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FRODO

Domain Ontology Societies in Distributed Organizational Memories

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Overview

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- History and other context
- Distributed Organizational Memories
- A Framework for Ontology Management in DOMs
- A Simple Example Walktrough
- Summary & Outlook

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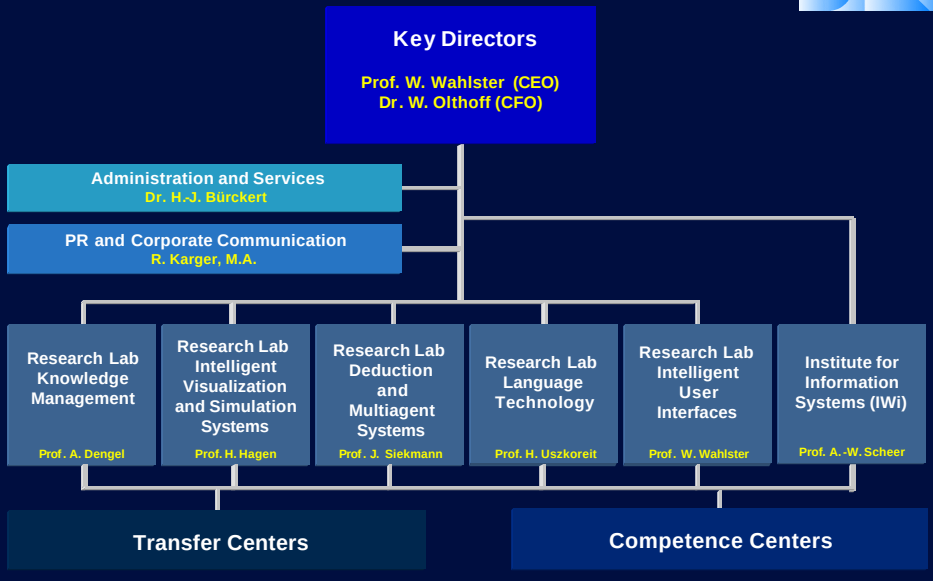
The Structure of DFKI



Roots of the DFKI Knowledge Management Department

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- Starting Point: **Technical Expert Systems** with their typical research questions (knowledge acquisition and representation, inferencing)
- Some Application Projects:
  - IDEAS System Design (Hoechst):
    - Explanation of Adverse Events in Clinical Studies
  - KONUS-Prototype (Stihl):
    - Suggestion/Explanation/Critiquing for Crankshaft Design
  - ESB System (Saarberg):
    - Handling of Expriences about Faults of Machines in Coal Mining
- Fusion with Document Analysis & Understanding Group

Consequences From First Application Projects

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- **Assistant Systems** Instead of Expert Systems
- System as **Knowledge & Communication Medium**
- **Knowledge Evolution** as Task
- Integration of **Different Formality Levels** of Knowledge
- Integration with **Legacy Systems** and **Standard Applications**
- **Links** between Heterogeneous Information Items

This leads to a working definition:

Knowledge = Information Made Actionable

Knowledge Management Addresses Context-Specific, Proactive Delivery of Information (KnowMore, Abecker et al., 1998)

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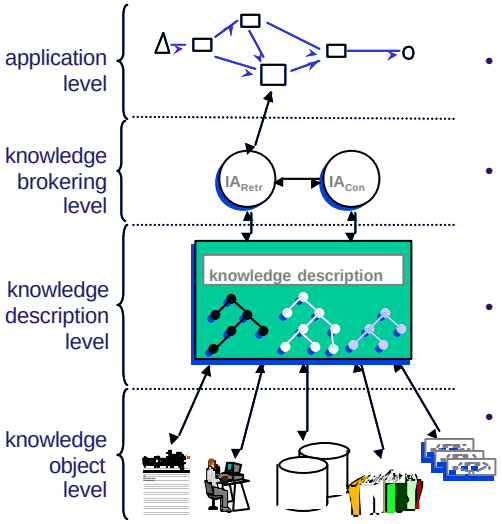

- Knowledge Workers are involved in complex processes
- Process models and their enactment provide context information and facilitate proactivity
- Ontologies are the explicit basis for the knowledge description level
- Access to various information sources relies on formal knowledge item descriptions

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Motivation for Distributed Organizational Memories

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- Old motivation (mainly practical aspects)
- This summer in Vancouver: HSBC Slogans
  - „Don´t underestimate the power of local knowledge.“
  - „The world‘s local bank.“
- Thus: Knowledge Management should aim at *balancing local and global needs and strengths*!
- In the FRODO project, we propose the introduction of (relatively independent) local, but co-operating Organizational Memories.
- In Organizational Memory Information Systems, *ontology management* is crucial for creating a balance between local and global knowledge.

