerging phenomena that have attracted attention over the past 15 years (2004/2005 and beyond). Their observation that recent taxonomy research

increasingly engages with emerging areas such as digital platforms aligns with this study's results, quantitatively demonstrating a significant rise in publications during this maturation phase in response to digital transformation and the expansion into new, complex domains, especially within the LIS context.

Second, an analysis of prominent sources, authors, and documents in this study reveals that Nickerson et al. (2013) and Kundisch et al. (2022) are among the most influential works in taxonomy development research, with Nickerson et al. receiving the highest number of both global and local citations. Additionally, authors like Muntermann J. and Nickerson R. C. emerge as the most prolific and impactful contributors. However, when compared to the findings of Oberländer et al. (2019), a contrasting pattern becomes evident. Although Nickerson et al.'s (2013) method is now widely cited, Oberländer et al. (2019) reported that it was rarely applied in practice as a taxonomy development method, appearing in only 17% of the articles they reviewed, while most studies did not rely on any specific taxonomy development method. This discrepancy highlights an ongoing disconnect between the high theoretical influence of works like Nickerson et al. (2013) and their limited practical application and methodological implementation in taxonomy development, as indicated by Oberländer et al. (2019).

The present study's findings on keyword trends and conceptual focus complement those of Oberländer et al. (2019), who noted that at that time, the term "taxonomy" was the most frequently used, followed by "typology" and terms such as "taxonomic framework" or "typological theory." This study confirms the continued dominance of the term "taxonomy" based on keyword co-occurrence analysis while also revealing a shift in thematic emphasis toward terms like "ontology," "classification," "development process," and "consensus." These emerging keywords reflect a growing trend in recent taxonomy literature toward collaborative, procedural, and standardized approaches. This is further supported by Irfan et al. (2019), who highlight the increasing incorporation of external knowledge sources and domain-specific measures—such as domain pertinence, consensus, and structural relevance—at various stages of taxonomy generation, particularly in data modeling and hierarchy formation. These findings suggest that taxonomy development is evolving into a more systematic, semantically enriched, and community-driven process that emphasizes adaptability, precision, and interdisciplinary relevance.

Researchers like Nickerson, Muntermann, and Kundisch have had a big impact on the field of design science research, as shown by the results of our co-citation, co-authorship, and bibliographic coupling analyses. The co-citation, co-authorship, and bibliographic coupling analyses highlight Nickerson et al. (2013) central role in co-citation analysis and significant contributions to the field. Co-authorship analysis reveals that Cluster 3, including Muntermann and Nickerson, demonstrates high centrality. Bibliographic coupling shows that authors such as Oberländer AM, Rau D, Muntermann J, Kundisch D, Varshney U, and Nickerson have had a big impact on taxonomy development research, especially through the Design Research Science approach. This aligns with Kundisch et al. (2022), who advocate for an iterative and cumulative approach to taxonomy development and emphasize that taxonomies should not remain static after their initial publication but should evolve through refinement, evaluation, and updates by the broader research community. While affirming the foundational role of these key contributors, this study further suggests that future taxonomy development should also incorporate new technologies and actively engage peripheral researchers to promote methodological innovation and sustain the field's relevance in emerging contexts.

The thematic analysis reveals a shift away from traditional biological and ecological classifications toward more dynamic, human-centric, and digital data-based approaches. Behavioral studies, social impacts, and themes like cluster analysis and information management are gaining prominence, while traditional taxonomies are declining in relevance. Basic themes, such as taxonomy design, continue to provide foundational insights, while motor themes, such as information retrieval, remain central to ongoing research. Emerging topics like ontology are still awaiting further exploration while declining themes like Bloom's taxonomy are losing relevance. The evolving nature of taxonomy development research highlights the need to enhance taxonomy methodologies with new technologies, address the decline of traditional taxonomies, and explore niche areas for more practical and adaptable classification systems. The presence of niche themes such as risk management and qualitative analysis in this study is in line with the taxonomy evolution analysis by Irfan et al. (2019), who identified a critical need for methodologies that not only generate taxonomies but also evolve them, ensuring accurate representation of underlying data structures. Together, these insights highlight the importance of continuous innovation in taxonomy methodologies to meet the demands of modern knowledge and data ecosystems.

