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International standards for KOS supporting information
retrieval and machine learning assessment:

Thesaurus Standards for Taxonomies

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Outline

- § Thesauri and taxonomies compared
- § Introduction to KOS standards
- § Relevance of thesaurus standards for taxonomies
- § Introduction to Simple Knowledge Organization System (SKOS)
- § How ISO 25964-1 aligns and compares with SKOS

Thesaurus and Taxonomy Definitions

Definitions from the ISO 25964 standard

thesaurus

a controlled and *structured vocabulary* in which *concepts* are represented by *terms*, organized so that relationships between *concepts* are made explicit, and *preferred terms* are accompanied by lead-in entries for *synonyms* or *quasi-synonyms*.

– ISO 25964-1:2025(E) *Thesauri and interoperability with other vocabularies — Part 1: Thesauri, section 3: Terms and definitions*

taxonomy

a scheme of categories and subcategories that can be used to sort and otherwise organize items of knowledge or information.

NOTE Taxonomies range from the very simple to the very complex. In the simplest taxonomies the categories are not necessarily divided into subcategories, while in the complex ones, multiple hierarchical levels can be found. Other features too can be present, such as all the thesaurus features described in ISO 25964-1, and/or the features commonly found in classification schemes. Outside of this International Standard, the term is often used loosely to refer to any type of structured vocabulary.

– ISO 25964-2:2013(E) *Thesauri and interoperability with other vocabularies — Part 2: Interoperability with other vocabularies, section 3: Terms and definitions*

Accessibility²⁰⁰⁵

- SN Use a more speed
Compare with Air
SERVICE ACCESS
BARRIERS.
- NT Service Accessibility
- RT Architectural Barriers
Human Factors in
Travel Barriers
Universal Design

Accessibility of Facilities
USE **Architectural Barriers****Accessory Housing**¹⁹⁹¹

- SN Housing construction
proximity to an area
to accommodate
- UF *ECHO Housing*
Granny Flats
- BT Housing Types

Accident Prevention¹⁹⁷⁷

- BT Prevention
- RT Accidents
Safety

Accidents¹⁹⁷⁷

- NT Falls
Home Accidents
Traffic Accidents
- RT Accident Prevention
Burns
Death Causes

manifolds

- RT air intakes
exhaust systems
fuel systems
intake systems
pipes (tubes)
plenum chambers
- ∞ tubes
- ∞ water intakes

manifolds (mathematics)

- GS **manifolds (mathematics)**
. Riemann manifold
- RT coordinates
curves (geometry)
fibers (mathematics)
fixed points (mathematics)
topology

*manipulation*USE **manipulators****manipulators**

- SN (LIMITED TO MECHANICAL DEVICES
FOR REMOTE HANDLING)
- UF *manipulation*
- GS **manipulators**
. remote manipulator system
. . . Space Station Mobile Servicing
System
- RT control equipment
- ∞ effectors
end effectors
inverse kinematics
payload deployment & retrieval
system
remote control
remote handling
robot arms

self maneuvering units
space transportation system**manned Mars missions**

DEF Any of several options for manned missions to Mars in which spacecraft are built for a particular mission. A mission is estimated by around 2020 and may last from one year to three years depending on speed and design.

- GS space missions
. Mars missions
. . . **manned Mars missions**

- RT Crew Exploration Vehicle
in situ resource utilization
interplanetary flight
interplanetary spacecraft
long duration space flight
magnetic sails
manned spacecraft
Mars (planet)
Mars exploration
NASA space programs
return to Earth space flight
space exploration
terraforming

manned orbital laboratories

- UF *MOL (orbital laboratories)*
MORL
- GS laboratories
. space laboratories
. . . **manned orbital laboratories**
. . . Columbus module
. . . Destiny Laboratory Module
. . . Kibo Japanese Experiment
Module
. . . Skylab 1
. . . Skylab 2
. . . Skylab 3

Thesaurus examples – Excerpts

Browse Alphabetically

A B C D
U V W X Y

[Baby Boomers](#)

[Babysitters \(2004\)](#)

[Baccalaureate Degrees](#)

[Bachelor of Arts Degree](#)

[Bachelor of Science Degree](#)

[Bachelors Degrees](#)

[Back to Basics](#)

[Background](#)

[Bacteria \(1990 2003\)](#)

[Bacteriology \(2004\)](#)

[Badminton \(2004\)](#)

[Bahasa Indonesia \(2004\)](#)

[Bakeries \(2004\)](#)

[Bakery Industry \(2004\)](#)

[Ballads \(2004\)](#)

[Ballet \(1966 1980\)](#)

[Baltic Languages \(2004\)](#)

[Baluchi \(2004\)](#)

[Bands \(Music\) \(2004\)](#)

[Banking](#)

[Banking Industry \(2004\)](#)

[Banking Vocabulary \(2004\)](#)

Behavior Modification

Scope Note: Alteration of behavior by the use of conditioning techniques (Note: Prior to Mar80, the instruction "Behavior Modification, USE Behavior Change" was carried in the Thesaurus)

Category: [Learning and Perception](#)



[Search collection using this descriptor](#)

