

Global Knowledge Management

Knowledge Representation

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Collaborative Course Development!

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Prof. Dr. Markus Bick (Introduction, CEN Framework)

ESCP Europe Campus Berlin

Web: <http://www.escpeurope.de/wi>

Prof. Dr. Franz Lehner (Assessment, Process Integration)

University of Passau

Web: <http://www.wi.uni-passau.de/>

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The challenges

- How to codify knowledge?
- How to find, retrieve and utilize knowledge?
- How to represent knowledge?
- How to deal with differences regarding common knowledge?
- How to deal with cultural aspects of knowledge processes?
- How to make knowledge accessible?
- And many more...



Remember?

Definition – Knowledge

*“Knowledge comprises all **cognitive expectancies** – observations that have been **meaningfully organized, accumulated and embedded in a context** through experience, communication, or inference – that an individual or organizational **actor** uses to interpret situations and to generate activities, behavior and solutions no matter whether these expectancies are rational or used intentionally.”* (Maier 2002)

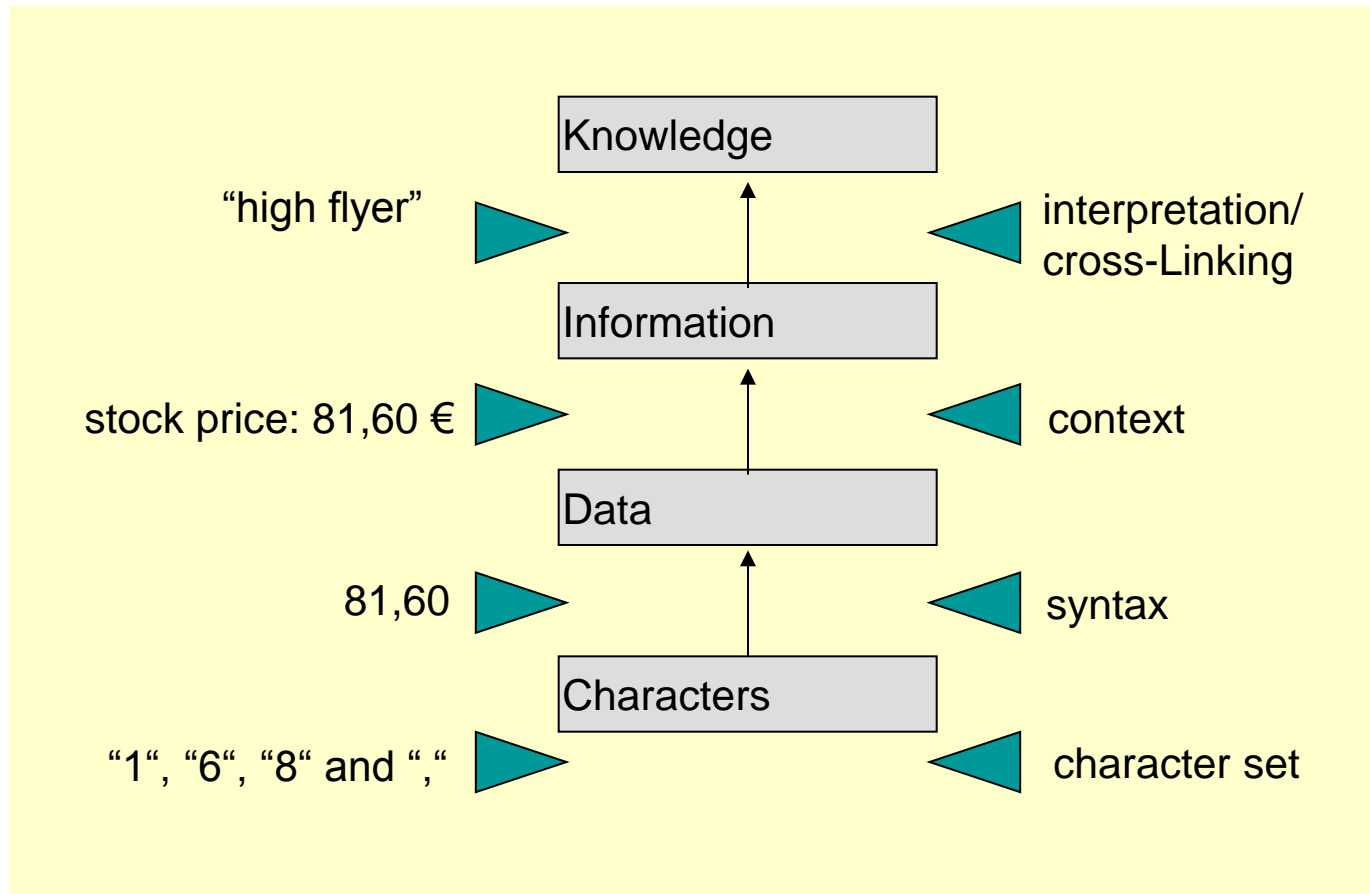
*“A set of **data and information** (when seen from an Information Technology point of view), and **a combination** of, for example know-how, experience, emotion, beliefs, values, ideas, intuition, curiosity, motivation, learning styles, attitude, ability to trust, ability to deal with complexity, ability to synthesize, openness, networking skills, communication skills, attitude to risk and entrepreneurial spirit to result in a valuable asset which can be used to **improve the capacity to act and support decision making.**”* (CEN 2004)



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Types and Classes of Knowledge



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Types and Classes of Knowledge

Declarative Knowledge:

- knowing that



Procedural Knowledge:

- knowing how



[Source:
<http://kartta.jkl.fi>]

- Position, room
- Lecture time
- Traffic rules

- Navigation
- Lecture behavior
- Traffic behavior



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Types and Classes of Knowledge

Organizational Knowledge:

- consists of the critical intellectual assets within an organization

Individual Knowledge:

- knowledge of each person (employee)



Building cars....

Steering / using
production facilities

[Picture Source:
<http://commons.wikimedia.org>]



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Types and Classes of Knowledge

Explicit Knowledge:

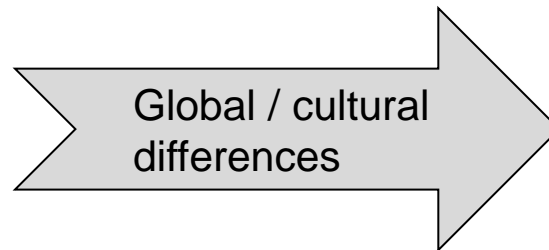
- codified knowledge that can be easily shared and understood

- Traffic rules
- Driving instructions
- ...

