

# Evaluating PSI Ontologies by Mapping to the Common Sense

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# Outline

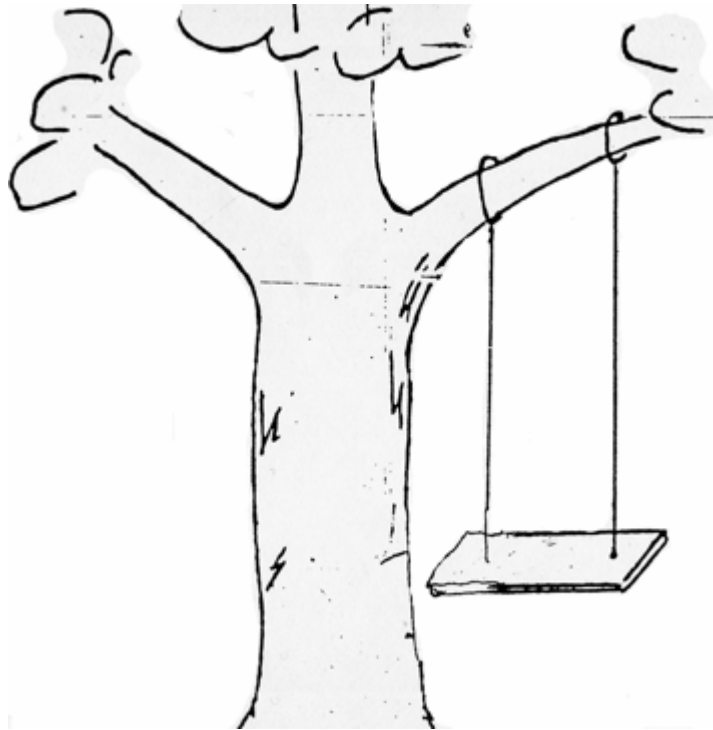
- Evaluation of ontologies
  - Why, What and How-To?
- Performance Simulation Initiative (PSI)
  - PSI Ontologies Suite, reasons for evaluation of PSI ontologies
- Common Sense as a “golden standard”
  - What is Common Sense
  - Sources
- Evaluation results
  - PSI Meta
  - Mapping to upper level ontologies
  - Good mappings = close to common sense?
- Conclusions and Outlook

# 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?

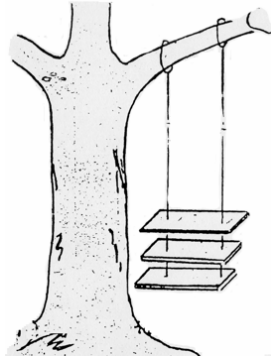
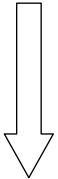
Making **swing**: strengthened wooden board, reliable ropes



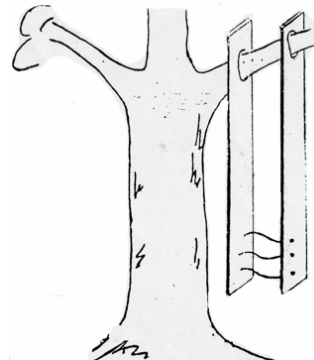
# Evaluation of Ontologies: Why?

Making swing: strengthened wooden board, reliable ropes

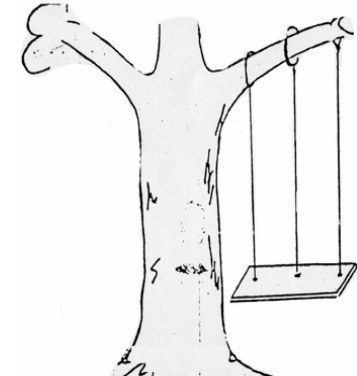
Ambiguity  
in terms ...



