Interoperability of knowledge organization systems with and through ontologies

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In terms of establishing interoperability one may distinguish...

*Data modeling ontologies* (e.g. SKOS)

Instrument *for* establishing interoperability

*Reality representation ontologies* (some biomed. Ontologies are on the way to such)

Subject *of* establishing interoperability with other KOS

Method for reengineering and improving existing KOS
Data modeling ontologies

• An “explicit specification of a conceptualization” (Gruber 1993)
• “interface specification”, “language for communicating with the agent”, “Data modeling representation at a level of abstraction above specific database designs” (Gruber 2009)
• Semantic data models / conceptual schema (Peckham & Maryanski 1988)
Data modeling ontologies

• Formalism
• No specific method
• SKOS specification (W3C 2009b)
  = ontology for thesauri and other KOS
• “Data can be exported, translated, queried, and unified across independently developed systems and services.” (Gruber 2009)
Data modeling ontologies

• Problem when combining ontologies

  Person \(\text{is-a}\) (Event) organization committee member \(\text{is-a}\) Doctor

• Also maintenance and reasoning problem
Reality representation ontologies

• Necessity of *modeling method*
  – OntoClean (Guarino & C. A. Welty 2009)
  – “Ontological realism” (Smith & Ceusters 2010)
  – Fundamental ontological principles (Jansen 2009)

• Describes entities based on their intrinsic (intensional) properties (Guarino et al. 2009)
Semantic Web standards

• OWL has two (model-theoretic) semantics
  – RDF
    • everything is a resource ... triples / graphs all over
    • custom reasoning algorithms necessary
    • matches nature of data modeling ontologies
  – OWL-DL
    • strict separation of individuals and classes
    • strong reasoning support (various profiles)
    • more adequate (yet still limited expressivity)
      for reality representation ontologies

• Standards do not address method or
terminological control
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Data modeling ontologies for establishing interoperability

- Interoperability in the sense of an enabling infrastructure... Ontology?
Reengineering KOS using (reality representation) ontological methods

• Central:
  – Individuals representing particulars/objects
  – Classes (universals) abstracting objects *intensionally*

• Expression more domain knowledge than in KOS, e.g. properties

• Way hierarchy is applied
  – Precise semantics of is-a, part-of
  – Methods such as OntoClean (Guarino)

• Relation to classification method unclear
Difference classifications vs. reality representation ontologies

0  Common auxiliaries of general characteristics
03  Common auxiliaries of **materials**
032  Naturally occurring mineral materials
033  Manufactured mineral-based materials
034  Metals  **Ambiguous**
035  Materials of **mainly** organic origin  **Overlap**
036  Macromolecular materials. Rubbers and plastics
039  **Other materials**  **Not intensionally definable**
Refining relationships (in thesauri)?

• Birds *associated with* Ornithology
  a bird *is subject in* an ornithology

→ Change of structure *and* content
Reengineering KOS using (reality representation) ontological methods

• Pros
  – Logical structure
  – Permit reasoning
  – Improved search expansion
  – Easier to maintain

• Cons
  – Initial effort
Interoperability between reality representation ontologies and KOS

• Do *complex* domain ontologies exist?
  – Generally reengineered KOS
  – Efforts particularly in the biomedical domain
    (e.g. Gene Ontology, NCI thesaurus)

• Still many uncertainties:
  – Method
  – Quality
  – Purpose
  – Definition
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