Overall, as seen in Table 4, gaps and future research in taxonomy development within the LIS domain may benefit from several strategic directions. First, the growth of the domain gives us a chance to deal with data problems more effectively (Irfan et al., 2019; Omair and Alturki, 2020; domain expansion). For example, we can create bioinformatics taxonomies that work in LIS-related biological data environments and are more useful than the old biological taxonomy methods of McCloskey and Bulechek (1995) and Follette and Houts (1996). Second, there is a critical need to design taxonomies for under-researched LIS domains such as cultural heritage. According to Oberländer

et al. (2019), taxonomy development was mostly focused on new and existing phenomena, like the Internet of Things, information technology, and digital platforms. However, areas like cultural heritage were still not well studied (Chaudhry and Jiun, 2005; Hasibuan, 2011; Kambau and Hasibuan, 2017), pointing out an important area for future research in the LIS field (under-researched domain). Nickerson et al. (2009, 2013) and Archibugi and Michie (1995), on the other hand, wrote foundational works that give general advice on how to design taxonomies. However, they don't talk about the specific needs of domains like cultural heritage in LIS, which is an area that needs more research.

Using domain analysis for taxonomy development (Buccella et al., 2019; Graf, 2020; Hjørland, 2002), especially making multiple taxonomic views from a dataset to help users from different domains (Irfan et al., 2019), can also improve the usefulness and accuracy of LIS in different situations. This method is different from earlier ones that focused on single taxonomic views, like Chaudhry and Jiun (2005), Milne (2007), and Cheng et al. (2008). These works were important, but they might not be very flexible for different user situations (domain analysis).

Additionally, this study suggests the importance of taxonomy modeling tools, standards, and information ethics in promoting consistency and transparency as supported by Kundisch et al. (2022). This issue has become increasingly prominent with the growing relevance of applications of big data, eXtensible Business Reporting Language (XBRL), controlled language, and software engineering in taxonomy development (Alshazly et al., 2014; Ida, 2011; information standardization and ethics). To support clearer, more scalable designs (Kundisch et al., 2022; Oberländer et al., 2019), taxonomy structure frameworks and visualization techniques need to be improved even more. This is especially true for adding more taxonomy structures than the most common ones, like hierarchical clustering (Liu et al., 2012; taxonomy archetypes and structure). Later, while Varshney et al. (2015) significantly advanced knowledge modeling in taxonomy design, their approach lacks standardized benchmarking and consensus techniques, which limits the ability to evaluate and compare taxonomic structures across contexts. Methods like benchmark systems for taxonomy development and consensus techniques for taxonomic structure comparison are crucial for enhancing semantic alignment, especially in digital library systems, where there is currently a lack of a standard or benchmark system (Irfan et al., 2019; taxonomy benchmarking and consensus).

On the other hand, the literature still shows a lack of taxonomies explicitly designed to support applications beyond the conceptual level, resulting in a shortage of taxonomies for practical analysis, business strategy, or other real-world practices (Oberländer et al., 2019). This study shows how important taxonomies are for business models and analytics in LIS when it comes to business information. These topics haven't been investigated much, even though Hanelt et al. (2015) and Remane et al. (2017) have made some progress (taxonomy monetization). This method, called design science research (DSR; Kundisch et al., 2022; Omair and Alturki, 2020; Szopinski et al., 2020), can also improve the iterative and practical quality of taxonomy development in LIS. It can also help with the problem of not having enough methodological guidance on how to evaluate taxonomies in LIS. Lastly, integrating taxonomy and ontology for open-linked data and interoperability (Gaitanou et al., 2022; Omair and Alturki, 2020) is crucial for fostering data sharing, metadata alignment, and semantic web compatibility in LIS environments. This approach is particularly relevant for supporting ontology-driven domain development, as highlighted by Niu and Issa (2015; semantic and open-linked data).

