INVENTIVE

Evaluating PSI Ontologies by Mapping to the Common Sense

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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

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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
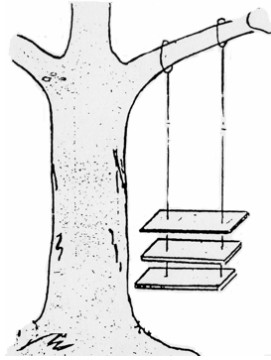
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Evaluation of Ontologies: Why?

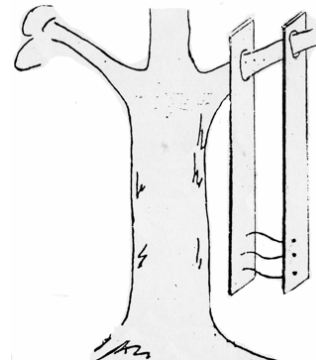Making swing: strengthened wooden board, reliable ropes
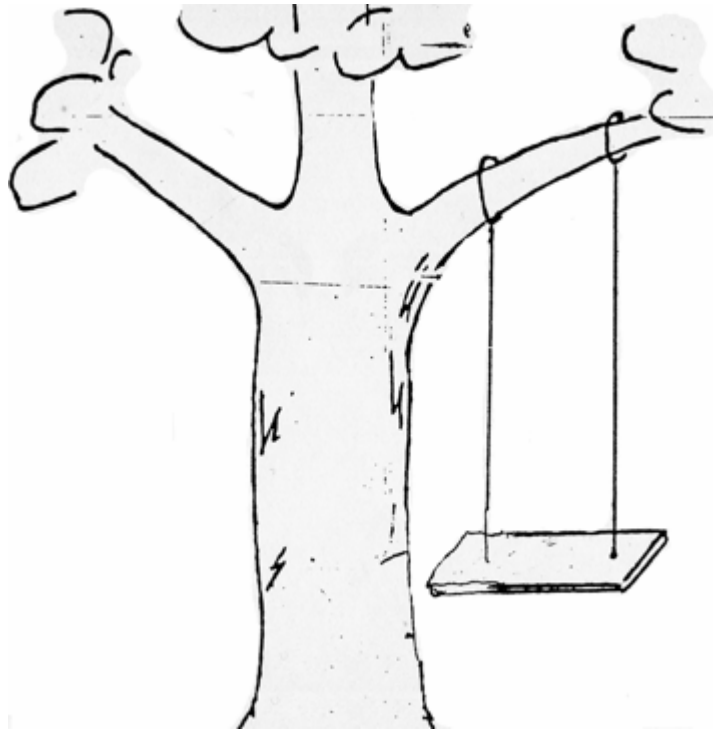
Evaluation of Ontologies: Why?
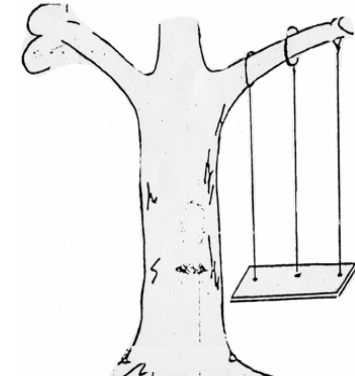
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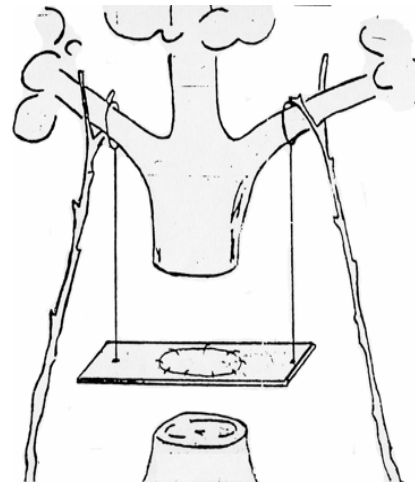
Ambiguity in terms …

