Let's ***Semanticise the World!!*** ***… or not??***

M.Missikoff

Lab for Enterprise Knowledge and Systems

LEKS, IASI-CNR

Summary

- The Knowledge Economy and the "***K***" factor
- Beyond Knowledge Management Systems: the Semantics
- From ***e-Enterprise*** to ***s-Enterprise***
- From ***K*** for humans to ***K*** for computers
- The role of Semantics: Towards ***SemKM***.
- SemKM in the Enterprise: the ***K-Factory***
- Just theory? Some key semantic technologies
- Many failures in the past… and today?

Why *Knowledge* is vital

- ***K***: the “oil of the third Millennium”
- The double nature of the Knowledge
  - ***K*** as a merchandise (buy, refine, stock, sell, …)
  - ***K*** as a powerful enabler (know what, how, who, …)
- To improve
  - The value of products and services
  - The wealth of a community, a region, a nation
  - The quality of life
- ***K*** must be: collected, organised, represented, stored, distributed, utilized, …

Knowledge is Modeling

Modeling is a key activity to understand a fragment of reality…

- When the modeled object do not exist yet (e.g., in **designing** a complex artifact)
- When the fragment of reality is **not tangible** (e.g., the organization of an enterprise)
- Concerns **general** (e.g., a mock-up of a car) or **specific** (e.g., the electric circuit schema) aspects
- **Different models** for the same complex entity (e.g., the *human body:* skeleton, mussels, blood vessels, …)
- **Objectives of modeling**: creating a mental imagine, communicating, exchanging information, produce value, …

General Model Theory

Three inter-related traits of a General Model Theory (H. Stachowiak, 1973)***:***

(1) *Mimetism*: Models are representative of "something";

(2) *Reductionism*: Models are reductive in the sense that they depict some but not all aspects of the phenomenon (→ ***incompleteness***);

(3) *Pragmatism*: Models are created for a purpose. The modeler creates a model with a special purpose in mind (we don't address ***Art*** here ...).

Different modeling methods

- **Concrete**, e.g., a plastic model of a building
- **Figurative**, e.g., a drawing of a car, of a road map
- **Narrative**, e.g., a text describing a landscape
- **Schematic**: schemes and diagrams that illustrate the vectorial forces in the structure of a bridge
- **Mathematic**: a system of equations that rigorously represents the air flowing in a wind tunnel, an algebraic expression representing a digital circuit

All aim at capturing Knowledge

The first Knowledge Base

Enterprise Knowledge

The 2000 Lisbon European Council indicated that Europe in 2010 will be the first Knowledge-based economy in the World

- The ***K*** as an intangible enterprise asset (K Capital), that will help the ***Darwinian leap*** of Production systems and Societies
- ICT solutions need to consider new scenarios:

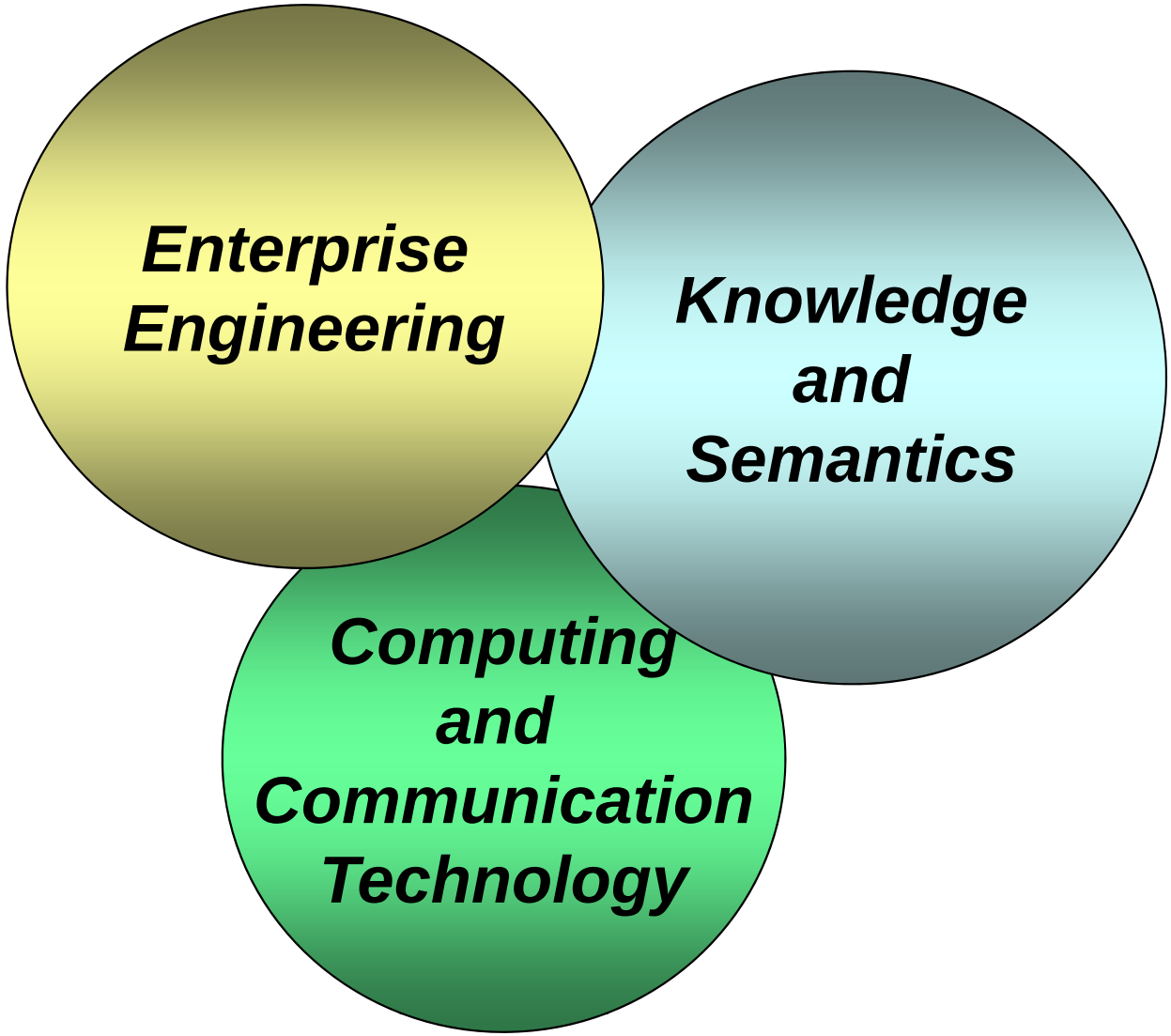
  Business & Organizational
  - Networked Enterprise
  - Virtual organizations
  - Digital Business Ecosystems

  Technological
  - Future Internet
  - Service oriented computing (SaaS)
  - Semantic Knowledge computing
- ***K*** is necessary to manage the increasing complexity and integration

Needs for Change

- **New ICT** solutions, to be effective, requires a deep understanding of:
  - **enterprise organisation**, and its evolution wrt the emerging scenario
  - **Service economy** and its new operational strategies (new organizations needs new EIS)
  - **HR** and the ever changing role of human capital, both inside and outside the enterprise; the role of stakeholders and public actors
- **Semantic Knowledge Computing** will contribute to:
  - Support the management of increasingly complex organizations
  - Support the Service-oriented economy
  - Offer opportunities that increase the quality of business

3 pillars of a synergic approach



… then, *knowledge* about what?

- The **company** itself: how it is organised, how it operates (BP), what skills (HR) are available, where can be found
- **services** and **goods** produced
- **market**, **customer** profiles, their segmentation
- **Partners** (*outsourcing*) and **providers**
- **Competitors**
- **Financial market, asset management**
- **Legislation**, recommendations, laws and regulations

… and what we do with all that *knowledge*?

- Support **decision making** for *domain experts* and *managers*
- **ICMS - Intelligent Content Management Systems** (Docs)
- **Business Process Re-engineering** (BPR), *change management*
- support **Virtual Enterprise** creation and operation
- improve **SCM** (Supply Chain Management) and **CRM** (Customer Relationship Management), **PLM** (Product Lifecycle Management)
- better allocation of people on tasks (**HRM - staffing**)
- **Education** for Intellectual Capital enhancement

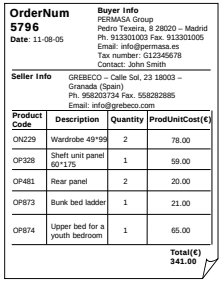
and, last but not least,

- **Intelligent integration of (heterogeneous) data and services**
- **Enterprise Application** development (especially EIS)
- Enterprise Business/Application **Interoperability**

A comprehensive view of EK

Enterprise Knowledge (EK), we consider:

- a fuzzy galaxy of any kind of **content**,
- expressed in any **human-oriented** form, but
- fully digitalized, in any **electronic** form



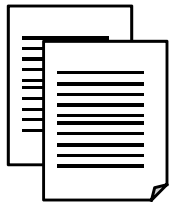
OrderNum
5796
Date: 11-08-05

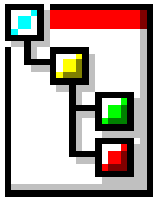
Buyer Info
PERMASA Group
Pedro Texeira, 8 28020 – Madrid
Ph. 913301003 Fax. 913301005
Email: info@permasa.es
Tax number: G12345678
Contact: John Smith

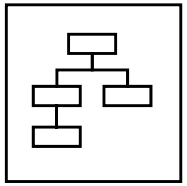
Seller Info GREBECO – Calle Sol, 23 18003 – Granada (Spain)
Ph. 958203734 Fax. 558282885
Email: info@grebeco.com

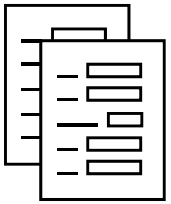
Product Code	Description	Quantity	ProdUnitCost(€)
ON229	Wardrobe 49*99	2	78.00
OP328	Sheft unit panel 60*175	1	59.00
OP481	Rear panel	2	20.00
OP873	Bunk bed ladder	1	21.00
OP874	Upper bed for a youth bedroom	1	65.00

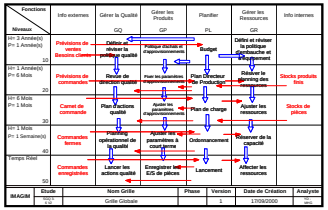
Total(€) 341.00

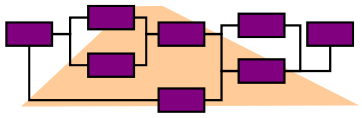












- **Computer knowledge**: traditionally software programs

Enrich Enterprise *K*

Now… inject ***Semantics*** into Enterprise ***K***: easy??

