# Do we need an Ontology of Ontologies???

## Panel Discussion

### Tampere, October 10, 2002

**Panelists:**

| | |
|---|---|
| **Vadim Ermolayev** | Zaporozhye University, Ukraine |
| **Nicola Guarino** | National Research Council LADSEB-CNR, Italy |
| **Jari Palomäki** | University of Tampere, Finland |
| **Bernhard Thalheim** | Techn. University of Cottbus, Germany |
| **Yair Wand** | University of British Columbia, Canada |
| **John Morris** (virtually) | Canada |

**Moderation:**
**Heinrich C. Mayr**

# Motivation

❧ **Ontologies are "in"**

❧ at many conferences, especially ER'2002

❧ come with a bulk of different meanings

❧ a new buzzword for everybody to talk about anything??

- standardized parameter (type) definitions
- models and metamodels
- explicit natural language specifications
- domain specific vocabularies
- "a core body of knowledge .."
- etc. etc.

❧ universal, domain specific, group specific, individual

❧ different levels of formality

⇒ **the panel should bring some light into that muddle**

# Program

- ◥ Short position statements by the panelists (5 min maximum)

  - ■ provocative

- ◥ Interaction/discussion (45 min)

  - ■ Questions, remarks, comments by the participants

  - ■ Answers, further statements by the panelists

- ◥ Resume by the panelists (3 min maximum)

# Vadim /1

◥ **Yes, we do!**

■ for solving the interoperability challenge

■ for (…**automated**!?) negotiation in open (cross-national, cross-clerical, cross-cultural systems)

◥ **Example:** A hot dog refused in New-York City…

■ Conceptual misunderstanding between two people because of cultural differences
  – needs proper resolution

■ Imagine an intelligent information system accepting the query: "Show all the places selling hot dogs in X metropolitan area. Order per price"
  – needs ontology alignment

# Vadim /2

- ◤ **Yes, we do!** … **from the modeling perspective**
  - ■ **Ron Weber's keynote message:**
    - we need a formal theory to check and found our modeling methods
  - ■ but this formal theory is also the MATURE part of our world; it doesn't really matter if we agree or not!
  - ■ Shall we seek for a formal theory to map our current one to its model on the higher (heavenly) level of understanding?
  - ■ Where ends this long road to "ULTIMATE" knowledge or theory
  - ■ Is it "the ONTOLOGY of ontologies $_{of\ ontologies}$"?
- ◤ **Yes, we do!** … **but**
  - ■ People do not really like to be directively bounded by any (even VERY RIGID and VERY RATIONAL) norms
  - ■ People do not always interoperate in a patterned manner (natural language, emotions, intuition, all other staff, which could not (yet) be represented by a formal theory)
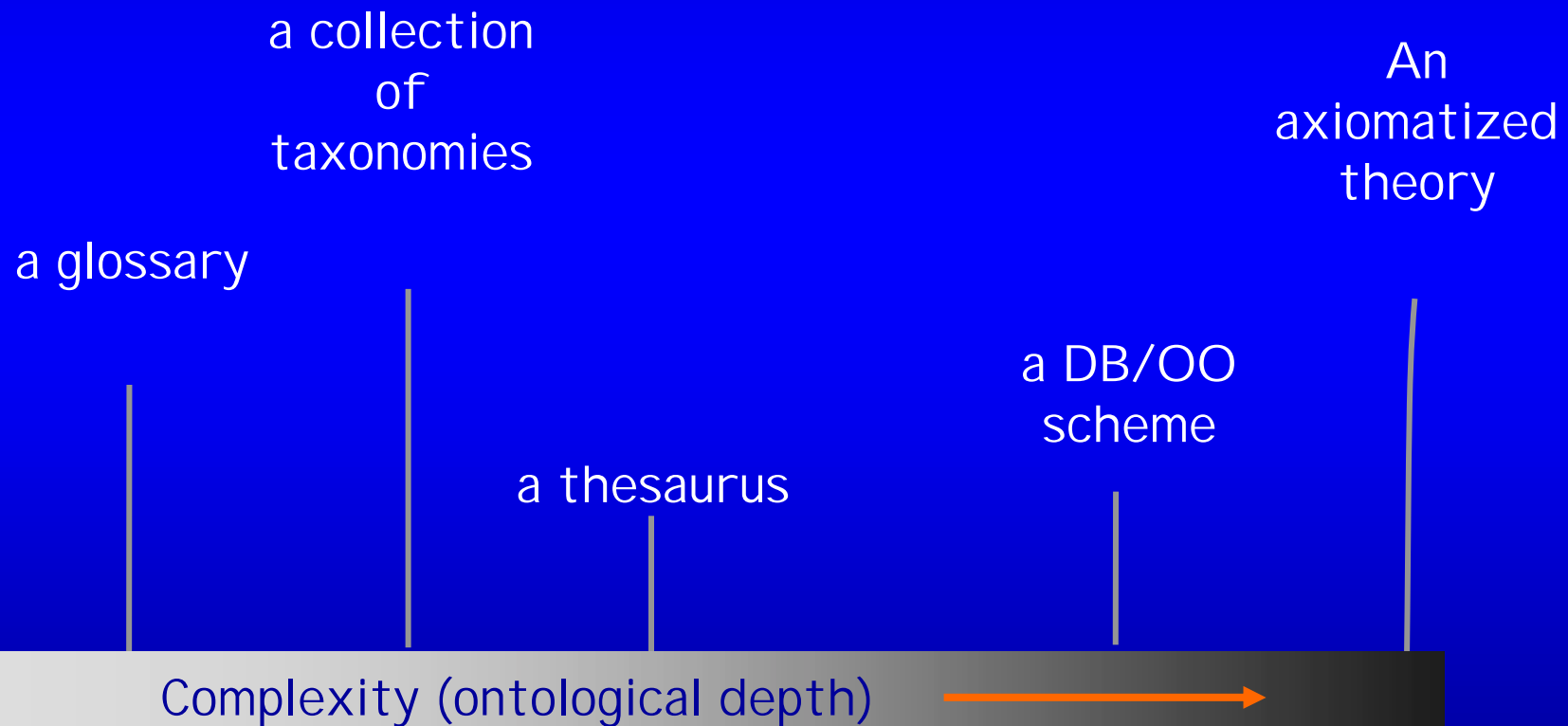
# Vadim /3