Implicit / Tacit Knowledge:

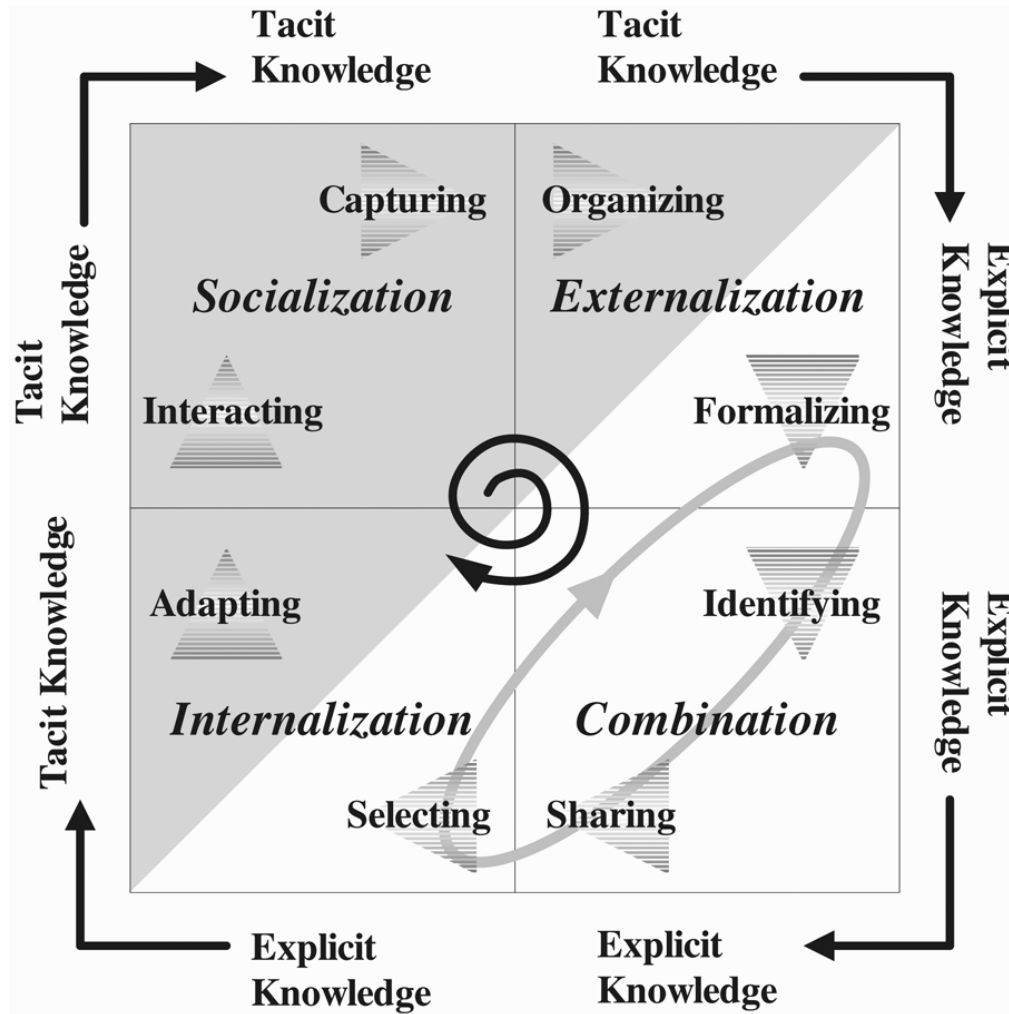
- knowledge that people carry in their minds and is, therefore, difficult to access

- Traffic customs
- Interpretations
- ...



[Picture Source:
<http://commons.wikimedia.org>]

SECI Model (Nonaka & Takeuchi, 1996)



- Socialization
- Externalization
- Combination
- Internationalization



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Key questions

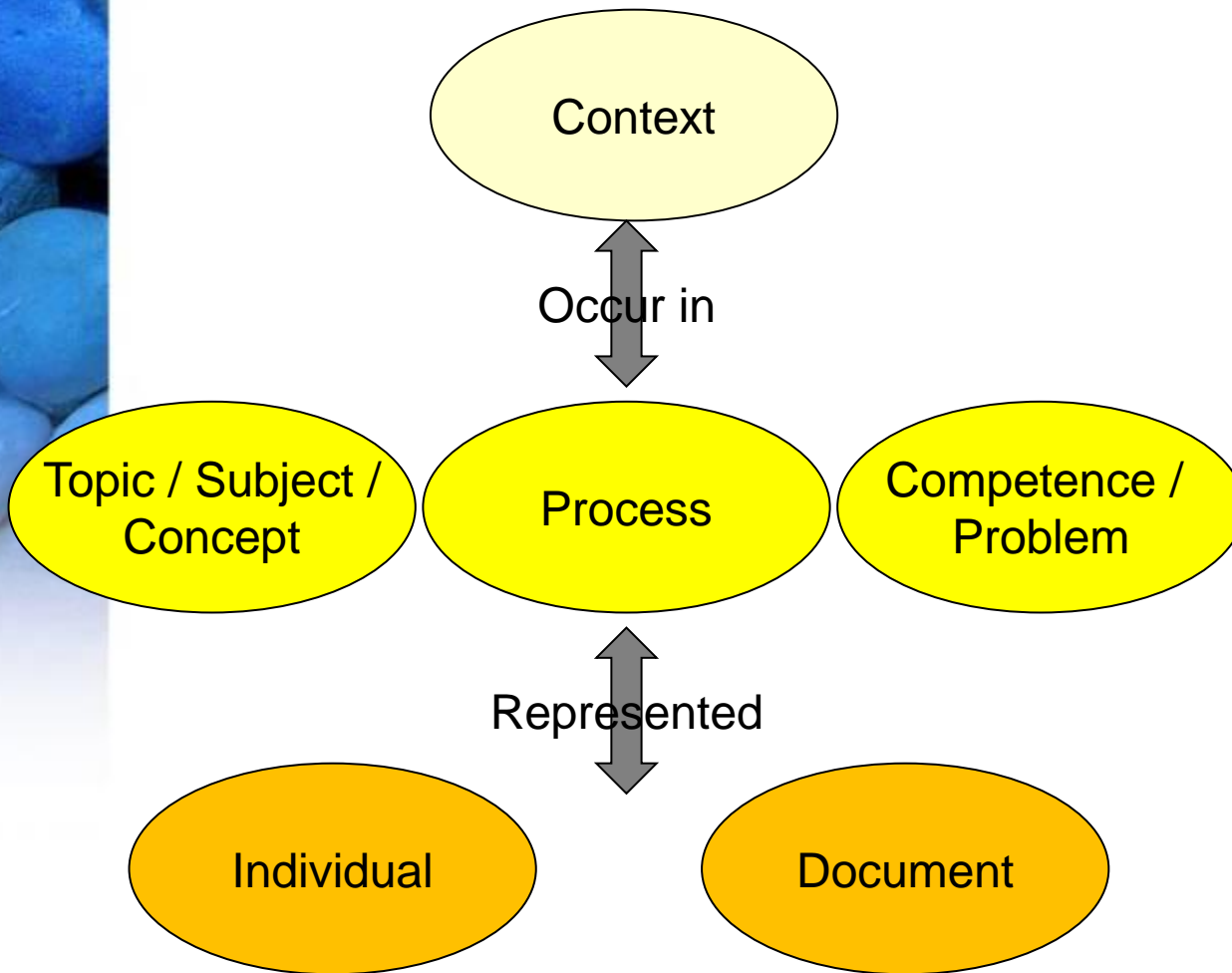
- Which knowledge does an organization have?
 - Outcome (e.g. how to build a car)
 - Process (e.g. which steps are necessary to build a car)
 - Competences (e.g. how to design an engine fulfilling certain constraints)
- Which knowledge is critical (e.g. how to combine fuel technologies)?
- Which knowledge needs to be shared?
 - Between people, groups, departments, organizations
- How to represent this knowledge?
 - Making knowledge and relations explicit
 - Providing opportunities for knowledge identification and creation (searching, inference mechanisms / data mining)