- *S-Knowledge* elicitation and **acquisition**
- *S-Knowledge* **representation**
- *S-Knowledge* update and **maintenance**
- *S-Knowledge* **validation**
- *S-Knowledge* search and **retrieval**
- **Reasoning** and *s-knowledge* creation
- *S-Knowledge* display and **presentation**
- Actual **use** of *s-knowledge* in all the **enterprise activities**

The ***s-Enterprise***, a first intuition

Rephrasing a famous interview of 35+ years ago

"The question which asks how to use the semantic technology* in the enterprise, is, in short, the wrong question. A better formulation is to ask how the enterprise should be run given that sem-tech exist. The best version of all is the question asking what, having sem-tech, the enterprise now is."

Stafford Beer, 1972

* originally: ***computer***

Knowledge: Two forms, one content

Human-oriented knowledge, can be understood even if:

- Fuzzy, incomplete, often ambiguous
- Semantics heavily contextualised
- Text, image, sound, video, drawing, …

Machine-oriented knowledge, to be “understood*” must be:

- Precise, complete and unambiguous (hopefully!)

* Undestanding happens when an actove entity modifies its behaviour according to the acquired knowledge

The Semantic Convergence

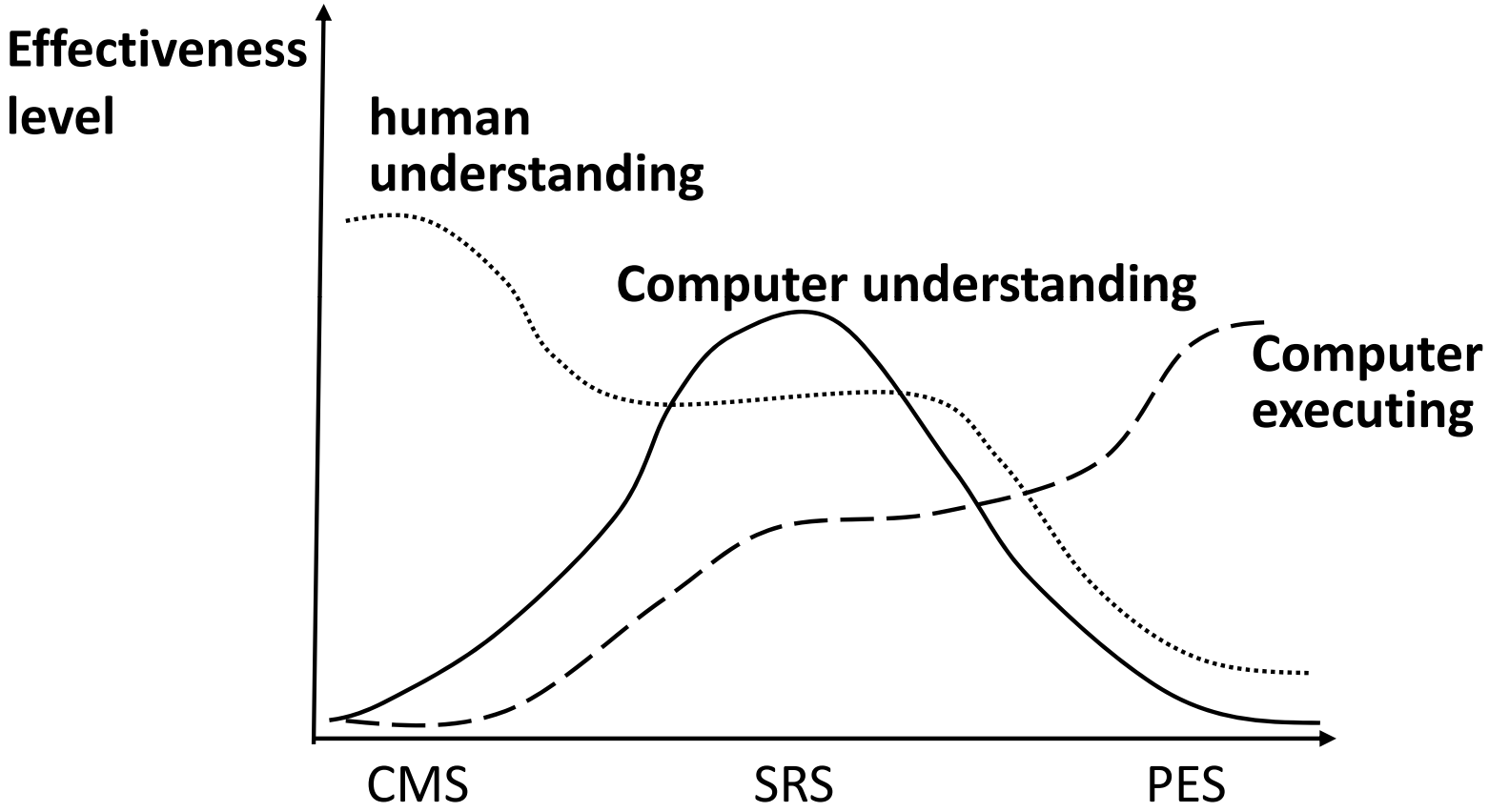
- Towards an epochal convergence
- The **Knowledge Convergence** between humans and computers

Despite:

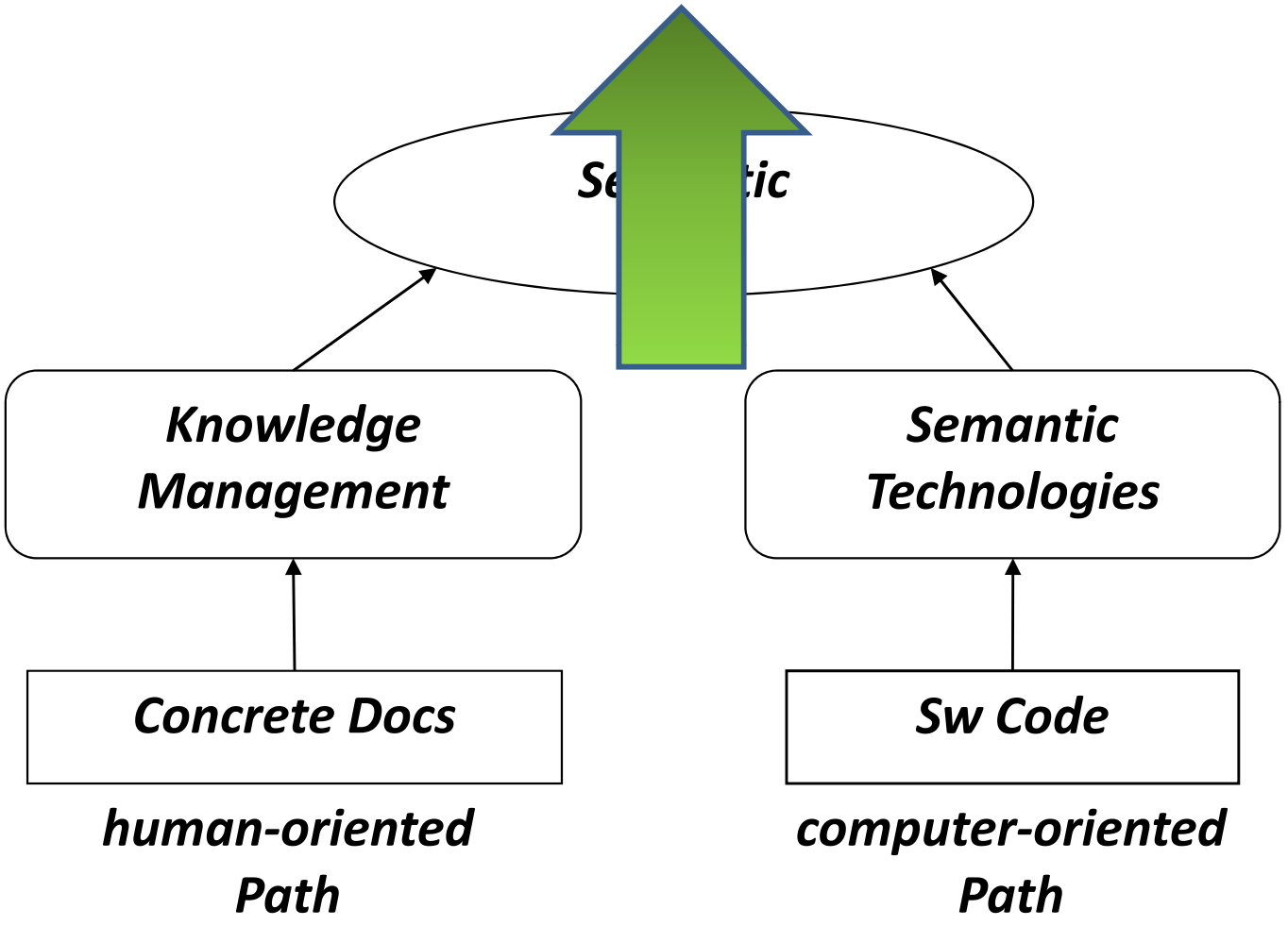
- Different forms, different coding, different standards, different terminology, different …
- Same content will be avilable for both, i.e., the

