The Abdus Salam
International Centre for Theoretical Physics

United Nations
Educational, Scientific and
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IAEA
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Knowledge Representation Methods and their Application

P. PUHR-WESTERHEIDE
GRS mbH Forschungsinstitute
Boltzmannstrasse
P.O. Box 1221
85748 Munich
GERMANY

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School of Nuclear Knowledge Management

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Peter Puhr-Westerheide

Gesellschaft für Anlagen- und Reaktorsicherheit (GRS) mbH
ppw@grs.de T. +49 (0)89 32004 353

Examples of well Introduced Shareable Knowledge Representations

- Operating manuals
- Patent specifications
- Medical treatment prescriptions
- Text books

Some Tools for Semantic Net and Knowledge Representation

- Intelligent Views http://www.i-views.de
- Ontoprise http://www.ontoprise.de
- Concept Map (Cmap) http://www.ihmc.us
- Protégé http://www.smi.stanford.edu/projects/protege
- MindMap http://www.conceptdraw.com/en/products/CDPMindMap
- ThinkMap http://www.plumbdesign.com/products/thinl
- TouchGraph http://www.touchgraph.com
- StarTree http://www.inxight.com/map
- TheBrain http://www.thebrain.com

Knowledge Representation

- To make knowledge shareable, its representation is of interest.
  - In the scientific / technical / business / administrative world, it is custom to record knowledge representation
- Reports, descriptions w/o formalisms
- Metadata, taxonomies, semantic nets, ontologies
- Canonical representation: no hope
  - One unaccomplished hope was that a canonical representation of knowledge could be achieved, i.e. a unique representation without redundance. Except for special cases, uniqueness is nearly nowhere procurable. As an outcome, various representations of the same knowledge area can hardly be compared to show their equality.

Recent Knowledge Representation

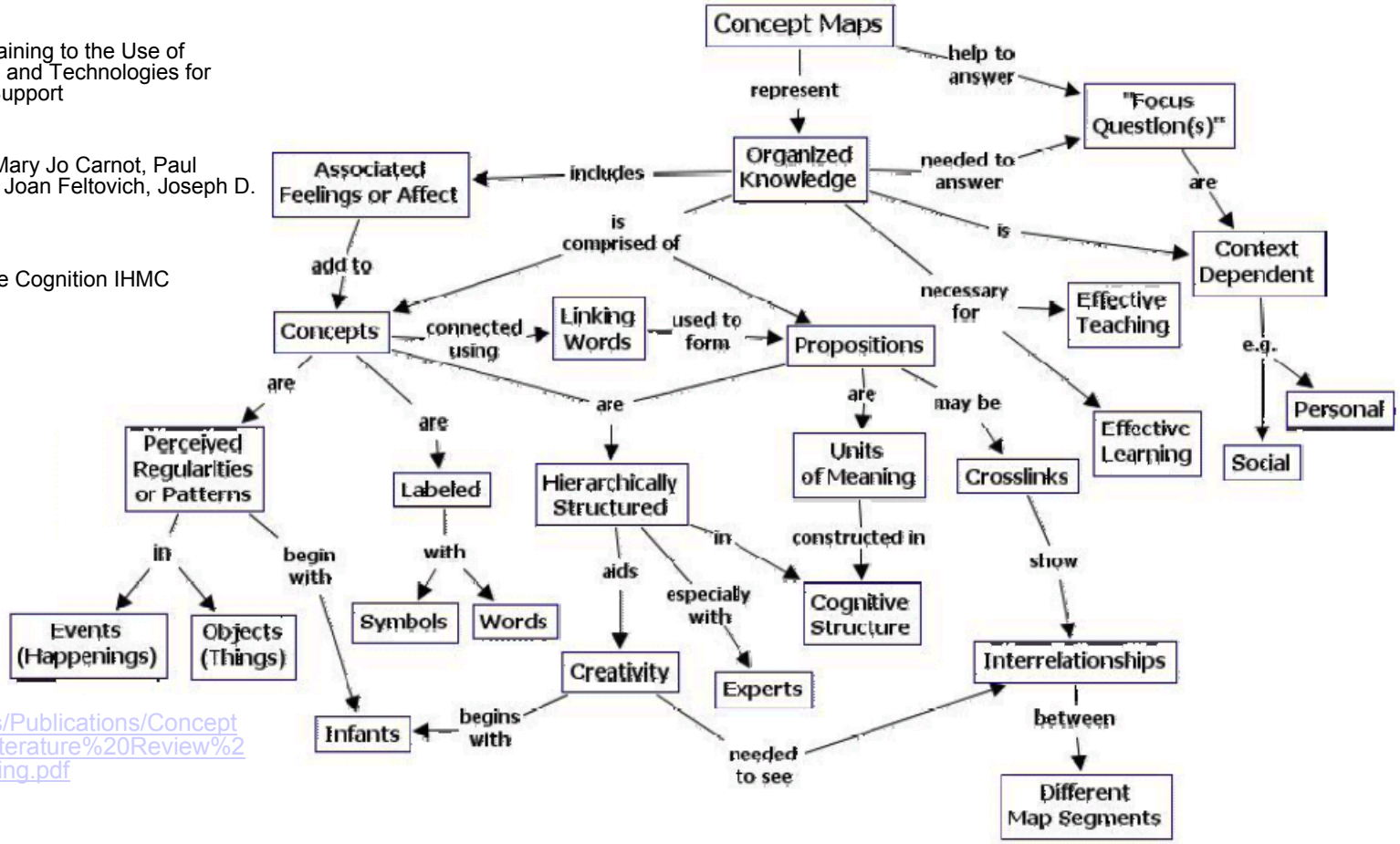
- “Classical” Web Sites
  - High maintenance efforts
- Dossiers, compendiums, textbooks
  - Mainly textual, with links to important documents etc.
  - Little flexibility, difficult to keep up to date
- Wikis (e.g. the Free Encyclopedia http://www.wikipedia.org)
  - promising development: “dynamic” , self- organising collaboration on web documents