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Knowledge Entities



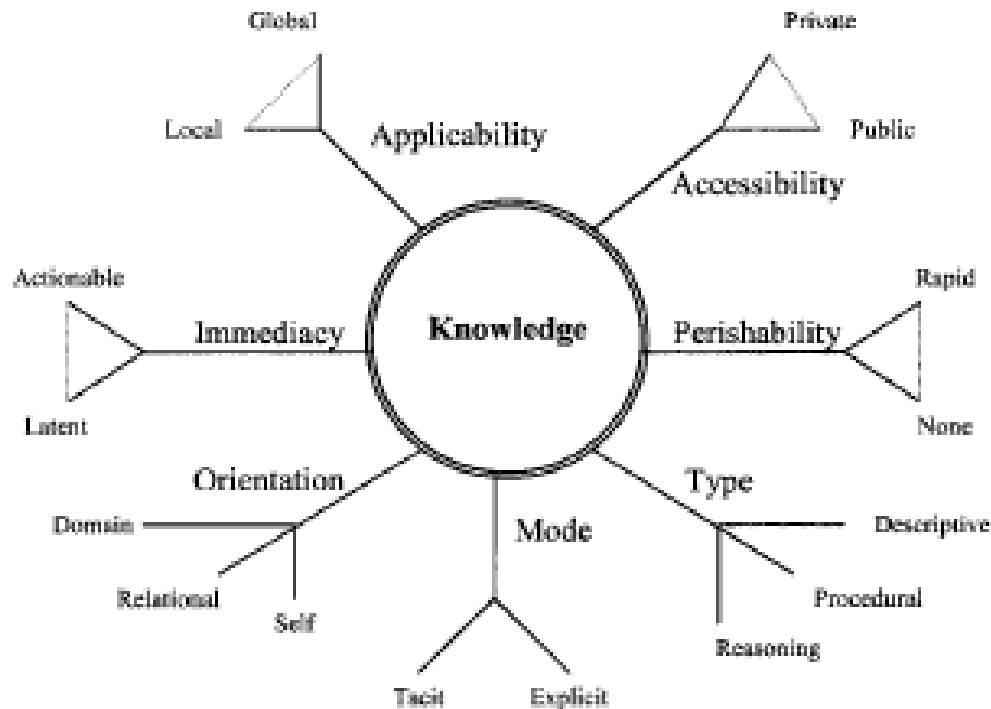
- How to organize knowledge
 - By topic, by process, by problem etc
- Represented through
 - Individuals and competences
 - Documents of any format
- Defining relations and interdependencies



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Knowledge Types (Holsapple & Joshi, 2007)



Additional attributes

- **Nature (Dixon, 2000)**
 - Frequent vs non-frequent
 - Routine vs non-routine
- **Complexity**
 - Expert ... common
- **Importance**
 - Critical
 - Important
 - Routine



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Some solutions

- Conceptual approaches
 - Natural language
 - Formal representation such as predicate logic
 - Data model
 - Semantic networks
 - (Concept) Graphs
 - Ontologies, taxonomies, folksonomies
 - Data models
 - Social tagging
 - ...
- Representation formats
 - XML
 - RDF
 - OWL
 - But also: doc, html, avi, gif, ...
- Remember the goals: identifying knowledge, creating new knowledge, relating (multi-lingual, multi-perspective) knowledge

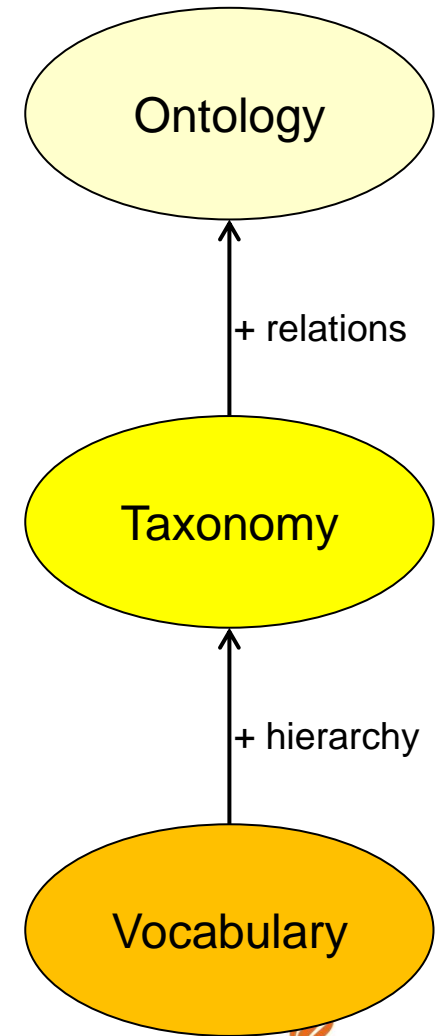


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Basic concepts

- Ontology (an IS perspective): An ontology defines the terms used to describe and represent an area of knowledge (W3C). Ontologies include computer-usable definitions of basic concepts in the domain and the relationships among them
 - Specialization: Folksonomy as an aggregation of concepts created by stakeholders
- Taxonomy: A hierarchical organizational structure for the classification of concepts
- Vocabulary: Set of concepts and terms to describe a domain