Semantics

The three paths



Two Converging Paths: the Third Way



The Third Way – The Third K

A **Formal Computable Framework**, that includes

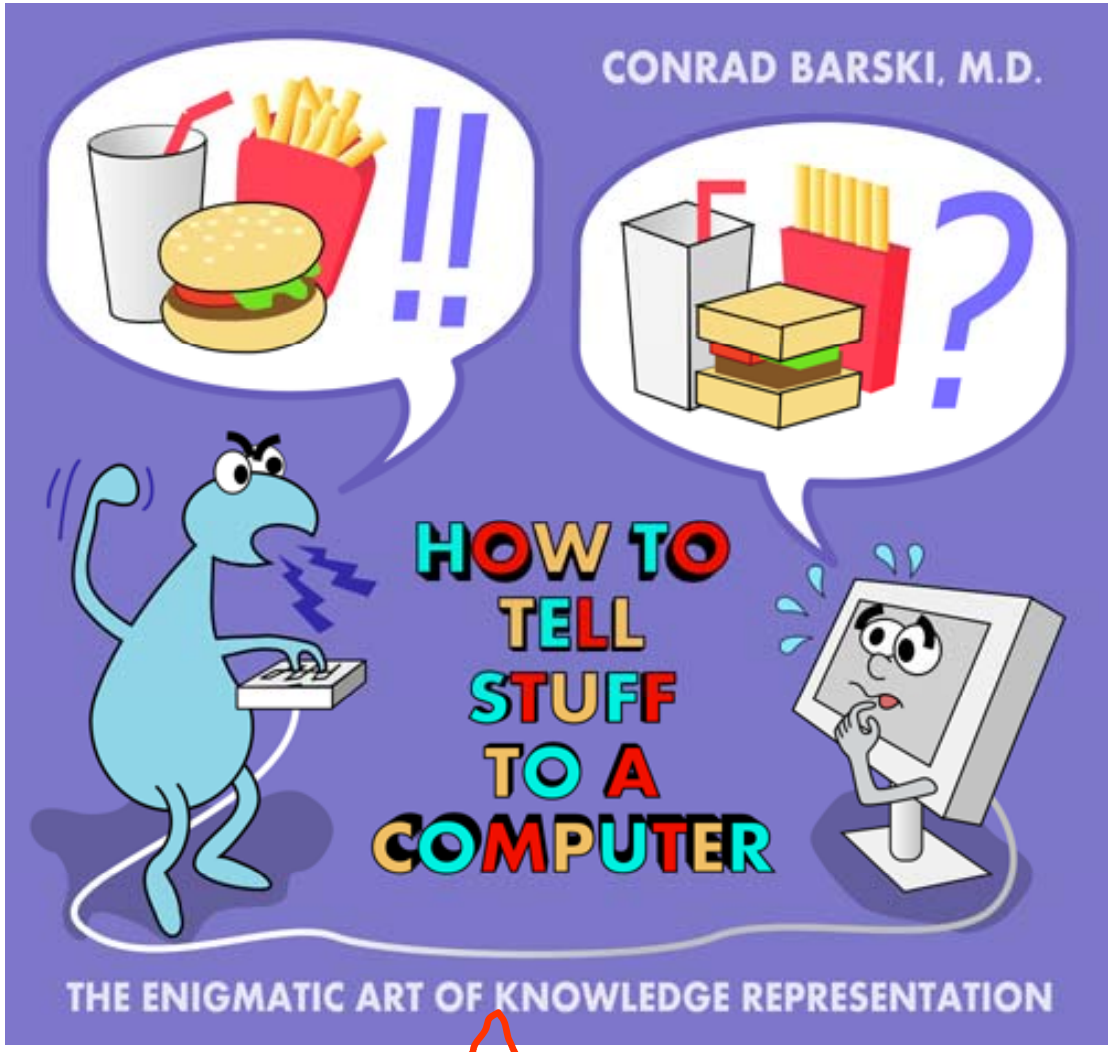
- **Rich Formalisms**, for the computer, but with clear, intuitive human-oriented representations
- **Semantic Apparatus**, to relate the theory to the real world entities
- **Computation Environment**, to elaborate the knowledge at the two key levels:
  - Organise it, manage it, provide its evolution
  - Use it to solve problems

Advanced Knowledge Processing Environment

Aimed at

- Check for **K quality** (e.g., absence of contradictions)
- Create **correlations** among knowledge elements
  - Equivalence, Inclusion, overlapping, disjointness
  - Similarity, alignment, search and discovery
  - Mappings and transformations (lossless, lossy)
- Derive **new knowledge** (e.g., diagnosis, decision making)
- **Synthesize** new knowledge (e.g., planning, BP)

Semantic-K Acquisition



The new role of Semantic-K Mining in Enterprise documents

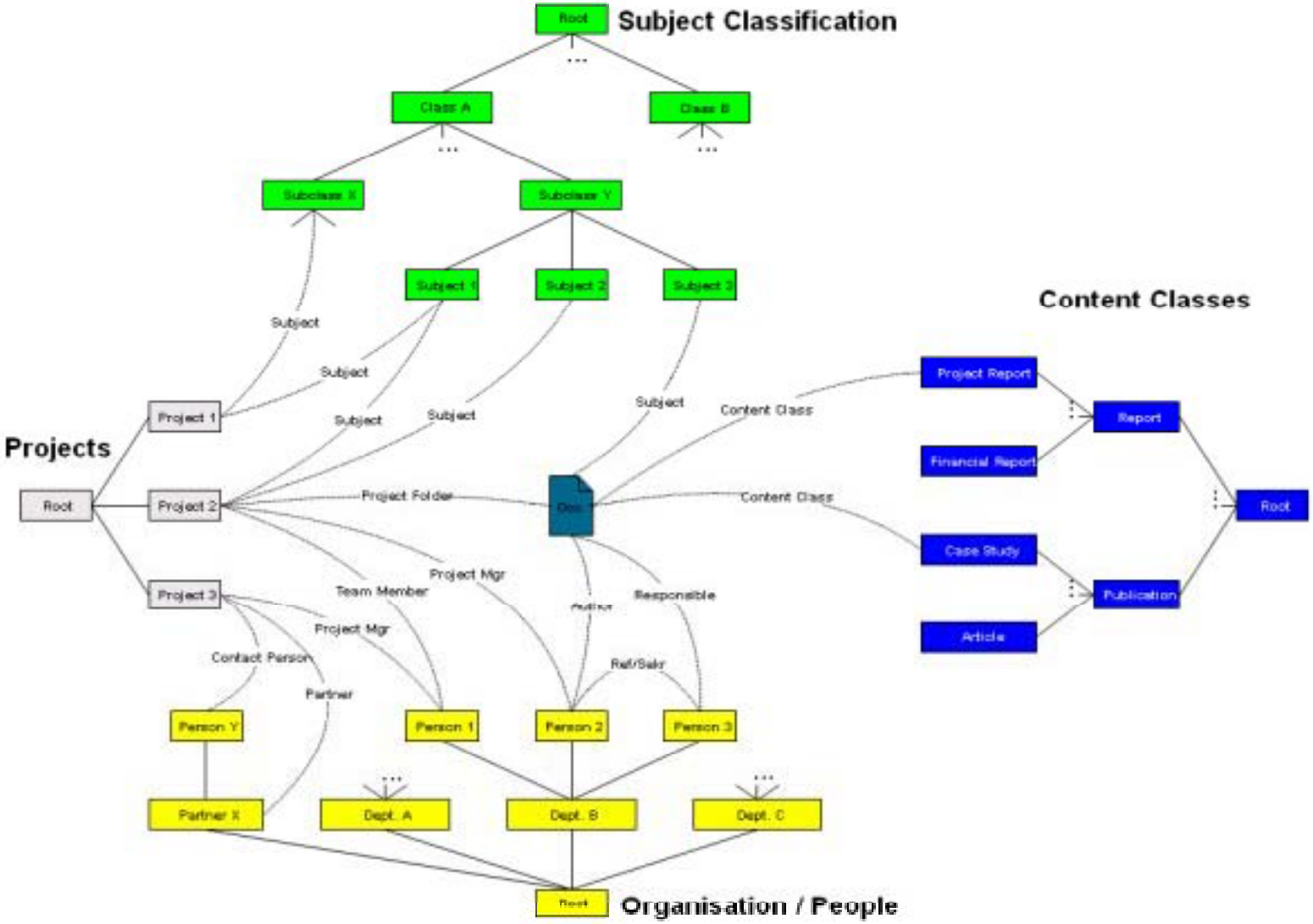
How do we represent Knowledge Semantics?

*"…To solve really hard problems, we'll have to use several **different SK** representations. This is because each particular kind of representation paradigm has its own **virtues** and **deficiencies**, and none by itself would seem adequate for all the **different** functions and **situations** … "*