Knowledge Representation: A Cmap on Concept Maps

From: A Summary of Literature Pertaining to the Use of Concept Mapping Techniques and Technologies for Education and Performance Support

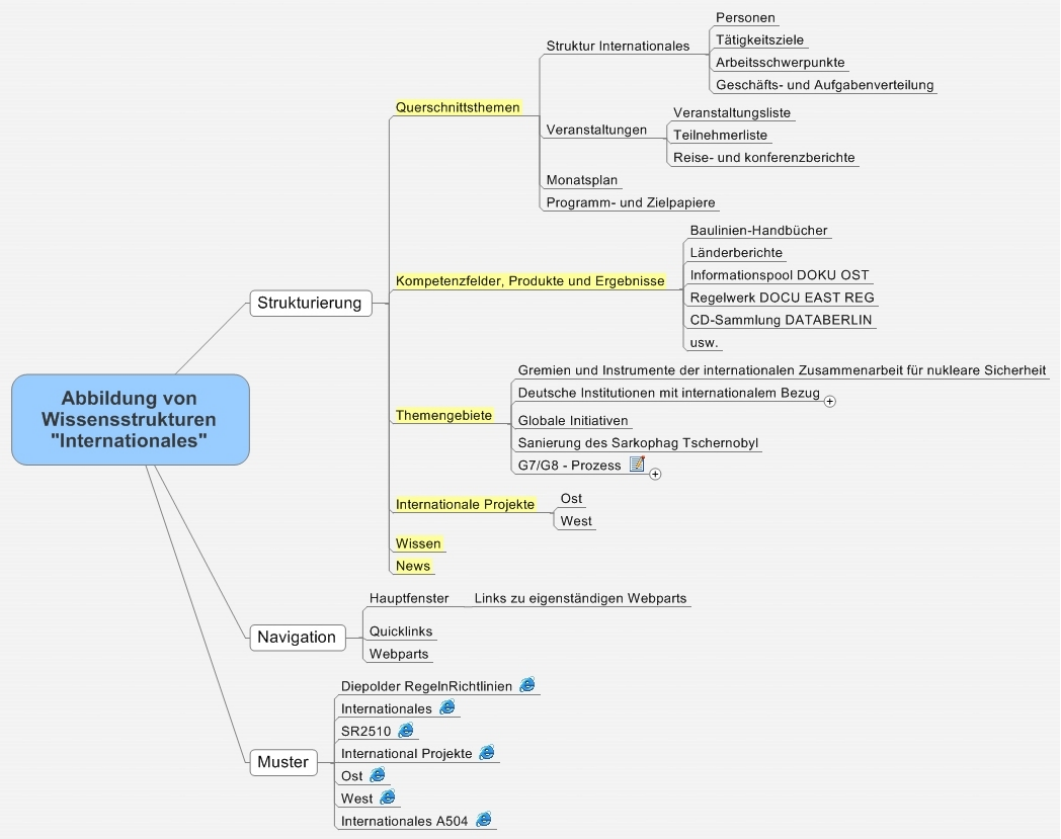
Alberto J. Cañas, John. W. Coffey, Mary Jo Carnot, Paul Feltovich, Robert R. Hoffman, Joan Feltovich, Joseph D. Novak

