

Ontology, Scientific Method, and the Research Agenda: Two Provocations and ~~One~~ Argument

Two!

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Provocation #1...

*(by Frank van Harmelen, CIA-ws,
Edinburgh, 11 Sep 2006)*

- **Ontology research is done.....**
 - We know how to make, maintain & deploy them
 - We have tools & methods for editing, storing, inferencing, visualising, etc
- **... except for two problems:**
 - Learning
 - Mapping
- **Natural Language technology is also done...**
 - at least it's good enough



Ontology: The Traditional Definition

- An ontology = a **formal specification of a *shared* conceptualization of a certain domain**
- Goal: embed this semantic knowledge into systems so that they better serve us:
 - must be (1) **computer-processable** *and*
 - must be (2) **human-understandable**

- Research issue:
- **Two legs, but they aren't equally long now!**

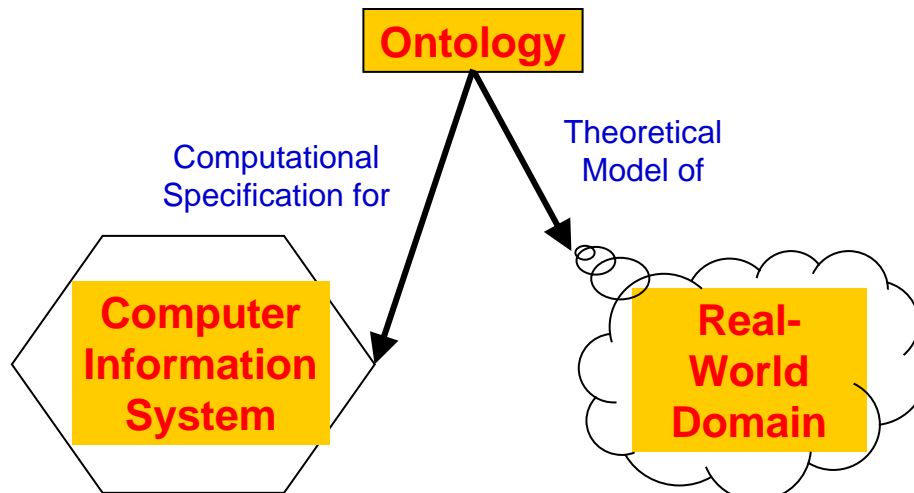


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Ontology, the Conceptual Triangle, and the Two (Not Equally Long) Legs



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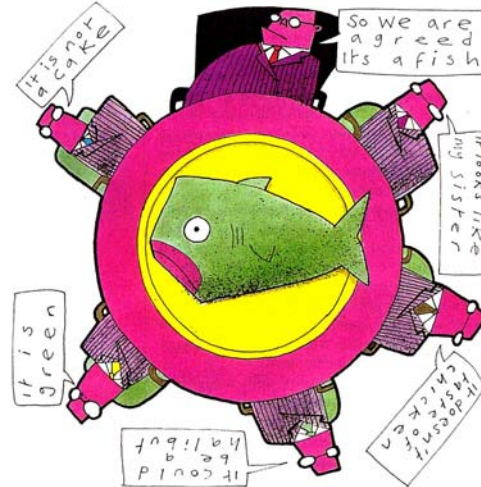
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Ontology: The Traditional Problem – Shared Understanding

- Ontology: specifies **shared background knowledge**
- In fact, expresses some conceptual **domain theory**
- Theory implies **use**: Static representation is not enough
 - Domain **Inferencing** (PSM, domain-specific)
 - Domain **Validation** (external, in-context: goal, situatedness)

No Ontology
Without Methodology



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Financial Times, Oct. 2000

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Ontology as Scientific Method

- Ontology is (new!) scientific method for formal conceptualization and theory formation
 - In-between logico-mathematical, and essayistic/natural language
- Formal conceptual modelling
 - Provides ways for data reduction, abstraction, graphical models
- Added value of computational paradigm
 - simulation, what-if scenario reasoning, coherence testing, etc.
- But: evaluation ultimately has to be empirical
 - Ontology is domain theory (field/case studies, reflective practice)
 - External validity is decisive, more than logical and computational consistency and coherence:
 - **(Formal) Pragmatics > Semantics**
- Pragmatic use cases, **not** representation will be decisive