"strengthen"
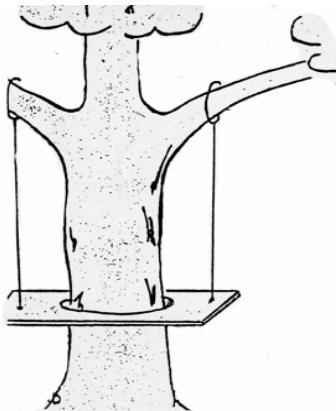

"reliable" 1
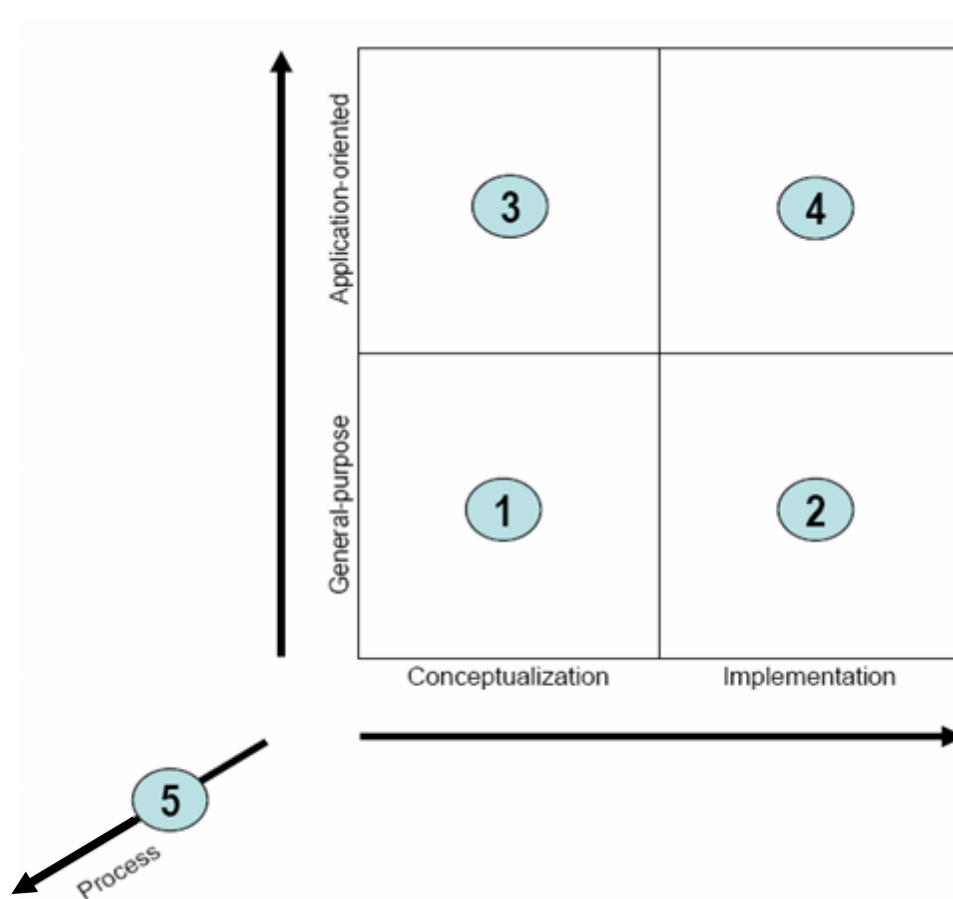

"reliable" 2

…wrong (and costly) solutions

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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
