Evaluating PSI Ontologies by Mapping to the Common Sense

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May 24, 2007, Kharkiv, Ukraine
Outline

• Evaluation of ontologies
  – Why, What and How-To?

• Performance Simulation Initiative (PSI)
  – PSI Ontologies Suite, reasons for evaluation of PSI ontologies

• Common Sense as a “golden standard”
  – What is Common Sense
  – Sources

• Evaluation results
  – PSI Meta
  – Mapping to upper level ontologies
  – Good mappings = close to common sense?

• Conclusions and Outlook
Evaluation of Ontologies: Why?

• Ontology - shared and agreed specification of conceptualization [Gruber 1993]

• Ontology – is a semiotic object [Gangemi et al, 2005]
  It reflects the subjective views of its creators (knowledge engineers, domain experts etc)

• There may be different ontologies for the same body of knowledge
Evaluation of Ontologies: Why?

Making *swing*: strengthened wooden board, reliable ropes
Evaluation of Ontologies: Why?

Making swing: strengthened wooden board, reliable ropes

Ambiguity in terms ...

...wrong (and costly) solutions
Evaluation of PSI Ontologies by Mapping to the Common Sense

Evaluation Dimensions

1. Conceptual modeling
2. Usage of representation languages
3. Suitability of the model w.r.t. a domain and use cases
4. Suitability of the implemented model w.r.t. a domain and use cases
5. Ontology engineering process
Evaluation of Ontologies: How to?

- **Logical evaluation**
  - Logical correctness of an ontology as a formal theory
- **Human expert evaluation**
  - Set of predefined criteria, domain standards, requirements
- **Data-driven evaluation**
  - Tagging of domain documents
- **Application-driven evaluation**
  - Plug the ontology into an application and evaluate results
- **“Golden Standard”**
  - Standard ontology required => well established domains
- **Set of metrics**
  - Structural, functional metrics, usability
Performance Simulation Initiative (PSI)

- Internal Initiative of Cadence Design Systems, GmbH
- Research and Development in Engineering Design Performance Assessment and Management
- A horizontal framework for R&D cooperation
  - E.g., PRODUKTIV+ project (German Federal Ministry of Education and Research)
- Current PSI partners:
  - VCAD, Cadence Design Systems, GmbH
  - Dept of Cybernetics and Gerstner Lab, Czech Technical Uni
  - CERTICON Corp.
  - Intelligent Systems Research Group, Zaporozhye National Uni
- ZNU does knowledge modeling and management
PSI Ontologies Suite v.1.6
PSI Ontologies Suite v.1.6

The high-level structure of the PSI and PRODUKTIV+ Ontologies Suite. White packages represent the Core. Colored packages are the Extensions.
PSI Ontologies: Evaluation Dimensions

1. Conceptual modeling
2. Usage of representation languages
3. Suitability of the model w.r.t. a domain and use cases
4. Suitability of the implemented model w.r.t. a domain and use cases
5. Ontology engineering process
Evaluation of PSI Ontologies: How to?

- **Logical evaluation**
  - Logical correctness of an ontology as a formal theory => *Use it*

- **Human expert evaluation**
  - Set of domain standards, requirements =>
    - no established standards => *No*

- **Data-driven evaluation**
  - Tagging of domain documents => documents are unstructured => *No*

- **Application-driven evaluation**
  - Plug the ontology into an application and evaluate results =>
    - => no applications yet => *No*

- **“Golden Standard”**
  - Standard ontology required => *Use Common Sense*

- **Set of metrics**
  - Structural, functional metrics, usability => *May Be in Future*
Common Sense

- Scientific theories do not emerge in vacuum
- There is some background knowledge = common sense
- Scientists are aware of and may (not) use common sense in their theory
- Formalized (long way, but…) Common Sense:
  - OpenCYC, SUMO, DOLCE, BFO, OCRHE,… but not so much
- Drawbacks are:
  - High level of abstraction in formalized common sense
Evaluation w.r.t. Common Sense

- Use Upper Level Ontologies from different sources:
  - Suggested Upper Merged Ontology (SUMO)
  - WordNet
  - Descriptive Ontology for Linguistic and Cognitive Engineering (DOLCE)
  - Basic Formal Ontology (BFO)
  - Object-Centered High-Level Reference Ontology (OCHRE)
- Map independently
  - Only to DOLCE
  - Via WordNet to SUMO
- Find upward cotopies first
- Compare results
Evaluation of PSI Ontologies Suite w.r.t. Common Sense

• Construction of PSI-Meta ontology – upward cotopies of domain concepts

• E.g.:

DesignArtifact's upward cotopies are
Scenario 1: Mapping to SUMO via WordNet

- **WordNet** – provides almost all PSI concepts with their natural language semantics

- **SUMO** – concepts and instances in one semantic network – has benefited from harmonization with WordNet
Scenario 2: Mapping to DOLCE

- **DOLCE** – provides **formal** hierarchy of upper-level concepts

- Does not use WordNet, instead WordNet is "sweetened" with DOLCE
Evaluation Results

• **Quality of mappings** to WordNet+SUMO and to DOLCE is not the same:
  – WordNet+SUMO is good in Processes, various Parameters
  – DOLCE is good in Abilities/Beliefs of Actor, in Tasks, in Descriptions

• **WordNet** helps to resolve ambiguous concept names
  – Manual work

• Good mappings are for PSI Task, Actor, DesignArtifact ontologies => real common sense orientation

• Average quality mapping of Negotiation Process => underdevelopment of upper-level ontologies
Concluding Remarks

• Evaluation of ontologies
  – Is must-have for many real-world intelligent applications

• Evaluation of ontologies for any domain
  – Is hard, often manual, process

• Evaluation of ontologies for a new domain
  – May be checked against the Common Sense as a “golden standard”

• Results of evaluation
  – May influence both “golden standard” and domain ontology
Future Work

• Evaluation of PSI Ontologies Suite against all evaluation dimensions

• Refining of PSI Ontologies Suite

• Presentation of PSI Ontologies Suite for shared use
Evaluation of PSI Ontologies by Mapping to the Common Sense

Resources:
PSI: http://ermolayev.com/ISRG/ISRG-projects-PSI.htm

Questions please