"strengthen"

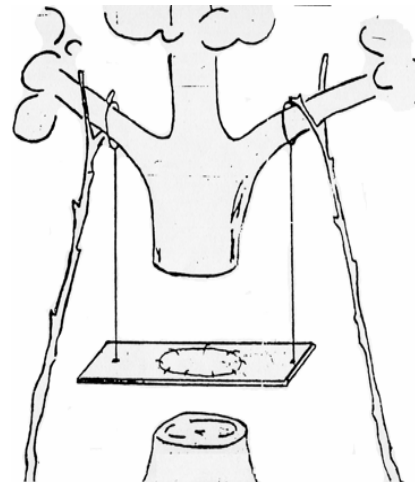
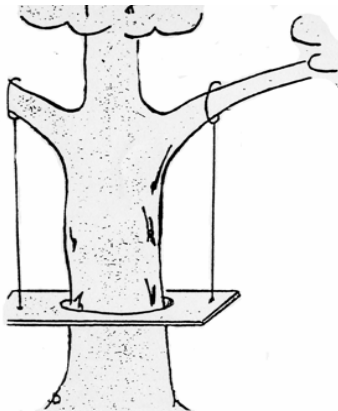


"reliable" 1

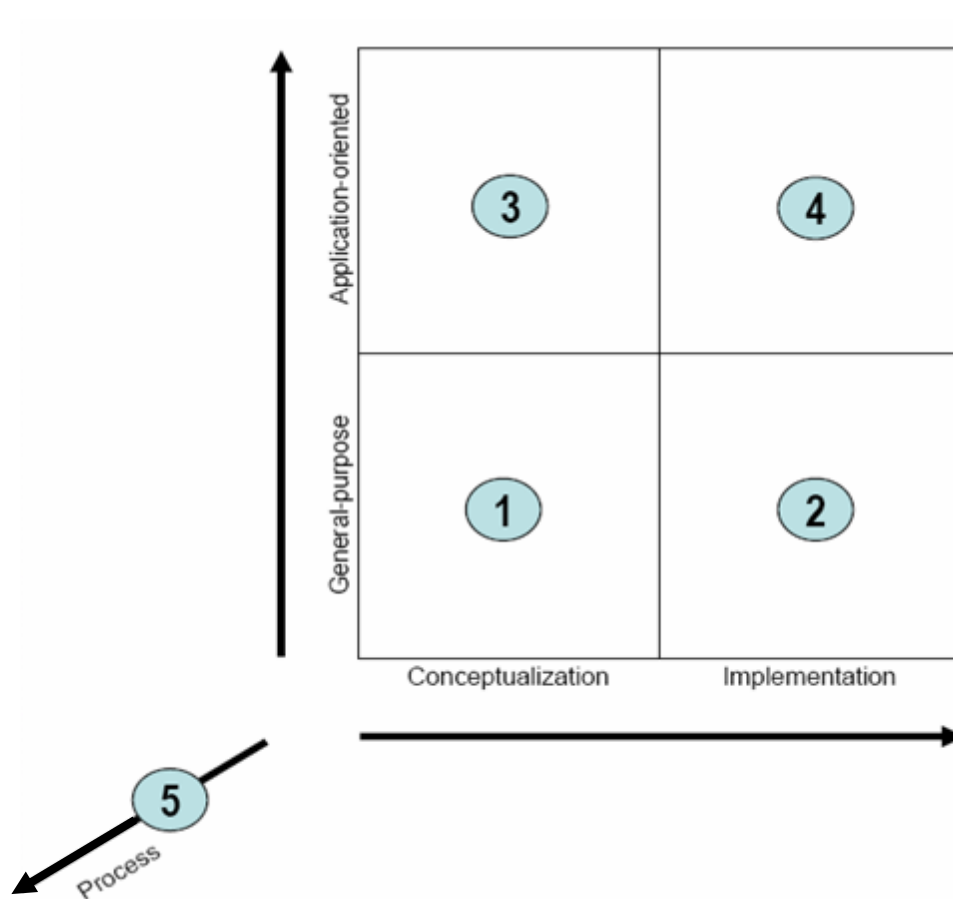


"reliable" 2