From Centralized to Distributed Approaches

FRODO: A framework for distributed organizational memories

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- project is sponsored by German Ministry for Education and Research (bmb+f) from Jan 2000 - Dec 2002
- basic research project, settled in the center of several more application-oriented projects
- main topics:
  - scalable OM framework
  - weakly-structured workflows
  - acquisition of ontological knowledge
  - distributed inferences for information support
  - methodology for introducing OMs

Domain Ontologies as prime example for creating a balance between local and global knowledge

Theoretical basis of a comprehensive approach

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Three dimensions have to be taken into account

Dimension	Expansion	Transition Tools
Formality	*From*: informal *To* : formal	„Standard“ KA
Sharing Scope	*From*: individual *To* : group(s)	Negotiation
Stability	*From*: momentary *To* : permanent	(Monitoring)

Dependencies between dimensions demand integrated view (van Elst & Abecker, 2001 & 2002)

Local and Global Domain Ontology Agents in Multi-OMs

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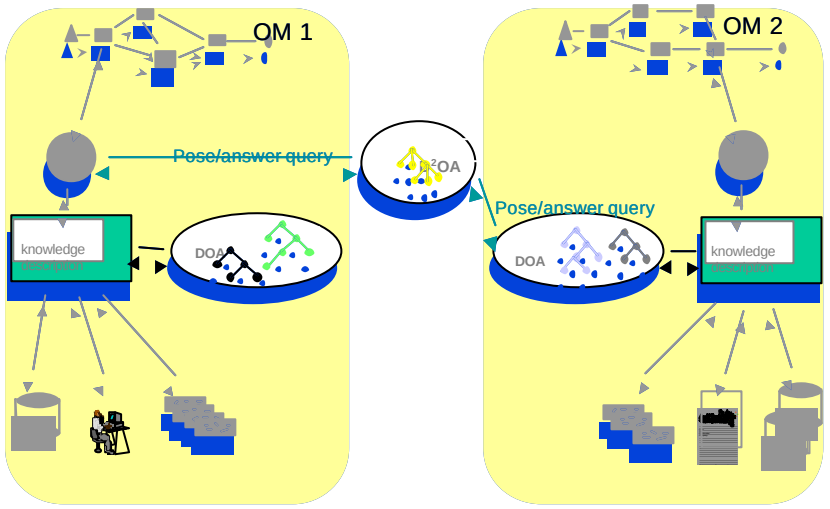

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Framework for comprehensive ontology management

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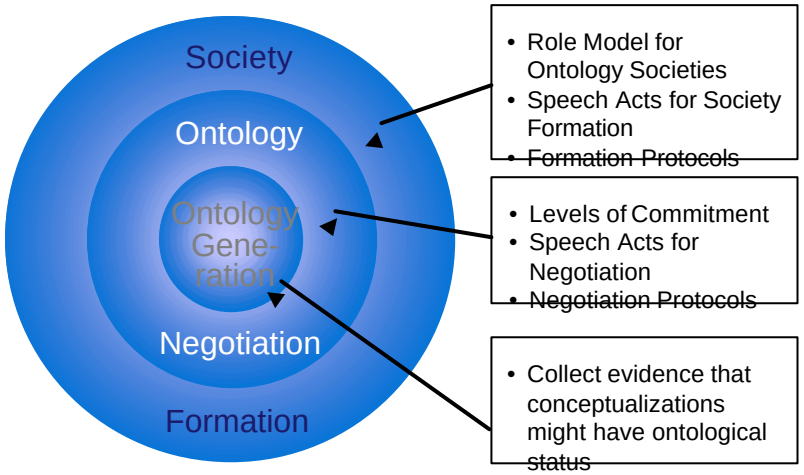

