

Intelligent Systems on the World Wide Web

Ontology Lifecycle



York Sure

AIFB

Institut AIFB

Universität Karlsruhe (TH)

<http://www.aifb.uni-karlsruhe.de/WBS>

Ontology

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AIFB

„People can't **share knowledge** if they do not speak a **common language**.“ [Davenport & Prusak, 1998]

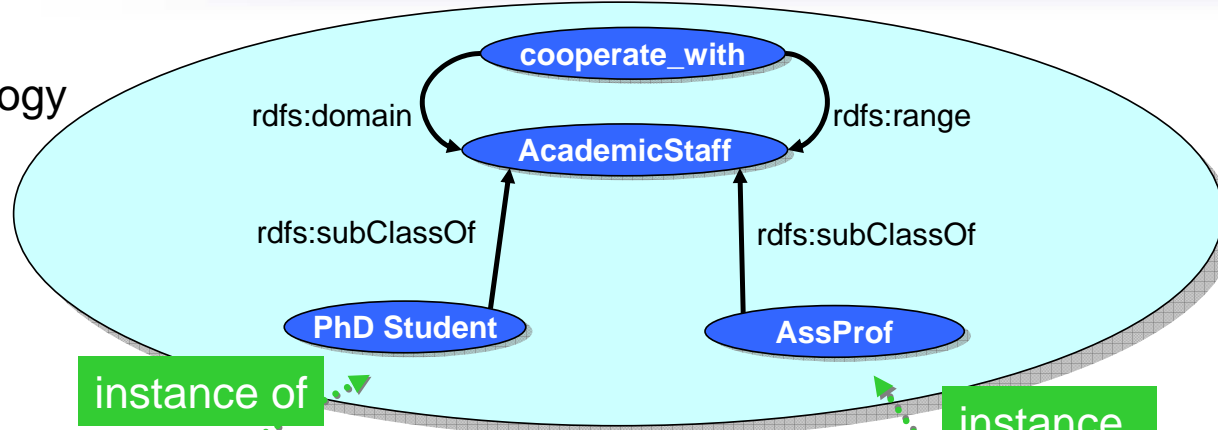
„An ontology is an **explicit specification** of a **conceptualization**.“ [Gruber, 1993]

- Ontologies enable a **better communication** between Humans/Machines
- Ontologies **standardize** and **formalize** the meaning of words through concepts

Slide 2

Ontology & Metadata

Ontology



instance of

instance of

Annotation

<pre> <swrc:PhD_Student rdf:ID="sha"> <swrc:name>Siegfried Handschuh</swrc:name> <swrc:cooperate_with rdf:resource = "http://www.aifb.uni- karlsruhe.de/WBS/sst#sst"/> </pre>	<pre> <swrc:AssProf rdf:ID="sst"> <swrc:name>Steffen Staab </swrc:name> ... </swrc:AssProf> </pre>
---	--