Theoretical and practical implications

This study contributes to the theoretical development of taxonomy research in Library and Information Science (LIS) by highlighting the need to update existing frameworks in response to digital transformation, data complexity, and interdisciplinary demands. The increasing focus on user-centered and data-driven approaches suggests that taxonomy models should integrate modern methodologies, such as domain analysis, consensus techniques, and adaptive design, to remain relevant. The challenge lies in balancing theoretical rigor with practical usability to ensure taxonomies are both conceptually sound and functionally adaptable.

Bibliometric analysis further enhances LIS scholarship by mapping research networks, identifying influential studies, and uncovering gaps in the field. Through co-citation, co-authorship, and keyword analysis, this study reveals how research themes have evolved and where innovation is needed. By distinguishing active areas from stagnant ones, these insights can guide curriculum design, future research, and resource allocation.

Practically, the findings support the development of flexible, user-centric taxonomies tailored to real-world information needs. Practitioners should adopt iterative and evidence-based design approaches, drawing from leading frameworks such as those proposed by Nickerson. Organizations can use taxonomy trends to guide strategic planning, while policymakers should invest in research infrastructure, standardization efforts, and scholarly collaboration. Educators are encouraged to incorporate computational tools and emerging taxonomy methods into LIS schools to better prepare students for evolving industry needs.

Conclusion and limitation

This study presents the first comprehensive bibliometric analysis of taxonomy development research over the past 50 years (1974–2024), identifying key trends, influential

Table 4. Future directions for taxonomy development research.

No.	Publication phases	Key trends topic	Themes	Prominent author and document	Gaps & future directions
1	Early development (1974–1996)	"Nursing," "nursing diagnosis," "standard," "information analysis," "learning system," and "mental disease."	Declining topic: "Biomedical taxonomy" and "Bloom's taxonomy."	McCloskey and Bulechek (1995), Follette and Houts (1996)	Bioinformatics taxonomy (*Domain expansion*)
2	Growth and expansion (1997–2014)	"Classification," "cluster analysis," "information management," "decision making," "information system," "data mining," "nomenclature," "methodology," "artificial intelligence," and "design"	Basic themes: "Taxonomy design"	Nickerson et al. (2009, 2013), Archibugi and Michie (1995).	Taxonomy design for under-researched domains, such as cultural heritage (*Under-researched domain*)
			Motor themes:		
			1. "Classification schemes," "information systems," and "method"	1. Chaudhry and Jiun (2005), Chaudhry (2010).	1. Domain analysis for taxonomy development (*Domain analysis*)
			2. "Big data," "XBRL," "controlled language," "software engineering"	2. Ida (2011), Alshazly et al. (2014)	2. Taxonomy modeling tools, standards, and information ethics (*Information standardization & ethics*)
			Niche themes: "Hierarchical clustering," and "Bayenesian rose tree"	Liu et al. (2012), Balijepally et al. (2011)	Taxonomy structure framework and visualization (*Taxonomy archetypes and structure*)
3	Maturation (2015–2024)	"Taxonomy," "taxonomy development," "knowledge management," "business model," "information use," "search engine," "ontology," "literature review" "qualitative research," "development process," "development method," and "consensus"	Basic themes: "Knowledge modeling," and "taxonomy design"	Kundisch et al. (2022), Varshney et al. (2015)	Consensus techniques for comparing taxonomic structures (*Taxonomy benchmarking and consensus*).
			Motor themes: "Business model," "business intelligence," and "data marketplace"	Hanelt et al. (2015), Remane et al. (2017)	Taxonomy of business models and analytics (*Taxonomy monetization*).
			Niche themes: "Qualitative research," "risk management," "taxonomy building," and "maturity model"	Szopinski et al. (2020), Kundisch et al. (2022), Omair and Alturki (2020)	Design science research method for taxonomy development (*Methodological guidance*).
			Emerging themes: "Semantic," "ontology," and "predicted maintenance"	Niu and Issa (2015)	Taxonomy and ontology for open linked data and interoperability (*Semantic and open-linked data*)

contributors, and evolving research themes. By analyzing 268 articles, the findings reveal three distinct phases—early development, growth and expansion, and maturation—with a sharp increase in publications during the maturation phase, peaking in 2020 and 2021. The study highlights the dominance of conference proceedings over journal publications, indicating that new developments are often first introduced in conferences before being formalized in scholarly journals. Prominent contributors include Nickerson, Muntermann, and Varshney, with Nickerson et al. (2013) being particularly influential. The keyword analysis reflects a shift from foundational taxonomy concepts to more application-driven research, with themes such as "business models" and "consensus" becoming increasingly prominent. This trend suggests a growing focus on standardization and practical implementation of taxonomies across different fields.