...wrong  
(and costly)  
solutions



# 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

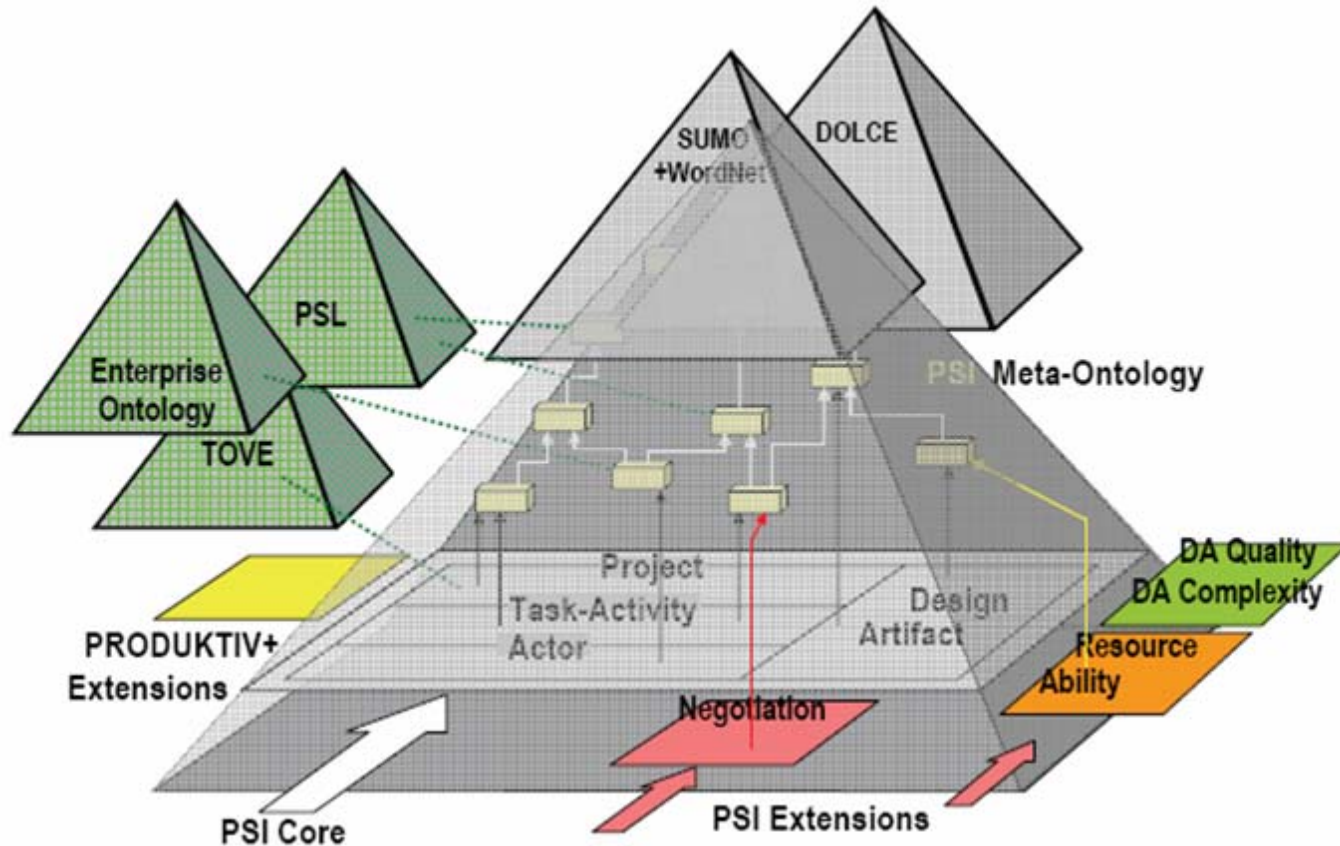
# Evaluation of Ontologies: How to?

