# The representation of Knowledge Organization Structure (KOS) data. a multiplicity of standards

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## The purpose of KOS standards

**1 Input of KOS data into programs / Transfer of data from one program to another**

1.1 Format for original input files (XML difficult for that, need a user-friendly format)

1.2 Transfer from one KOS management program to another

1.3 Transfer from a KOS management program to an information system that uses a KOS for authority control, query expansion (synonym and /or hierarchic), display/browse/search, or other purposes

1.4 Transfer from a KOS management program to a KOS use (display / browse / search / etc.) program

**2 Accessing KOS for applications. Includes querying KOS and viewing results** (for example, using Z39.50)

2.1 By people. Standardized displays would be helpful here (but have the same problems as standardizing the interfaces to search engines).

2.2 By systems to use data from internal or external KOS for many types of processing, such as inference, natural language processing, knowledge-based clustering, index construction, query term expansion etc.

**3 Identifying specific terms/concepts in specific KOS**

This requires rules for URIs that uniquely identify specific term/concept records in specific thesauri. Needs a name resolution service (such a KOS registry)

3.1 Links from one KOS to another

3.2 Indexing terms/concepts in the metadata for an object, or any other reference to a term/concept in a text/object

**4 Prescribing or giving guidance on good practices**

For some products, proper practices guarantee properties to be standardized

**Two levels of standardization**

Standards that give a general format, leaving the user(s) or user communities to develop specifics (e.g., relationship types)

Standards that give specifics, either hard-coded in the format or given separately as a name space supplementing a general standard.

(In the KOS domain there is a third level of standardization, standardizing concepts and terms and their relationships, but that is not the subject of this note.)

## Evaluation of standards

**1 Expressivity**

What kinds of statements can be made about the domain. What kind of operations and inferences do these statements support. This depends on the underlying data model.. This must be judged with respect to the requirements of the expected application.

1.1 How extensible

1.2 Expressing processing rules (e.g., for relationship types)

**2 Ease of application**

2.1 Ease of writing software

2.2 Compatibility with related standards

2.3 Ease of understanding the standard and of writing and reading specifications

2.4 Ease of writing and reading data files

2.5 Parsimony of expression

2.6 Size of data files

**3 Depth of support** (in place or anticipated)

3.1 Recognition of the body issuing the standard

3.2 Technical support available

3.3 Availability of software

3.4 Breadth of adoption

# The many forms of Knowledge Organization Systems (KOS) and their standards

**Dictionaries, glossaries**

ISO 12200:1999, Computer applications in terminology--Machine Readable Terminology Interchange Format (MARTIF)--Negotiated Interchange
ISO 12620:1999, Computer applications in terminology--Data Categories.

**Thesauri**

ISO 2788-1986(E) / ANSI/NISO Z39.19-1993(R1998) (www.niso.org)
ZThes (using Z39.50, strictly ANSI Z39.19)
http://www.loc.gov/z3950/agency/profiles/zthes-04.html)
Browser at http://muffin.indexdata.dk/zthes/tbrowse.zap
Vocabulary Markup Language (VocML) (under discussion at NKOS)
See also http://ceres.ca.gov/KOS/
ISO 5964-1985(E) (multilingual)
USMARC format for authority data
(http://lcweb.loc.gov/marc/authority/ecadhome.html)

**Topic maps** (reference works, encyclopedias) (http://www.topicmaps.org/about.html)
ISO/IEC 13250:2000 Topic Maps
XML Topic Maps (XTM) 1.0 (http://www.topicmaps.org/xtm/1.0/)

**Concept maps**

**Classification schemes**

USMARC format for classification data
http://lcweb.loc.gov/marc/classification/eccdhome.html

**Ontologies**

Knowledge Interchange Format (KIF) NCITS.T2/98-004
(http://meta2.stanford.edu/kif/dpans.html)
Ontology Markup Language (OML) /
Conceptual Knowledge Markup Language (CKML)
(http://www.ontologos.org/OML/CKML-Grammar.html)
Ontology Interface Layer (OIL) (http://www.ontoknowledge.org/oil/)

**Generic standards for knowledge structures, entity-relationship models**

Resource Description Framework (RDF) (http://www.w3.org/RDF/)
Metadata Coalition. Open Information Model (OIM). Knowledge Management Model (http://www.mdcinfo.com/OIM/)
XTM might also fit here