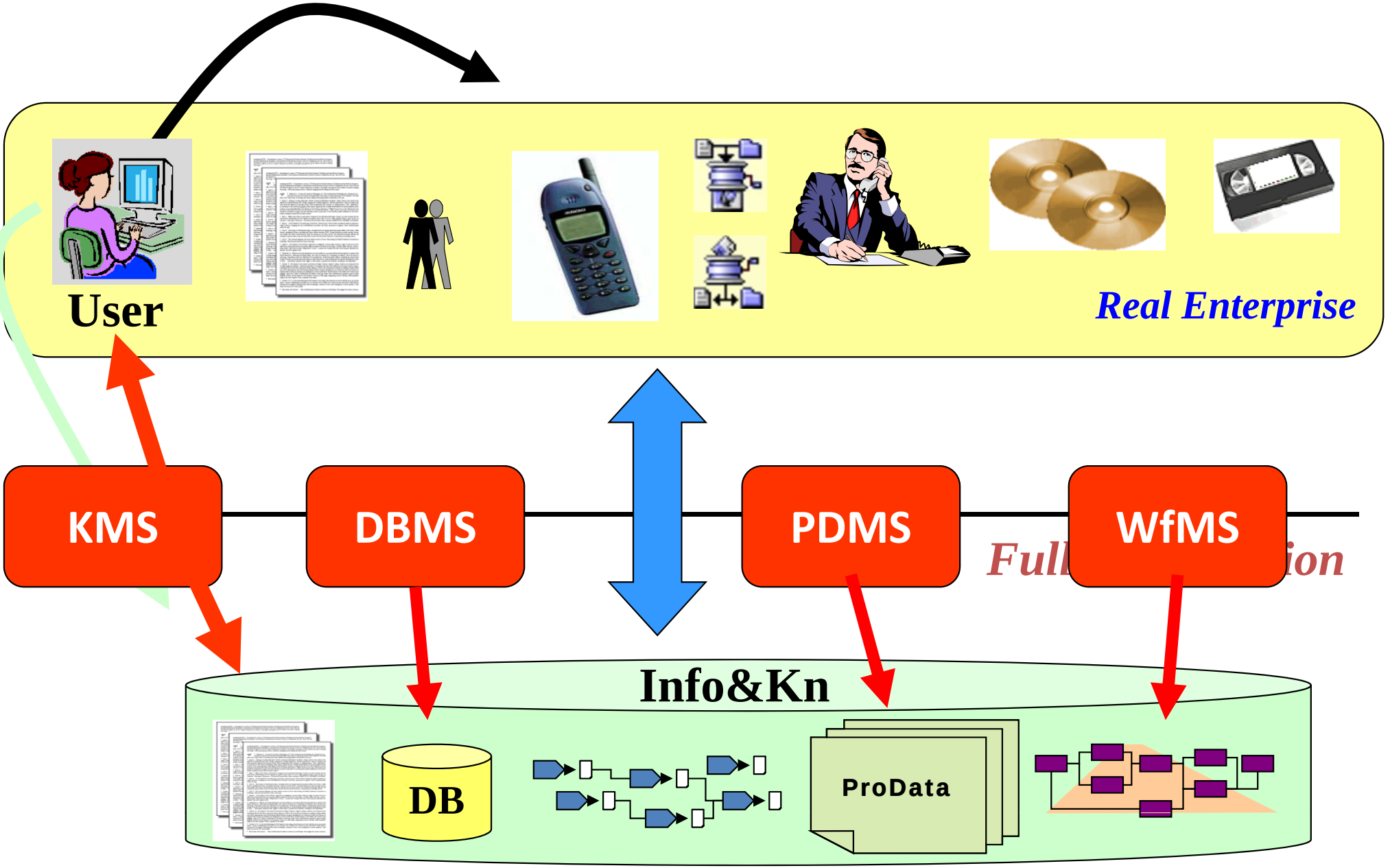
(Marvin Minsky)

Enterprise Semantic Knowledge

Towards Enterprise Semantic Knowledge



The *e-Enterprise*



EIDiF: Enterprise Image in Digital Form

From *e-Enterprise* to *s-Enterprise*

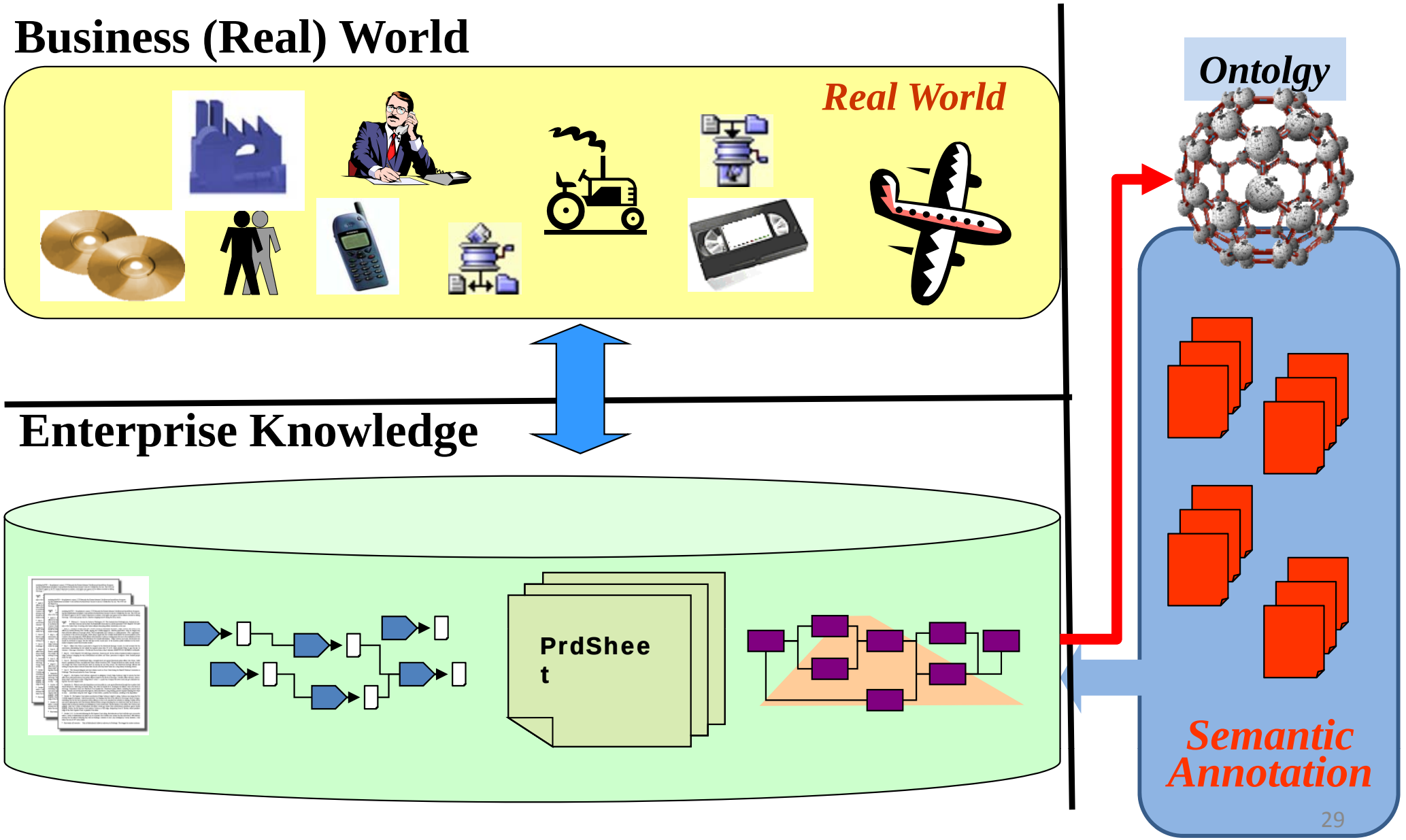
- Lost in an ocean of information and knowledge
- **Mission 1: to know all the knowledge we have**
- Search and retrieval based on concepts and not on **keywords**
- Identify the essence of the Enterprise Knowledge: **Ontology**
- Connect Information and Knowledge to the Ontology: **Semantic Annotation**

Why ontologies?

… Given a domain, its ontology forms the heart of any system of knowledge representation … Without ontologies (i.e., the explicit underlying conceptualizations) knowledge representation is largely incomplete …

(B. Chandrasekaran, Jorn R. Josephson, V. and Richard Benjamins)

The Semantic Enterprise



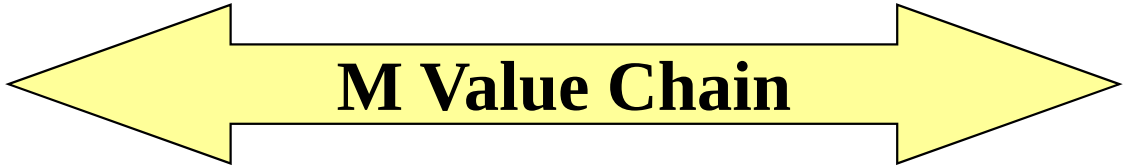
The Semantic Knowledge Factory

Two Spaces

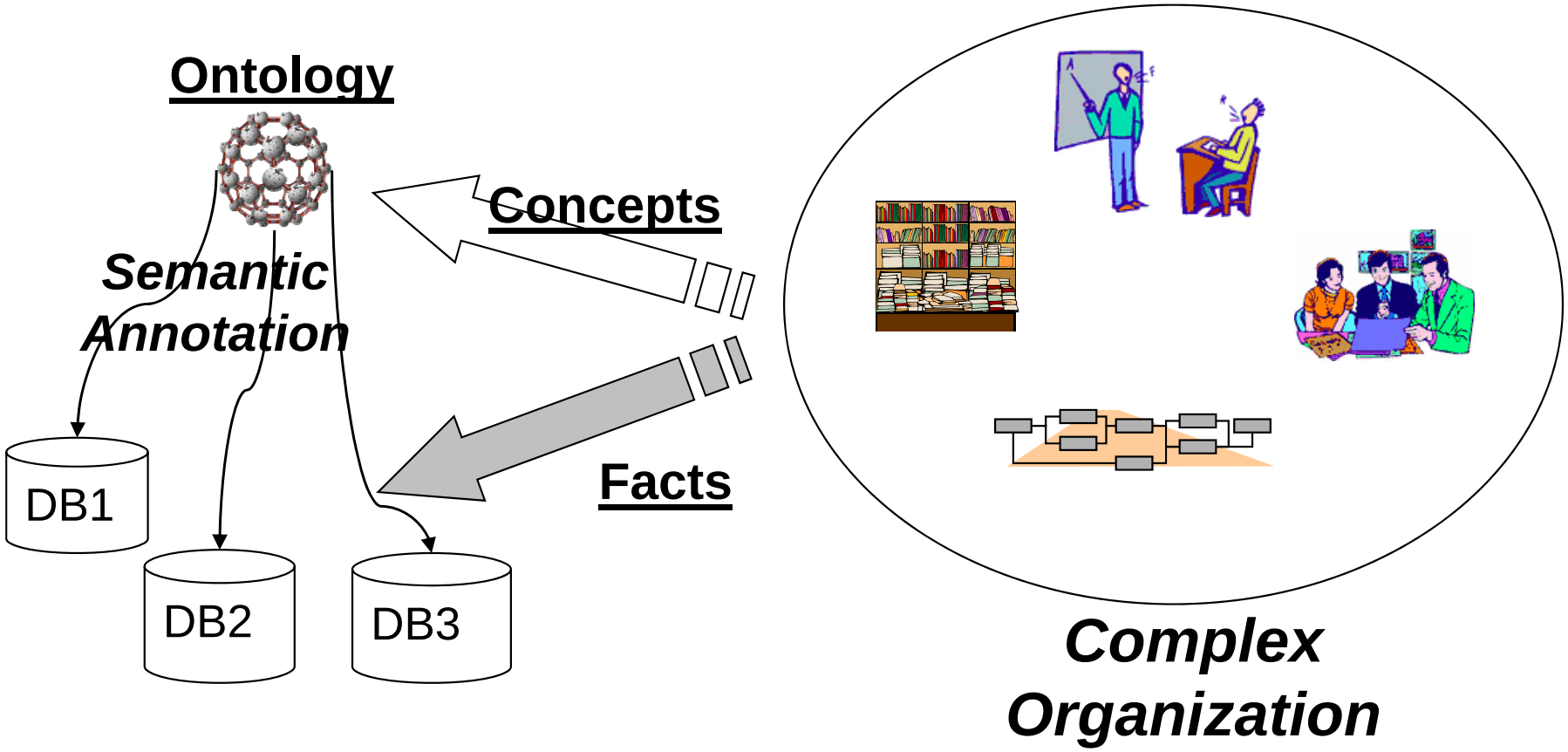
The learning Organization

(intangible dimension)