- **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

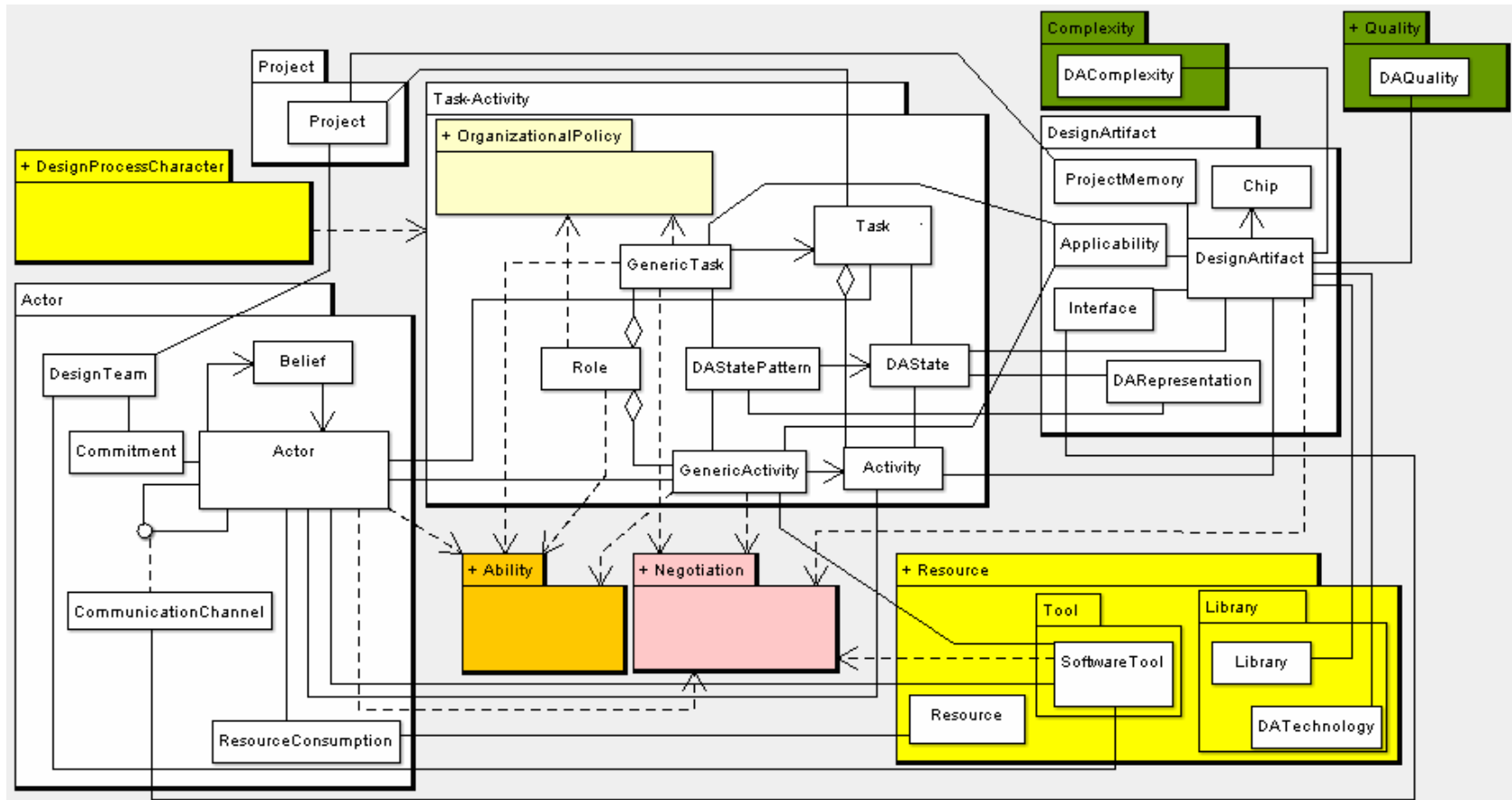
# Performance Simulation Initiative (PSI)