**ISO terminology-related standards** (two repeated)

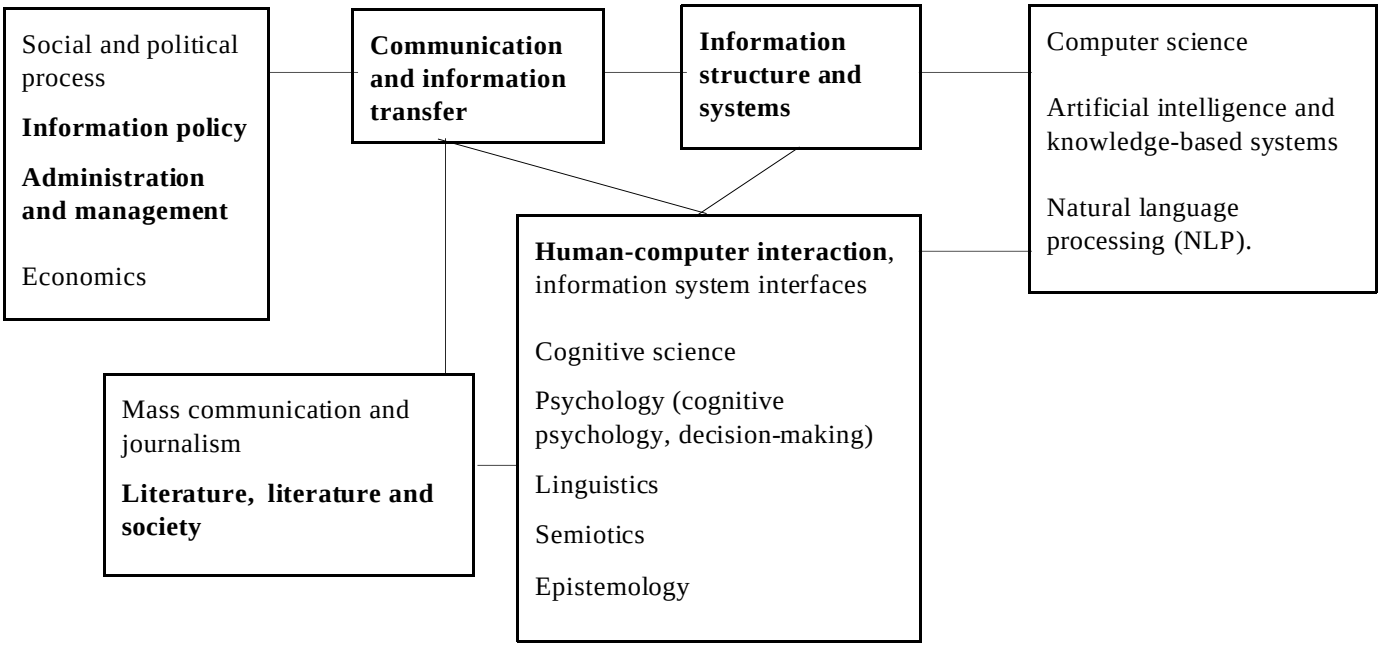
| | |
|---|---|
| ISO 639:1988 | Code for the representation of names of languages |
| ISO 639-2:1998 | Code for the representation of names of languages - Part 2: Alpha-3 code |
| ISO 704:2000 | Principles and methods of terminology |
| ISO 860:1996 | Terminology work - Harmonization of concepts and terms |
| ISO 1087-1:2000 | Terminology - Vocabulary |
| ISO 1087-2:2000 | Terminology work - Vocabulary - Part 2: Computer applications |
| ISO 1951:1997 | Lexicographical symbols particularly for use in classified defining vocabularies |
| ISO 6156:1987 | Magnetic tape exchange format for terminological/lexicographical records (MATER) |
| ISO 10241:1992 | Preparation and layout of international terminology standards |
| ISO 12199:2000(E) | Alphabetical ordering of multilingual terminological and lexicographical data represented in the Latin alphabet |
| ISO 12200:1999 | Computer applications in terminology - Machine-readable terminology interchange format (MARTIF) - Negotiated interchange |
| ISO/TR 12618:1994 | Computer aids in terminology - Creation and use of terminological databases and text corpora |
| ISO 12620:1999 | Computer applications in terminology - Data categories |

Standards in preparation:

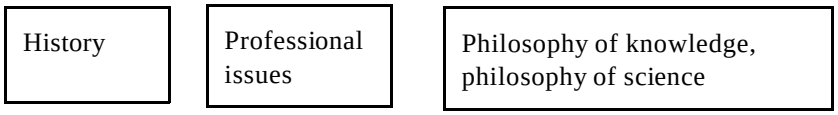
| | |
|---|---|
| ISO/DIS 639-1 | Code for the representation of names of languages – Part 1: Alpha-2 code (Rev. of ISO 639) |
| ISO/PWI 12200-Amd 1 | Computer applications in terminology - Machine-readable terminology interchange format (MARTIF) - Amendment 1: Extended MARTIF (including a normative Annex H to ISO 12200) |
| ISO/CD 12615 | Bibliographic references for terminology work |
| ISO/DIS 12616.2 | Translation-oriented terminography |
| ISO/AWI 12618 | Computer applications in terminology - Design, implementation and use of terminology management systems (Rev. of ISO/TR 12618) |
| ISO/FDIS 15188 | Project management guidelines for terminology standardization |
| ISO/CD 16503 | Computer applications in terminology - Representation format for terminological data collections - MARTIF-compatible with specified constraints (MSC) |
| ISO/CD 16642 | Computer applications in terminology - Meta model for representing terminological data collections |
| ISO/CD 17241 | Computer applications in terminology - Generic model (GENETER) for SGML-based representations of terminological data |

# Domains in and around information studies (bold = faculty strength)

## Disciplinary domains




**Overarching domains** (connected to everything)




## Context domains

- Librarianship;
- **Digital libraries**;
- **Archives and records management**;
- Information and knowledge management;
- **Information and learning, children's and young adult's information, children's and young adult's literature**;
- **School library media**;
- Health information, medical informatics.

# A concept map example

# Specific KOS data that must be represented

## Overall data structure

Consider **three levels**: Term variants (strings), terms, concepts

**Term variants (strings)**

AST, aspartate aminotransferase, GOT, glutamate oxaloacetate transamaninase

Give information about term variants

Term variants can be related to each other, e.g, a term variant may have a sort form.

**Terms**

Term = a group of variants of the same term, represented by a preferred member of the group

aspartate aminotransferase, glutamate oxaloacetate transamaninase

Give information about the term (some of this inherits to all term variants)

Link term variants to terms (AC = ACronym)

| | |
|---|---|
| aspartate aminotransferase | AC AST |
| glutamate oxaloacetate transamaninase | AC GOT |

Other frequent relationship SP Spelling Variant

May give meaning-based relationships among terms; alternatively, see concepts.

**Concepts**

Concepts can be established independently from any terms. Can also establish concepts as groups of terms with the same meaning and represent them by a preferred term; all other terms are considered non-preferred synonyms:

aspartate aminotransferase
ST glutamate oxaloacetate transamaninase

Give information about concepts and relate concepts to concepts

aspartate aminotransferase
BT aminotransferases

Often a much simpler structure is used, linking term variants directly to concepts through ST. Even simpler systems employ USE instead, restricting its range to concepts that have been declared descriptors (jumping over any narrower concepts that might exist).

Groups of terms or concepts might also be unit, including fixed graphs of concept relationships

**Data elements**

At each level, there are many, many pieces of information that are required by one application or another. Standards need to accommodate these pieces of information. Any of these pieces of information can be represented as relationships (as in RDF) or as data fields.

Administrative data: Source tracking for each piece of information, history of changes / audit trail.

Schema data, for example, hierarchy of relationship types.

**Information on arrangement / display**

KOS to be used by people should convey meaning. Thus information about the sequence of concepts in a linear display or the placement of concepts in a concept map becomes important.

# Elements of an XML KOS data specification

This scheme illustrates some types of data needed in a sophisticated KOS management system but is by no means complete. It is parsimonious yet allows the recording of many types of data. It gives enough information to derive a full XML specification.

This spec assumes that data from each source are grouped, so that source attribution is not needed for each element; otherwise the structure would be much more complex. This works for a communications format but not for an internal database format.

The term itself is indicated in a relationship of type TERM. This allows for terms in multiple languages for the same concept and simplifies the schema since elements in *term* would be the same as in *relationship target*.

The *scope* element was inspired by the Topic Map Standard ( http://www.topicmaps.org/xtm/1.0/)

The scheme needs a method for indicating a relationship set defined elsewhere and used within the source or for defining a relationship set for the source.