The thematic analysis reveals a transition from traditional, biological classifications toward dynamic, human-centric approaches, integrating behavioral studies and technological advancements. This shift underscores taxonomy's expanding role beyond classification into domains including knowledge management, artificial intelligence, and decision-making frameworks. However, this study's limitations include potential biases from using a single database (Scopus), which may miss relevant

research, and the reliance on citation metrics, which may not fully capture research quality or practical impact. This study demonstrates how the *Bibliometrix* can effectively map the intellectual and thematic structure of taxonomy research over time. Researchers can replicate its use to analyze large bibliographic datasets, identify influential works, and trace evolving research trends. Combining co-citation and bibliographic coupling offers both historical and contemporary perspectives. The software may also have technical limitations that make it hard to do more complex analyses without writing extra code. For example, it doesn't directly support integrating linked data, semantic data, or external database APIs (like Crossref or PubMed). Future research could address these limitations by incorporating multiple databases and exploring alternative metrics and analytical tools. In addition, we recommend integrating automated analysis with manual thematic validation to improve accuracy and interpretive depth.

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This material is the authors' own original work, which has not been previously published elsewhere. The paper is not currently being considered for publication elsewhere. The paper reflects the author's own research and analysis truthfully and completely.

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Data availability statement

The data that support the findings of this study are available from the corresponding author, M.R.H.

References

Agbo FJ, Oyelere SS, Suhonen J, et al. (2021) Scientific production and thematic breakthroughs in smart learning environments: A bibliometric analysis. *Smart Learning Environments* 8(1): 1–25.

Al-Debei MM and Avison D (2010) Developing a unified framework of the business model concept. *European Journal of Information Systems* 19(3): 359–376.

Aldenderfer MS and Blashfield RK (1984) *Cluster Analysis*. California: Sage Publications, Inc.

Alshazly AA, Elfatatry AM and Abougabal MS (2014) Detecting defects in the software requirements specification. *Alexandria Engineering Journal* 53(3): 513–527.

Archibugi D and Michie J (1995) The globalisation of technology: A new taxonomy. *Cambridge Journal of Economics* 19(1): 121–140.

Aria M and Cuccurullo C (2017) Bibliometrix: An R-tool for comprehensive science mapping analysis. *Journal of Informetrics* 11(4): 959–975.

Baas J, Schotten M, Plume A, et al. (2020) Scopus is a curated, high-quality bibliometric data source for academic research in quantitative science studies. *Quantitative Science Studies* 1(1): 377–386.

Bakos Y (1998) The emerging role of electronic marketplaces on the Internet. *Communications of the ACM* 41(8): 35–42.

Balijepally V, Mangalaraj G and Iyengar K (2011) Are we wielding this hammer correctly? A reflective review of the application of cluster analysis in information systems research. *Journal of the Association for Information Systems* 12(5): 375–413.

Bashshur R, Shannon G, Krupinski E, et al. (2011) The taxonomy of telemedicine. *Telemedicine and e-Health* 17(6): 484–494.

Batista JO, Almeida JPA, Zambon E, et al. (2022) Ontologically correct taxonomies by construction. *Data & Knowledge Engineering* 139: 102012.

Berger S, Bürger O and Röglinger M (2020) Attacks on the Industrial Internet of things-development of a multi-layer taxonomy. *Computers & Security* 93: 101790.

Beydoun G, García-Sánchez F, Vincent-Torres CM, et al. (2013) Providing metrics and automatic enhancement for hierarchical taxonomies. *Information Processing & Management* 49(1): 67–82.