(concrete dimension)

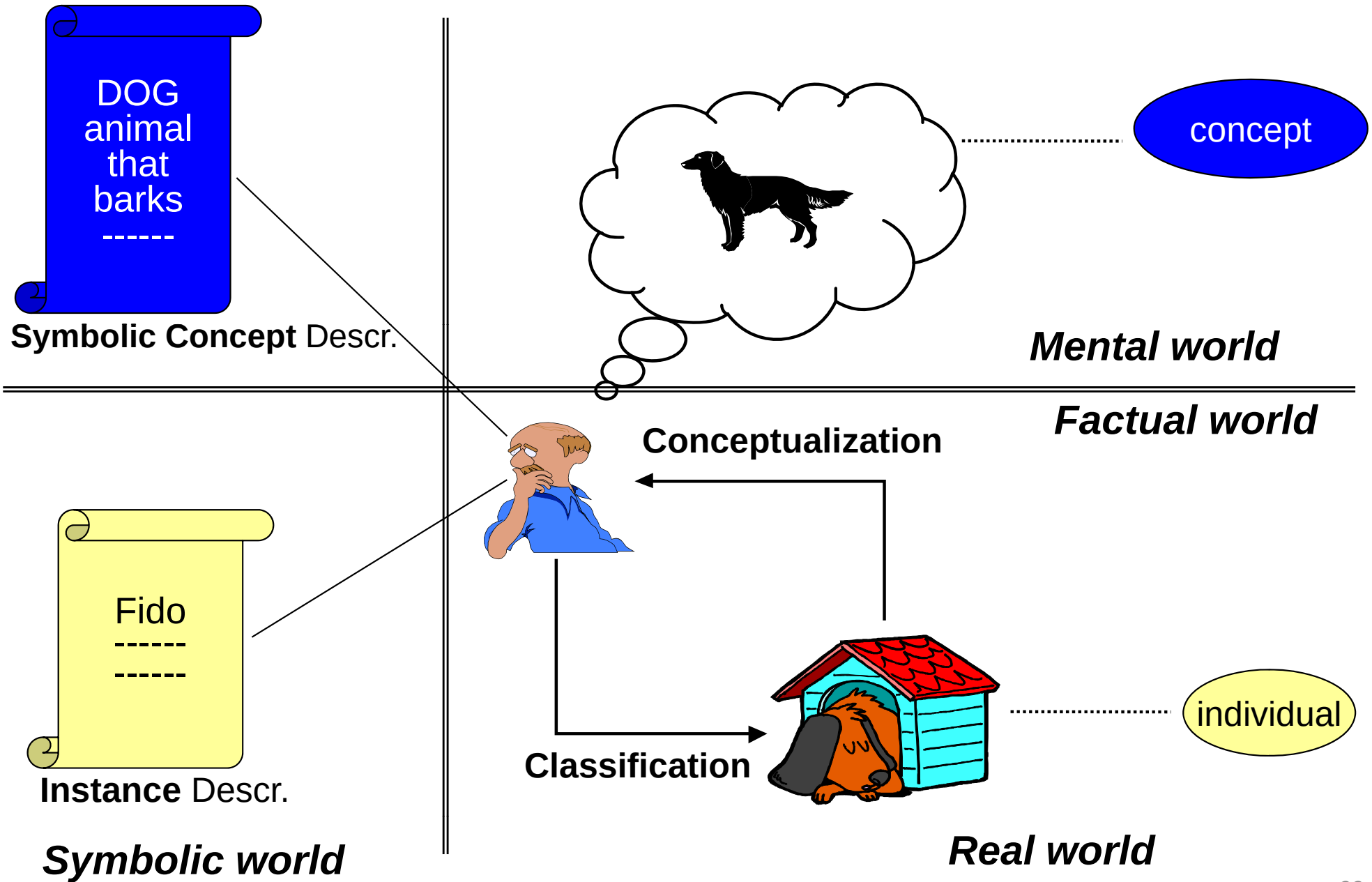


Building a SemKM

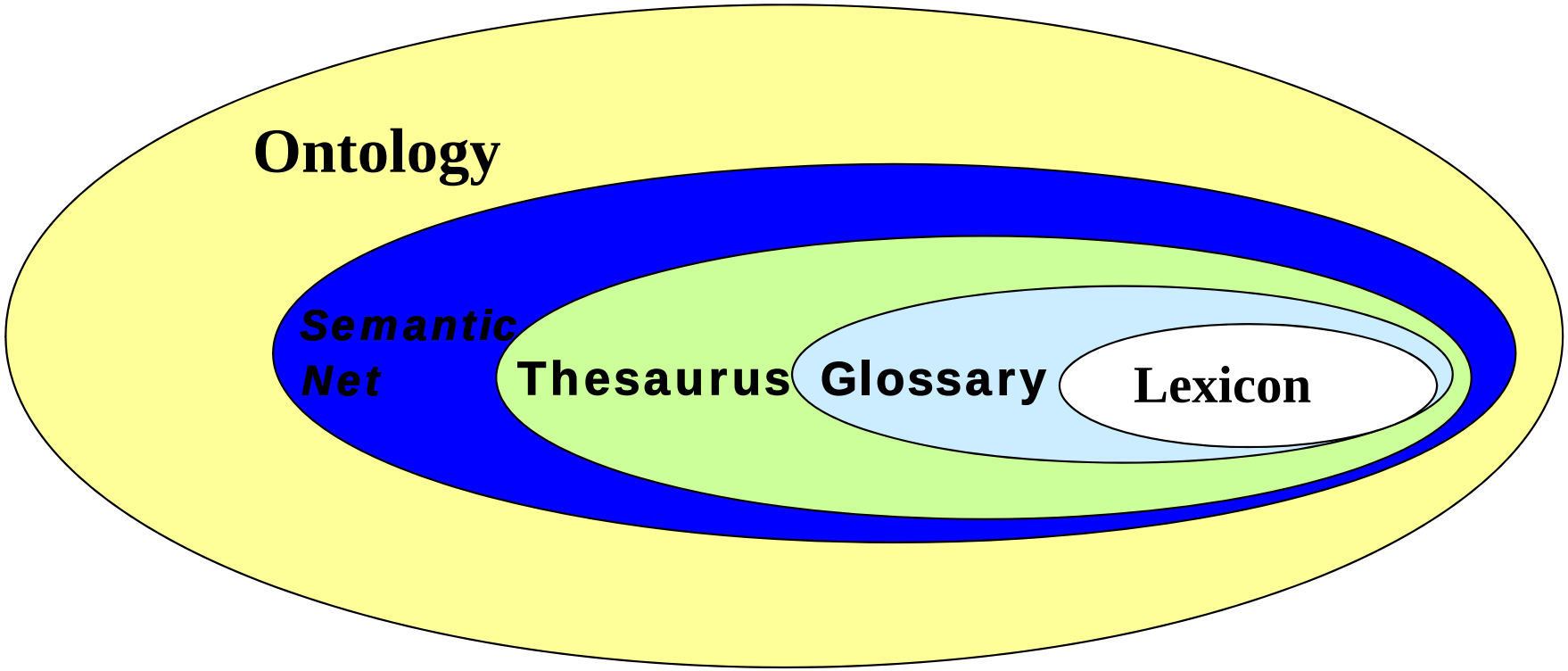


No revolution: an incremental approach

Conceptualization & Instantiation



From Terminology to Ontology



Ontology building methodology: **UPON**
(Information Systems Journal, April 2009)