Default is minOccurs="1" maxOccurs="1"

Source (minOccurs="0" maxOccurs="unbounded")
- Pointer to or definition of relationship set used
- Unit: Concept or term or group of terms (minOccurs="0" maxOccurs="unbounded")
  - Unique identifier
  - Hierarchy position (minOccurs="0" maxOccurs="unbounded")
    - Hierarchical level
    - Class number / notation
    - Scope for which this concept/term holds (minOccurs="0" maxOccurs="unbounded")
  - Relationship (minOccurs="0" maxOccurs="unbounded")
    - Relationship type
    - Relationship target
      - /* See below for structure. */
    - Relationship strength (minOccurs="0" maxOccurs="1")
    - Audience level /* Of this relationship */ (minOccurs="0" maxOccurs="unbounded")
    - Perspective /* Of this relationship */ (minOccurs="0" maxOccurs="unbounded")
    - Scope for which this relationship holds (minOccurs="0" maxOccurs="unbounded")
    - Relationship, added information (minOccurs="0" maxOccurs="unbounded")
      - /* This could be a scope note explaining the relationship, an image illustrating the relationship, another term, etc. */
      - Type of added information /* Relationship types might be reused here. */
      - Relationship target
      - Audience level /* Of this piece of info. */ (minOccurs="0" maxOcc="unbounded")
      - Perspective /* Of this piece of information */ (minOccurs="0" maxOcc="unbounded")

Where relationship target has this structure (unifying term, text, images, multimedia document)

Relationship target
Type
/* Includes types of terms (descriptor, other preferred term, non-preferred term and types of texts and other documents, may be an elaborate hierarchy. */
Target value (a term or a document)
Term
Term variant (minOccurs="0" maxOccurs="unbounded")
Type of variant
/* Such as Preferred Spelling, other SPelling, ABbreviation, Full Term. */
Term form (complete term or Stem plus suffix)
Complete term
Stem plus suffix
Stem
Suffix
Document
Language (zero to many, exactly one for terms)
Audience level /* Of this rel.ship target */ (minOccurs="0" maxOccurs="unbounded")
Perspective /* Of this relationship target */ (minOccurs="0" maxOccurs="unbounded")
Scope for which this/term holds (minOccurs="0" maxOccurs="unbounded")

## A taste of ISO 12620

From Translation Research Group www.ttt.org, Last updated: January 27, 2001

**CLS Framework: ISO 12620 data categories section 05**

**Menu of data classes**
| (1) Terms | (2) Term-Related Data Categories | (3) Equivalence | (4) Subject Field |
| (5) Concept Related Description | (6) Concept Relation | (7) Conceptual Structures | (8) Note |
| (9) Documentary Language | (10) Terminology Management |

**Section 5: Concept related description**

Description: Any kind of explanatory material used to elucidate a concept.

Blind MARTIF Representation: <descrip type=X>...</descrip> **or**
Blind MARTIF Representation: <ptr type=X target=Y/>, where Y is the refid of a<refObject type=binaryData>, which as noted above, can contain embedded binary data (in hex) or a URL, and X is one of the following:

**5.1 definition**

Description: A statement that describes a concept and permits its differentiation from other concepts within a system of concepts.

Blind MARTIF Representation: <descrip type=definition>content unrestricted</descrip>

**5.2 explanation**

Description: A statement that describes and clarifies a concept and makes it understandable, but does not necessarily differentiate it from other concepts.

Example: Explanation of catalyst: <chemistry> material that triggers or accelerates a chemical reaction

**5.3 context**

Description: A text or part of a text in which a term occurs.

Note 2: Contexts are documented very frequently in descriptive and translation-oriented terminology work. Some databases use "example" for contextual references. Such data categories should be converted to the data category "context" for interchange purposes.

In addition to providing information about concepts, contexts provide text-typological information valuable for determining term usage and collocational references. Consequently some databases classify context as a term-related data category.

**5.4 example**

Description: Descriptive material that provides a sample of the entity defined in the entry.

### 5.5 nontextual illustrations

#### 5.5.1 figure

Description: A diagram, picture, or other graphic material used to illustrate a concept or group of concepts.

#### 5.5.2 audio

Description: Sound, spoken words, music, or other audible representation used to illustrate or explain terms or concepts. Example: A recording of the pronunciation of a term

#### 5.5.3 video

Description: Recorded visual images used to represent or illustrate terminological information.

Example: Video images can be used to illustrate a concept, a process, a test method, etc.