- 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

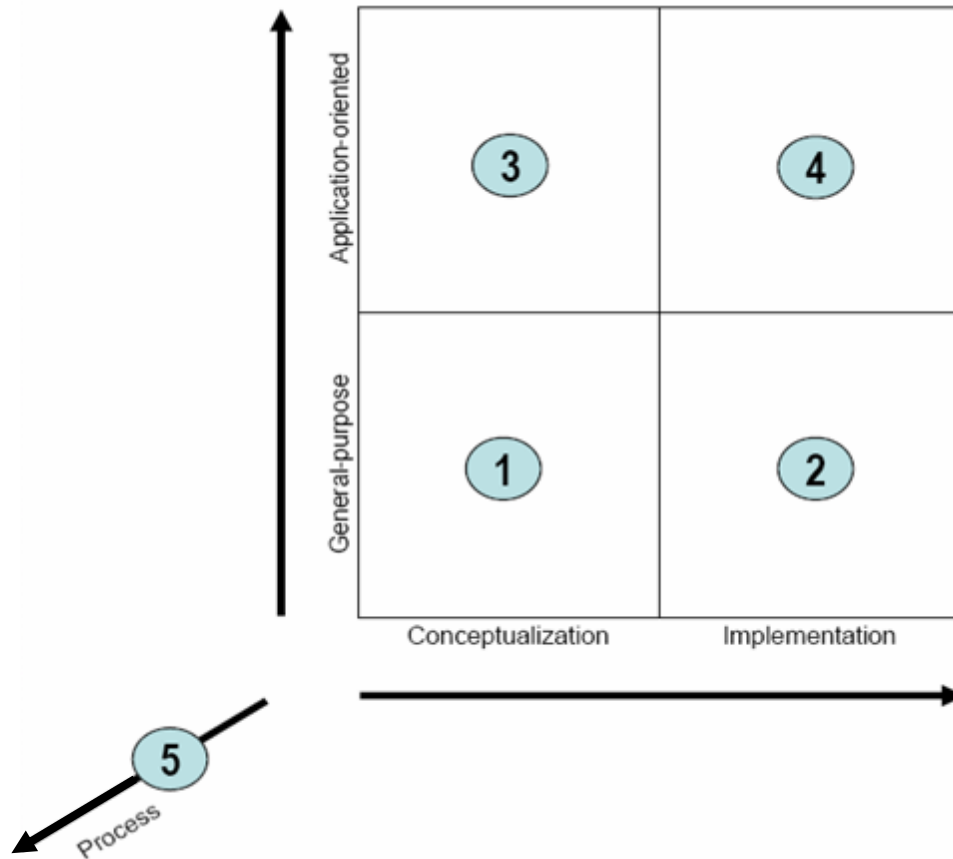


# PSI Ontologies Suite v.1.6



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

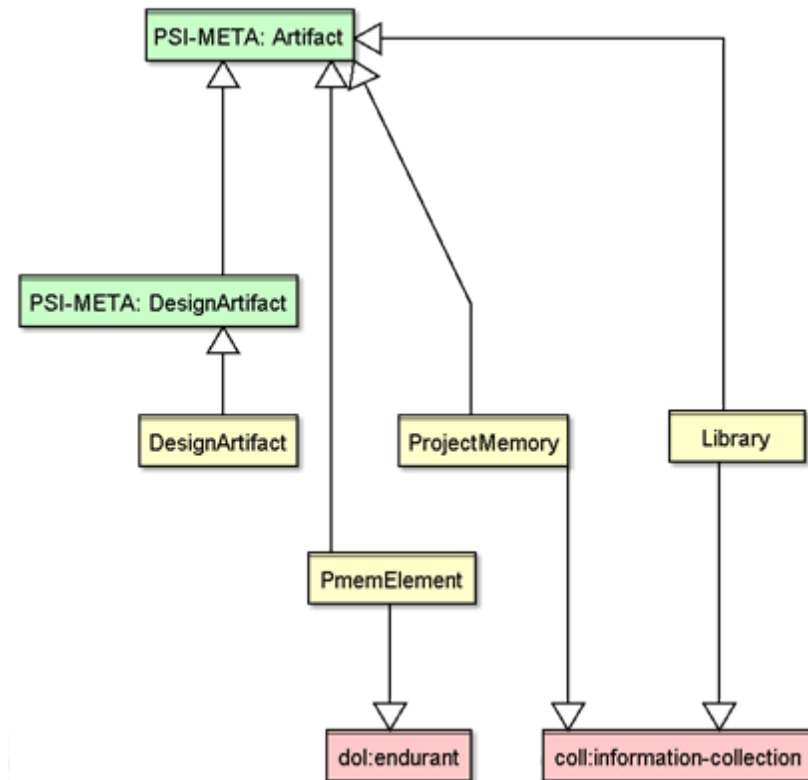
- Use Upper Level Ontologies from different sources:
  - Suggested Upper Merged Ontology (**SUMO**)
  - **WordNet**
  - Descriptive Ontology for Linguistic and Cognitive Engineering (**DOLCE**)
  - Basic Formal Ontology (**BFO**)
  - Object-Centered High-Level Reference Ontology (**OCHRE**)
- Map independently
  - 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