Cooperate_with

Web Page

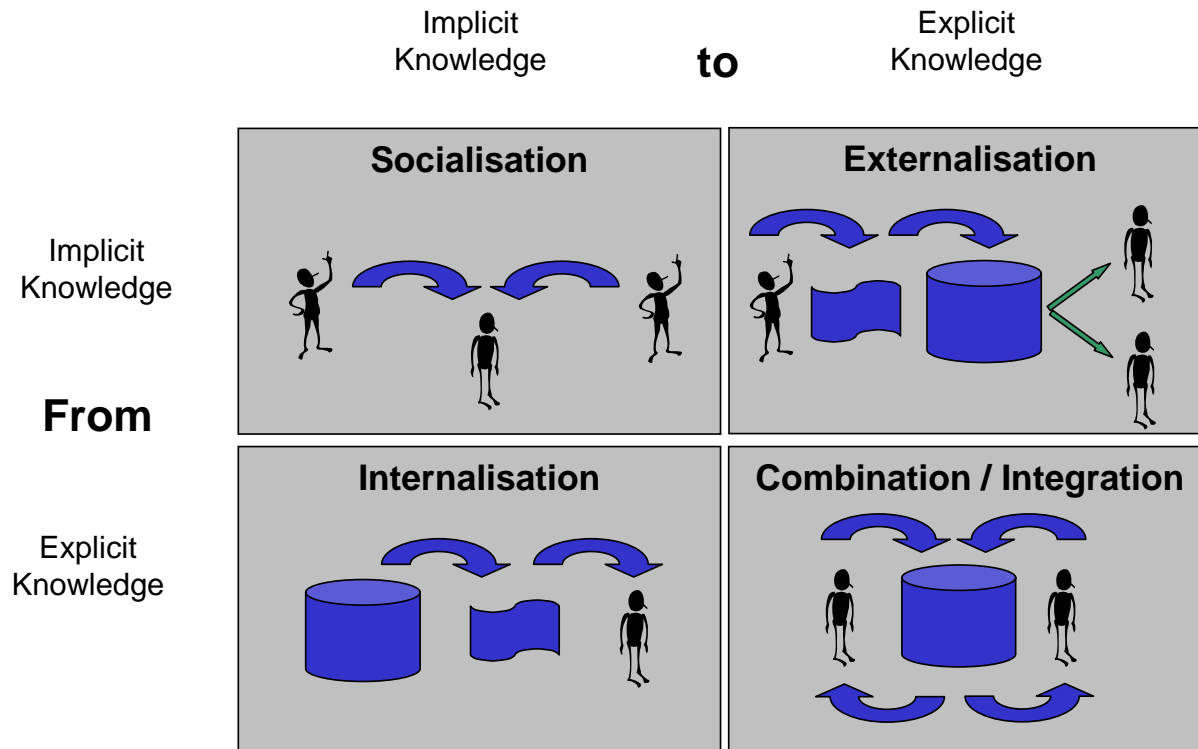
<p>Siegfried Handschuh</p>  <p>He is working together with Steffen Staab in the Knowledge Management Group</p>	<p>Research:</p> <p>Semantic Web, Knowledge Management, Natural Language,</p>
--	--

Links have explicit meanings!

URL

<p>http://www.aifb.uni-karlsruhe.de/WBS/sha</p>	<p>http://www.aifb.uni-karlsruhe.de/WBS/sst</p>
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Explicit vs. Implicit Knowledge



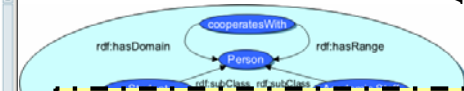


Case study: OntoWeb.org

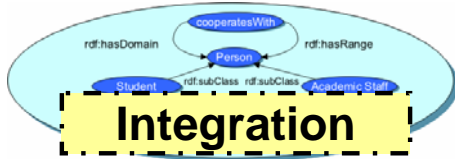
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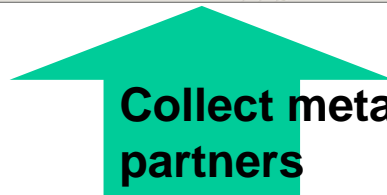
AIFB



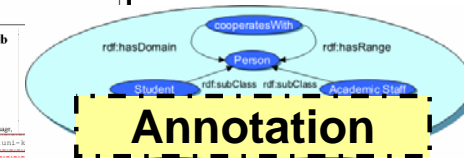
Portal Generation
Navigation
Query/Search
Content



Integration



Collect metadata from participating partners



Annotation

Ontology-based Processes



Knowledge Meta Process

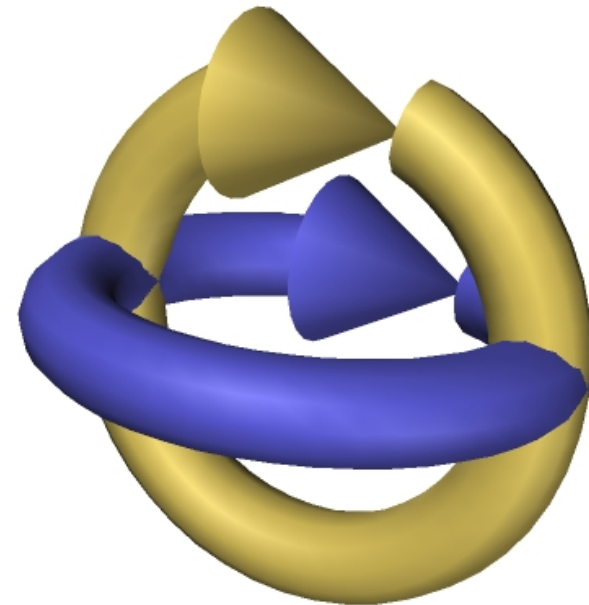


Design, Implementation,
Evolution of Ontology

Knowledge Process



Usage of Ontology





OTK Methodology:

Knowledge Meta Process

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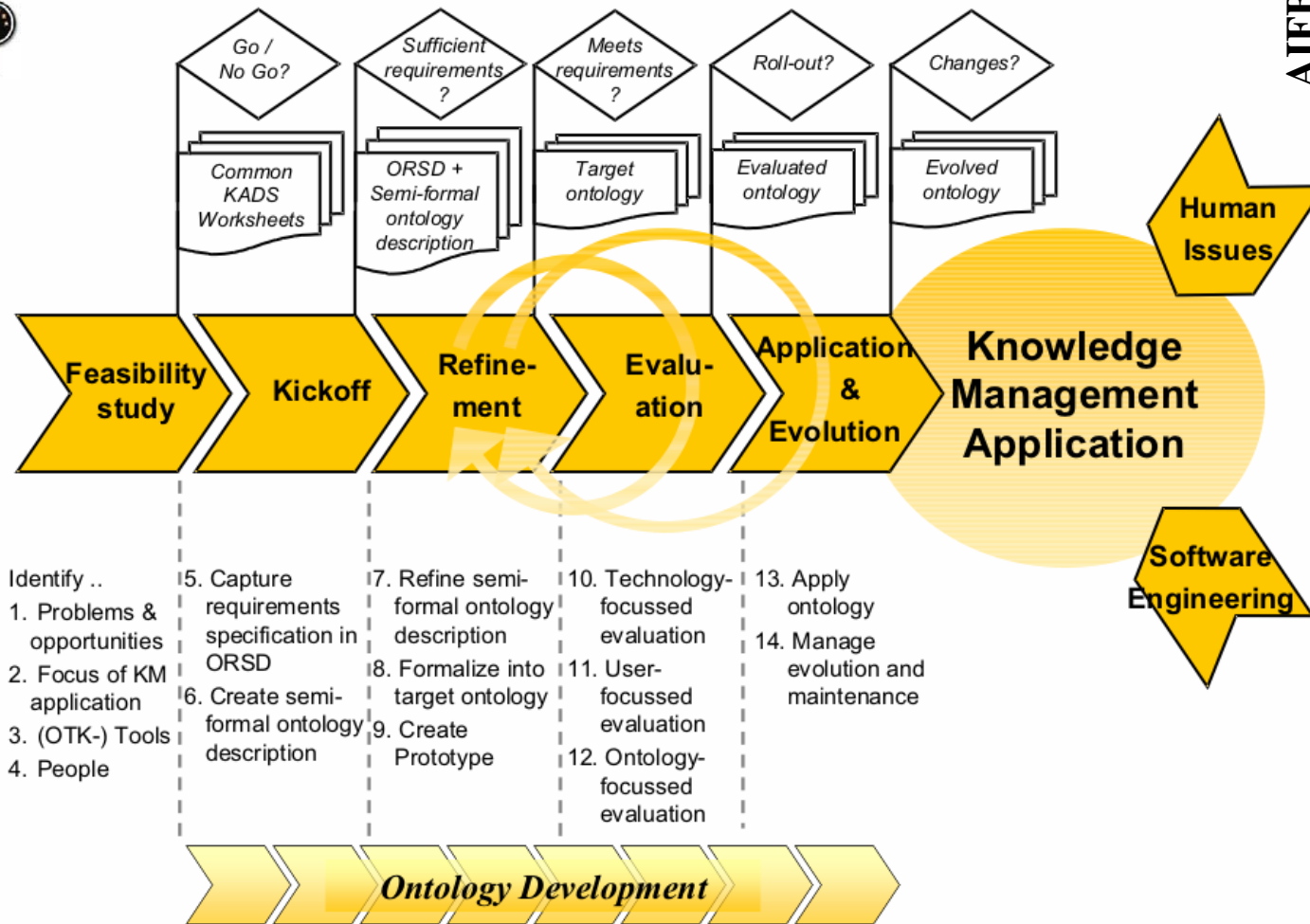
- **Task:** Build ontology based KM applications