Broader Terms

[Conditioning](#)

Narrower Terms

[Applied Behavior Analysis](#)

[Contingency Management](#)

[Desensitization](#)

[Positive Behavior Supports](#)

Use this term instead of

[Behavior Therapy](#)

[Behavioral Counseling \(1967 1980\)](#)

[Cognitive Behavior Modification](#)

[Biology Instruction \(1966 1980\)](#)

[Bowling \(2004\)](#)

Related Terms

[Addictive Behavior](#)

[Behavior](#)

[Behavior Change](#)

[Biofeedback](#)

[Classical Conditioning](#)

[Cognitive Restructuring](#)

[Counseling](#)

[Functional Behavioral Assessment](#)

[Intervention](#)

[Olfactory Perception](#)

[Operant Conditioning](#)

[Psychotherapy](#)

[Rehabilitation](#)

Thesaurus
examples
– Excerpts

Taxonomy examples – Excerpts

– Computer and information sciences

Artificial intelligence

- Artificial neural networks
- Expert systems
- Genetic programming
- Machine learning

– Artificial intelligence

Machine learning

- Decision tree learning
- Deep learning
- Ensemble methods
- Machine learning algorithms
- Relevance vector machines
- Supervised machine learning
- Support vector machines
- Unsupervised machine learning

Topics

☐ URI	(38)
☐ Taxonomies	(36)
☐ RDF	(18)
☐ Technical documentation	(14)
☐ SKOS	(13)
☐ Java	(8)
☐ SPARQL	(7)
☐ Metadata	(6)
☐ ADMS	(5)
☐ Microsoft Excel	(4)

Knowledge and Data Assets

☐ DBpedia	(4)
☐ Wikidata	(1)
☐ schema.org	(1)

Technologies and Applications

☐ Windows	(13)
☐ Recommender systems	(6)
☐ Apache Solr	(5)
☐ Elasticsearch	(4)
☐ Linux	(4)

Filter By:

COURSE TYPES

☒ Fundamentals ⓘ

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☐ Arts and Design (39) ▾

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☐ Administrative

☐ Communication

☐ Finance

☐ Marketing and Sales

☐ Operations

☐ Project Management

☐ Small Business

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☐ Construction and Trades (2) ▾

☐ Data Science & Artificial Intelligence ▾

☐ Health and Fitness (74) ▾

What type of space do you have?

room

Ballroom

Boardroom

Car Showroom

Cellar Room

Classroom

Club Room

Conference Room

Comparison of Knowledge Organization Systems



Term List	Name Authority	Taxonomy	Thesaurus	Ontology
Ambiguity control	Ambiguity control Synonym control Attributes	Ambiguity control (Synonym control) Hierarchical relationships	Ambiguity control Synonym control Hierarchical relationship Associative relationships	Semantic relationships Classes Attributes

Thesauri and Taxonomies Compared

Thesauri

- Ø All terms have relationships, but “hierarchies” may be as few as 2 terms.
- Ø Follow ISO thesaurus standards.
- Ø Support concept scoping, disambiguation, and relationships with similar concepts.
- Ø Approach is term-centered and what terms are linked to/from it.
- Ø Used for publications, libraries, research
- Ø Especially serving indexers/indexing.
- Ø Historically in print, now also digital. Display options reflect printed format.

Taxonomies

- Ø All terms belong to a limited number of major hierarchies (or facets).
- Ø Do not strictly follow ISO standards.
- Ø Support classification, categorization, concept organization.
- Ø Approach is a top-down browse navigation.
- Ø Used in business, industry, commerce
- Ø Especially serving end-users when browsing.
- Ø Developed for digital displays.

Standards for Knowledge Organization Systems

Standards in general are of two basic types:

1. Standards for **specifications** (measurements, protocols, coding, etc.)
 - Supports exchange and interoperability.
2. Standards for **design**
 - Supports an expected experience and results by different users without training
 - Supports a higher quality result

Standards for knowledge organization systems also are of each type:

1. For **specifications and interoperability**: For various knowledge organization systems
Dublin Core, RDF, RDFS, SKOS
 - May also be called “data models”; may be used in combination
2. For **design**: Especially for thesauri
 - ISO 25964 *Thesauri and interoperability with other vocabularies*
 - ANSI/NISO Z39.19 *Guidelines for the Construction, Format, and Management of Monolingual Controlled Vocabularies*

Thesaurus Standards

§ ISO 25964 Information and documentation — Thesauri and interoperability with other vocabularies

Part 1: ISO 25964-1: 2011 *Thesauri for information retrieval*

- Reviewed and confirmed in 2022.
- Revision work completed November 2025. Revision to be published in 2026.

Part 2: ISO-25964-2: 2013 *Interoperability with other vocabularies*

- Reviewed and confirmed in 2023.
- Revision in progress in 2026. Revision expected to be published in 2027.

§ ANSI/NISO Z39.19-2005 *Guidelines for the Construction, Format, and Management of Monolingual Controlled Vocabularies*

(American National Standards Institute / National Information Standards Organization)

- Reviewed and confirmed in 2010. Overdue for a revision.
- Comparable to ISO 25964-1: 2011 but does not cover multilingual thesauri.