The Institute for Human and Machine Cognition IHMC



http://www.ihmc.us/users/acanas/Publications/ConceptMapLitReview/IHMC%20Literature%20Review%20on%20Concept%20Mapping.pdf

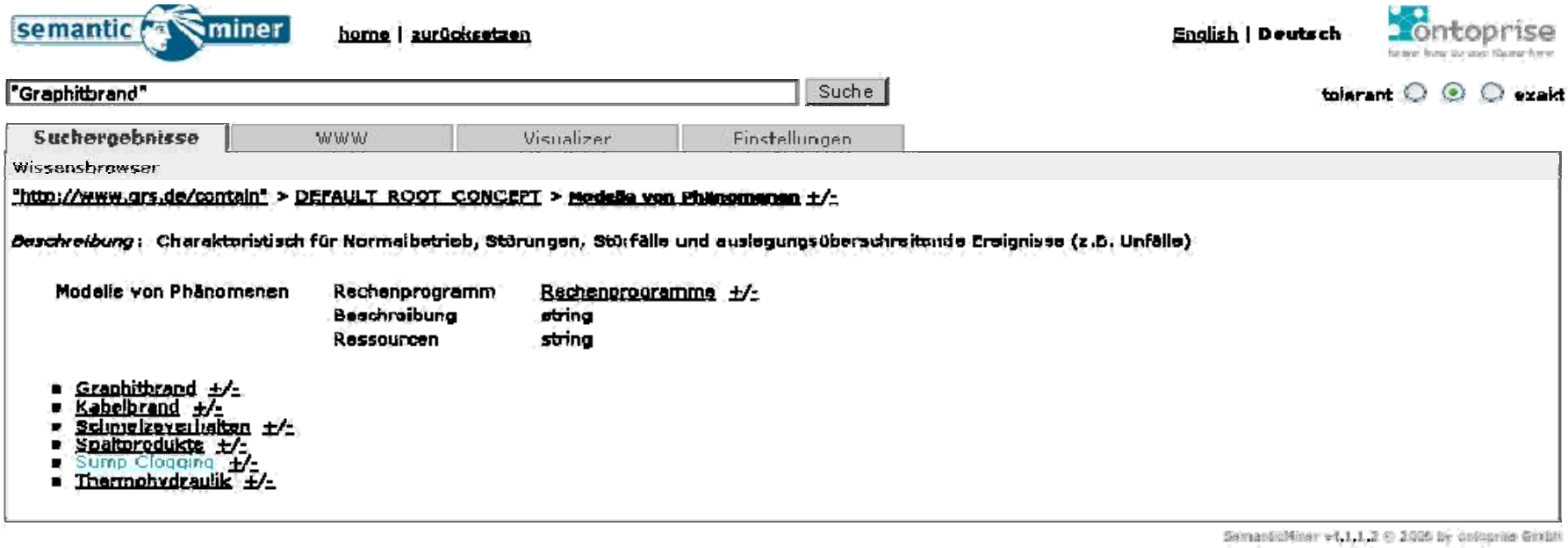
Knowledge Representation: Knowledge Structure Example with Mindmap