#### 5.5.4 table

Description: An array of data arranged in columns and rows used in documenting, explaining, or describing a concept within a terminology collection.

#### 5.5.5 other binary data

Description: Any foreign data not covered by the previous categories.

Example: Spreadsheets, virtual reality files, flight simulations, and the like.

### 5.6 unit

Description: A relationship between a reference value as defined by an authoritative body; a quantity measured. Example: force is measured in newtons; length in millimetres; weight grams

Note: There is only one unit for each quantity in SI. The unit used to measure a quantity can be extraordinarily valuable in a terminology collection. In some cases, it can represent a major characteristic for determining the precise identity of a referenced concept, especially if polysemy or lack of precision creates ambiguity in a text.

### 5.7 range

Description: The relationship between a set of limits within which a quantity is measured, as expressed by stating the lower and upper range values.

example: 0 - 100 ˚C = liquid state of water

Note: Range, like unit, can be a critical delimiting characteristic in defining a concept, particularly in materials databases.

### 5.8 characteristic

Description: A mental representation of a property of an object serving to form and delimit its concept. Example: compressibility (gas); flammability (fuel); liquidity (financial assets)

**Appendix B. The Zthes Abstract Model in XML**
(from http://www.loc.gov/z3950/agency/profiles/zthes-04.html)

**Appendix B.1. The Zthes DTD for XML**

This DTD was supplied by Thomas Place. It is put forward not as a ``good" XML representation of Thesaurus information (whatever that might be construed to mean) but as a pragmatically valuable alternative encoding of the Zthes abstract record. Real Zthes data sets have been exchanged in the form of XML documents conforming to this DTD.

```
<!-- Zthes DTD
    Based on Z39.50 Profile for Thesaurus Navigation, version 0.1 (20 Feb 1999)
    Version of DTD: 25 Feb 1999 -->

<!-- #PCDATA: parseable character data = text
    occurrence indicators (default: required, not repeatable):
    ?: zero or one occurrence (optional)
    *: zero or more occurrences (optional, repeatable)
    +: one or more occurrences (required, repeatable)
    |: choice, one or the other, but not both
 -->

<!ENTITY % term "termId, termName, termQualifier?,  termType?, termLanguage?">
<!ENTITY % admin "termCreatedDate?, termCreatedBy?, termModifiedDate?,
termModifiedBy?">

<!ELEMENT Zthes (%term;, termNote?,  %admin;,relation*)>

<!ELEMENT relation (relationType, sourceDb?, %term;)>

<!ELEMENT termId              (#PCDATA)>
<!ELEMENT termName            (#PCDATA)>
<!ELEMENT termQualifier       (#PCDATA)>
<!ELEMENT termType            (#PCDATA)>
<!ELEMENT termLanguage        (#PCDATA)>
<!ELEMENT termNote            (#PCDATA)>
<!ELEMENT termCreatedDate     (#PCDATA)>
<!ELEMENT termCreatedBy       (#PCDATA)>
<!ELEMENT termModifiedDate        (#PCDATA)>
<!ELEMENT termModifiedBy      (#PCDATA)>
<!ELEMENT relationType        (#PCDATA)>
<!ELEMENT sourceDb            (#PCDATA)>
```

(This appendix should include a crosswalk with any pre-existing Thesaurus DTDs if appropriate.)

**Appendix B.2. Sample Zthes-in-XML Document**
This document was supplied by Thomas Place.

```
<?XML version="1.0" ?>
<!DOCTYPE Zthes SYSTEM "zthes.dtd">
<Zthes>
    <termId>102067</termId>
    <termName>video art</termName>
    <termType>PT</termType>
    <termNote>
        Use for works of art that employ video technology, especially videotapes. For the study
        and practice of the art of producing such works, use "video."
    </termNote>
    <relation>
        <relationType>UF</relationType>
        <termId>102067/001</termId>
        <termName>art, video</termName>
        <termType>ND</termType>
    </relation>
    <relation>
        <relationType>BT</relationType>
        <termId>185191</termId>
        <termName>[time-based works]</termName>
        <termType>NL</termType>
    </relation>
    <relation>
        <relationType>RT</relationType>
        <termId>54153</termId>
        <termName>video</termName>
        <termType>PT</termType>
    </relation>
    <relation>
        <relationType>RT</relationType>
        <termId>253827</termId>
        <termName>video artists</termName>
        <termType>PT</termType>
    </relation>
</Zthes>
```