Why Use a Thesaurus Standard for Taxonomies



- § **Data model standards** (especially SKOS) are available for taxonomies, but **standards for design/quality** are not.
- § The distinctions between thesauri and taxonomies are often blurred.
 - Both are increasingly built on the SKOS data model.
 - Both tend to be built with the same software tools.
- § Thesauri have more features than taxonomies do.
Taxonomies do not have features that thesauri lack (although the structural design tends to be different).
- § The most important feature of taxonomies, the **hierarchical relationship**, functions the same in both taxonomies and thesauri.
 - Understanding how to implement hierarchical relationships correctly is very important.
 - ISO 25964-1 and ANSI/NISO Z319.19 have extensive explanations and examples of types of acceptable hierarchical relationships.
- § Design quality has become more important:
Inconsistencies may be tolerated by human users, but not in automation/AI uses.

Introduction to SKOS



SKOS (Simple Knowledge Organization System)

- § A data model to represent knowledge organization systems
- § A World Wide Web (W3C) recommendation (2009)
- § “A common data model for sharing and linking knowledge organization systems via the Web” <https://www.w3.org/TR/skos-reference/>
- § A KOS built on SKOS is machine-readable and interchangeable.
- § Encoded using XML and RDF (Resource Description Framework).
- § To enable easy publication and use of such vocabularies as linked data.

SKOS fully supports various types of KOSs:

- § term lists, taxonomies, thesauri, classification schemes, terminologies, and glossaries
- § most of name authority data (not detailed attributes)

Introduction to SKOS



SKOS Principles

- § A KOS is a group of **concepts** identified with URIs and grouped into a **concept scheme**.
- § Concept can be labeled with any number of lexical strings (**labels**) in any natural language.
- § Concepts can have one **preferred label** in any natural language and any number of **alternative labels**.
- § Concepts can be documented with **notes** of various types: scope notes, editorial notes, history notes, change notes, examples, and definitions.
- § Concepts can be grouped into **collections**, which can be labeled and/or ordered.
- § Concepts can be linked to each other using **hierarchical** and **associative** semantic **relations**.
- § Concepts of different concept schemes can be linked using four basic types of **mapping relations**.

Introduction to SKOS



SKOS Elements

Concept Scheme & Collection	Concepts	Labels & Notation	Documentation	Semantic Relations	Mapping Relations
ConceptScheme	Concept	prefLabel	scopeNote	broader	exactMatch
inScheme	hasTopConcept	altLabel	definition	narrower	closeMatch
Collection	topConceptOf	hiddenLabel	example	related	broadMatch
orderedCollection		notation	changeNote	broaderTransitive	narrowMatch
member			editorialNote	narrowerTransitive	relatedMatch
memberList			historyNote		

Machine-readable example: skos:prefLabel
Human-readable example: Preferred label

SKOS Extension for Labels (SKOS-XL) is a second part to the standard, which models labels as resources, so they can have properties (types), too.

How ISO 25964-1 Aligns and Compares with SKOS

Thesaurus Standards vs. SKOS: Terms vs. Concepts



Thesaurus standard model: Terms

- § Two types of terms:
 1. Preferred terms
 2. Nonpreferred terms
- § The preferred term is in an equivalence *relationship* with any number of nonpreferred terms.
- § Content is indexed/tagged to preferred terms only.

SKOS vocabulary model: Concepts

- § Concepts have:
 1. Preferred labels
 2. Alternative labels
- § This is not a relationship; but multiple *labels* for a single concept.
- § Content is indexed/tagged to concepts, as named by their preferred labels.

How ISO 25964-1 Aligns and Compares with SKOS

The standards align on the *meaning and usage* of features:

- § Terms = Concepts
- § Concept relationships:
 - BT / NT = Broader concept / Narrower concept
 - RT = Related concept
- § Top Term (TT) = Top Concept
- § Scope note, History note, Definition
- § Concept identifiers

These include the core features.

ISO 25964-1 has, but SKOS lacks:

- § Sub-types of hierarchical relationships
 - Generic - specific (BTG/NTG)
 - Whole - part (BTP/NTP)
 - Generic - instance (BTI/NTI)
- § Use + / UF +

SKOS has, but ISO 25964-1 lacks:

- § Collections and members (containers to organize members)
- § Hidden label (another kind of alternative label)
- § Notation, Change note, Example
- § Mapping relations to link distinct KOSs
- § Transitive super-property for inferencing: broaderTransitive and narrowerTransitive
- § SKOS-XL to designate types of preferred labels

Summary

- § Taxonomies are most similar to thesauri, and have features that are preferable for certain uses.
- § Taxonomies vary, are vaguely defined, and do not have their own dedicated standards.
- § Thesaurus standards, such as ISO 25964-1 are largely suitable for taxonomies for best practices in design.
- § Since modern information taxonomies have been created specifically for the digital environment, the data model type of standard to make KOSs machine readable, SKOS, is especially associated with taxonomies.
- § ISO 25964-1 and SKOS align where it matters in the *meaning* of taxonomy and thesaurus elements; where they do not align are in the less common features.

References

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