What the community calls ontology learning

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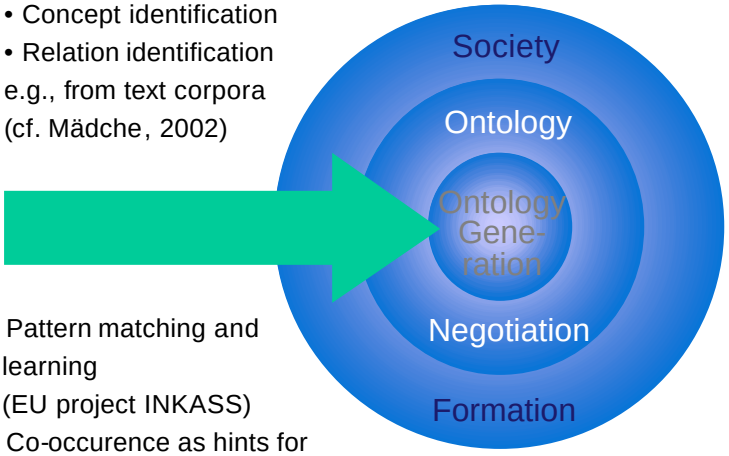
- Concept identification
- Relation identification

e.g., from text corpora (cf. Mädche, 2002)



- Pattern matching and learning (EU project INKASS)
- Co-occurence as hints for possible relations (KnowMore, 1998)

Ongoing work:
Several sources of evidence & their integration

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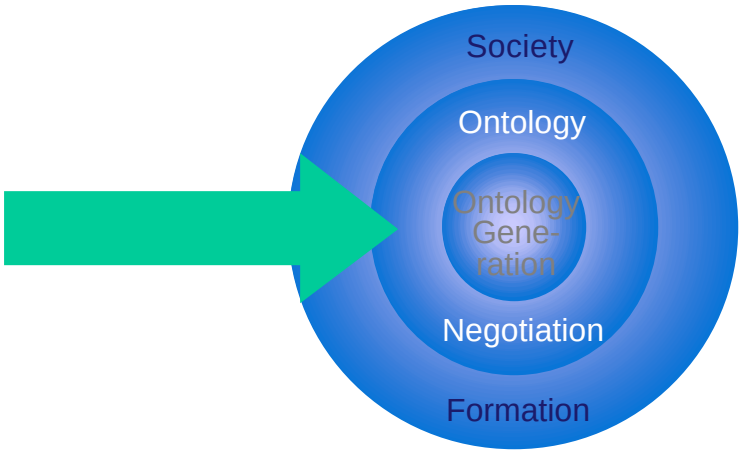

Ontology Negotiation Speech Acts & Protocols

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- In FRODO, we defined speech acts with respect to
  - Ontology Utilization (Query, AnswerQuery, ...)
  - Ontology Evolution (Edit, SuggestUpdate, ...)
- These speech acts are implemented on top of the JADE agent platform and the Protégé system for ontology management.
- Bailin & Truszkowski (2001) define further speech acts and protocols (wrt. Clarifications, Explanations, etc.)
- Negotiation speech acts and protocols do not make any assumptions *why* an actor commits (or: *when* an actor should commit).

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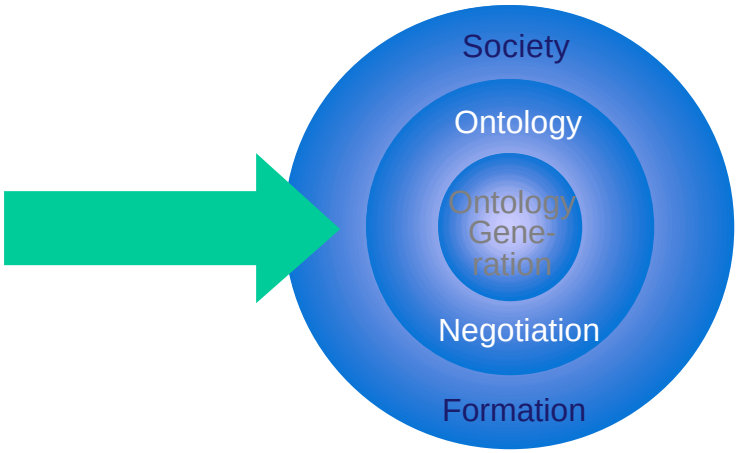