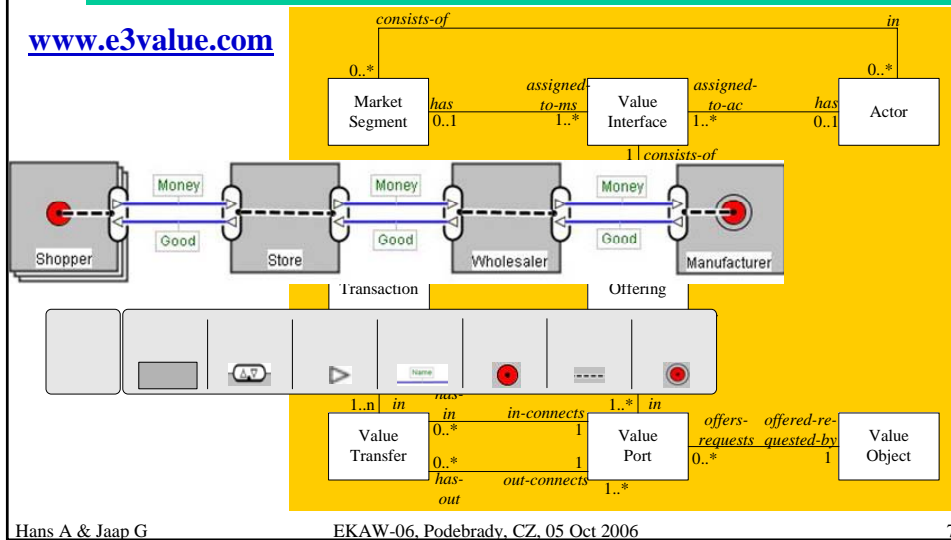
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Example: What's in a Business Model? The ontology

www.e3value.com



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Inferencing, Validity, and the Structure of Argument

- $D + T \Rightarrow_R C$ - Core idea of scientific argument
 - Data plus Theory produce Claims through Reasoning
 - Toulmin: Reasoning is field-dependent (non-universal logic)



- Practical reasoning: often **no** deductive validity (e.g. Searle, Walton, argumentation theorists)
- Scientific disciplines, and KE experience: yes, **but** acceptable (domain) **patterns do** exist

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KE: The Knowledge-Level Principle of Rationality Needs Revision

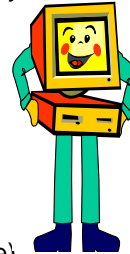
- Newell (1982): KL principle of rationality
 - Program (symbol) level (= what computer scientists normally do)
 - **KL hypothesis: there is a [conceptual] level above**, “characterized by knowledge as the medium and the principle of rationality as the law of behavior”
 - **Rationality = “If an agent has knowledge that one of its actions will lead to one of its goals, then the agent will select that action”**
- KL principle still of value to KE
 - Much of current Semantic Web KE is at programming / symbol level (representation), not Knowledge Level
 - Learn from > 20 years of KE (incl. EKAW, K-CAP): e.g. KE reusable patterns of expertise, knowledge structuring, ...
- **But also: Newell’s Knowledge-Level principle is not good enough anymore**

KE: Replace by Communicative Action Principle of Reasonableness

- Why the KL principle of rationality is not good enough
 - It is inherently individualistic, cognitivist, a-social
 - It ignores social nature of knowledge and rationality
 - It does not work for distributed open systems, such as the Web (e.g. Semantic Web Services, Social Networks, eBusiness, etc.)
- Most practical reasoning is **not deductively valid** (Searle)
 - Foundation to be found not in formal logic, but in Speech Act Theory (Austin, Searle) and in Universal Pragmatics (Habermas)
 - Progress in Argumentation theory (“Informal Logic”), Schemes
- Hence: **KL principle to be replaced by:**
 - **CA (Communicative Action) Principle of REASONABLENESS**

Intelligent Agency in an Open Distributed Environment

- Agent is IS
 - “situated in some environment, and capable of autonomous action in this environment” to meet its goals (Wooldridge, Jennings)
 - Has capabilities: responsiveness (reactivity), social ability, proactiveness
- Reasoning related to such capabilities
 - Goal-oriented
 - Practical (deciding about appropriate belief or action)
 - Approximate, good enough, not deductively valid, etc.
 - Role of patterns (work well as solutions, although fallible)
 - (cf. KE experience: predefined Task/PSM patterns)
 - Context inclusive