Blakeman K (2018) Bibliometrics in a digital age: Help or hindrance. *Science in Progress* 101(3): 293–310.

Bloom BS (1956) *Taxonomy of Educational Objectives: The Classification of Educational Goals. Handbook I: Cognitive Domain*. New York, NY: David McKay Company.

Buccella A, Cechich A, Porfiri J, et al. (2019) Taxonomy-oriented domain analysis of GIS: A case study for paleontological software systems. *ISPRS International Journal of Geo-Information* 8(6): 270.

Chaudhry AS (2010) Assessment of taxonomy building tools. *Electronic Library* 28(6): 769–788.

Chaudhry AS and Jiun TP (2005) Enhancing access to digital information resources on heritage: A case of development of a taxonomy at the integrated museum and archives system in Singapore. *Journal of Documentation* 61(6): 751–776.

Cheng CP, Lau GT, Law KH, et al. (2008) Regulation retrieval using industry specific taxonomies. *Artificial Intelligence and Law* 16(3): 277–303.

Curtis MJ (2023) How to write a scientific paper. In: *The Quintessence of Basic and Clinical Research and Scientific Publishing*. Singapore: Springer Nature, pp.687–694.

Donthu N, Kumar S, Pandey N, et al. (2021) Research constituents, intellectual structure, and collaboration patterns in Journal of International Marketing: An analytical retrospective. *Journal of International Marketing* 29(2): 1–25.

Dos Santos Maculan BCM and Aganette EC (2018) A Teoria da Classificação Facetada na Construção de Taxonomias Facetadas (The Theory of Faceted Classification Applied to the Construction of Faceted Taxonomies). In: *ONTOBRAS*, pp.56–67.

Fiedler KD, Grover V and Teng JTC (1996) An empirically derived taxonomy of information technology structure and its relationship to organizational structure. *Journal of Management Information Systems* 13(1): 9–34.

Follette WC and Houts AC (1996) Models of scientific progress and the role of theory in taxonomy development: A case study of the DSM. *Journal of Consulting and Clinical Psychology* 64(6): 1120–1132.

Fonseca BDPFE, Sampaio RB, Fonseca MVDA, et al. (2016) Co-authorship network analysis in health research: Method and potential use. *Health Research Policy and Systems* 14(1): 34–10.

Fruhwirth M, Rachinger M and Prlja E (2020) Discovering business models of data marketplaces. In: *Proceedings of the 53rd Hawaii international conference on system sciences*, pp.5738–5747. DOI: 10.24251/hicss.2020.704.

Fteimi N and Lehner F (2018) Analysing and classifying knowledge management publications–A proposed classification scheme. *Journal of Knowledge Management* 22(7): 1527–1554.

Gaitanou P, Andreou I, Sicilia MA, et al. (2022) Linked data for libraries: Creating a global knowledge space, a systematic literature review. *Journal of Information Science* 50(1): 204–244.

Glass RL and Vessey I (1995) Contemporary application-domain taxonomies. *IEEE Software* 12(4): 63–76.

Gnoli C (2020) Faceted classification: A guide to theory and practice. *Journal of Information Science Theory and Practice* 8(1): 1–16.

Graf AM (2020) Domain analysis applied to online graffiti art image galleries to reveal knowledge organization structures used within an outsider art community. *Knowledge Organization* 47(7): 543–557.

Gregor S (2006) The nature of theory in information systems. *MIS Quarterly* 30(3): 611–642.

Hanelt A, Hildebrandt B and Polier J (2015) Uncovering the role of IS in business model innovation-a taxonomy-driven approach to structure the field. DOI: 10.18151/7217345.

Hasibuan ZA (2011) An overview of an integrated approach to digital preservation: a case study of Indonesian e-Cultural heritage and natural history information retrieval system. In: *2011 international conference on advanced computer science and information systems*. IEEE.

Hjørland B (2002) Domain analysis in information science: Eleven approaches – Traditional as well as innovative. *Journal of Documentation* 58(4): 422–462.

Ida M (2011) XBRL extension for knowledge discovery in higher education. In: *2011 eighth international conference on fuzzy systems and knowledge discovery (FSKD)*, vol. 4, pp.2120–2123. IEEE. DOI: 10.1109/fskd.2011.6020064.