- **Problems:**
 - **Collaboration** between domain experts and knowledge engineers
 - **Evaluation** of ontologies

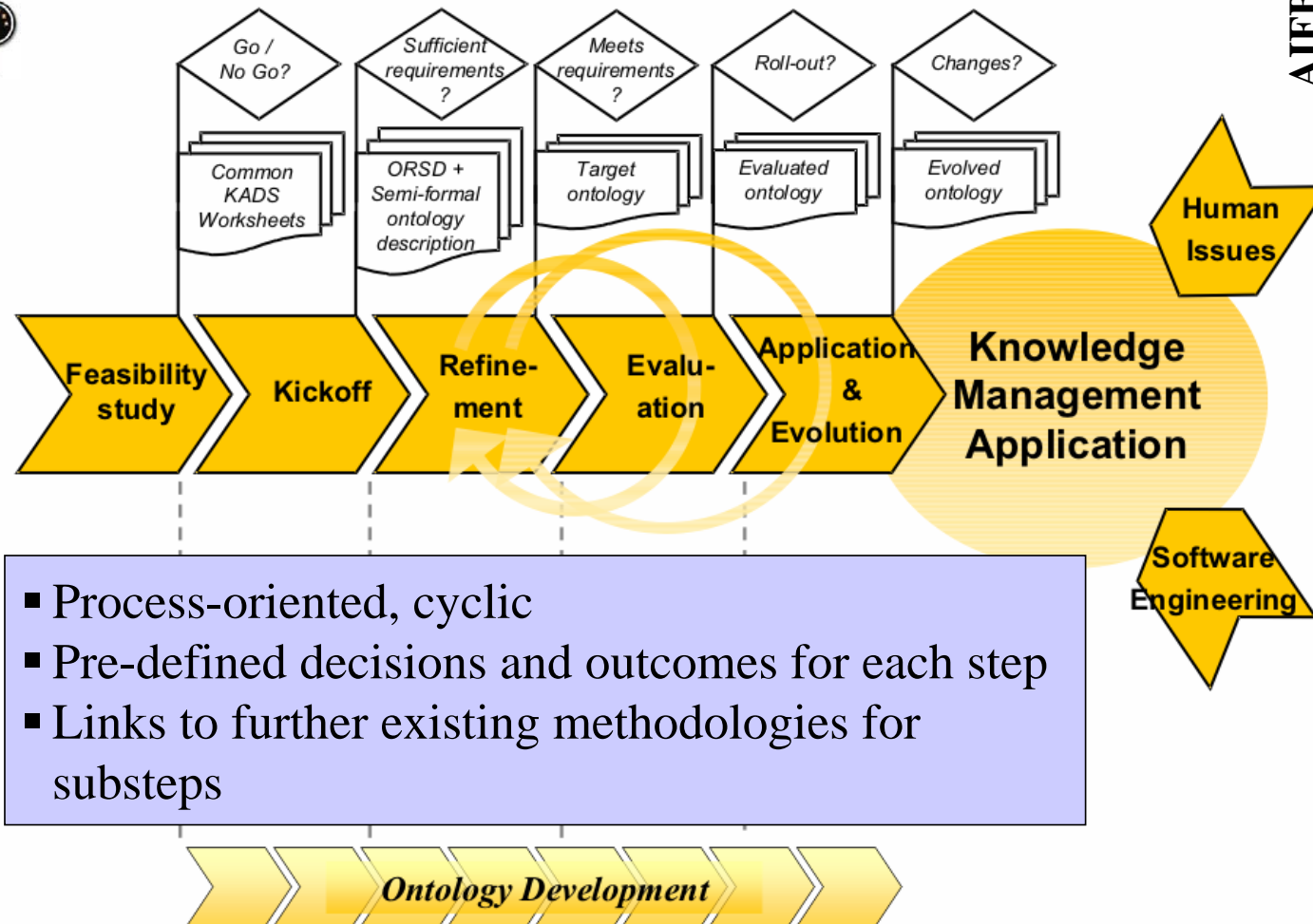
- Process-oriented, cyclic
- Pre-defined decisions and outcomes for each step
- Links to further existing methodologies for substeps

