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Conceptual modeling of Information and Knowledge Technologies in the Thesaurus of Library Science, Archival Science, and Information (TEBAI)

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Abstract

The inclusion of terms and descriptors related to Information and Knowledge Technologies (IKT) in a thesaurus for Library Science, Archival Science, and Information Science poses a conceptual and methodological challenge for the field of knowledge organization. A central risk in this process is the adoption of technological determinism, which subordinates information systems to the technologies that support them. This paper analyzes the development of a SKOS-based semantic model for the IKT domain within the Thesaurus of Library Science, Archival Science, and Information (TEBAI), with the aim of contributing a representational framework that is adaptable to the thesaurus and that demonstrates how technologies can add value to information systems while preserving their status as autonomous conceptual spaces. From a theoretical perspective grounded in Library and Information Science, the study argues that technologies function as enabling—but not determining—components of information systems. The adoption of SKOS is presented as a strategy that allows this conceptual distinction to be formally represented, supports semantic interoperability, and reinforces the disciplinary identity of the thesaurus.

Keywords: Thesaurus; Terminology; Information and Knowledge Technologies

1.0 Introduction

The construction of a thesaurus for Library Science, Archival Science, and Information Science (TEBAI) requires multiple domain analyses across the areas it encompasses. These analyses are supported by research reflected in the scholarly literature of the relevant specialties, a previous version of the thesaurus, and systematic consultation with subject experts (TEBAI 2025).

Information and Knowledge Technologies (IKT) constitute a transversal domain across the three disciplines; however, their relevance requires them to be analyzed as a distinct domain. This presents a specific challenge in terms of capturing conceptual relevance, articulating the relationship between IKT and Information Science, and developing a semantic model suitable for formal representation within the SKOS standard.

The objective of this work is to present the domain model and the conceptual categories designated for IKT in TEBAI, and to explain their inclusion and relationships with other major thematic areas of the thesaurus.

IKT represent a field in constant evolution and are indispensable to knowledge organization, as they support the information systems that mediate between advances in knowledge and users seeking access to them. The sustained growth in information volume and complexity reinforces the need for conceptual models capable of organizing, representing, and enabling effective retrieval within this evolving technological context.

“While I can’t truly predict the future, I am quite certain that the volume of information coming at us isn’t going to go away, lessen in intensity, or slow down. The information explosion is going to continue, and we all need to find ways to make sense of it—to improve retrieval, to refine analysis, to pull out the real value of information so that the people who need it, get it” (Hlava 2015, xxiv).

2.0 Theoretical Elements

In the presentation of the site hosting the research carried out at the Institute for Library and Information Research (IIBI), it is explained that IKT studies: “Explore the theories, trends, and technological applications of information sciences and computer sciences and their relationship with libraries, archives, and museums, collections, services, content, and media, as well as their effects, problems, and solutions” (https://iibi.unam.mx/web/agenda.php).

These few words express how institutions and organizations configured through social, organizational, normative, and cognitive processes in Information Sciences, in their convergence with Computer Sciences, are supported by technological theories, trends, and applications.

The construction of a thesaurus reflects theoretical and epistemological decisions grounded in knowledge organization as an intellectual activity aimed at the systematic representation of concepts and relationships within a given domain, in order to facilitate access to and retrieval of information (Hjørland 2003; Smiraglia 2014). Hjørland (2003, 89) states: “...and were highly interested in establishing services which could stimulate the application of knowledge to specific purposes”. At the domain level, knowledge used by a discourse Community can be framed by a structured ontology, or represented symbolically with a classification, or rendered in the form of a controlled vocabulary, uch as a thesaurus (Smiraglia 2014, 88–91).

Prior to these authors, other theorists had deepened the foundations that allowed such assertions. Buckland (1991) proposed a broad conception of information that included not only data and documents, but also the processes and contexts that give them meaning. Along similar lines, Saracevic (1999) emphasized the human and social dimension of information systems, noting that their effectiveness cannot be evaluated solely in technological terms.

Accordingly, Smiraglia (2012, 114) defines a domain as follows:

“A domain is best understood as a unit of analysis for the construction of a KOS. That is, a domain is a group with an ontological base that reveals an underlying teleology, a set of common hypotheses, epistemological consensus on methodological approaches, and social semantics. If, after the conduct of systematic analysis, no consensus on these points emerges, then neither intension nor extension can be defined, and the group thus does not constitute a domain.”