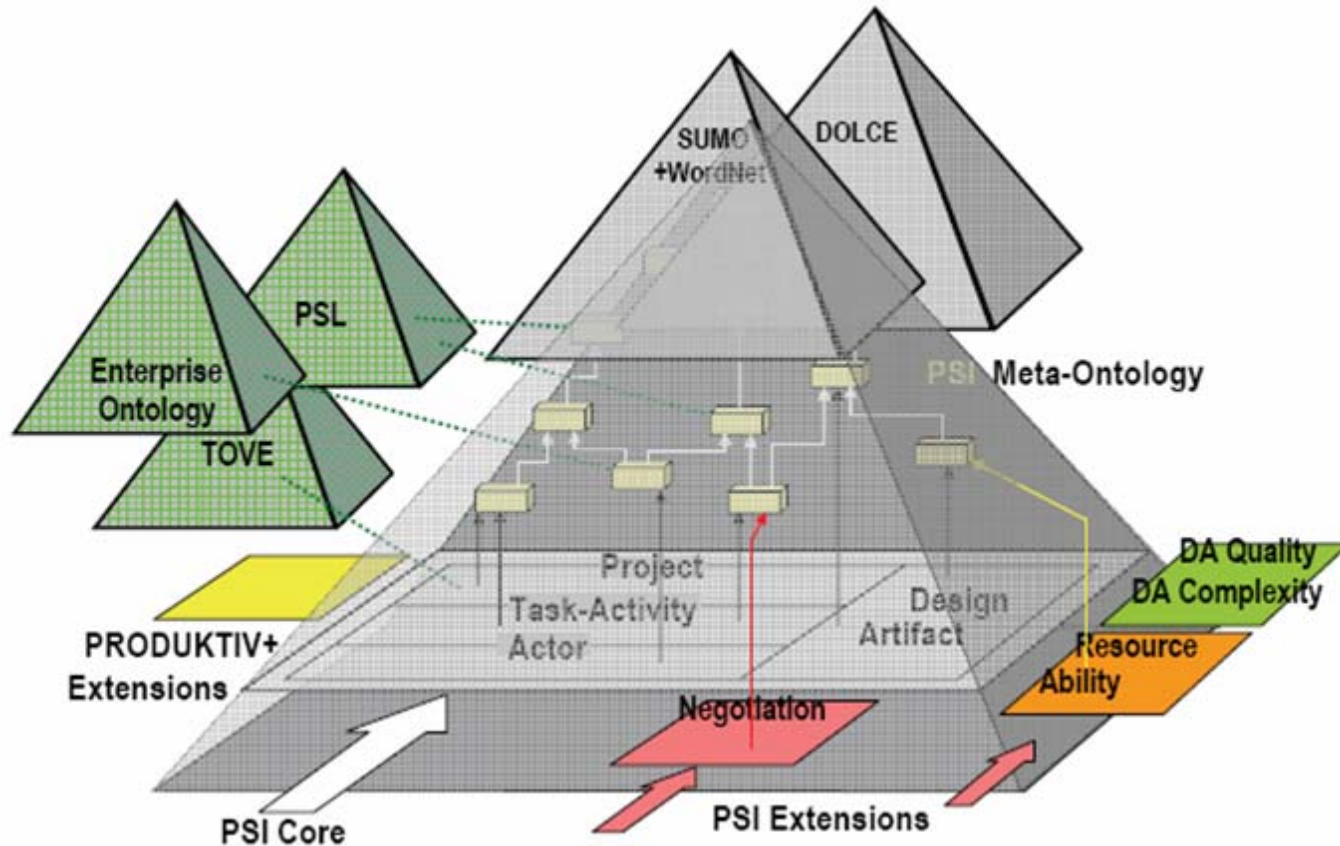
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Evaluation of Ontologies: How to?

- ## 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

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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