Slide 7

OTK Methodology: Knowledge Meta Process



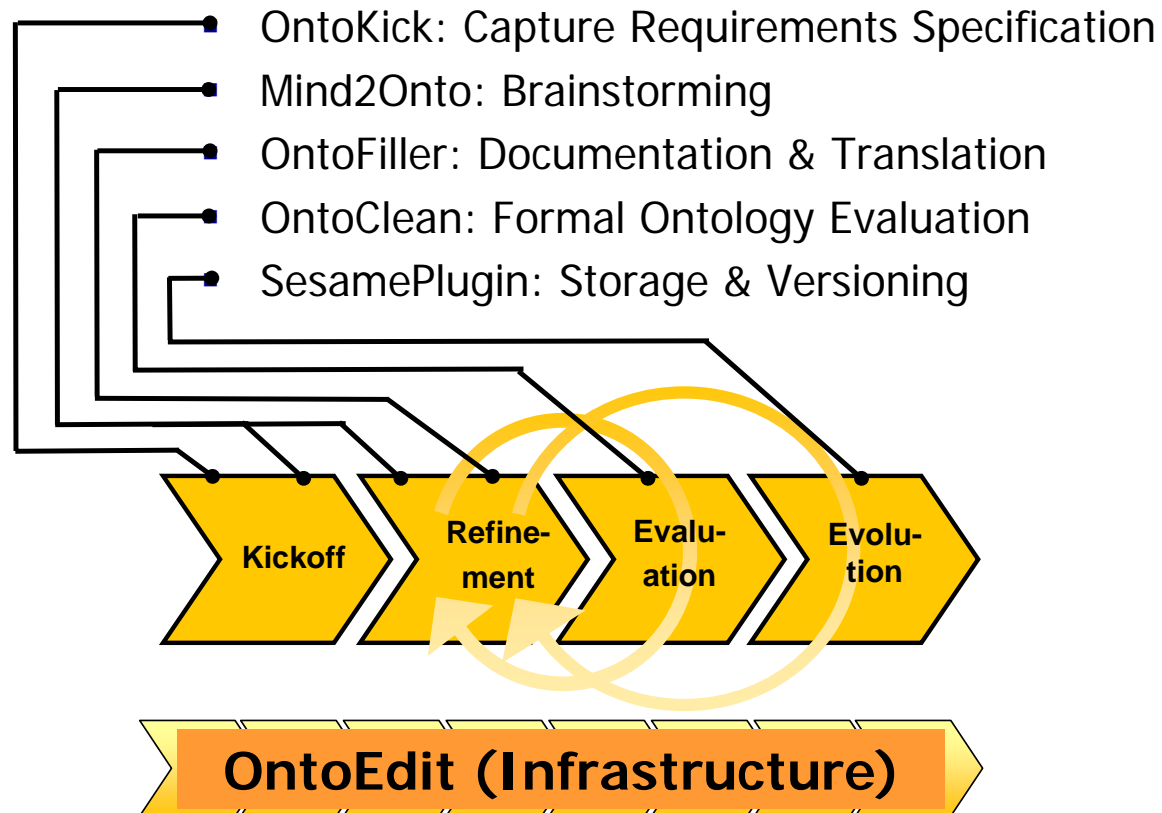
OTK Methodology: Knowledge Meta Process



- Process-oriented, cyclic
- Pre-defined decisions and outcomes for each step
- Links to further existing methodologies for substeps

Tools

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Slide 10



Feasibility

Feasibility Study

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AIB

- KM systems only function satisfactorily if they are properly integrated into the organization
- Many factors other than technology determine the success of such a system
- (Based on CommonKADS)

- Focus domain for ontology
- Identify people involved
- GO / No GO decision

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Feasibility

Feasibility study

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Current State: Skills Management