The incorporation of IKT into TEBAI not only enriches the vocabulary of the discipline but also improves the precision of information retrieval in digital environments and automatic indexing systems. This continuous updating is crucial because knowledge organization systems must reflect both the state of professional language and the evolution of the technology that supports information systems.

TEBAI does not include descriptors corresponding to information systems as part of technology. Information systems focus primarily on procedures involving document transfer and institutional priorities in acquisition and preservation, whereas computer systems are oriented toward identifying the technological means that make information recording and retrieval feasible (Guadarrama 2025, 219).

The thesaurus requires engagement with the terminology present in the designations used in information and knowledge, and technology offers solutions closely related to the implementation of terminology in computational environments. Therefore, it is appropriate to present technological descriptors expressed in that context.

The informational phenomenon implied using technology requires an analysis of the elements that function to relate documents with the necessary coherence and depth to properly fix their contents through clear and precise language, expressed in a form understandable by computers.

The ISO 25964 standard was adopted not only as a guide for term inclusion but also to address technological terminology with criteria of interoperability and semantic structuring explained in its provisions.

Among the technologies used in information organizations, the Simple Knowledge Organization System (SKOS) is suitable for modeling thesaurus descriptors as entities manageable by computer applications. SKOS is considered an intermediate step, a bridge between the chaos resulting from the low level of structuring of today’s Web and the rigorous descriptive formalism of ontologies defined with OWL (Web Ontology Language), among which SKOS is included.

“The aim of SKOS is not to replace original conceptual vocabularies in their initial context of use, but to allow them to be ported to a shared space, based on a simplified model, enabling wider re-use and better interoperability.” (Isaac and Summers 2009, sec. 1).

3.0 Methodology

The methodology was developed from a qualitative, pragmatic, and analytical approach typical of research in terminology and thesauri. The W3C SKOS standard was adopted as a framework for semantic representation, in accordance with ISO 25964, with the aim of formalizing conceptual relationships and ensuring model interoperability.

With respect to the vocabulary on the subject, it is necessary to approach it through the domain analysis proposed by Hjørland, who refers to a theoretical perspective that seeks to understand the information produced on a topic through the cultural and social context of the discourse community. This generates information that, once processed, provides elements to capture the essence of the domain and, among other aspects, to represent it through the terminology used in products available within the field of practice. The author establishes eleven modalities to capture the essence of a domain (Hjørland 2002).

Candidate IKT terms were selected using some of Hjørland's eleven modalities, emphasizing criteria of disciplinary relevance, conceptual stability, relationships among terms (Lancaster 2003, 23), usage in the academic literature of the specialty, and expert opinion. Terms were obtained through automated searches used to compile the initial TEBAI terms (Naumis-Peña et al. 2022), separating those corresponding to. Each term entry included data on the thematic areas in which it was located, enabling subsequent review. Once separated by areas, each was complemented with manual searches, as explained in other publications on TEBAI (Naumis-Peña 2025; Suárez Sánchez 2022).

In summary, the selection of terms included in the IKT model was based on the following criteria in the construction of controlled vocabularies:

Disciplinary relevance, that is, frequency and pertinence of term usage in Library Science, Archival Science, and Information.

Conceptual stability, prioritizing concepts with a reasonable degree of consolidation, even within a dynamic field such as technology.

Semantic integration capacity, evaluating the possibility of establishing hierarchical, associative, and equivalent relationships with other terms in the scheme.

Descriptors in the thesaurus incorporate hierarchical, equivalent, and related relationships, as well as scope notes explaining their meaning within the general context of TEBAI. These notes allow users not only to find exact terms but also to explore related conceptual fields. A notable feature is the use of IKT descriptors expressed as acronyms, abbreviations, or emerging denominations, developed in full as equivalents to offer alternatives to thesaurus users.

The IKT area was divided into the following classes, identified among retrieved terms that qualified as dominant within the subject:

Systems analysis

History of technology

Informatics

Robotics

Communication systems

Information technologies

Telecommunications

Regarding systems analysis, there exists a broader scope than the technology used, since in libraries, archives, museums, or repositories, the focus is on sociotechnical information systems where users, processes, standards, collections, and technologies interact. Therefore, a scope note suggests associating **systems analysis** with another descriptor indicating the type of system in which the task is performed, for example, search and retrieval processes based on queries.

