The role of ontology in data sharing within a multi-disciplinary context - An example from energy resources management domain

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Introduction

- Existing initiatives within SDI (GMES, GEOSS, SEIS,...) aim at information sharing
- Main challenges:
  - Develop standards and specifications to assure technical interoperability
  - Terminology and cognitive interoperability problems prevent development of fully operative and transferable information systems
- Aims:
  - Stress the role of ontology in maximizing the overall use of the spatial information within energy resources management domain
  - Enhancement of geographic information discovery in Catalogue Services
Information sharing within multi-disciplinary context

- Huge SDIs currently being built
  
  Example:
  - EnerGEO: European contribution to GEOSS
  
  Goals:
  - develop a strategy for a global assessment of the current and future impact of the exploitation of energy resources on the environment and ecosystems
  - demonstrate this strategy for a variety of energy resources worldwide.
  - provide resources in order to generate domain specific knowledge by integrating resources into the common architecture.

- Status:
  - Heterogeneous user communities
  - Different perspectives upon the same reality
Geoportals: The need for new discovery mechanisms

- Current search in geoportals:
  - Query title, abstract, keywords etc.
  - Applying spatial and temporal filters
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- Causes semantic heterogeneity problems
  - Keywords are restricted by ambiguities of natural languages (Athanasis, 2008)
  - Communities have various perspectives on the same domain
  - Use of different terminology

→ Users cannot discover all relevant information sources
- Problems of low recall & low precision
Semantic Heterogeneity

- Naming heterogeneity: synonyms, multilinguality
- Cognitive heterogeneity: different meanings of concepts
The role of ontology in mitigating semantic heterogeneity problems

Ontology:
“formal, explicit specification of a shared conceptualization” (Gruber, 1993)

Ontology Engineering - Example: Biomass

- Semi-automatic extraction of relevant terms for energy domain
  - Text Mining (QDA Miner)
Ontology Engineering - Example: Biomass

- Semi-automatic extraction of relevant terms for energy domain
  - Text Mining (QDA Miner)
- Enhancement of results by using existing standardization efforts
  - acquire concept’s names from existing classification/Thesaurus/Taxonomies (e.g. Agrovoc, EuroVoc)
  - many concepts were taken from INSPIRE GEMET Thesaurus
Ontology Engineering - Example: Biomass

- Protegé Ontology Editor
  - Supports OWL
    - markup language with logical formalism
  - Consistency check of ontology by available logic Reasoners (e.g. FaCT++)
Ontology Engineering - Example: Biomass

- Alignment to top-level ontology (SWEET) in order to enable transferability (e.g. `humanactivities.owl`)

- SWEET:
  - group of top-level ontologies designed to be extended by experts in Earth Science
  - modular design
  - extensible
  - scalable
Ontology Engineering - Example: Biomass
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- **Equivalent classes:**
  - renewableEnergy class is equivalent with nonConventionalEnergy class

- **Necessary condition:**
  - existential restriction *some*: not only renewable energy contributes to the existing heat demand, but also other energy sources

- **Necessary and sufficient condition:**
  - universal restriction *only*: users searching for sustainability will discover only renewable energy datasets
Outlook/Future work

- Challenge → domain expertise
- Multilinguality
- Ontology extension (adding new concepts)

- integrate the ontology into EnerGEO Geoportal searching capabilities
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Biomass Example

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