It Is What It Does: The Pragmatics of Ontology as Language, Contract, and Content

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What is this talk about?

- What are ontologies?
  - *a theoretical framework for "Sharing Experiences and Best Practices"*
- What are they for?
  - *ways of using ontology, and why they matter*
- How do we build them?
  - *argument for a design perspective and engineering methodology*

Why Create Ontologies?

- to enable data exchange among programs
- to simplify unification (or translation) of disparate representations
- to employ knowledge-based services
- to embody the representation of a theory
- to facilitate communication among people

What is an ontology?

- An ontology is an explicit specification of a conceptualization.
- A conceptualization is an abstract, simplified view of the world that we want to represent.
- If the specification medium is a formal representation, the ontology defines the vocabulary.

Ontology and Knowledge

- The Knowledge-level:
  a level of description of the knowledge of an agent that is independent of internal format.
  - *An agent "knows" if it acts like it does.*
  - *A software agent "acts" by telling and asking.*

- An agent commits (conforms) to an ontology if it "acts" consistently with the definitions
  - *Ontological Commitments are agreements to use the vocabulary in a coherent and consistent manner.*
  - *Common ontology ≠ common knowledge.*

What isn’t an ontology?

- a database or program
  - *because they share internal formats*
- a conceptualization
  - *because it isn’t a specification - it’s a vision*
- a table of contents
  - *but wait, isn’t a Taxonomy an Ontology?*
  - *only if it defines a set of concepts*

Ontology as Language

Language = syntax + vocabulary

- Ontology.org - XML based industry standards for e-commerce data exchange
- Gene Ontology, EcoCyc, etc. - for encoding complex biological data

The role of formalism

- Formal specification helps communicate the definition of terms in reader- and context-independent ways.
- Formal language semantics allows some automated consistency checks.
- Formal axiomatization is never sufficient.
  - *It always comes down to the primitives!*

Example Ontologies: Very Formal

- **EngMath** - basis for mathematical modeling of physical systems
  - *physical quantities, units, dimensions*
- **Frame Ontology** - unifying theory for frame-based representation systems
  - *classes, relations, slots*
- **Configuration Design** - for representing a design task
  - ***components, subparts, attributes, constraints***

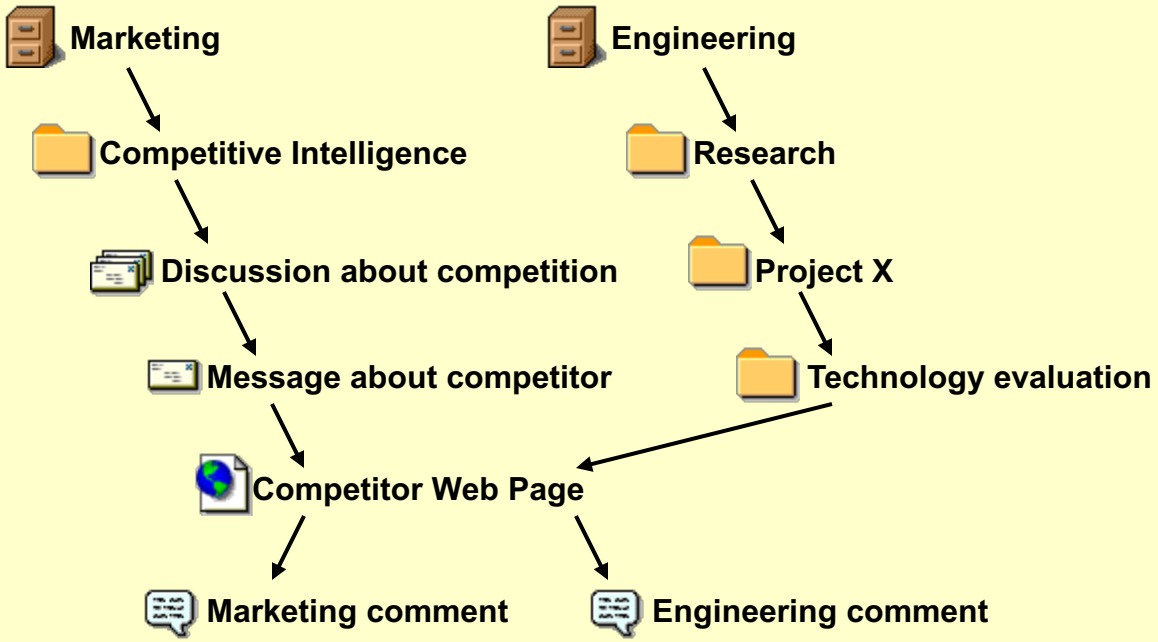
Example Ontologies: Semiformal

- **Biblio Ontology** - for unifying data about publications
  - *author, document, publication date*
- **CommerceOne's Catalogs** - for describing products and integrating buyer services
- **Extricity's Process Ontology** - for integrating processes across businesses

Example Ontologies: Informal

- **HTML Ontology** - for linking documents
  - *URLs and anchor tags*
- **Intraspect's Context Ontology** - for capturing and sharing information in its context of use by knowledge workers
  - *parent/child, document, message, comment*

Representing Context of Use



The Intraspect Ontology

- Hierarchy with typed nodes
  - *allow multiple parents, no inheritance*
- Implicit metadata (author, date, filetype)
- Explicit metadata
  - *titles and descriptions*
  - *user-defined types and attributes*
- Conversational relations
  - *next-in-thread/in-reply-to*
  - *context-sensitive annotation*

Ontology as Content

Sometimes the ontology *is* a theory.

- VerticalNet, CommerceOne - catalog entries as the basis for netmarkets
- Yahoo ontology as real estate
- library taxonomies - such as NLM initiatives for medical literature
- VT Ontologies - ontologies encoding sets of design constraints for elevators were used as inputs to knowledge services.

Ontology as Contract

Purposes of Ontologies

- data exchange
- unification/translation
- calling knowledge services
- representing theories
- human communication

Parties to the contract

- programmers
- data admins
- programmers, netbots
- scientists
- collaborators

Ontologies as Designed Artifacts

The Design Perspective

- Ontologies are designed to meet functional objectives
  - *data exchange, unification, representation, communication …*
- Representational choices are design decisions
- Design methodologies include validation, optimization against design criteria

General Design Criteria for Ontological Engineering

- **Clarity** - context-independent, unambiguous, precise definitions
- **Coherence** - internally consistent
- **Extendibility** - anticipate the uses of the vocabulary, allow monotonic extension
- **Minimal Encoding Bias** - avoid representational choice for benefit of implementation
- **Minimal Ontological Commitment** - define only necessary terms, omit domain theory

Wrap up

- Ontologies are what they do: artifacts to help people and their programs communicate, coordinate, collaborate.

- Ontologies are essential elements in the technological infrastructure of the Knowledge Age.