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PSI Ontologies Suite v.1.6

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PSI Ontologies Suite v.1.6
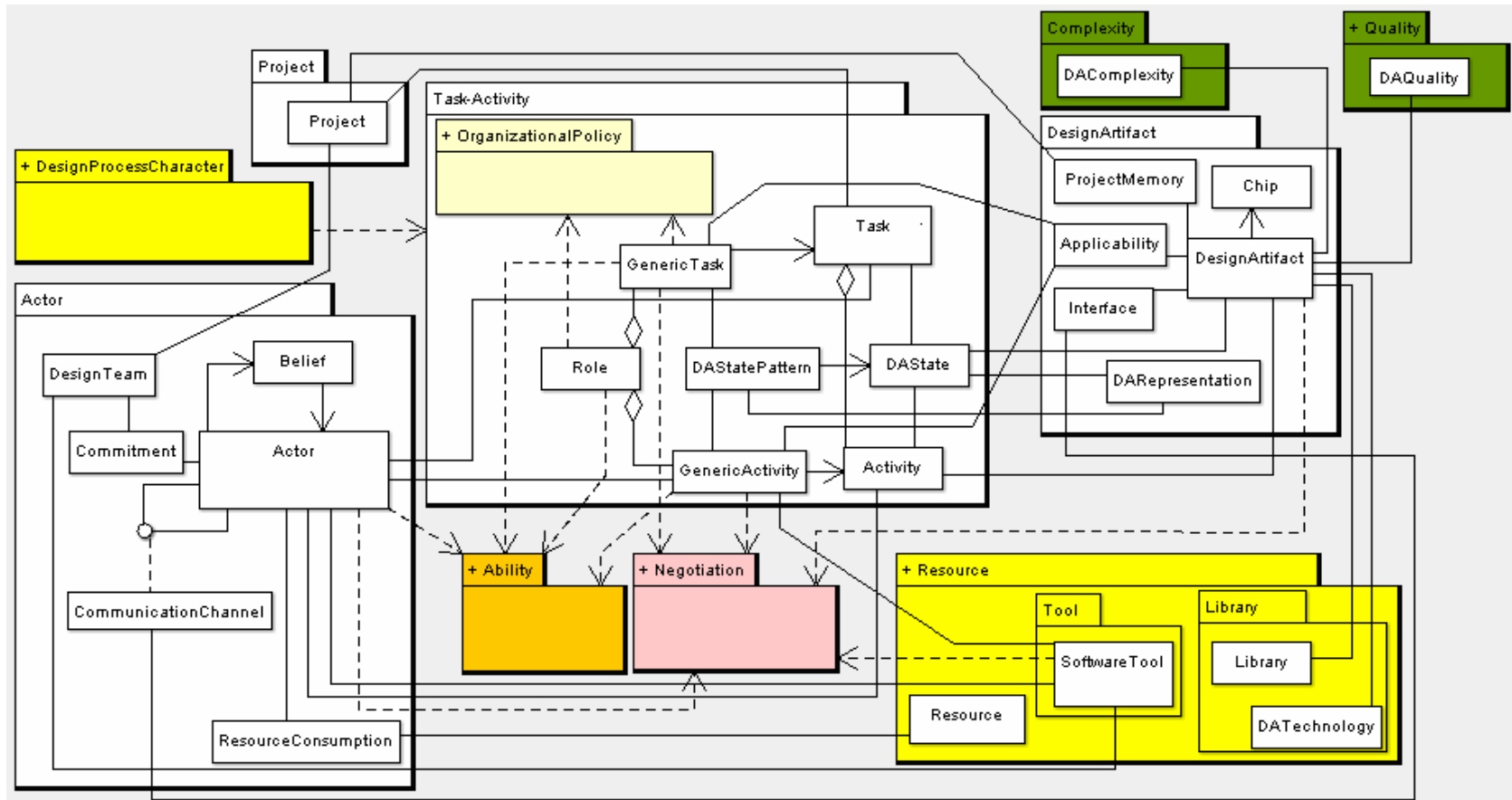
The high-level structure of the PSI and PRODUKTIV+ Ontologies Suite. White packages represent the Core. Colored packages are the Extensions