Sociotechnical systems are defined as such because they integrate technical components such as facilities, hardware, and software with data users to provide data services within a defined boundary. A system comprises technical and social subsystems that are interdependent and interactively responsive, jointly forming the system's internal environment. In essence, data analysis tasks can be summarized as follows:

"...review that covers three critical aspects of data quality: first, ensuring data quality through deliberate design; second, understanding the dynamic interplay between data and its users within sociotechnical systems; and third, attributing ongoing value to data resources as their roles evolve" (Fu et al. 2024, 1).

In addition to associations with other descriptors, specific descriptors are included: Systems analyst, Systems evaluation, Information management, Digital humanities, Software. As a related term, Database is included. Hardware is excluded, as it is not addressed in the library science literature and is not a task of information professionals. Each of the mentioned terms has its own entry and development in TEBAI.

The next class within IKT is **History of technology**. This topic is not extensively developed, although it includes the specific term *Evolution of technology*. The class refers to the historical dimension related to the specialty within Information Science. As with other classes, the limited development reflects the absence of terms found in the reviewed literature.

Informatics, the third IKT class, according to the Dictionary of the Royal Spanish Academy, is "the set of scientific and technical knowledge that makes possible the automatic processing of information by means of computers". It is a technical and scientific discipline centered on data automation. In Information Sciences, it is used to analyze methods, techniques, and systems for automatic information processing through representation, processing, storage, retrieval, and transmission of data and information. The classes assigned and retrieved in term searches are Codes, Computer programs, Simulation, and Computer system. The latter is further subdivided up to a fifth level, concluding with Text mining, a descriptor also widely used in metric studies of information.

The fourth class, **Robotics**, is frequent in recent literature, as libraries increasingly use robots. Specific terms located include Automated storage, User assistance, and Lending and return robots. Related terms are Libraries and Library services.

Communication systems, the fifth class, contains the largest number of descriptors and comprises four subclasses: Cybernetics, Internet, Nodes, and Networks.

Cybernetics includes a scope note explaining it as the theory of mechanical, electronic, and electrical control systems designed to replace human functions. However, literature questioning its representativeness considering Artificial Intelligence is noted:

"As a newborn discipline studying and engineering intelligent agency, AI developed very quickly compared to other disciplines and needed to borrow its vocabulary from related fields. Cybernetics was available at the time, though, intriguingly, it failed to gain traction as an academic field" (Gagliano and Gehl 2008, cited by Floridi and Nobre 2024, 3–4).

Cybernetics is used with representative frequency in Information Sciences. Artificial Intelligence is included under Cybernetics as a Related Term, and the generic term supporting it in TEBAI is Information Technologies.

In the **Internet** subclass, which has the greatest depth level, some inconsistencies related to the Multites software were identified. To avoid repetitions that could complicate indexing, MARC and MARC 21 are not included as markup languages among Internet descriptors, although they appear as related terms. In TEBAI, MARC and MARC 21 are integral to cataloging, which is divided into four aspects following Zeng's recommendations and forms part of data structure standards (Zeng and Qin 2022, 24).

Finally, the subclasses **Nodes** and **Networks** are presented. Networks include scientific networks and communication networks. Within the conceptual framework of networks, scientific networks (also subsumed under Scientific Collaboration) and communication networks are identified as derived categories. At a higher level of abstraction, the concept of network is hierarchically positioned under Internet, alongside the more specific concept of Intranet.

The subsequent class, **Information Technologies**, is defined as "...a set of methods and ways of obtaining, processing and providing information in the interests of various users and consumers" (Zhao 2024, 921). Specific descriptors include Remote storage, Artificial intelligence, Information systems interoperability, On-demand service, and Digital technology. Among the conceptual decisions adopted within the domain of Artificial Intelligence—many of which have been subject to extensive discussion—the inclusion of the concept Smart Accessory stands out. This concept denotes complementary devices that function as extensions of system capabilities, notably through communication mechanisms such as Bluetooth.

4.0 Presentation of Results in SKOS

To illustrate the process required to transform TEBAI into formal knowledge for incorporating thesaurus descriptors into an ontology, modeling was performed on the descriptor Systems analysis, the first generic term in the Information and Knowledge Technologies area and one of TEBAI's main categories. This example was chosen because it includes the Main Category, Scope Note, Broader Terms, Narrower Terms, and Related Terms Related Terms (Dextre Clarke 2001).

The transformation of TEBAI descriptors into a SKOS-based model was carried out to ensure semantic interoperability, vocabulary reuse in digital environments, and alignment with international standards for knowledge organization. SKOS, developed and recommended by the World Wide Web Consortium (W3C), constitutes the most widely accepted reference framework for formal representation of knowledge organization systems in the Semantic Web (Miles and Bechhofer 2009).