Basic concepts in the global context

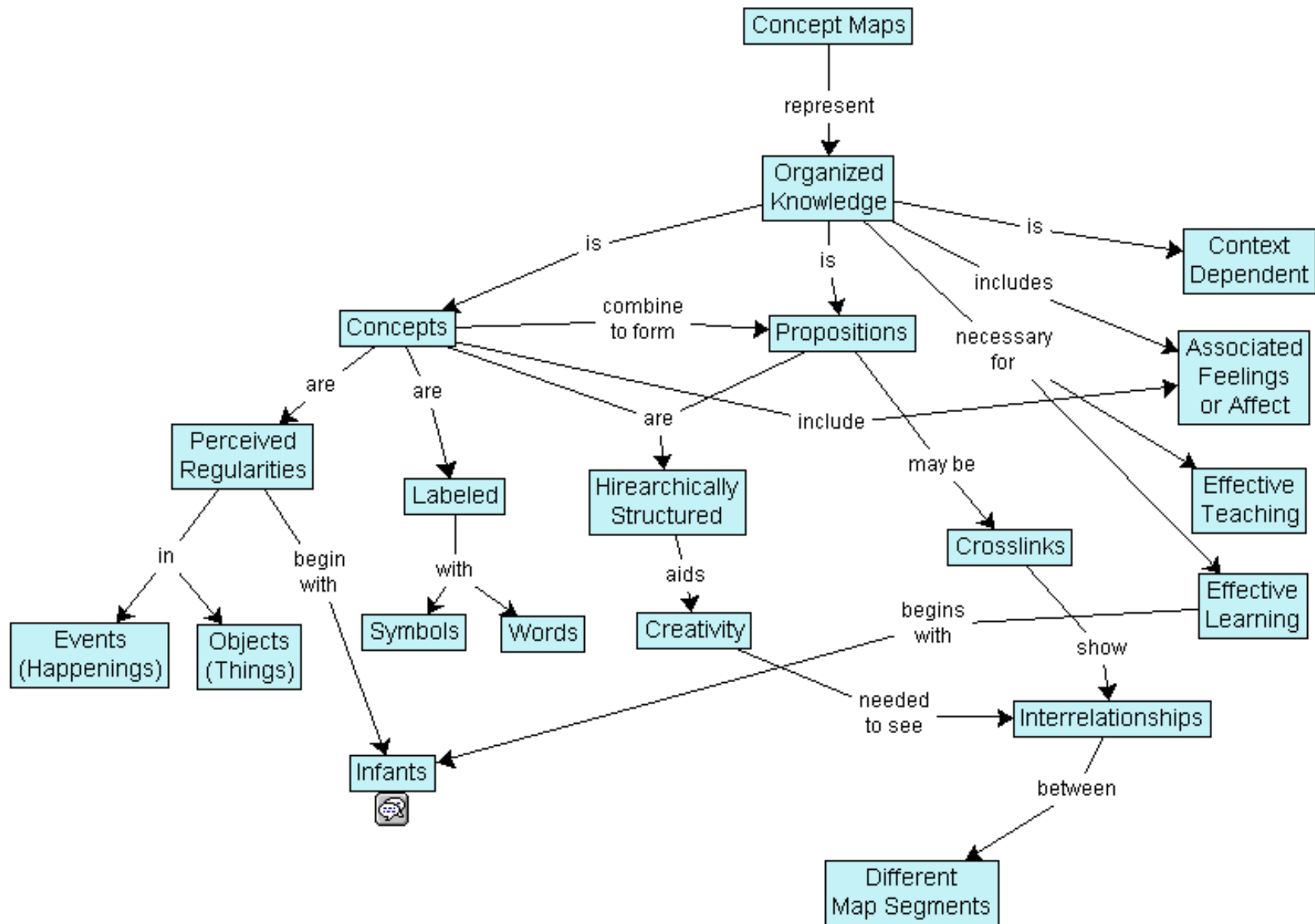
- ▣ Ontology
 - Relating multiple languages
 - Relating concepts
 - Creating multiple meaning of concepts (e.g. what does the concept “sauna” mean)
- ▣ Taxonomy
 - Limited for multi-perspective representations and complex relations
 - Easier to handle in multiple languages / cultures / organizations
- ▣ Vocabulary
 - Controlled vocabularies to create shared understanding of a domain
 - Rather simple to translate



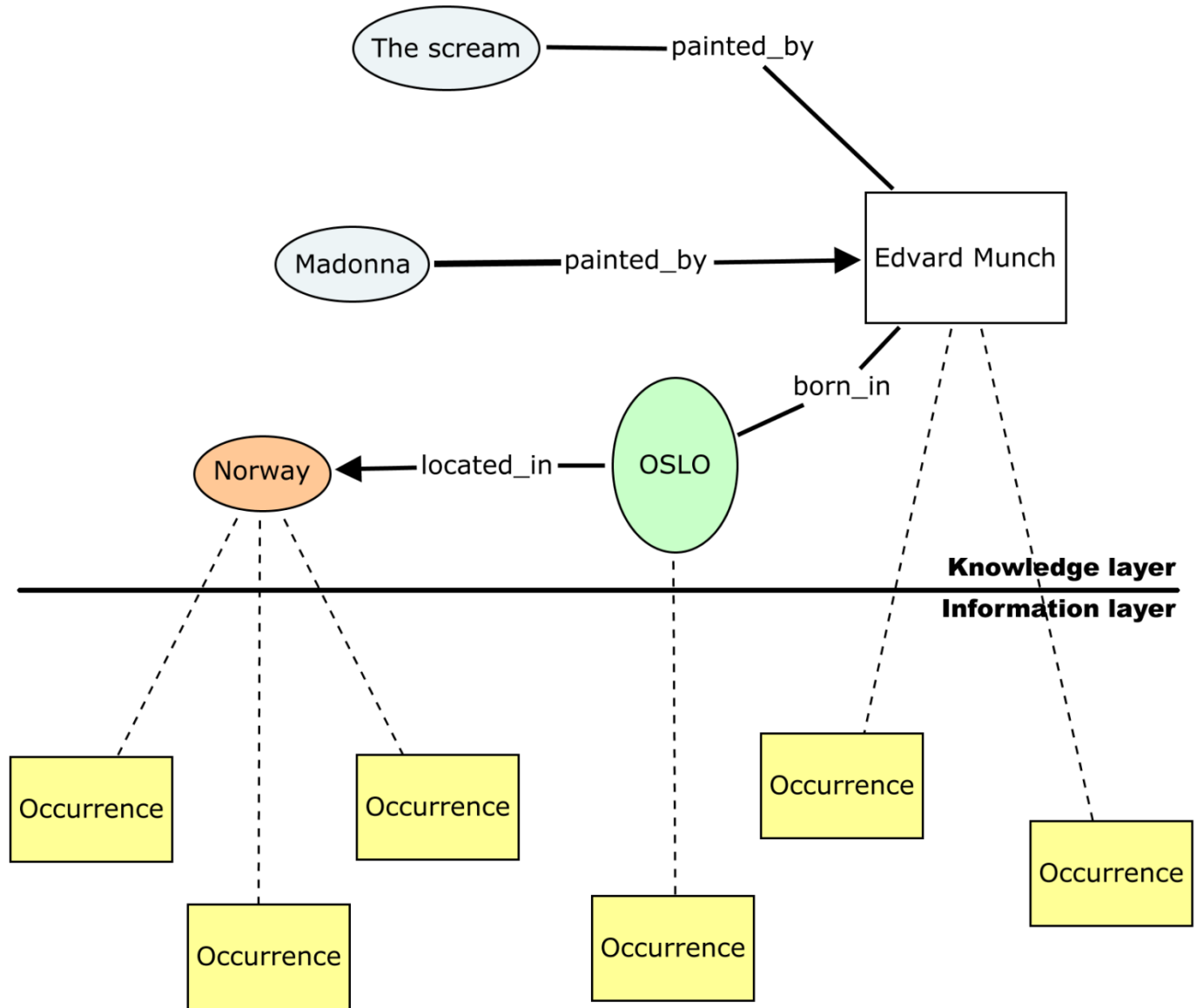
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Concept Maps