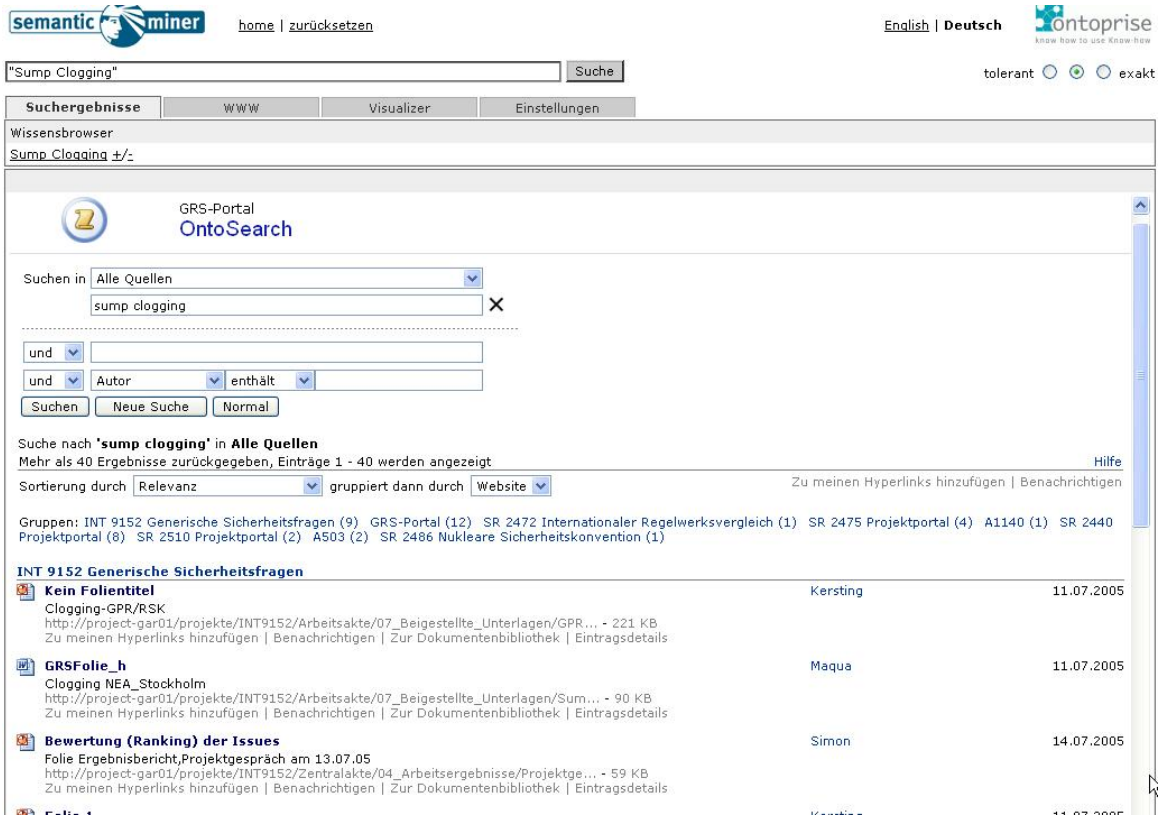
Knowledge Representation: Mindmap Web Document

Knowledge Visualization: Semantic Miner

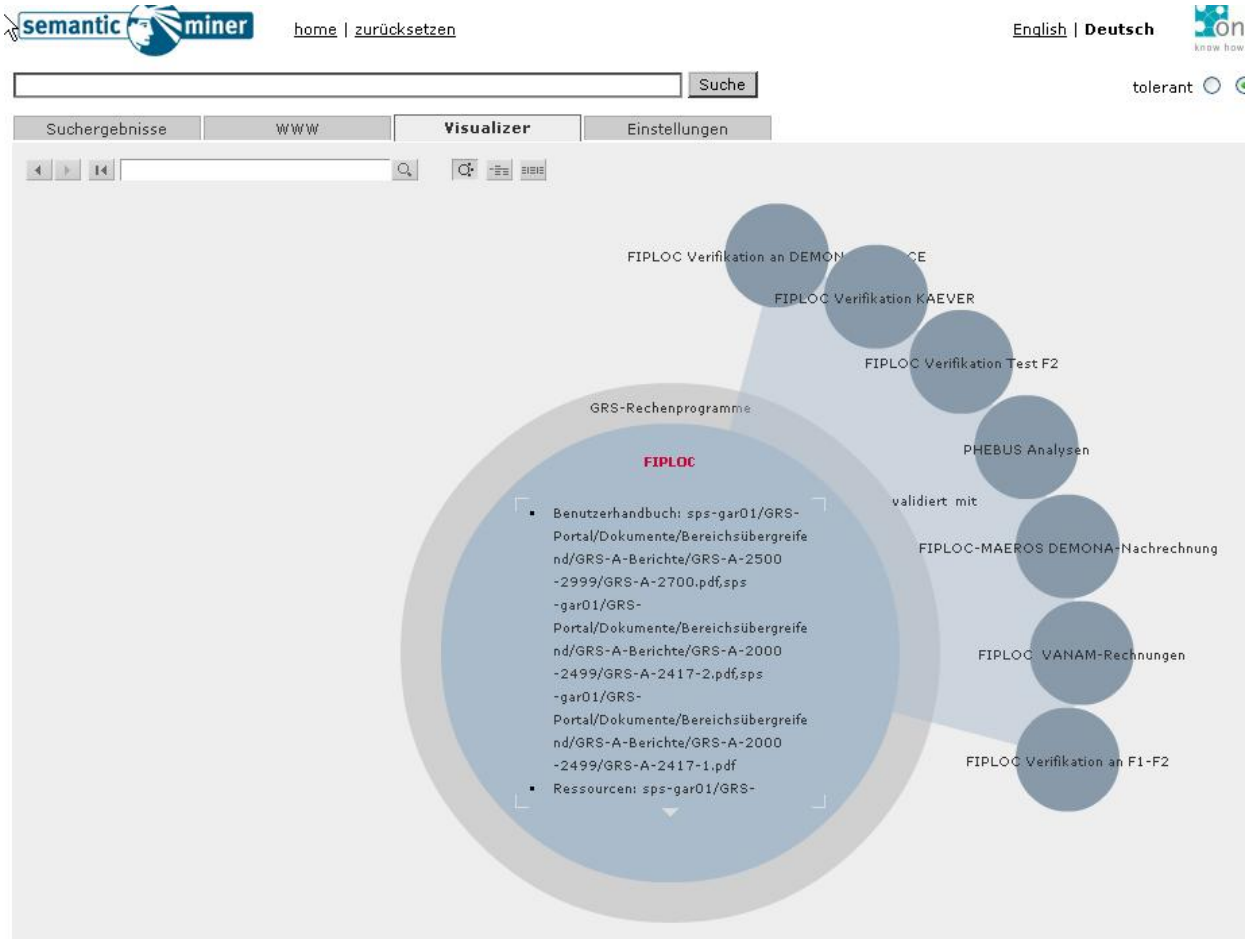
- Developed by Ontoprise
  - Pilot project on development of a “Containment”-Ontology
    - 2-days Workshop with 4 field and 3 KM experts: first draft
    - Refined by other experts