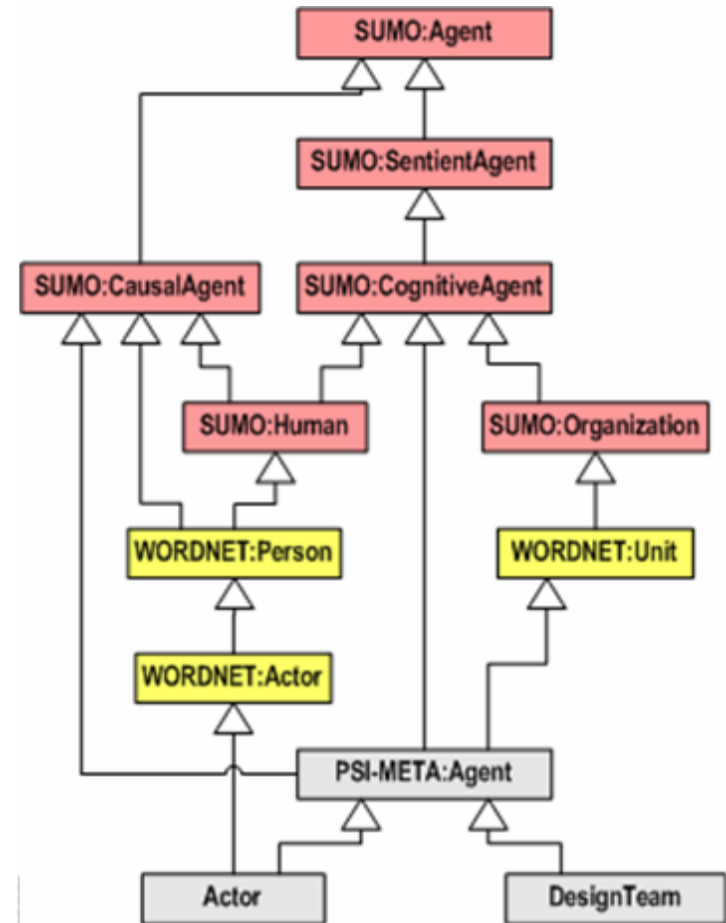
- E.g.:

**DesignArtifact**'s upward cotopies are



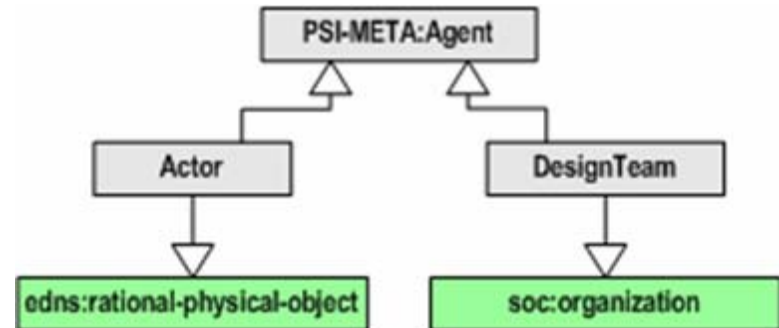
# Scenario 1: Mapping to SUMO via WordNet

- **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

**Resources:**

PSI: <http://ermolayev.com/ISRG/ISRG-projects-PSI.htm>

E-paper: [http://ermolayev.com/eva\\_personal/PS/PSI-ISTA-07\\_CR.pdf](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](http://ermolayev.com/eva_personal/PS/ISTA-2007-PSI-to-CommonSense.pdf)

**Questions  
please**