Topic Maps



<http://commons.wikimedia.org>

Example: Protege

The screenshot displays the Protege 3.1 interface for editing an OWL class. The window title is "travel Protégé 3.1 (file:IC:\protege-owl\owl\travel.pprj, OWL Files (.owl or .rdf))". The menu bar includes File, Edit, Project, OWL, Code, Window, Tools, and Help. The toolbar contains various icons for file operations and editing. The main interface is divided into several panes:

- Subclass Relationship:** Shows the project "travel" and an asserted hierarchy. The hierarchy is as follows:
 - owl:Thing
 - Accommodation
 - BedAndBreakfast
 - BudgetAccommodation
 - Campground
 - Hotel
 - AccommodationRating
 - Activity
 - Contact
 - Destination
 - BackpackersDestination
 - Beach
 - BudgetHotelDestination
 - FamilyDestination** (selected)
 - QuietDestination
 - RetireeDestination
 - RuralArea
 - UrbanArea
 - City
 - Town

- Class Editor:** For Class: FamilyDestination (instance of owl:Class). It has tabs for Name, SameAs, and DifferentFrom. The Name tab shows "FamilyDestination". The rdfs:comment tab shows "A destination with at least one accommodation and at least 2 activities." The Annotations tab shows a table:

Property	Value	Lang
rdfs:comment	A destination with at le...	
- Asserted Conditions:** Shows asserted conditions for the class:
- Destination (NECESSARY & SUFFICIENT)
- hasAccommodation ≥ 1
- hasActivity ≥ 2
- Properties:** Lists properties for the class:
- hasAccommodation (multiple Accommodation) with cardinality 1
- hasActivity (multiple Activity) with cardinality 2
- hasPart (multiple Destination)
- Disjoints:** Shows a disjoint relationship with RetireeDestination.

At the bottom right, there are radio buttons for "Logic View" (selected) and "Properties View".

Ontology Example: Visual Representation

travel Protégé 3.1 (file:VC:\protege-owl\owl\travel.pprj, OWL Files (.owl or .rdf))

File Edit Project OWL Code Window Tools Help

protégé

OWLClasses Properties Forms Individuals Metadata OWLViz

Asserted Model Inferred Model

CLASS BROWSER

For Project ● travel

Asserted Hierarchy

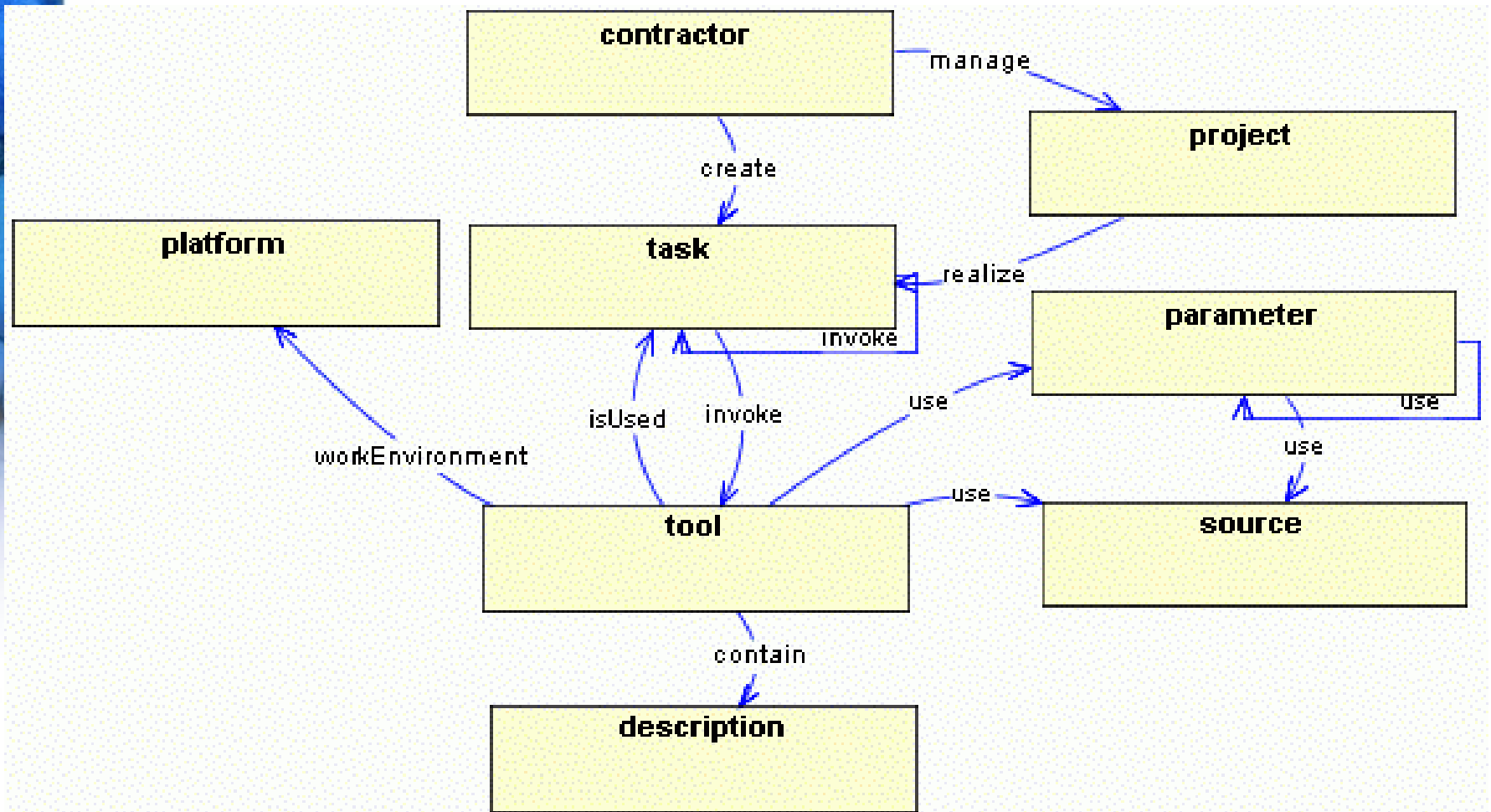
Visual Representation of the Ontology:

- Destination** (Necessary & Sufficient)
 - RuralArea** (Necessary & Sufficient)
 - Farmland (Necessary & Sufficient)
 - NationalPark (Necessary & Sufficient)
 - UrbanArea** (Necessary & Sufficient)
 - Town (Necessary & Sufficient)
 - City** (Necessary & Sufficient)
 - Capital (Necessary & Sufficient)
 - BudgetHotelDestination (Necessary & Sufficient)
 - RetireeDestination (Necessary & Sufficient)
 - Beach (Necessary & Sufficient)
 - FamilyDestination (Necessary & Sufficient)
 - QuietDestination (Necessary & Sufficient)
 - BackpackersDestination (Necessary & Sufficient)
 - Surfing (Necessary & Sufficient)
- AccommodationRating (Necessary & Sufficient)
- Contact (Necessary & Sufficient)
 - Sight (Necessary & Sufficient)

Legend:

- Destination (NECESSARY & SUFFICIENT)
- ⊃ ∃ hasAccommodation BudgetAccommodation
- ⊃ ∃ hasActivity (Sports ⊔ Adventure)
- NECESSARY

Ontology Example: Visual Representation



<http://www.ecolleg.org/>



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Ontology Example: RDF

The screenshot shows the Protégé 3.1 interface for editing an ontology. The main window is titled "travel-rdf Protégé 3.1 (file:VC:\protege-owl\owl\travel-rdf.pprj, OWL Files (.owl or .rdf))". The interface is divided into several panes:

- Subclass Relationship Pane:** Shows the "Asserted Hierarchy" for the project "travel-rdf". The hierarchy is as follows:
 - owl:Thing
 - Accommodation
 - AccommodationRating
 - Activity
 - Contact
 - Destination
 - BackpackersDestination** (selected)
 - Beach
 - BudgetHotelDestination
 - FamilyDestination
 - QuietDestination
 - RetireeDestination
 - RuralArea
 - Farmland
 - NationalPark
 - UrbanArea
 - City
 - Capital
 - Town

- Class Editor Pane:** Shows the editor for the class "BackpackersDestination" (instance of rdfs:Class). It has three tabs: "Name", "SameAs", and "DifferentFrom". The "Name" tab is active, showing the class name "BackpackersDestination". Below it, the "rdfs:comment" is defined as "A destination that provides budget accommodation and offers sport or adventure activities." To the right, the "Annotations" table shows:

Property	Value	Lang
rdfs:comment	A destination that prov...	
- Properties Pane:** Shows the "rdfs:subClassOf" relationship and a table of properties. The "rdfs:subClassOf" table lists "Destination". The properties table is:

Property	Cardinality	Type
hasAccommodation	Multiple	Accommodation
hasActivity	Multiple	Activity
hasPart	Multiple	Destination

Ontology Example: RDF

The screenshot displays the OwlSight web application interface. At the top, the menu bar includes 'File', 'Bookmarks', 'Ontology Repo', and 'Help'. The main content area is titled 'Ontology Information' and shows the following details:

- Ontology URI: <http://www.w3.org/TR/owl-guide/wine.rdf>
- DL Species: [SHOIN\(D\)](#)
- Class Count: 137
- Individual Count: 206
- Object Property Count: 18
- Data Property Count: 3

Below this, the 'Class Tree' is visible on the left, showing a hierarchy starting with 'Thing', followed by 'ConsumableThing', 'EdibleThing', 'Meal', 'MealCourse', 'PotableLiquid', 'Juice', and 'Wine'. Other classes include 'NonConsumableThing', 'Region', 'Vintage', 'VintageYear', 'WineDescriptor', 'WineColor', 'WineTaste', and 'Winery'.

The main panel shows the 'Class Tree' selected for the URI <http://www.w3.org/TR/2003/PR-owl-guide-20031209/wine#Wine>. It contains several sections:

- Annotations:** A table with two rows: 'label' with values 'wine' and 'vin'.
- Asserted Superclasses:** A list of superclasses for 'Wine', including '(hasMaker only Winery)', '(hasBody exactly 1)', '(hasColor exactly 1)', '(hasFlavor exactly 1)', '(hasMaker exactly 1)', '(hasSugar exactly 1)', '(madeFromGrape min 1)', '(locatedIn SOME Region)', and 'PotableLiquid'.
- Asserted Subclasses:** A list of subclasses: 'DessertWine', 'EarlyHarvest', and 'LateHarvest'.
- Asserted Equivalent Classes:** A list containing 'Wine'.
- Inferred Subclasses:** A list of inferred subclasses: 'AmericanWine', 'DryWine', 'FrenchWine', 'FullBodiedWine', and 'Gamay'. Each item has a 'Why?' button next to it.

The bottom of the browser window shows the 'Internet' icon and a zoom level of 100%.

<http://pellet.owdl.com/owlisight/>

Ontology Use

- Creating models for domains
- Knowledge Management
 - Processes
 - Problems
 - Topics / Subjects
 - People
- Usage
 - Describe / relate
 - Query
 - Tag
 - Publish
 - Share
 - Create
 - ...
- Assessment
 - Usage analysis
 - Updating frequency
 - ...