Irfan R, Khan S, Abbas MA, et al. (2019) Determining influential factors and challenges in automatic taxonomy generation: A systematic literature review of techniques 1999-2016. *Information Research: An International Electronic Journal* 24(2): n2.

Kambau RA and Hasibuan ZA (2017) Concept-based multimedia information retrieval system using ontology search in cultural heritage. In: *2017 second international conference on informatics and computing (ICIC)*. IEEE.

Ko A and Gillani S (2020) A research review and taxonomy development for decision support and business analytics using semantic text mining. *International Journal of Information Technology and Decision Making* 19(01): 97–126.

Kumar S (2015) Co-authorship networks: A review of the literature. *Aslib Journal of Information Management* 67(1): 55–73.

Kundisch D, Muntermann J, Oberländer AM, et al. (2022) An update for taxonomy designers: Methodological guidance from information systems research. *Business & Information Systems Engineering* 64(4): 421–519.

Linnaeus C (1735) *Systema naturae, sive regna tria naturae systematice proposita per classes, ordines, genera, & species*. 1st edn. Theodorum Haak, Lugduni Batavorum (Leyden). Facsimile reprinted 1964 by B. de Graff, Nieuwkoop.

Liu X, Song Y, Liu S, et al. (2012) Automatic taxonomy construction from keywords. In: *Proceedings of the 18th ACM SIGKDD international conference on Knowledge discovery and data mining*, pp.1433–1441. DOI: 10.1145/2339530.2339754.

Lund H and Ørnager S (2016) Company taxonomy development: The case of an international emergency response organization. *Aslib Journal of Information Management* 68(2): 193–211.

Lyu P, Liu X and Yao T (2023) A bibliometric analysis of literature on bibliometrics in recent half-century. *Journal of Information Science* 0(0). DOI: 10.1177/01655515231191233.

McCloskey J and Bulechek G (1995) Validation and coding of the NIC taxonomy structure. *Image the Journal of Nursing Scholarship* 27(1): 43–49.

Milne C (2007) Taxonomy development: Assessing the merits of contextual classification. *Records Management Journal* 17(1): 7–16.

Mohamad AN, Sylvester A and Campbell-Meier J (2024) Towards a taxonomy of research areas in open government data. *Online Information Review* 48(1): 67–83.

Mukherjee D, Lim WM, Kumar S, et al. (2022) Guidelines for advancing theory and practice through bibliometric research. *Journal of Business Research* 148: 101–115.

Nickerson R, Muntermann J, Varshney U, et al. (2009) Taxonomy development in information systems: Developing a taxonomy of mobile applications. In: *European conference in information systems*.

Nickerson RC, Varshney U and Muntermann J (2013) A method for taxonomy development and its application in information systems. *European Journal of Information Systems* 22(3): 336–359.

Niu J, Issa RR and Mutis I (2015) Taxonomy development toward the domain ontology of construction contracts: A