◥ **Yes, we do!** … **from the engineering perspective**

- Software systems are the models of human encounters
- Simplification is primarily caused by the usage of the communicative mean – a language
- Design of simplified formal ULTIMATE knowledge is CHALLENGING but POSSIBLE – foundational ontologies
- This will facilitate semantic interoperability in open software systems

◥ **Current Efforts … yet to be mentioned**

- W3 and DAML consortiums, OntoWeb thematic network
- Emerging joint OntoWeb and AgentLink activity and taskforce on Ontologies for Multi-Agent Systems

⇒ **Let's start a**

**Conceptual Modeling Foundational Ontology Taskforce**

# Nicola /1

- **Not every KB is an ontology**
  - *Epistemic* truth vs. *ontological* truth
  - Simulation (predicting behavior) *out of scope*
- **Ontologies perform *terminological services***
  - At run-time
  - At developing-time
- **Different computational requirements**
- **Different functional requirements**
  - Whether humans are involved or not
  - Sharing agreements vs. *understanding disagreements*
  - Establishing *trustable mappings* among sources
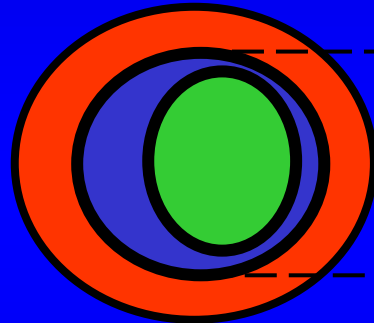- **Reference ontologies vs. lightweight ontologies**

# Nicola /2

## What is *an* Ontology?

a collection
of
taxonomies

An
axiomatized
theory

a glossary

a DB/OO
scheme

a thesaurus
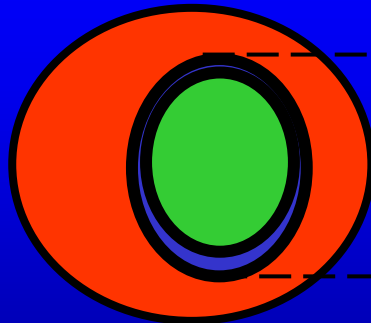
Complexity (ontological depth) →