A Motivational Example: Newsgroups

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- Different people play different roles in NGs:
  - some people ask questions
  - experts answer the „tricky“ questions
  - someone maintains the FAQ
  - some people just „listen“
  - ...
- Roles may constrain possible actions in the NG
- Sometimes, the „social law“ is even made explicit

Transferred to the realm of „domain ontologies“ in DOMs

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- some agents might have the ability to answer ontological question („is A subclass of B?“), but the don‘t have to
- some agents are obliged to answer such questions
- some agents have the right to change the ontology
- some agents are willing to contribute to ontology evolution
- some agents always need to most actual version of an ontology, others not
- ...

A role model is the blueprint of a society

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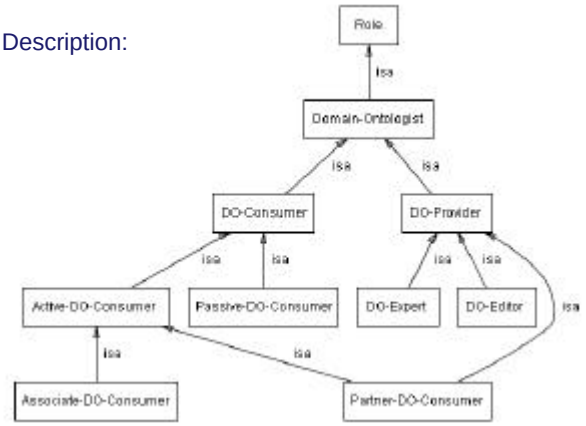
Knowledge Level Description:

- Goals
- Knowledge
- Competencies
- Rights
- Obligations



Determing rights and obligations are the basis for role taxonomy engineering

Role Model for Ontology Societies

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	Non User	Passive User	Associate User	Partner User	Expert	Editor
Query		R	R	R	R	R
Answer Queries					R/O	R
Receive Update			R	R	R	R
Suggest Update		R	R	R/O	R	R/O
Edit						R
Send Upd. Notif.						R/O
ApplyForRole	R	R	R	R		
Grant						R
Guarantees						
Guarantee Quality						O

- Ontology Utilization
- Ontology Evolution
- Ontology Socialization

R: has-the-right-to
O: is-obliged-to

Social Model is Defined and Implemente by Rules

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- SpeechAct ::= (FRODO_SA, Protocol^{0,1})
- Competency ::= (ReceiverRole, SpeechAct, Action.
- Right ::= **perform** Competency **if** Condition.
- Obligation ::=
  when SpeechAct **from** ReceiverRole **andif** Condition **perform** Competency |
  if Condition **perform** Competency.
- Role ::= rolename(Right*, Obligation*).
- Rolemodel ::= rolemodelname{Role*}.

Rights are modeled as *filter rules*

Obligations are modeled as *reactive* or *proactive rules*

Social layer ensures fair processing of rights and obligations.

Ontology Societies Are Bootstrapped From SocIA

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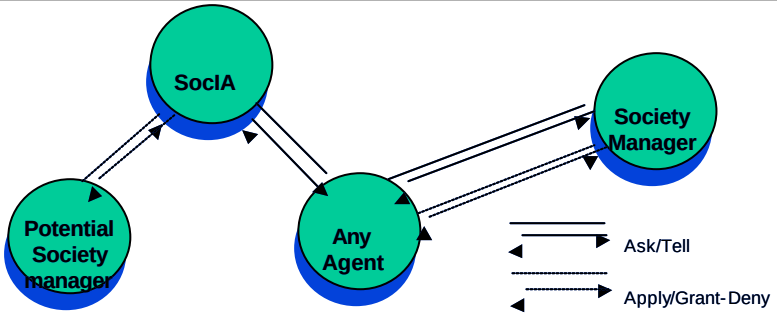

- Society Managers manage an *abstract role model* for a specific society and the *instantiation*, i.e., associations between concrete agents and their role wrt. the society.
- An agent may become Society Manager for a specific society by application at the Society Instantiation Agent (SocIA), which is a kind of *yellow page service for societies*.