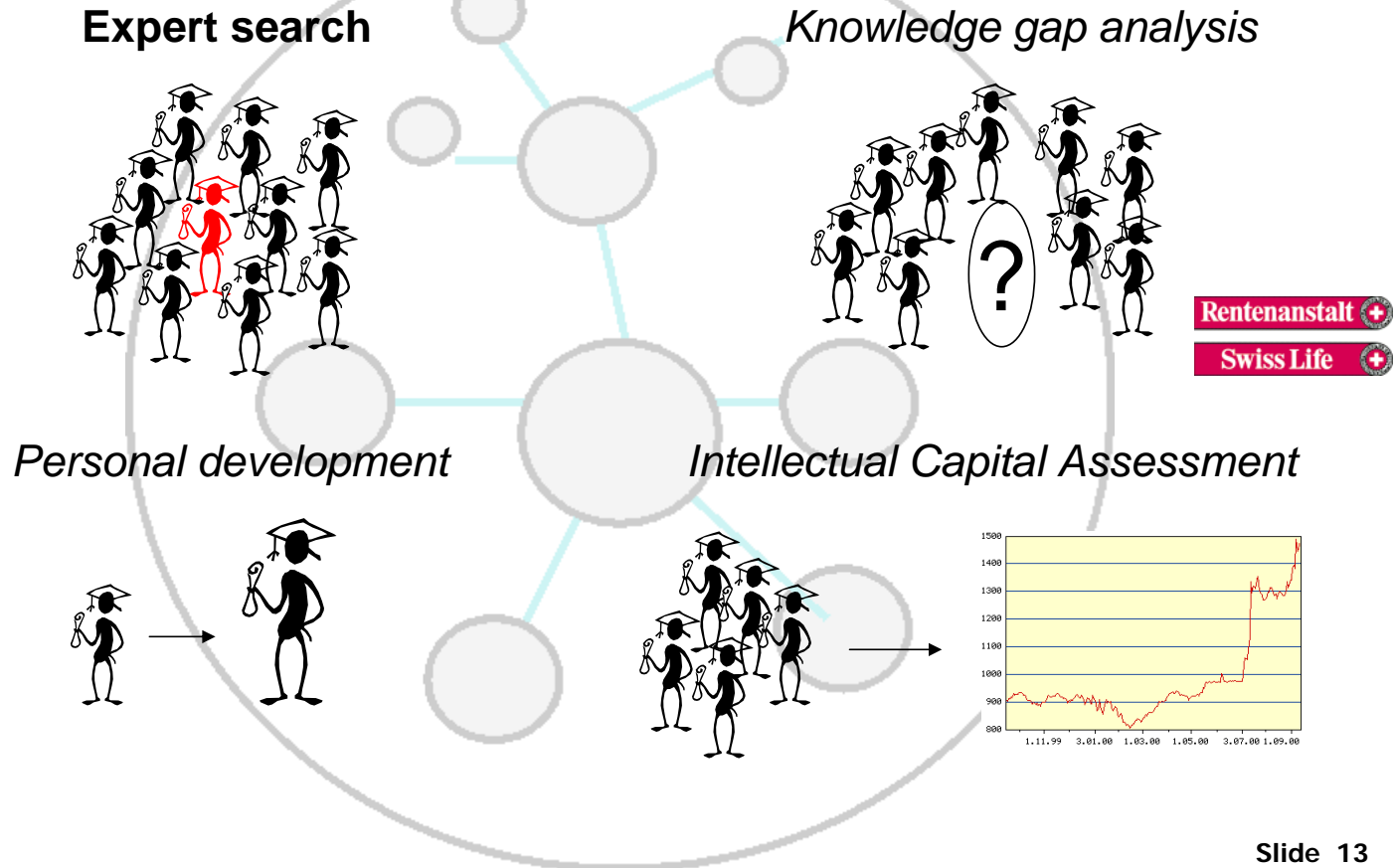
- Employee data distributed over many systems
- Different schemata for data
- Incomplete data