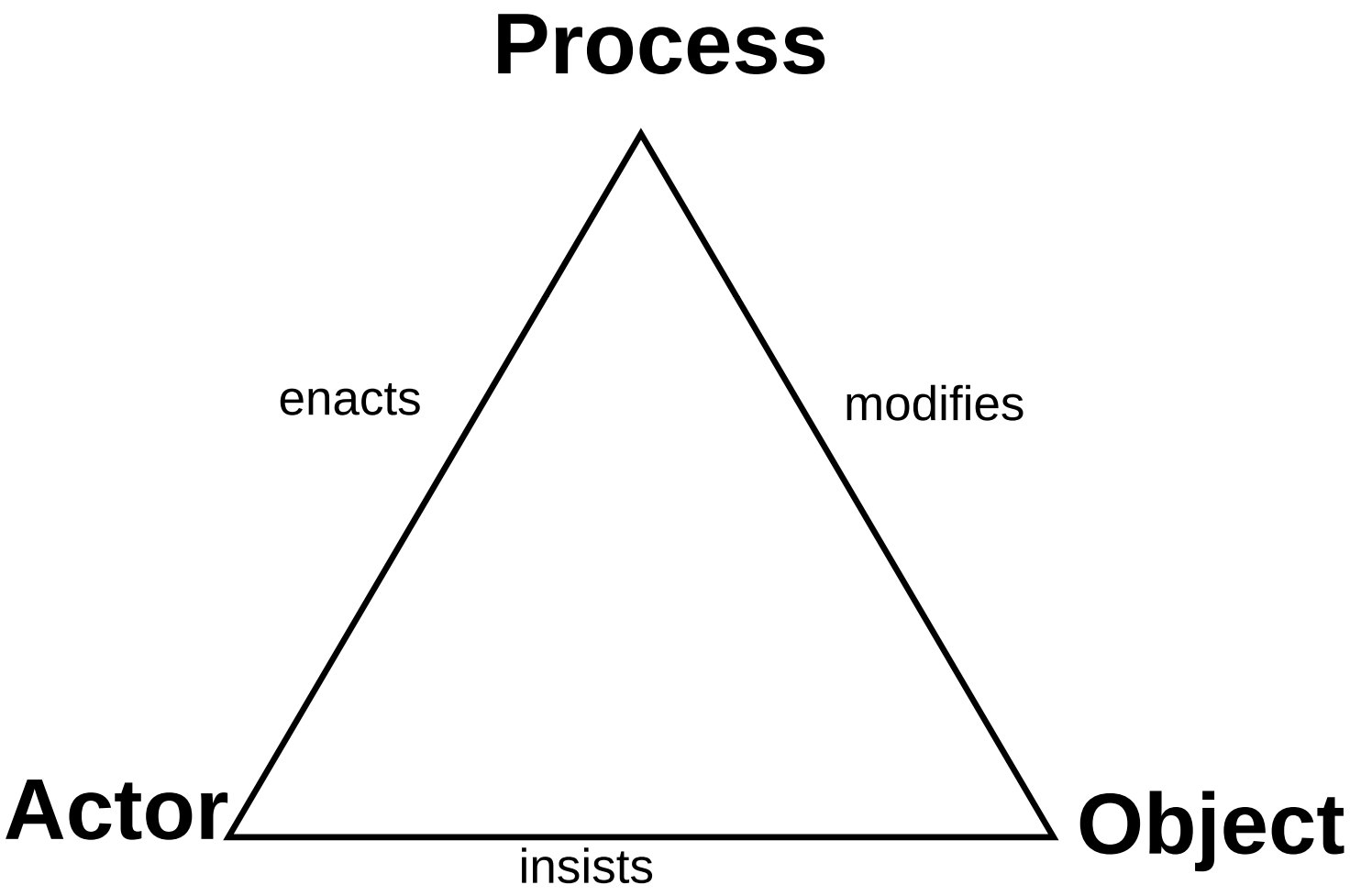
An Enterprise Ontology Framework

OPAL – Object, Process, Actor

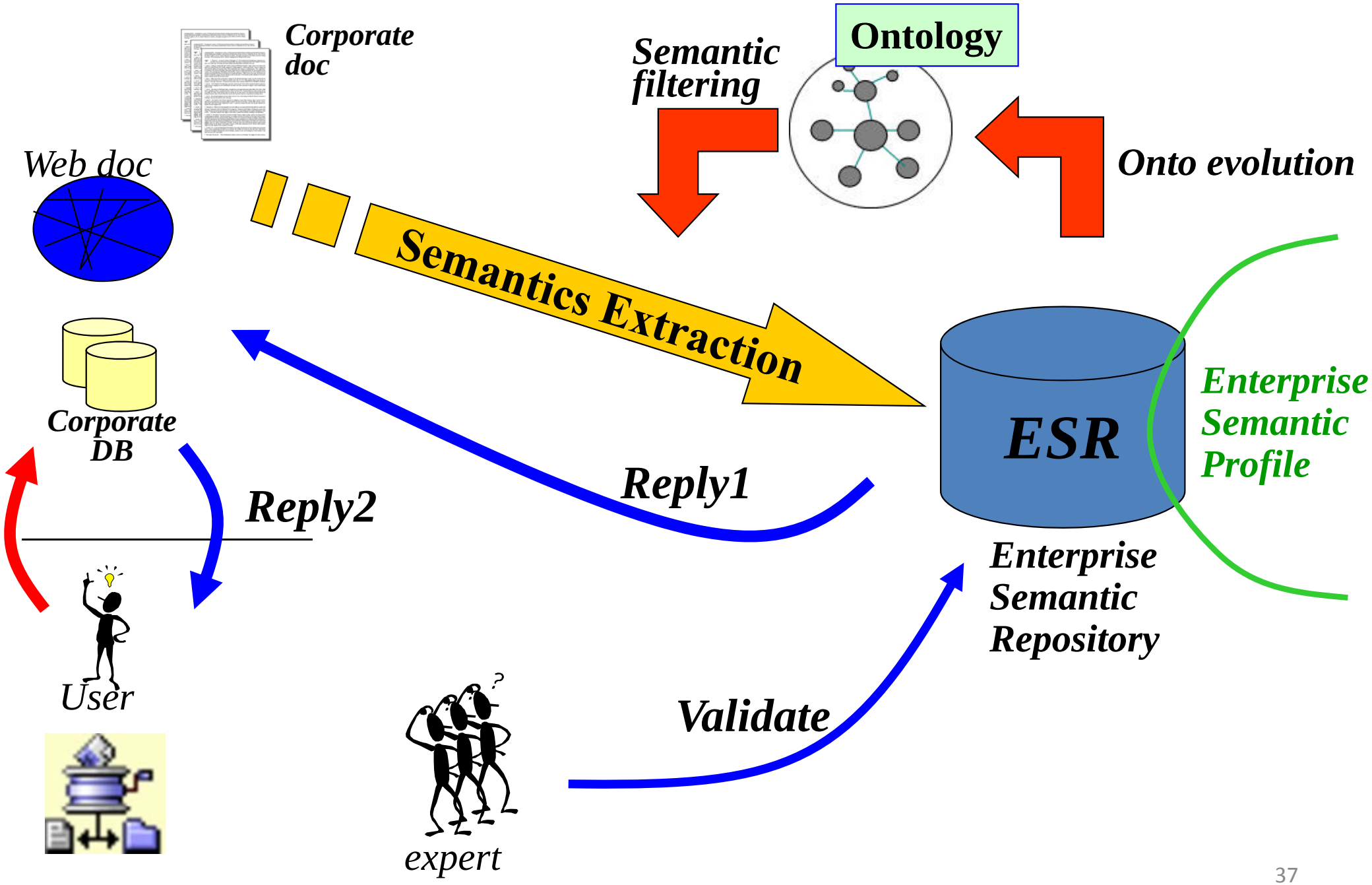
- **Object**
  - Passive entity, whose state may change by means of the effect of a process
- **Actor**
  - Active entity, capable of performing a process
- **Process**
  - Activities performed by actors, aimed at modifying entities

Then: properties, events, goals, rules, ...