# Nicola /3
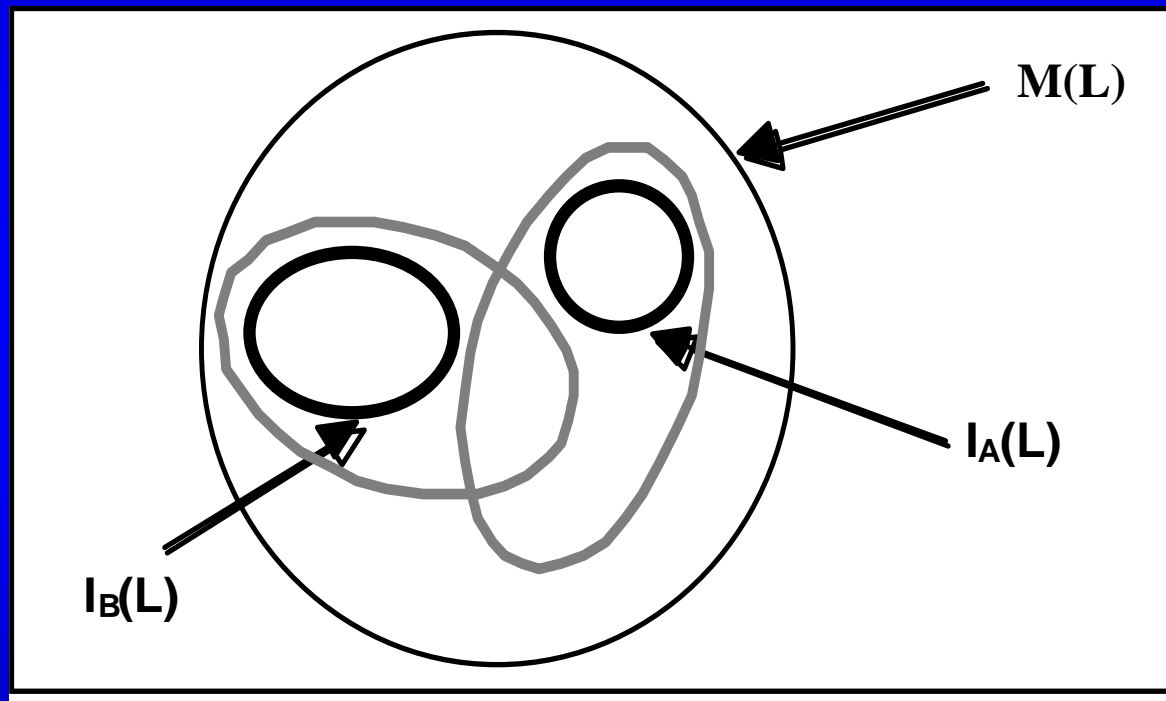
## Good and bad ontologies

Bad ontology

Good ontology

## Ontology quality

- Completeness
- Accuracy
- Cognitive adequacy

# Nicola /4

## The Ontology Sharing Problem (2)



Two different ontologies may overlap while their *intended* models do not (especially if the ontologies are not accurate enough)

# Nicola /5

## Ontologies vs. Conceptual Schemas

◣ **Conceptual schemas**

- *Often not accessible at run time*
- *Usually no formal semantics*
- *attribute values taken out of the UoD*
- *constraints relevant for database update*

◣ **Ontologies**

- *Usually accessible at run time*
- *formal semantics*
- *attribute values first-class citizens*
- *constraints relevant for intended meaning*

# Nicola /6

## What is *an* Ontology?

◣ A specific **artifact** designed with the purpose of expressing the **intended meaning** of a (shared) **vocabulary**

◣ A shared vocabulary plus a specification (**characterization**) of its intended meaning

◣ "An ontology is a specification of a conceptualization" [Gruber 95]

◣ ...i.e., an ontology accounts for the **commitment** of a language to a certain **conceptualization**

# Jari /1

◣ **from the philosophical point of the question is not a well-posed one!**

◣ In philosophy ontology is a part of metaphysics, which aims to answer at least these questions:

1. What is there?

2. What is it, that there is?

3. How is that, that there is?

(1) is difficult: what are the building blocks from which the world is composed, e.g. facts, things and properties, events.

(2) concerns the basic stuff from which the world is made, e.g. water, mind, matter.

(3) concerns the modes of existence, e.g. concrete, abstract, transcendental.