Rentenanstalt 

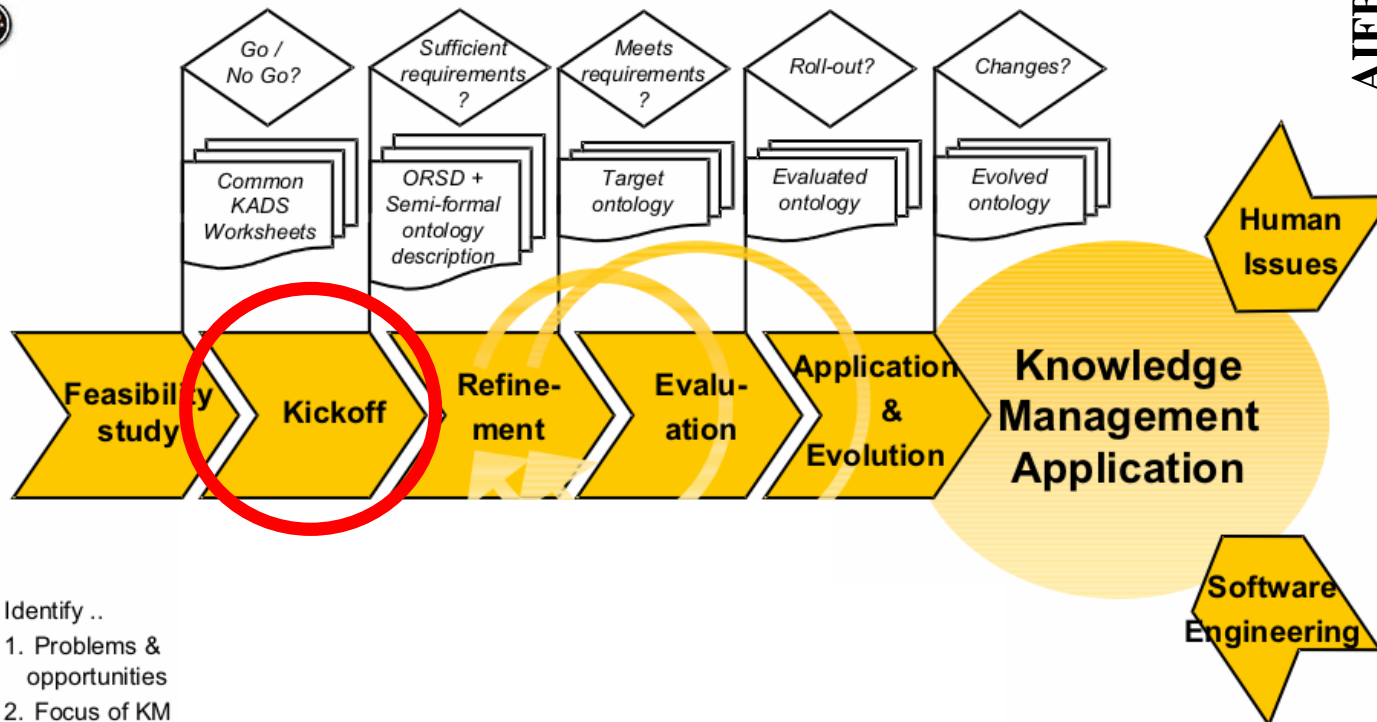
Swiss Life 

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Intended state: Skills Management



OTK Methodology: Knowledge Meta Process



Identify ..

1. Problems & opportunities
2. Focus of KM application
3. (OTK-) Tools
4. People





Ontology Kickoff

- Ontology Requirements Specification Document (ORSD)

1. *Domain & Goal*
2. *Design guidelines*
3. *Available knowledge sources*
4. *Potential users and user scenarios*
5. *Applications supported by the ontology*

E.g.
Competency
questions

Ontology
Learning!

- Analyze knowledge sources
- Develop ***baseline ontology description***

Draft version, typically most important concepts and relations are identified and described as an untyped graph

ORS – Ontology Requirements Specification

- **Goal of the ontology:**
 - Tracking and analyzing corporate business histories
- **Domain and Scope:**
 - Merger & acquisition, restructurings, management changes and other strategic activities in the chemical industry
- **Supported Applications:**
 - Web-based Corporate History Analyzer
- **Knowledge Sources:**
 - Research analysts (domain experts)
 - Document: c:/mydocuments/superdokument.doc
 - URL: <http://www.webpage.com>
- **Users and Use Cases:**
 - Users: Research analysts, strategic consultants
 - Use Case 1: Track strategies of specific companies
 - Use Case 2: Analyze strategic moves of competitors
- **Competency Questions:**
 - Attached Competency Questionnaire
- **Potentially reusable ontologies:**
 - not known

CQ – Competency Questionnaire



CQ Nr.	Competency Question	Concepts	Relation
CQ1	What are the subsidiaries, divisions and locations of company X?	company, subsidiary, division, location	company <i>has</i> subsidiary company <i>has</i> division company <i>has</i> location
CQ2	Which companies acquired company X?	company, acquisition	company <i>makes</i> acquisition acquisition <i>has</i> buyer acquisition <i>has</i> seller
CQ3	Which companies merged in 1990 in the rubber industry?	company, merger, year, industry	company <i>makes</i> merger company <i>isPartOf</i> industry merger <i>happensIn</i> year
CQ4	Who is CEO of company X?	CEO, company,	company <i>has</i> CEO
CQ5	Which activity of company X	activity	company <i>performs</i>