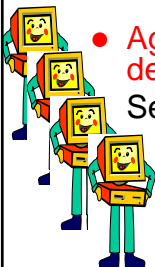
Components of Agent Knowledge and Rationality (1/2)

- Any communicative (speech) act raises some **validity claim C** (to truth, normative rightness, truthfulness)
- Agent “knows C” if C passes the test of the agent’s (pragmatic) **acceptability conditions** for the validity of C
- This acceptance test can be carried out by constructing an **argument** that makes claim C reasonable to adopt

- **Agent rationality = ability to construct and provide a defensible argument (if needed or requested)**

Several (and interacting) sources of agent’s knowledge:

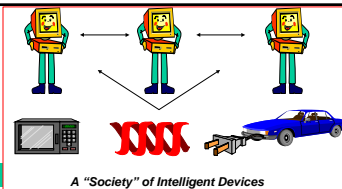
- What it already knows as pre-established body of knowledge
- What it comes to know from experiencing/acting in its environment
- What it comes to know by communicating (and arguing) with other agents (incl. Web info as background knowledge source)
- What it can newly establish (from all of the above) by reasoning



Components of Agent Knowledge and Rationality (2/2)

- Note 1: This is an inherently **pragmatic** theory
 - of (rationality in) knowing, communicating, and acting
- Note 2: Rational argument has component structure
 - so **multi-aspect model of validity** is required
- Note 3: Ontology: **explicitates assumptions** that underlie but usually are left implicit in argument establishing C
 - **Shared background knowledge and/or Acceptability conditions**
- Note 4: Intelligence in IS ultimately has to involve forms of **self-organization**, at different levels
 - Agent network adaptation (cf. semantic overlay networks, gossiping) in reaction to openness/changes in environment
 - Agent goals (desires, intentions): in the end, not static input (as in utility theory), but dynamic co-outcome of practical reasoning
 - Importance of **reflection** about **strategic goals, values and context**

KE: The CA Principle of Reasonableness



- KL-revised: characterized by **actionable knowledge, set in environment** as the **medium**
- And the Communicative Action (CA) **Principle of Reasonableness** as the **law of behaviour**:
 - Part A (warrant): If a [belief, goal, action] claim C satisfies an agent's acceptability conditions for its validity, the agent is warranted in adopting C
 - Part B (backing): An agent acts reasonably if it is able (if so requested) to construct and provide a defensible argument showing that C is acceptable
 - *A: test acceptance; B: justify test and its logic*
 - *Note: Reasonableness is also law of social behaviour*
 - *KL rationality principle is limiting case of CA principle, part A*

Provocation #1...

(by Frank van Harmelen, CIA-ws,
Edinburgh, 11 Sep 2006)



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 - Learning
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Provocation #2...

(by HansA, EKA-2006,
Podebrady, 05 Oct 2006)



- **KR research is done.....**
 - We know how to *represent* ontologies and intell. IS components
 - We have tools & methods for editing, storing, inferencing, visualising, etc
- **... except for two problems:**
 - Dealing with pragmatic action context of systems
 - Self-organizing features of intelligent IS
- **Formal Logic technology is also done...**
 - at least it's good enough
 - (informal logic and formal pragmatics needed for real-world applications)

Argument #2: Why Ontology Research Isn't Done (Yet)

Dear professors Serban, R, ten Teije, A, van Harmelen, F, Marcos, M, Polo-Conde, C

We are pleased to see that your remarkable article

Ontology-driven extraction of linguistic patterns for modelling clinical guidelines

has the same key topics as an article in our journal *Acta Geodaetica et Geophysica Hungarica* in the following paper:

[Comparison of CHAMP and GRACE geopotential models with terrestrial gravity field data in Hungary](#)

Being an author in the same field of interest of *Acta Geodaetica et Geophysica Hungarica* we offer you

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KE Research Agenda



- 1. Use theory of meaning (pragmatics)
 - Web reality, social nature of K, goal/action orientation
- 2. Evaluation and validation framework revised
 - Ontology as scientific method for (substantive) theory formation
 - No ontology without methodology (PSM, Argument): from static representation to dynamics
- 3. “Good enough” reasoning
 - Stereotypical Patterns, Approximate, Collaborative, ...
- 4. Intelligent IS: Self-Organization, in open environment
 - (no deductive validity, but constructive validity)
- 5. Revised Knowledge-Level principles of rationality
 - “being reasonable” as foundation for IS