case study on AIA A201-2007. In: *Ontology in the AEC industry*, pp.217–250. DOI: 10.1061/9780784413906.ch10.
Niu J and Issa RRA (2015) Developing taxonomy for the domain ontology of construction contractual semantics: A case study on the AIA A201 document. *Advanced Engineering Informatics* 29(3): 472–482.
Oberländer AM, Lösser B and Rau D (2019) Taxonomy research in information systems: A systematic assessment. In: *Proceedings of the 27th European Conference on Information Systems (ECIS)*, Stockholm & Uppsala, Sweden, 8–14 June.
Omair B and Alturki A (2020) An improved method for taxonomy development in information systems. *International Journal of Advanced Computer Science and Applications* 11(4): 535–540.
Osterwalder A and Pigneur Y (2011) *Business Model Generation: Ein Handbuch Für Visionäre, Spielveränderer und Herausforderer* [*Business Model Generation: A Handbook for Visionaries, Game Changers and Challengers*]. Frankfurt: Campus Verlag.
Page MJ, McKenzie JE, Bossuyt PM, et al. (2021) The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. *International Journal of Surgery* 88: 105906.
Pérez CT and Costa D (2018) Developing a taxonomy of transportation waste in construction production processes. *Built Environment Project and Asset Management* 8(5): 434–448.
Posey C, Raja U, Crossler RE, et al. (2017) Taking stock of organisations' protection of privacy: Categorising and assessing threats to personally identifiable information in the USA. *European Journal of Information Systems* 26(6): 585–604.
Pradani W, Hasibuan ZA and Santoso HB (2022) Layered and modularized ontology architecture for Indonesian Cultural heritage (INDOCH) based on UNESCO cultural heritage taxonomy and CIDOC CRM. *Journal of Engineering Science and Technology* 17(ccnt): 90–98.
Prat N, Comyn-Wattiau I and Akoka J (2015) A taxonomy of evaluation methods for information systems artifacts. *Journal of Management Information Systems* 32(3): 229–267.
Raza U, Ahmad W and Khan A (2018) Transformation from manufacturing process taxonomy to repair process taxonomy: A phenetic approach. *Journal of Industrial Engineering International* 14(2): 415–428.
Remane G, Hanelt A, Tesch JF, et al. (2017) The business model pattern database—A tool for systematic business model innovation. *International Journal of Innovation Management* 21(01): 1750004.
Sabherwal R and King WR (1995) An empirical taxonomy of the decision-making processes concerning strategic applications of information systems. *Journal of Management Information Systems* 11(4): 177–214.
Samsudin AZH, Zakaria S, Miah SJ, et al. (2015) Improving access to digital information resources through the development of a knowledge taxonomy. In: *2015 2nd Asia-Pacific world congress on computer science and engineering (APWC on CSE)*, pp.1–7. IEEE. DOI: 10.1109/APWCCSE.2015.7476129.
Sia CL and Al-Hawamdeh S (2003) Taxonomy-building tools: An investigative study. *Journal of Information and Knowledge Management* 2(01): 63–77.
Sillet A (2013) Definition and use of bibliometrics in research. *Soins* 781(781): 29–30.
Stanton NA, Box E, Butler M, et al. (2023) Using actor maps and AcciMaps for road safety investigations: Development of taxonomies and meta-analyses. *Safety Science* 158: 105975.
Strasser A (2017) Delphi method variants in information systems research: Taxonomy development and application. *Electronic Journal of Business Research Methods* 15(2): 120–133.
Surwase G, Sagar A, Kademani BS, et al. (2011) Co-citation analysis: An overview. In: *Beyond librarianship: Creativity, innovation and discovery*, Mumbai, India, 16–17 September.
Szopinski D, Schoormann T and Kundisch D (2020) Criteria as a prelude for guiding taxonomy evaluation. In: *Proceedings of the 53rd Hawaii international conference on system sciences*.
Täuscher K and Laudien SM (2018) Understanding platform business models: A mixed methods study of marketplaces. *European Management Journal* 36(3): 319–329.
Teece DJ (2010) Business models, business strategy, and innovation. *Long Range Planning* 43(2–3): 172–194.
Usman M, Britto R, Börstler J, et al. (2017) Taxonomies in software engineering: A systematic mapping study and a revised taxonomy development method. *Information and Software Technology* 85: 43–59.
Varshney U, Muntermann J and Nickerson R (2015) Towards the development of a taxonomic theory. In: *Twenty-first Americas conference on information systems*, Puerto Rico.
Vickery BC (1960) *Faceted classification: A guide to construction and use of special schemes*. California: Aslib.
Visser M, Van Eck NJ and Waltman L (2021) Large-scale comparison of bibliographic data sources: Scopus, web of science, dimensions, crossref, and microsoft academic. *Quantitative Science Studies* 2(1): 20–41.
Wang D, Huang M and Wang Y (2011) Analysis of the IFRS taxonomy extension mode. In: *2011 international conference on business computing and global informatization*, pp.461–464. IEEE. DOI: 10.1109/bcgin.2011.121.
Yang A and Varshney U (2022) Mobile health evaluation: Taxonomy development and cluster analysis. *Healthcare Analytics* 2: 100022.
Yang K and Meho LI (2006) Citation analysis: A comparison of google scholar, scopus, and web of science. *Proceedings of the American Society for Information Science and Technology* 43: 1–15. DOI: 10.1002/meet.14504301185.
Yazgan E (2018) Development taxonomy of human risk factors for corporate sustainability in aviation sector. *Aircraft Engineering and Aerospace Technology* 90(6): 1012–1022.
Zott C, Amit R and Massa L (2011) The business model: Recent developments and future research. *Journal of Management* 37(4): 1019–1042.