# Jari /2

▼ **But,**

▼ in the field of conceptual modelling the above mentioned ontological questions are extremely important indeed

▼ two different inquires each having a right to the name "conceptual modelling":

    (1) when we are actually doing conceptual modelling

        ■ more basic

    (2) when we are describing the process of conceptual modelling

        ■ conceptually modelling conceptual modelling

        ■ has different ontological status than (1)

▼ In any given discussion, it is easy to fall into confusions through failure to determine to which of the two inquiries the discussion is intended to belong

ER2002

7-11
October
2002

Tampere

Heinrich C. Mayr

eBusiness
business technologies

# Bernhard /1

**Ontology
for
Ontology!!!**

◤ **Ontologies are `in' !**

1. Philosophical directions … !!!

2. Computer linguistic approaches … word fields

3. Prototyping or mind mapping directions … XML

4. Database modeling approaches … o-o o

◤ **Approaches to develop an ontology:**

1. The UML or Priest or Texas approach

2. The Sodom and Gomorrha modeling approach

3. Never read other people papers, never learn from others, better develop by yourself

# Bernhard /2

- 1. Sokrates says: "First you will need a Theory of Ontology!"
  - well-defined language
  - well-defined model theory
  - adaptable pragmatics
  - operational semantics
  - dockets, abstracts and summaries
- 2. "Haha", says Mephistopheles
  - … \you developed all this through ER!"
  - There is no `universal world' formula!"
  - You are not God!"
- "And next:", continues Mephistopheles
  - you need to educate people
  - … to understand, to integrate, to use, to develop,
  - to discuss, and to reason on ontologies!
  - And that is not for free!"

But ...",
says
Mephistopholes

# Yair /1

◣ We build information systems

◣ An information system is an artifact that acts as **representation** of a domain of phenomena

◣ This is a **semantic**, not technological, view of IS

◣ Information system development is a mapping:

  ■ a view of a domain $\Rightarrow$ a representing artifact

◣ The fundamental premise

  ■ IS development should aim at creating a **faithful** representation

◣ Three issues:

  ■ **Why** build an IS? - an **organizational and economic** question

  ■ **What** should be represented (what is in the domain and what can happen in it)? - an **ontological** question

  ■ **How** do we know or find out what is in the domain? - an **epistemological** question

**The Ontological View of IS**

# Yair /2

## Some statements

- One always uses an ontology
  - When reasoning about a domain
  - When communicating about a domain
  - When constructing an information system
  - When using an information system
- Building or using an information system implies an (explicit or implicit) **ontological commitment**

# Yair /3

▼ **The ontological view**

- An information system should be a good representation of a certain domain
- What can be or happen in the domain is the domain ontology
- Constructing or using an IS implies choosing an ontological view

▼ **An Ontology**

- The ontological commitment one makes when:
  - Constructing an information system
  - Using an information system

▼ **The ontological commitment can be:**

- **Generic:** the main concepts for thinking about any domain (e.g. things or processes)
- **Specific:** the instances of the generic concepts used for describing a certain type of domain (e.g. manufacturing)

**The ontological view vs ontologies**

# Yair /4

**Problems**

◥ There are many possible ontologies.

1. **How do we know which is the "right" one**?

◥ Many people involved

- Different users participating at the definition stage
- Users and analysts
- Users who will use the system

◥ Clearly, there should be some ontological agreement

2. **How do we know or assure participants share the same ontology**?

# Yair /5

**Problems and what to do about them**

- **Which** ontology?
  - **There is no such thing as the correct ontology**
- **Whose** ontology
  - **There is no way to prove that different people completely agree on an ontology**

- **So – what can we do?**

- **Only by empirical work!**
  - Test ontological predictions
  - Test effectiveness of methods based on the ontology
  - Devise tests to see if two people agree on a set of ontological assumptions and concepts

# John /1

◥ **Frustration:** First generations of software reveal limitations of the technology's origins in government and industry

◥ **New Opportunity:** Empower individuals with powerful software technology owned by and "tightly coupled" to that individual

◥ **Two Metaphors**

- ■ **"The Story": Software tells a story**, it
  - is an account of incidents and events and
  - involves protagonists and their relationship to an organization
  - Imagine that SW is constructed first of all from the narrative point of view of the individual

- ■ **"The Toolbox":** A mechanic's big red box on wheels
  - can be a model for personal software in terms of behavior and economics
  - Imagine that pers. SW is selected, learned and owned by individuals – SW to which organizations are then "happy" to interface

# John /2

◤ Imagine an ecology or economics of competing personal softwares

◤ Diffusion of new "personal" software in part governed by economics -- but made possible by "ontological" & software research

◤ Research on personal ontology will be *in part* an extension of research on work, HCI, user modelling, conceptual modelling, philosophy, cognitive science etc. etc.