Society Formation in FRODO

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What?	Society Templates	Society Model	Role Model
When?	Design @ Engineering Time	(Change @ Run Time)	Change @ Run Time
Who?	Society Instantiation Agent (SocIA)	Society Manager	Society Member
How?	`ApplyForRole` ← / `Accept` →		`ApplyForRole` ← / `Accept` →

Each Agent Can Play Different Roles wrt. Various Ontologies

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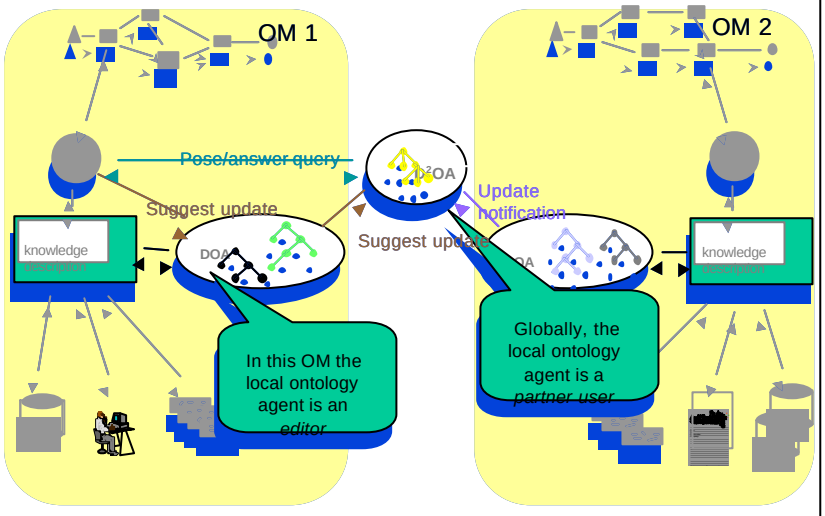

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A Simple Example Walktrough

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- We have *two Organizational Memories* (OM1/ Cornell University, OM2/Texas University) with their local domain ontology agents (DOA).
- For reasons of simplicity:
  - Very simple representation language.
  - The Cornell-Ontology is in fact a refinement of the Texas-Ontology.
- We have *one (empty) Distributed DOA* (D2OA) between the two OMs.
- Assume, the *ontology societies* have already been *set up*:
  - DOA-Cornell is Editor for the Cornell Ontology.
  - DOA-Texas is Editor for the Texas Ontology.
  - DOA-Texas and DOA-Cornell are Passive Users of (D2OA).
  - D2OA is Passive User of DOA-Texas and DOA-Cornell.

Text Classification is Used to Gain Evidence for Ontology Overlap

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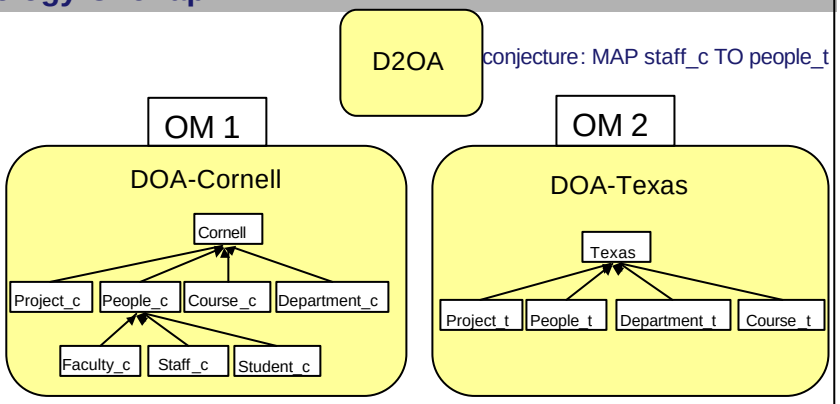

- Cornell: „Texas, give me your Staff_c documents“
- Texas: „I do not understand Staff_c“;
  suggestion: low-level communication, involve D2OA
- Cornell passes example Staff_c documents to Texas and tells D2OA.
- Texas classifies examples as people-Documents and tells D2OA.
- Texas delivers documents on the basis of similarity.