Knowledge Visualization: Semantic Miner



Knowledge Visualization: Containment Ontology



Some Odds of Knowledge

- Making explicit of what is not necessary to become explicit (wrong effort; a cat has not to express the distance to a mouse in centimeters in order to catch it)
- The ‘Bad Four F‘ whenever modelling an issue: Freezing, Flattening, Faulting, Forgetting
- Spurious Knowledge
  - Systematic Disinformation
  - Disinformation by Negligence
- Inundation by non goal- oriented information
- Lack of order criterias / schemes for information

Representing Knowledge

- Dossiers
  - Mainly textual, with links in the text to important documents etc.
  - Little flexibility, difficult to keep up to date
    - → promising development: Wiki (e.g. the Free Encyclopedia http://www.wikipedia.org) : dynamic" collaboration on web documents
- "Classical" Web Sites
  - High maintenance efforts

- “Knowledge Representation” in a more formal sense
  - Method: Conceptualization of a Knowledge Domain (Model)
    - Collection of relevant facts and objects (“concepts”) in the domain
    - Characterization of the concepts by its properties (“attributes”)
    - Description of the relation between concepts (“relations”)
    - Assignment of individuals (“instances”) to concepts
  - Knowledge Nets (Topic Maps, Concept Maps, Ontologies, Semantic Nets …)
    - Systematic Approach
    - (semi)formalized: may be understood by machines
      - Inferences may be drawn (queries)
      - Consistency checks
    - Controlled Vocabulary defined by experts
    - Visualization for ease of navigation

Experience gained

- Capturing Knowledge of Leaving Experts
  - ⊖ identification of critical knowledge still very informal
  - ⊖⊖ to date, no formal process in place; few activities, time is running out
  - ⊕ Strategies to include leaving experts in knowledge representation activities
- Knowledge representation and mapping
  - ⊕ Tools in place
  - ⊕ The notion is spreading, interest in some fields after demonstrating pilot applications
  - ⊕ Appreciable navigation and retrieval improvements
- Process-oriented KM
  - ⊕ ground has been laid
  - ⊖ extensive application still missing

Knowledge Activities related to Standards of Safety

- Sharing of knowledge on relevant safety issues
  - discussions and exchange of information in working groups
  - the exchange of recent knowledge on specific topics
  - definition of requirements for safety assessment methods
  - discussion of cross-cutting issues by multi-disciplinary expert groups (for example the activities on safety margins)
  - the definition of state of art and collective opinions on key safety issues
- Generation of new scientific information
  - specification of primary research areas
  - experimental projects and analytical exercises such as benchmarks and international standards
  - information collection on safety relevant events and their evaluation

Knowledge Activities related to Standards of Safety (cont.)

- Contribution to competence maintenance
  - transfer of information to countries with shrinking resources in nuclear safety research
  - training of young scientific people through involvement in national and international research projects
  - contribution to maintenance of unique experimental facilities and capabilities
- Archiving and distributing information
  - document management on joint programs
  - management of experimental data
  - conducing seminars and conferences
  - release of reports to the public.

Thank you for your Attention