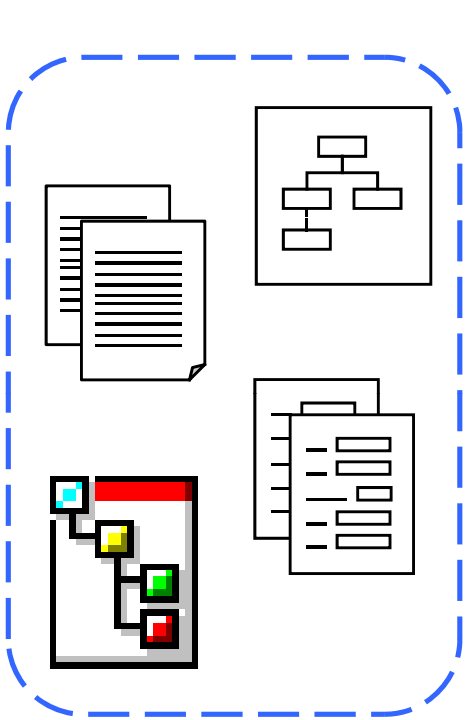
OPAL Golden Triangle



K lifecycle and Semantic Enrichment

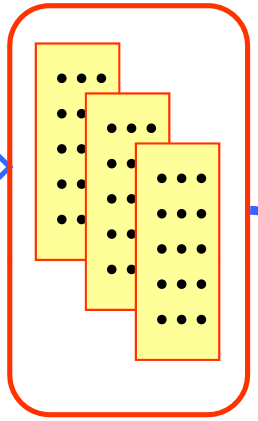


Mass Ontology Building



Enterprise DigIm

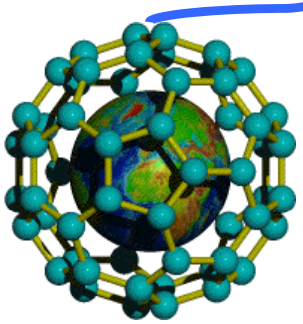
Term-GlossX



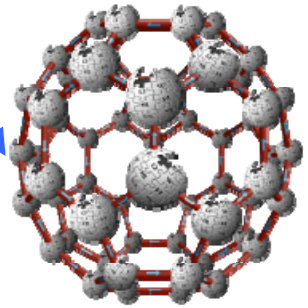
Term Vectors

Domain Exp Ontology Eng

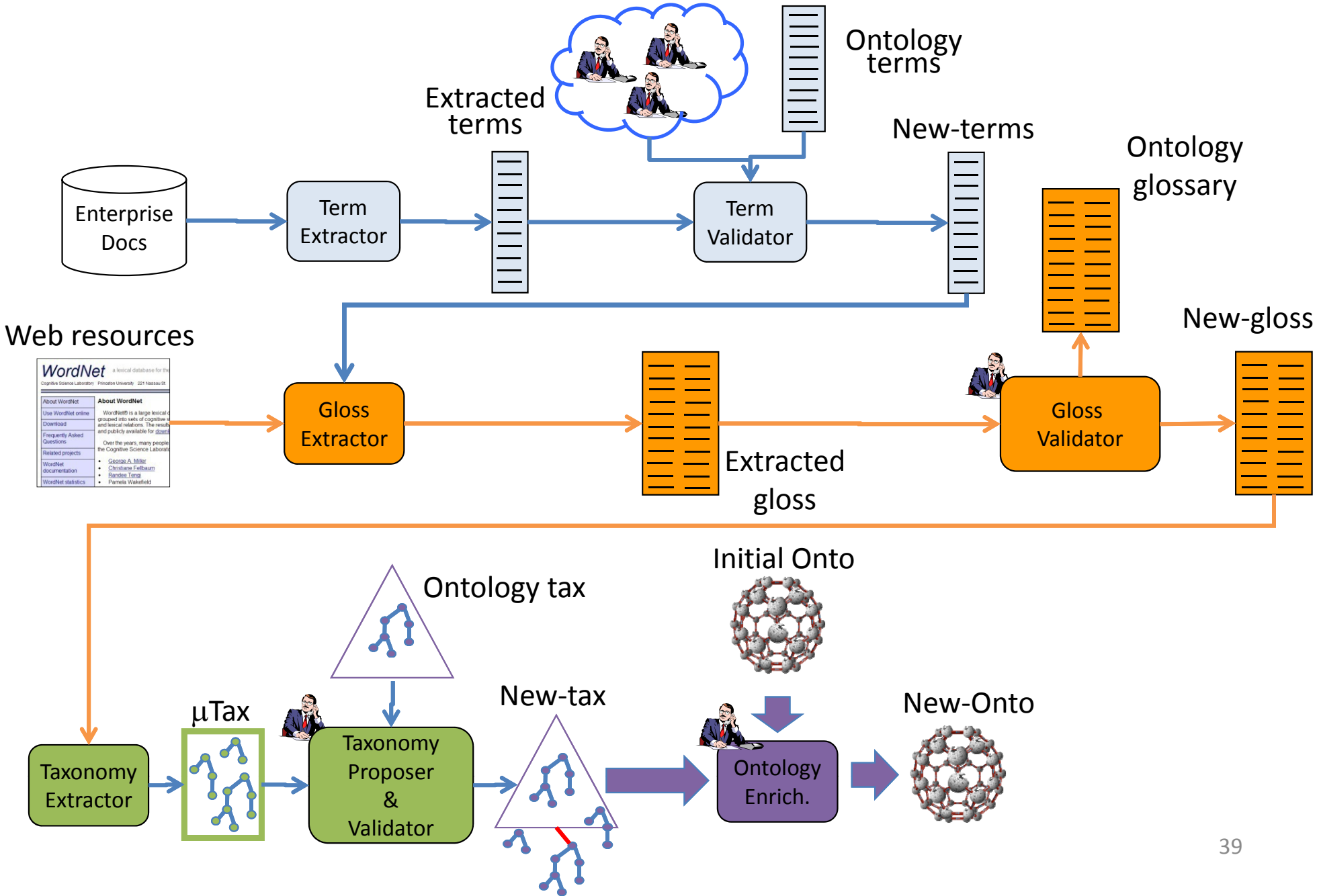
OntoBuild



Web Glossaries, Thesauri, Ontologies



Mass Ontology Building-2



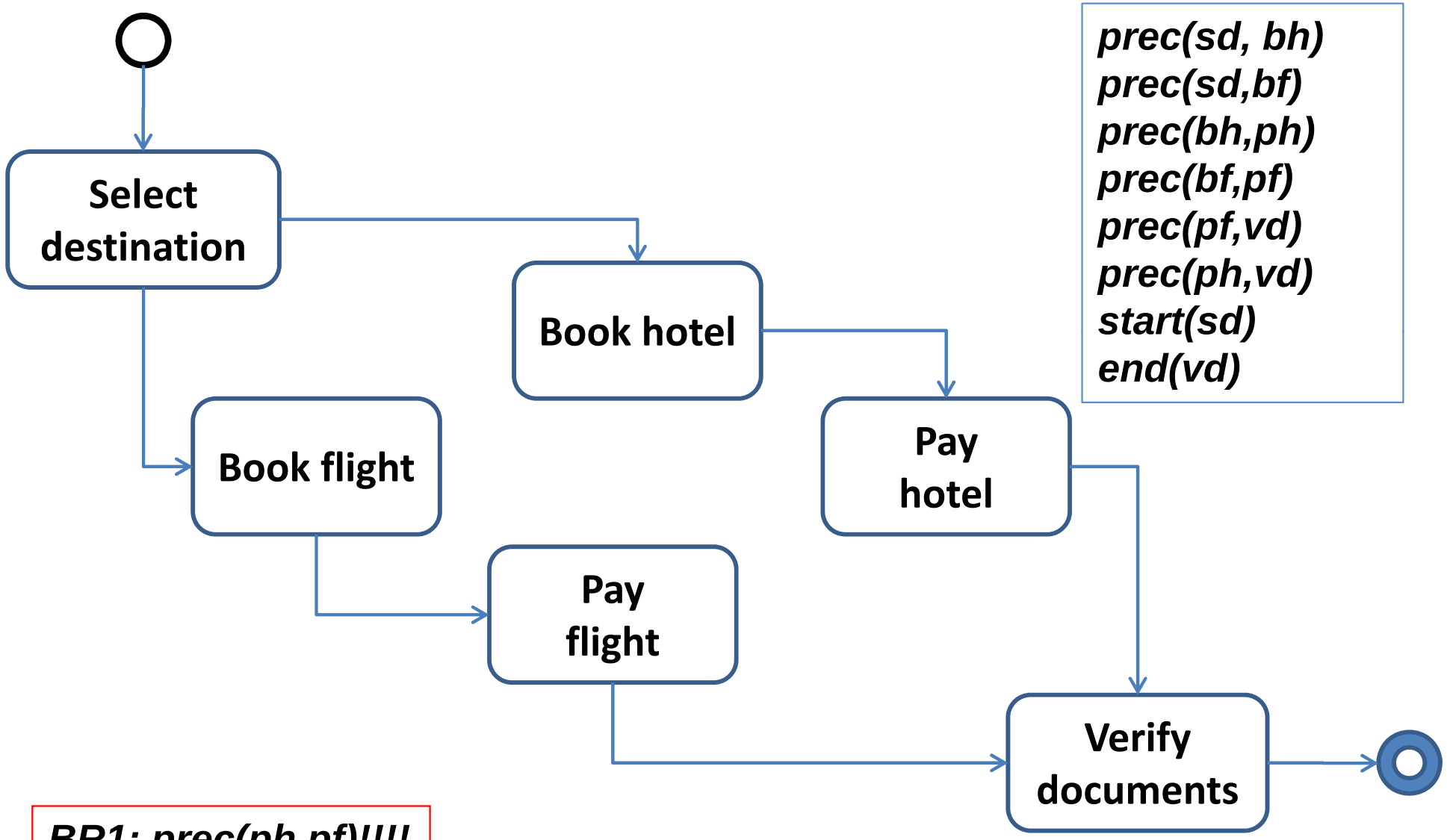
Towards Process Ontologies

A simple approach:

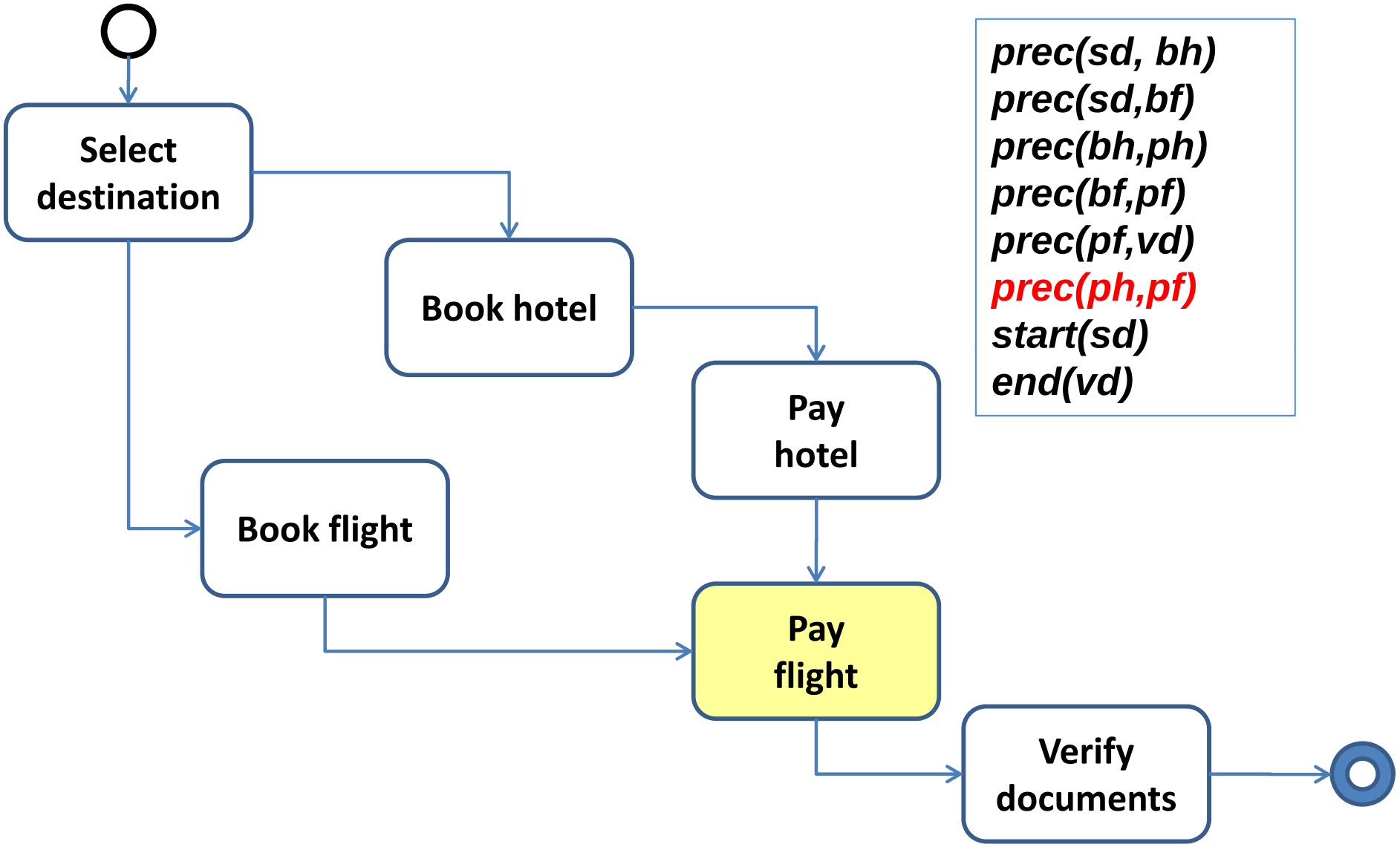
Adding the ***PREC*** construct

From OPAL to BPAL

A simple BP

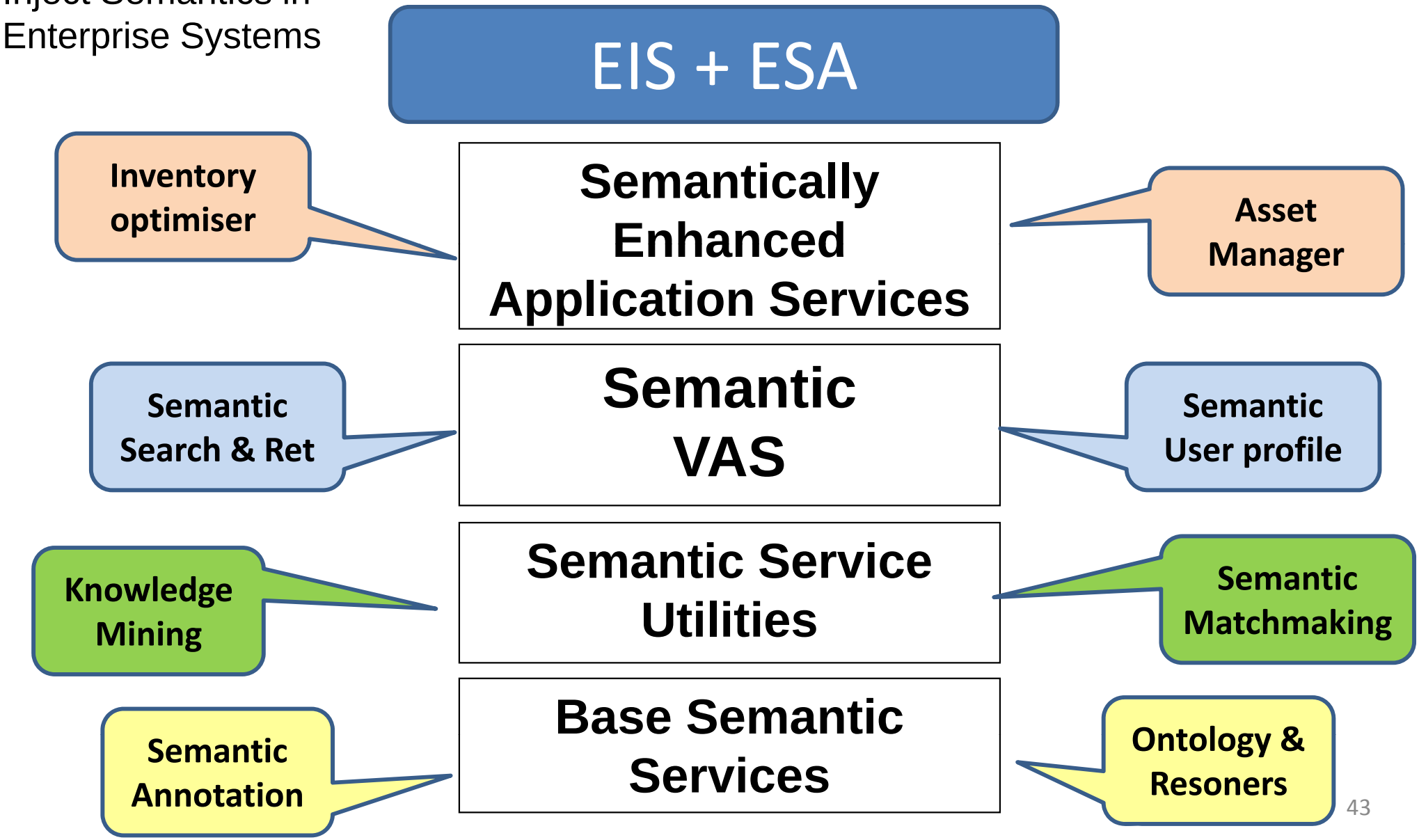

Select destination
Book hotel
Book flight
Pay hotel
Pay flight
Verify documents
prec(sd, bh)
prec(sd,bf)
prec(bh,ph)
prec(bf,pf)
prec(pf,vd)
prec(ph,vd)
start(sd)
end(vd)
BR1: prec(ph,pf)!!!!

A simple BP + BR

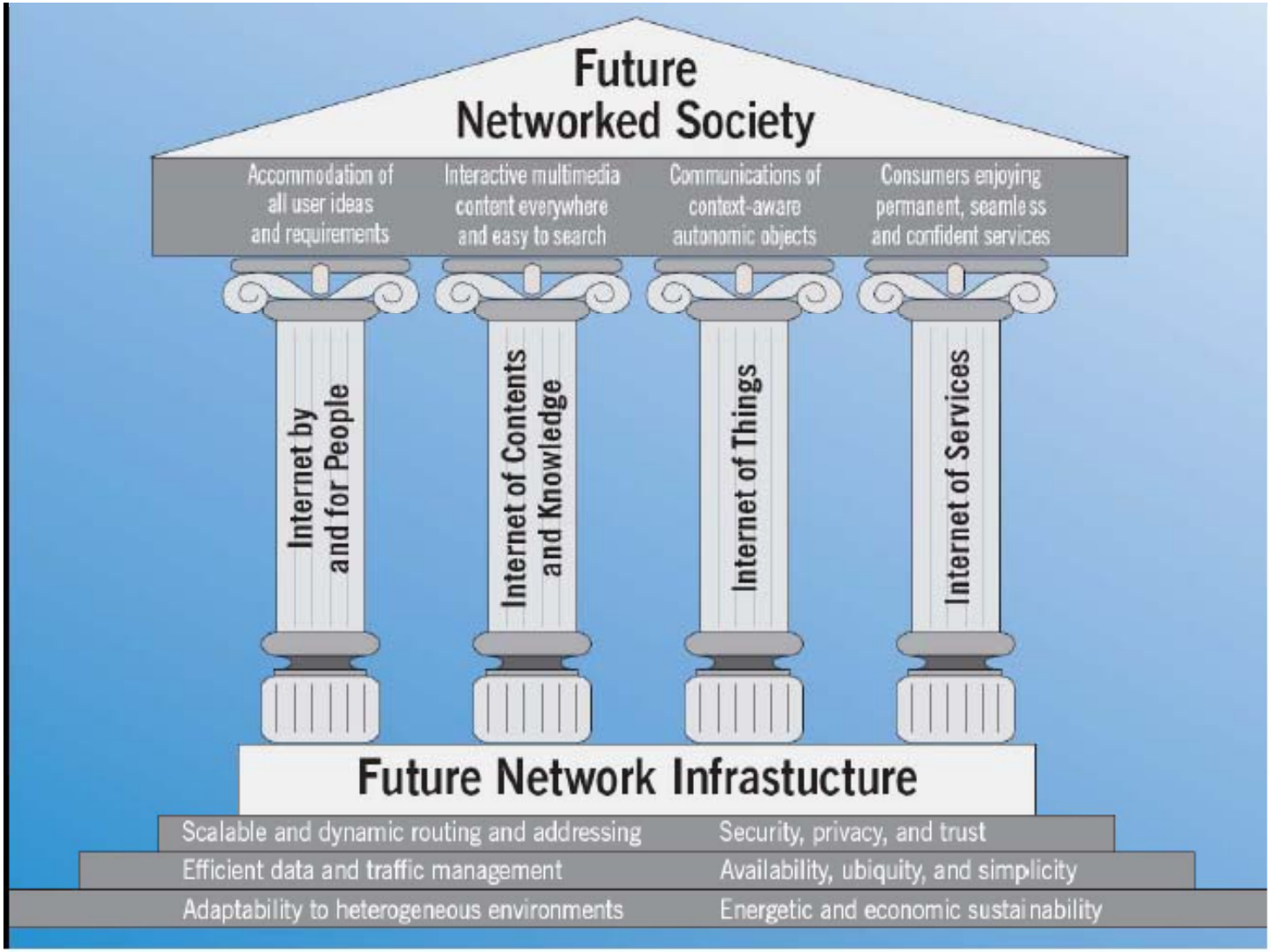


Where is the Tech going

Inject Semantics in Enterprise Systems



Future Internet



Conclusion

- We are going through an unprecedented socio-economic transformation
- Probably, the global scenario will never be as it used to be
- Globalization is really coming
- Enterprises need to deeply change
- Knowledge will surely be “the oil of the third millennium”
- But Knowledge without semantic technologies will be like crud oil without refineries.

Conclusions

- We refer to **Semantics** as the formal content of a body of (digital) knowledge
- **Formal Semantics** is needed to allow computers to have a comprehensive view of reality
- **Semantic Technologies** (ST) develop the enabling services towards semanticization of the world
- **Ontology Building** and **Semantic Annotation** are the prerequisite (both costly and time consuming)
- To proceed, we need a higher level of **automation** in the **Semanticization** Processes
- Why we may succeed today, where others failed in the past?

B'cause we restrict the scope, we reduce ambition.

The evident trend

Continuous development of:

- a rich collection of formal theories
- precise models for computers to meaningfully manage:
- increasingly large fraction of the business knowledge,
- covering the large majority of activities, behaviours, objects, and actors involved in business transactions.

Essential Bibliography

B. Avron, and E. A. Feigenbaum, editors. 1981. **The Handbook of Artificial Intelligence**, Volume 1: 143. (Reading, MA: Addison-Wesley, 1989)

Chandrasekaran, B. and Jorn R. Josephson, V. Richard Benjamins. 1999. What Are Ontologies, and Why Do We Need Them? IEEE Intelligent Systems. 14 (1)

John Sowa. Knowledge Representation: Logical, Philosophical, and Computational Foundations. 2000. Pacific Grove: Brooks/Cole.

R. J. Brachman, H. J. Levesque; *Knowledge Representation and Reasoning*, Morgan Kaufmann, 2004