Level 1: „no shared conceptualization“

Gain Evidence for Ontology Overlap (2)

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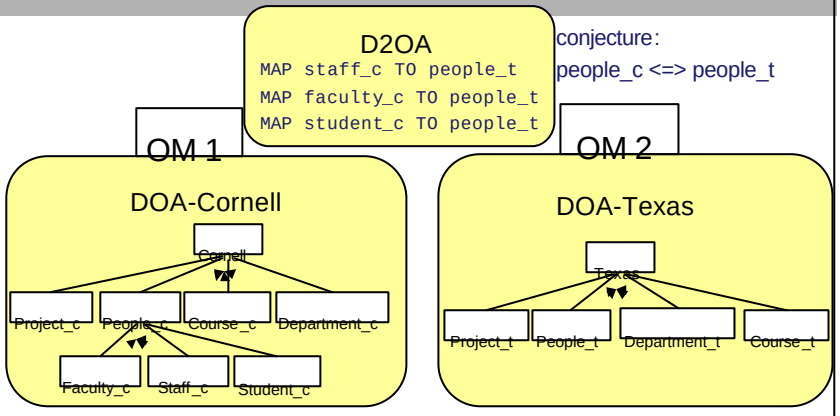

- D2OA‘s mapping rules are still NOT a shared conceptualization!
- But they can be used to ease communication.
- The structure defined by the mapping rules and other hints give evidence that an explicit sharing step may be worthwile.
- Possible sharing protocols are constrained by social structure.

Level 2: „mappings between Ontology Agents“

Level 3 „ontology negotiation“

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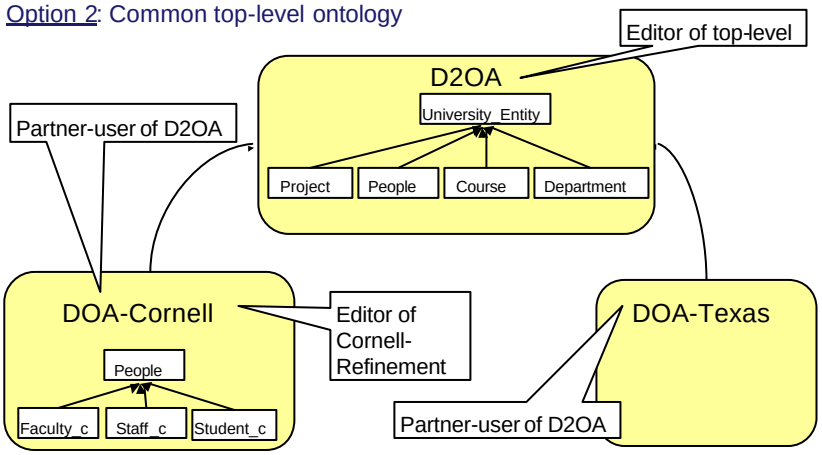
Option 1: No further agreements
at least Level 2 (mappings) can be utilized

Option 2: Common top-level ontology



Negotiated ontologies lead to changes in the society!

Level 3 „ontology negotiation“ (2)

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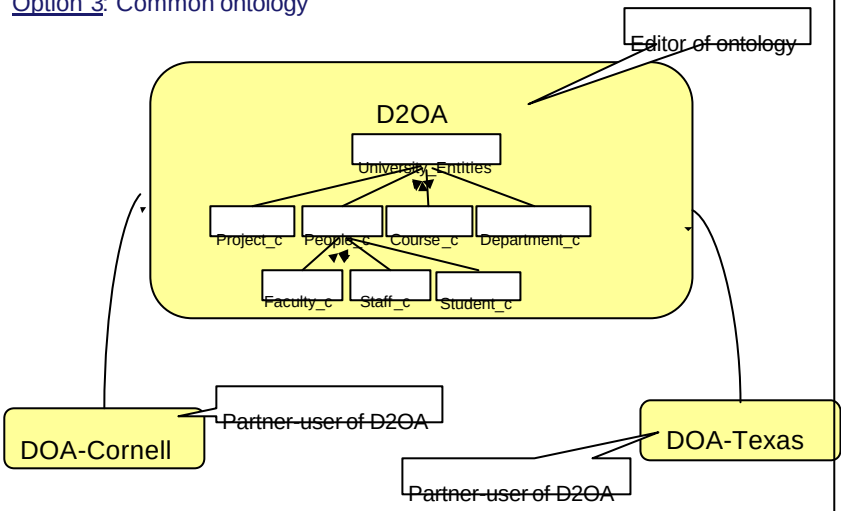
Option 3: Common ontology