The methodological process is supported by the principles established in ISO 25964, particularly regarding equivalence between traditional thesaurus relationships and SKOS semantic properties. This standard provides guidelines for building, managing, and interoperating thesauri, as well as mapping them with other knowledge organization systems, including vocabularies represented in semantic environments (ISO 2011, 2013).

Within this framework, each preferred term was modeled as an instance of skos:Concept, and the vocabulary was structured as a skos:ConceptScheme, ensuring internal coherence and unique identification. The assignment of persistent identifiers (URIs) follows W3C recommendations for publishing-controlled vocabularies on the Web of Data (W3C 2014).

For the term Information and Knowledge Technologies, formalization was carried out as a preferred concept (skos:prefLabel) in Spanish, incorporating the original thesaurus scope note as skos:scopeNote. This methodological decision is grounded in ISO 25964 guidelines, which indicate that scope notes are essential for correct semantic interpretation and for guiding indexing and information retrieval processes.

Hierarchical relationships expressed in the thesaurus as broader term (BT) and narrower term (NT) links were converted into skos:broader and skos:narrower properties, respectively. Thus, *Systems analysis* was represented as a subordinate term of the general concept, maintaining its hierarchical structure while also functioning as an intermediate node for more specific concepts such as *Systems analyst*, *Systems evaluation*, *Information management*, and *Digital humanities*. This modeling preserves the thesaurus's conceptual structure and enables its exploitation in semantic navigation and discovery systems (ISO 2013).

Associative relationships (RT) were translated into the skos:related property, preserving their non-hierarchical character. Thus, *Database* was linked as a related term to *Information and Knowledge Technologies*, reflecting a relevant semantic affinity for information retrieval processes without imposing an artificial hierarchical dependency. This decision aligns with recommendations from both ISO 25964 and the SKOS Reference,

which clearly distinguish hierarchical and associative relationships (Miles and Bechhofer 2009).

From a technical perspective, encoding was carried out in RDF/Turtle syntax, chosen for its readability, compactness, and widespread use in controlled vocabulary publication projects. The adoption of RDF as a data model enables thesaurus integration into linked data infrastructures and interoperability with other conceptual schemes published on the Semantic Web (W3C 2014).

Overall, this methodological conversion allows TEBAI to transition from a traditional terminological control model to an interoperable semantic infrastructure compatible with the Web of Data and current requirements of knowledge organization systems, without losing conceptual richness or the intellectual decisions inherent in its original construction.

5.0 Conclusions

The semantic analysis and modeling of Information and Knowledge Technologies (IKT) using SKOS enabled not only the structuring of a highly dynamic domain, but also the explicit articulation of fundamental conceptual decisions adopted in the Thesaurus of Library Science, Archival Science, and Information (TEBAI). Among these decisions, the clear separation between IKT and Information Systems is particularly significant, as it reflects an integrative conception of information systems that extends beyond purely technological considerations.

The results confirm that although IKT are indispensable components of contemporary information systems, their design, implementation, and evaluation also depend on organizational, normative, human, and cognitive factors. The placement of information systems in a distinct area within TEBAI therefore represents an epistemological position aligned with sociotechnical perspectives in Information Science.

From the standpoint of knowledge organization, this distinction provides conceptual clarity and avoids forms of technological reductionism that could negatively affect indexing and information retrieval. By not subordinating information systems exclusively to the IKT domain, TEBAI supports a more accurate representation of professional and scholarly practices, in which information systems are understood as complex environments of interaction among technologies, information, and users.

The implementation of a SKOS-based model reinforces this position by enabling differentiated semantic relationships between the IKT domain and information systems, preserving conceptual connections without imposing rigid hierarchical dependencies. This approach allows the thesaurus to function as an interoperable semantic infrastructure while maintaining the intellectual coherence of its conceptual design.

Finally, this study demonstrates that the terminological updating of TEBAI in response to technological change cannot be limited to the incorporation of new terms. Instead, it requires continuous conceptual revision to preserve theoretical consistency within the

thesaurus. The adoption of SKOS as a semantic modeling framework provides an effective strategy for supporting this process by combining standardization, flexibility, and capacity for evolution. In this way, TEBAI is consolidated as a robust instrument for organizing and retrieving information in a technological context characterized by ongoing transformation.

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