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LIST OF PUBLICATION

BOOKS:

Encyclopedia: Knowledge Organization System: Knowledge Taxonomy in International Encyclopedia of Business Management (Vanessa Ratten, Ed.).

Elsevier: The Netherlands. https://doi.org/10.1016/B978-0-443-13701-3.00449-7.

Book: Integrasi Manajemen Pengetahuan dan Sumber Daya Manusia (Integrating Knowledge Management and Human Resources), Literasi Nusantara: Indonesia, ISBN: 978-634-206-651-5.

Book Chapter: A Wake-Up Call After a Disaster: Initiating Archiving Household Documents Through a Digital Repository in Indigenous Knowledge Management in the Open Science Framework. (Josiline Chigwada and Patrick Ngulube, Ed.) IGI Global: USA, ISBN 9798337302041.

Book Chapter: The Library and Information Science Perspective on Knowledge Management in Creating and Sustaining an Information Governance Program. (Kris Helge & Caitlin A. Rookey, Ed.) IGI Global: USA, ISBN: 9798369304723

Book Chapter: Initiating Memory Institutions Convergence Through Digital Convergence in Indonesian World Heritage Sites in Multidisciplinary Approach to Information Technology in Library and Information Science. (Barbara Holland & Keshav Sinha, Ed.) IGI Global: USA, ISBN 9798369328415.

Book Chapter: Toward a Convergence of Memory Institutions in the Indonesian Presidential Library in the Multidisciplinary Approach to Information Technology in Library and Information Science. (Barbara Holland & Keshav Sinha, Ed.) IGI Global: USA, ISBN 9798369328415.

PAPERS:

Evolving Taxonomies: Fifty Years of Taxonomy Development in Library and Information Science. *Journal of Librarianship and Information Science*, *58*(1), 1–22, ISSN: 0961-0006. https://doi.org/10.1177/0961000625133437.

Developing a Cultural Heritage Taxonomy for an Indonesian World Heritage Site. *Journal of Documentation*, *81*(5–6), 1200–1217, ISSN: 1758-7379. Link: https://doi.org/10.1108/JD-03-2025-0063.

Hendrawan, M. R., Mat Isa, A., & Samsudin, A. Z. H. (2025). The Railway Museum as Memory Institutions and Tourism Attractions: Case Study in Area A of the Ombilin Coal Mining Heritage of Sawahlunto. *Record and Library Journal,*

11(2), 389–403. ISSN: 2442-5168. https://doi.org/10.20473/rlj.V11-I2.2025.389-403

Development of a Cultural Heritage Digital Repository for the Ombilin Coal Mining Heritage of Sawahlunto, *Journal of Information and Knowledge Management*, *15*(1), 82–97, ISSN: 2231-8836. https://doi.org/10.24191/jikm.v15i1.4540

Metadata Interoperability for Cultural Heritage Digital Repositories: A Case Study in Indonesian World Heritage Site Memory Institutions, *International Journal of Academic Research in Business and Social Sciences 14*(8), 545-561. ISSN: 2222-6990. http://dx.doi.org/10.6007/IJARBSS/v14-i8/22226

Multi-Disaster Risk Mitigation through Augmented Reality Conservation Map for Enhancing Cultural Heritage Attitude, *2nd International Conference on Information Science, Technology, Management, Humanities & Business (ITMAHuB), Shah Alam, Malaysia, Environment-Behaviour Proceedings Journal, 9*(SI 18), ISSN: 2398-4287. https://doi.org/10.21834/e-bpj.v9iSI 18.5484