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- Ontology Management is an important means to *balance between local and global concerns* in Distributed Organizational Memory scenarios.
- Ontology Negotiation needs (at least)
  - Generation of conceptualizations
  - Negotiation speech acts and protocols
  - Explicit handling of the sharing scope (societies)
- In FRODO, societies are used at
  - the systems engineering level (society models as blueprints for OM systems)
  - runtime to constrain actual behaviour of agents

Summary & Outlook (2)

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- Rights and Obligations are „the statutes“ of a FRODO society (minimal model: obligations(external, ø)).
- A society manager maintains the statutes, serves as a „book of statutes“ and maintains a register of society members (i.e., (role, agent)-pairs)
- Joining a society (with a specific role) is seen as a contract between the new member and all other members
- The details of this contract are regulated by the rights and obligations of the members role.
- In general, agents are free how they practise their role. However, FRODOAgents have a general mechanism to ensure fair processing of rights and obligations.

Vision: Agent-Mediated Knowledge Management

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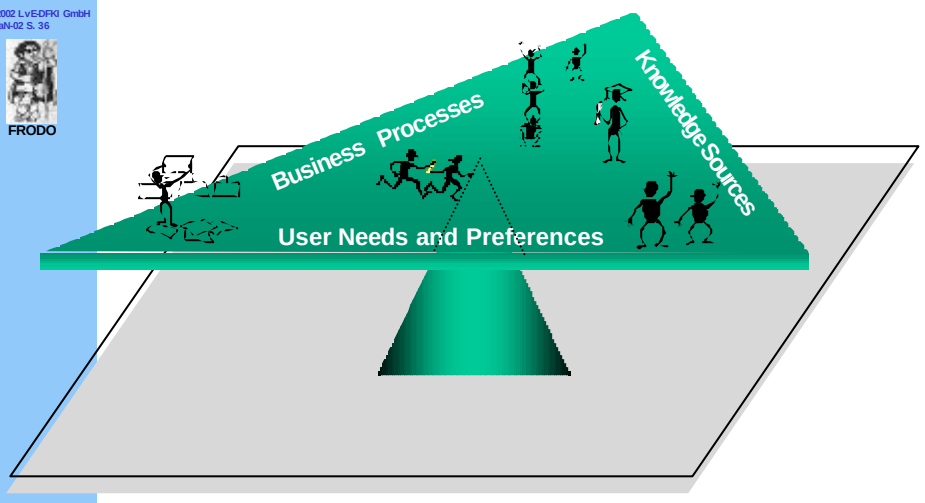

Make Societies of Agents Balance the “KM Seesaw”!

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Thank you for your attention!

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Summary & Outlook (2)

Mike Uschold's talk at the Semantic Web Workshop (WWW 2002, Hawaii)

Questions / Architecture	Who generates the mappings?	When define Agent to Agent mapping?	Topology	Degree of Agreement
Global ontology	*no mappings*	*no mappings*	Point-to-point	Agree on Everything
Manual mapping	Agent designers	Before agents interact.	Point-to-point	No *a priori* agreement
Interlingua ontologies	Agent designers	Auto-generated at agent interaction time.	Mediated	Agree on Interlingua ontologies
Community ontologies	Ontology designers	Auto-generated at agent interaction time.	Mediated	Agree on alignment mappings
Ontology Negotiation	Agents themselves	Auto-generated at agent interaction time.	Point-to-point	No *a priori* agreement
FRODO	Agents themselves	At interaction time	Mediated & Society	No *a priori* agreement

Table 1: Semantic integration architectures.