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Global Aspects

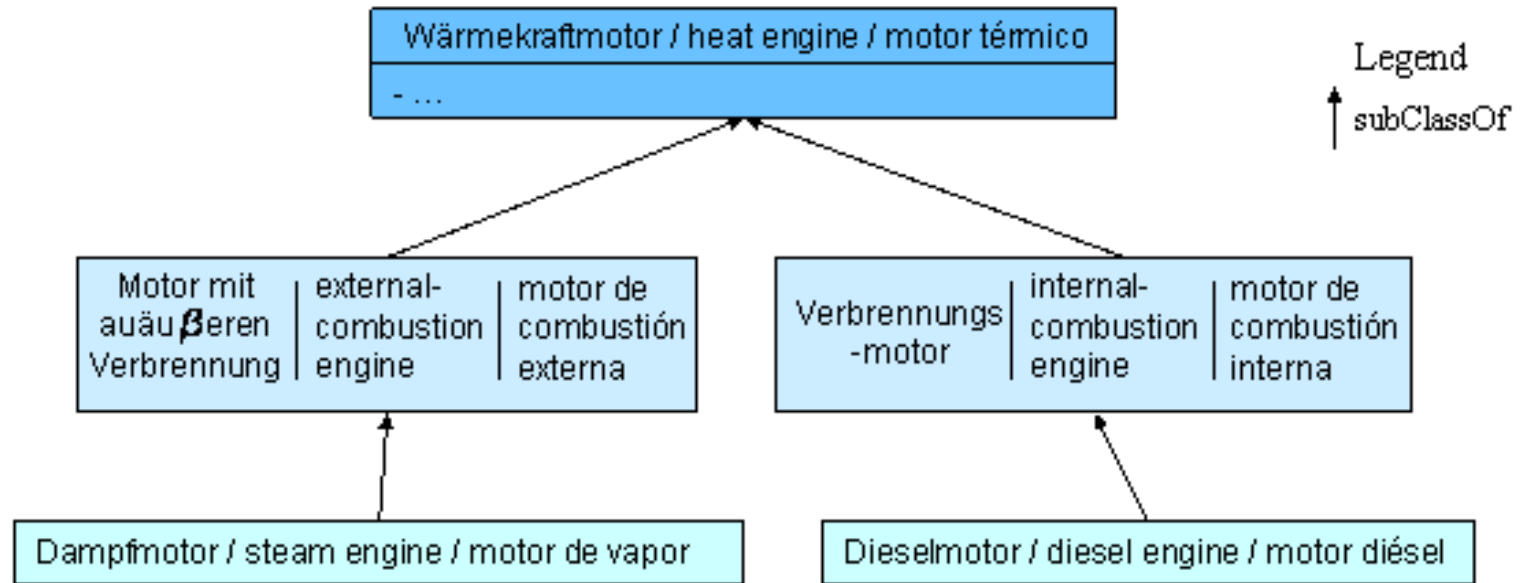
- Multilingual aspects
 - Translated ontology
 - Metamodel
 - Mappings (e.g. synonyms)
 - Conceptual differences
- Cultural aspects
 - Process and procedure mappings and comparisons
 - Conceptual differences
- Maintenance
 - How updates ontologies?
 - Who incorporates changes?
- Time
 - How long are concepts valid?
 - How to model those?



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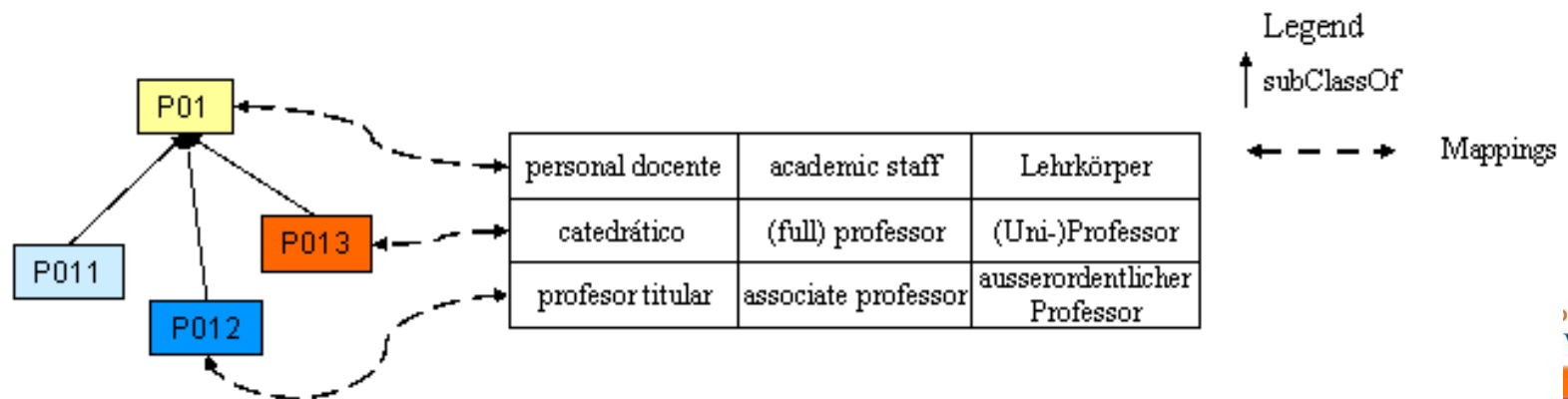
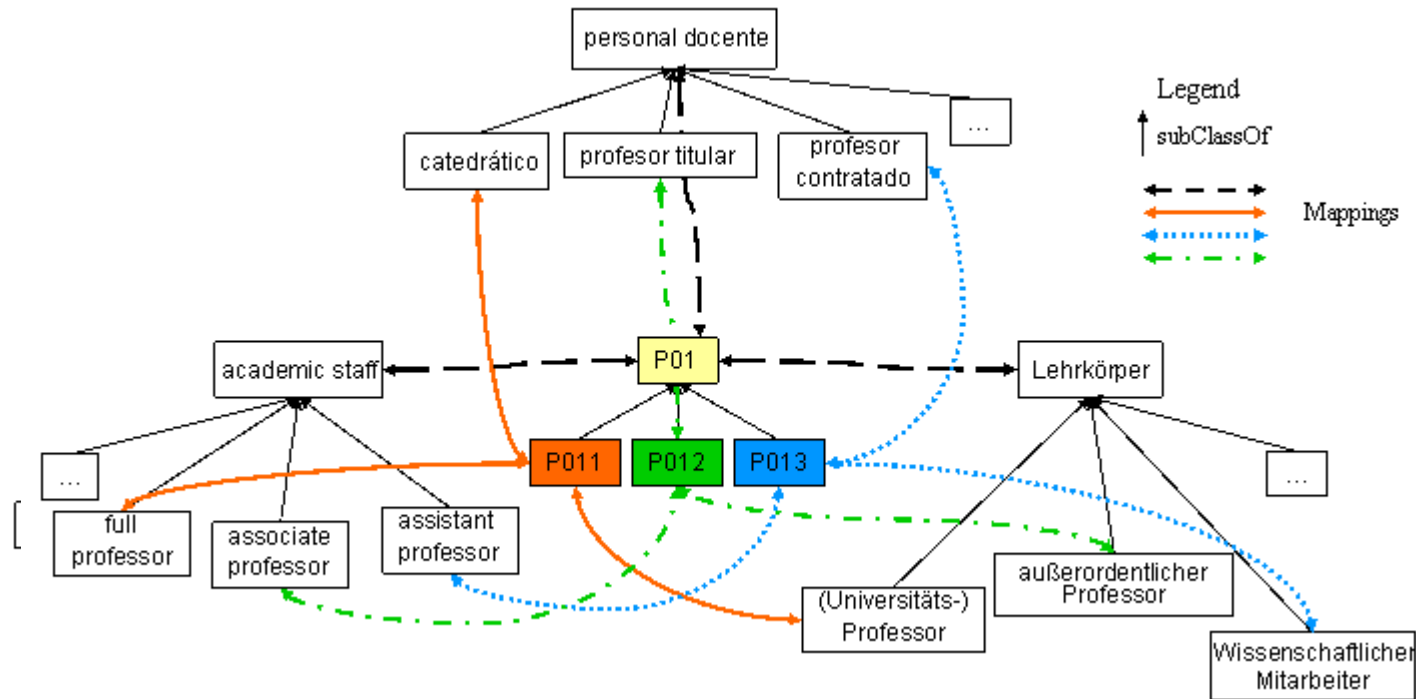
Multilingual Models (Montiel-Pensoda, 2008): Combined Meta-Model