◤ An ontology of the individual implies rigorously modeled behaviour of human actors, initially at least within limited domains

◤ Questions to be answered:
  - What is an "individual" for the purposes of software?
  - What is "software for the individual"?
  - Why is software for the individual important?
  - Why is software for the individual useful?
  - How is software for the individual different?
  - Why hasn't software for the individual "been done yet"?
  - Why is an ontological foundation for such software important?

# Heinrich /1

◣ "Ontology" viewed from a perception/cognition theory perspective (see Heinz von Foerster)

- ■ Individuals are capable of so-called cognitive processes

- ■ Cognitive processes allow an individual to perceive processes and objects ('model objects') within its environment and to establish relationships between the actually and the formerly perceived things

  => **Cognitive structure (knowledge)**

- ■ result of all cognitive processes at a certain point in time
- ■ components are (mental) **'models'**

# Heinrich /2

◣ new knowledge (models as part of the cognitive structure) may be derived from the cognitive structure by specific cognitive processes ('thinking', 'reasoning')

⇒ **Ontology again is a mental model (of the individual)**

◣ in order to be able to communicate with each other individuals need common *modeling concepts (MC)*, i.e. rules for modeling a certain universe of discourse (metamodels?, ontologies?)

◣ **modeling concepts are object of each education**
- mathematical theories
- systems of notions
- (artificial) languages

ER2002

7-11 October 2002

Tampere

Heinrich C. Mayr

eBusiness
business technologies
Industriestiftungsinstitut

# Heinrich /3

◤ For the 'physical transport' of  knowledge between individuals we
need *representation concepts (RP)*,
i.e. rules for allocating signs (perceptible physical entities) to
elements of the cognitive structure (*models*)

=> **representation is the mapping of models to signs**

◤ **Linguistic perception**
permits individuals to conclude from (observed) signs to the
models they represent if the underlying MC and RC are
known

⇒ individuals may communicate about a given universe of
discourse after having agreed on the MC and RC to be
applied:

**the modeling system MC x RC -> an ontology ?!**

# Interaction/discussion (45 min)

- **Arne to Yair**: no stop for being specific
  - every theory is an ontology
  - physics: further specific world; circuit designs
  - generic definitions: term is without means !!
  - request for clarification

- **Yair**: clair rules, what's specific and what not
  - example: model manufacturing environment, becoming more specific (production level)
  - 1st: ontological concept, 2nd: specific knowledge
- **Ralph:**
  - better mean to understand the real world
  - underline human skills
  - opposite to standardization
  - question of creativity

# Interaction/discussion (45 min)

- **Yair:**
  - people do not communicate without believing to certanin things
  - ontology is connected to language
  - there is no contradiction
- **Nicola:**
  - not task of ontology to decide what is "blanc constant"
  - split between philosophical attitude and CS attitude; we observe the world as it is
  - conceptualization; using a particular vocabulary
- **Jari:**
  - not to understand why defining new ontologies when conceptual modeling

# Interaction/discussion (45 min)

◣ **Ralph:** why not referring to semiotics

◣ **Nicola:** reality resists;

◣ **Jochim:**
- keyword is commitment;
- various ways to come to commitments
- role in social sciences
- basic theories like speech acts are important

◣ **Yair:**
- speech act does not contradict ontology

◣ **Gabriel:**
- why did philosophers gave it up? What you have to agree is to share a common language;

◣ **Nicola:**
- philosophers didn't give up; There is a merging of 2 different schools: analytical philosophy merging with "continental" school

# Interaction/discussion (45 min)

◥ **Ramez**
  - ■ conceptual modeling approaches use different terms for the same concepts; we should clarify this instead of defining huge ontologies

◥ **Bernhard:**
  - ■ important: how are we using these languages

◥ **Vadim:**
  - ■ top level ontology will perhaps not be very huge
  - ■ should formalize the basic notions
  - ■ conceptual codeling approaches are ontological ones

◥ **Ramez:**
  - ■ if we don't agree on basic notions how can people agree on knowledge???

# Interaction/discussion (45 min)

- **Tahko:**
  - language is not the only thing, cultural envvironment, social theories, learning theories, context???
  - What's a good ontology
- **Yair:**
  - look at my slide Nr 5!
- **Nicola:**
  - the point is that we do conceptualize in a different way
  - the problem is to explain these different conceptualizations
  - we need primitives to explain differences and commonalities
  - example: dictionary, some terms are neutral w.r.t. reality: formal primitives to compare
- **Vadim:**
  - good o. approximates the set of intended models