PSI Ontologies: Evaluation Dimensions
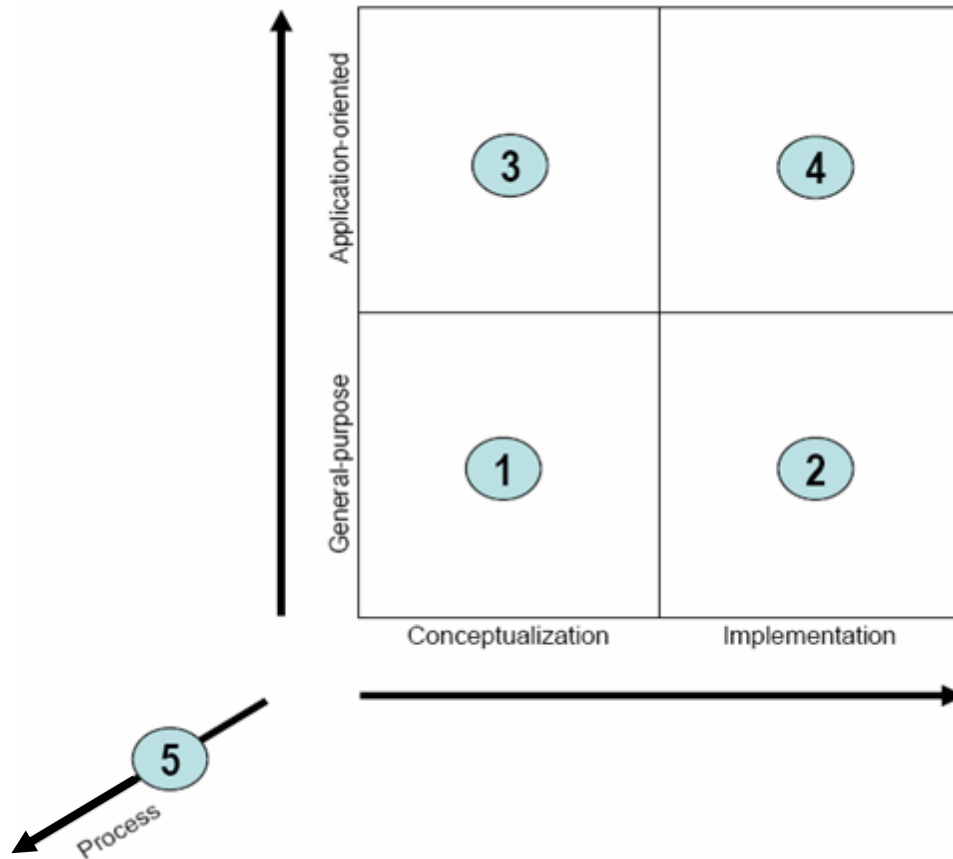
1 Conceptual modeling

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

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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**

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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

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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

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Evaluation of PSI Ontologies Suite w.r.t. Common Sense

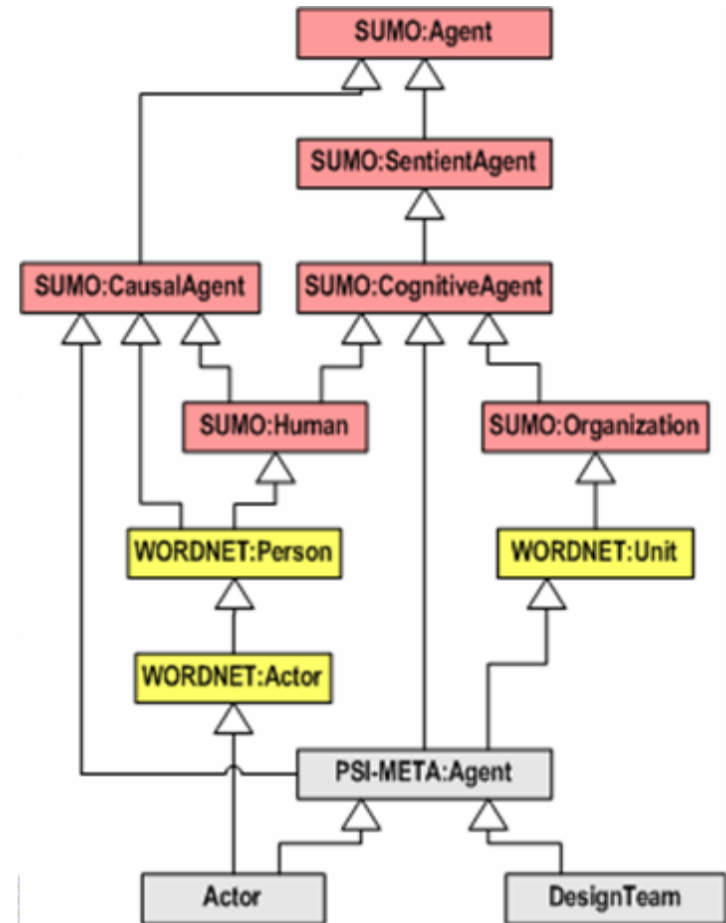- Construction of PSI-Meta ontology – upward cotopies of domain concepts