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Multilingual Models (Montiel-Pensoda, 2008): Mapping / Multilingual Vocabulary



Multilingual Models (Montiel-Pensoda, 2008): Mapping / Multilingual Vocabulary

Entity Properties

Ontology element

URI <http://www.organizations.org#FAO>

lexical entries associated to FAO concept

translation and synonym relations

Entries

Identifier	Part Of Speech	Language	
LexicalEntry-1	noun	English	x
LexicalEntry-2	noun	English	x
LexicalEntry-3	noun	Spanish	x

Lexical Entry Relationships

Identifier	
Synonyms	
LexicalEntry-2	x
Translations	
LexicalEntry-3	x

Lexicalizations

Entries

Label	G. Number	Gender	Dialect	Language	
FAO	Singular	Feminini		English	x
Food and Agricultural O...	Singular	Feminini		English	x

lexicalizations of the selected lexical entry

Lexicalization Term type

- Acronym Abbreviation
 Full form Short form
 Common Name Scientific Name
 Main Entry Formula
 Dialectal Variant M. Word Expression
 Transliteration Logical Expression
 Symbol Equation

Lexicalization Variants

Label	
Acronyms	
FAO	x
Short Forms	
Dialect Variant	
Equations	
Formulas	
Logical Expressions	
Spelling Variants	
Symbols	

Lexical Entry Senses

Usage Context

Sources

Notes

associated information to each lexical entry

[Lexical Entry](#) [Lexicalization](#)

[Lexical Entry](#) [Lexicalization](#) [Usage Context](#) [Sense](#) [Definition](#) [Note](#)

[Lexical Entry](#) [Lexicalization](#) [Usage Context](#) [Sense](#) [Definition](#) [Source](#)

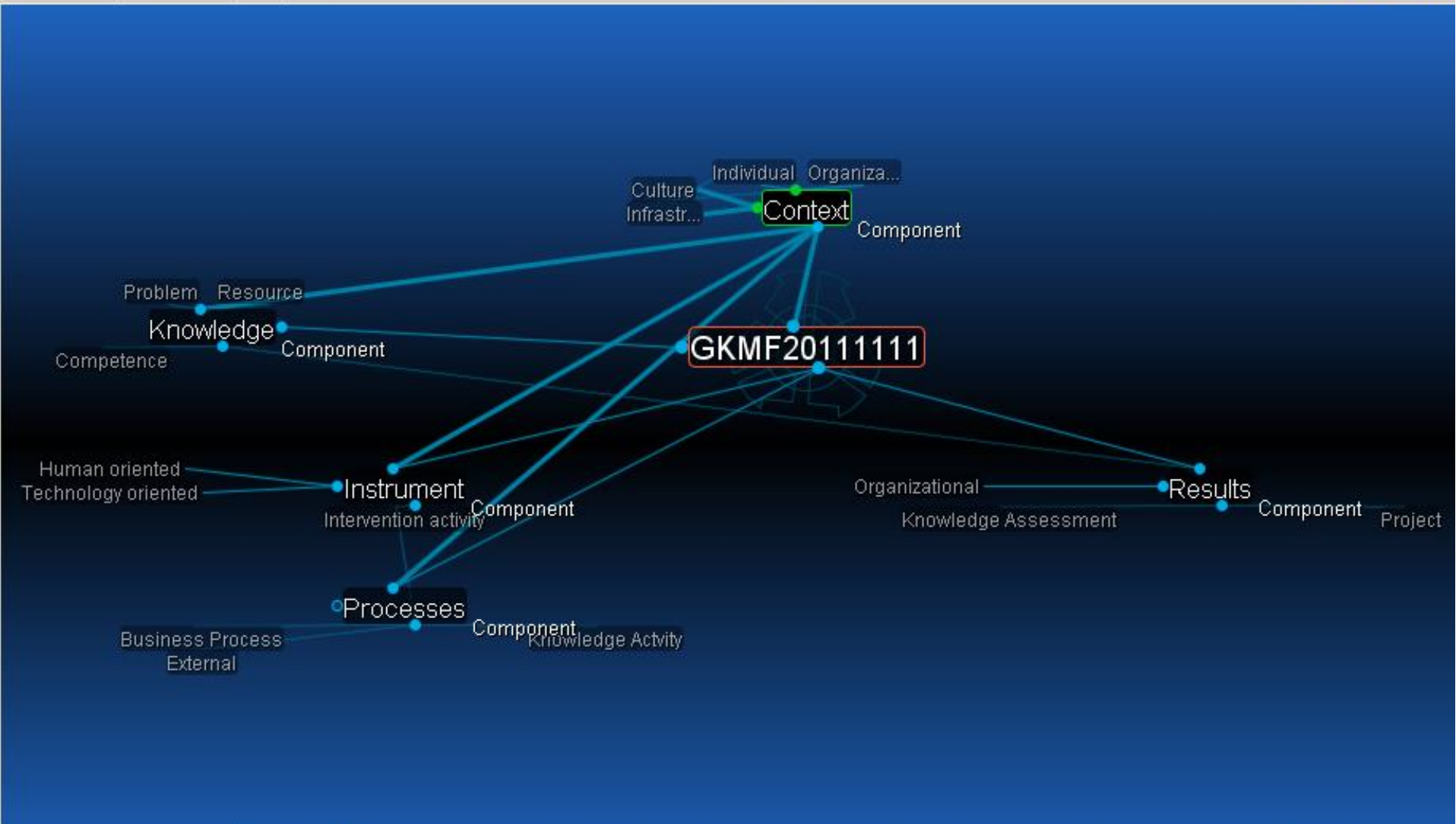
Knowledge Search: Ontology Browsing

GKMF20111111 - PersonalBrain 6.0

File Edit Thought View Options Window Help

Barriers for global workers utilizing Social Software

PERSONA
BRAIN



Search Infrastruc... Results Intervention activity Instrument Organization Context GKMF

Summary

- Key steps
 - Knowledge identification
 - Knowledge representation
 - Multilingual, multi-perspective
 - Consider collaborative practices
 - Knowledge prioritization and characterizing
 - Knowledge organization
- Match knowledge with business processes and KM activities
- Next step (and lecture): Tool support



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Contact Information

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