- E.g.:

  DesignArtifact's
  upward cotopies are

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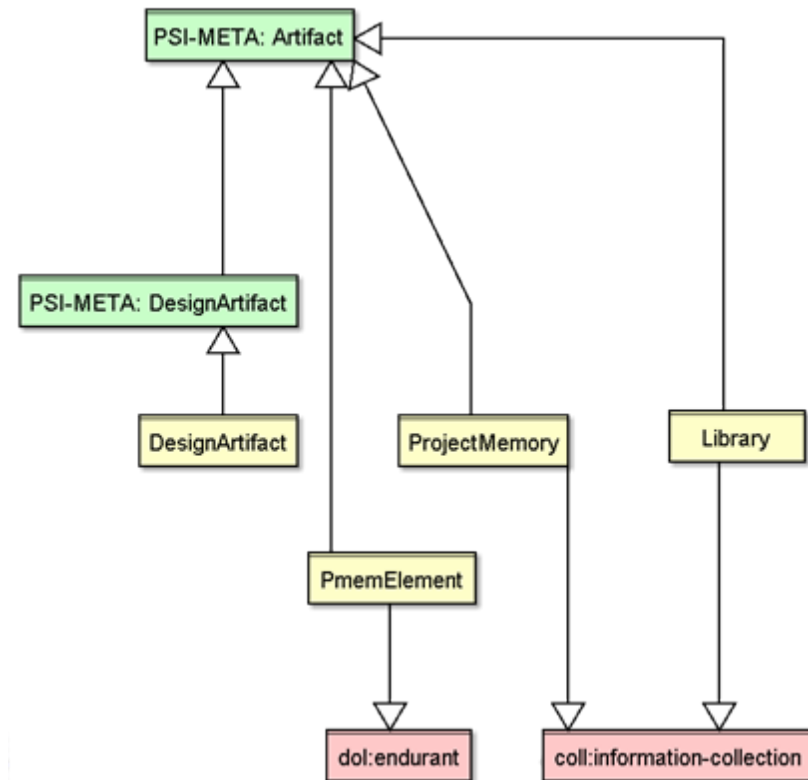
# Scenario 1: Mapping to SUMO via WordNet

- **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

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Scenario 2: Mapping to DOLCE

- DOLCE – provides formal hierarchy of upper-level concepts

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

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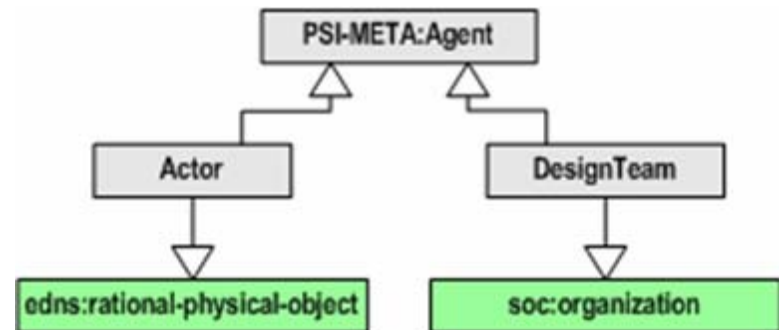
Evaluation Results

- 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

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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

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Future Work

- Evaluation of PSI Ontologies Suite against all evaluation dimensions

- Refining of PSI Ontologies Suite

- Presentation of PSI Ontologies Suite for shared use

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Resources:
PSI: http://ermolayev.com/ISRG/ISRG-projects-PSI.htm
E-paper: http://ermolayev.com/eva_personal/PS/PSI-ISTA-07_CR.pdf
This presentation: http://ermolayev.com/eva_personal/PS/ISTA-2007-PSI-to-CommonSense.pdf

Questions please

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