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Kick-Off

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- Ontology workshop to train domain experts in ontology modelling for
 - .. IT
 - .. Private customer insurance
 - .. Human Resource Management

- First version of domain ontology by expert
 - Manual development of ontology
 - Brainstorming (Mind Maps)
 - Middle-out approach

- Result: approx 700 Concepts in about 4 weeks

Rentenanstalt 

Swiss Life 

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Requirement specification

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Requirement specification

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New Ontology

Concepts & Relations | Instances | Relation axioms | Disjoint concepts | Requirement Specification | Identification | Metadata

Domain & Goal

Domain description

Sports & Recreation

- Food / Food Processing
- Hotel & Restaurant Equipment
- Industrial Equipment, Services & Supplies
- Information Technology / Robotics / Telecommunications
- Materials
- Medical / Scientific Products & Equipment
- Mining, Oil & Gas
- Sports & Recreation

Kick-Off date

08-01-2001

Completion deadline

12-31-2001

< Back Forward >



Requirement specification

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New Ontology

Concepts & Relations | Instances | Relation axioms | Disjoint concepts | Requirement Specification | Identification | Metadata

Design Guidelines

Design instructions

- Write all concepts with capital letters.
- Write all relations with small letters.
- If you are using more than one word for defining a concept or relation, use an underscore (e.g. "Power_plant")
- If you have only one concept as a subconcept, rethink your modelling decision!

Estimated number of concepts

500

Maximal depth of concept hierarchy

4

< Back Forward >



Knowledge Sources

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AITB

OntoPrise Ontology Engineering Workbench OntoEdit V1.0.3

File Edit Windows Help

C:\Programme\VisualAge for Java\ide\project_resources\OntoEdit\5-14_getess.xml

Concepts & Relations | Instances | Relation axioms | Disjoint concepts | Identification | Requirement Specification | About...

Knowledge Sources

Source List

Source	Type	Status
CQ Clous Revue 5-21-2001	Competency Questionnaire	NEW SOURCE
univer	Ontology	NEW SOURCE
wordD	Word Document	NEW SOURCE
xmlD	XML Document	NEW SOURCE
rdfD	RDF Document	NEW SOURCE
textD	Text Document	NEW SOURCE

1 Domain & Goal

Design Guidelines

Knowledge Sources

Users & Use Cases

Deployment

2 < Back Forward >

3

ADD... EDIT DELETE ANALYZE

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Knowledge Sources

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ALP B

OntoPrise Ontology Engineering Workbench OntoEdit V1.0.3

File Edit Windows Help

C:\Programme\VisualAge for Java\ide\project_resources\OntoEdit\5-1

Concepts & Relations | Instances | Relation axioms | Disjoint concepts

1

Domain & Goal

Design Guidelines

Knowledge Sources

Users & Use Cases

Deployment

Source List

Source

CQ Class Review 5 21 2001

univer

wordC

xmlDe

rdfDa

textDe

New source

Source type

Competency question

File (OXML, HTML, X)

OK

ADT

2

< Back

Forward >

Ontomat Options

General

OntoKick

Ontology Server

General Preferences

Tool selection

OXML-Files: **OntoEdit**

HTML-Files: HTML-Tool

XML-Files: XML-Tool

RDF-Files: RDF-To-Onto

Word-Documents: Text Tool

Text Document: Text Tool

OK

Cancel

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Kick-off

Knowledge Sources

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MB

OntoPrise Ontology Engineering Workbench OntoEdit V1.0.3

File Edit Windows Help

Concepts & Relations | Instances | Relation axioms | Disjoint concepts

1

Domain & Goal

Design Guidelines

Knowledge Sources

Users & Use Cases

Deployment

Source List

Source
CQ Clus Revue 5 21 2001
univer
wordC
xmlDe
rdfDa
textDe

Ontomat Options

- General
- OntoKick
- Ontology Server

General Preferences

Tool selection

OXML-Files: OntoEdit

HTML-Files: HTML-Tool

XML-Files: XML-Tool

DF-To-Onto

ext Tool

ext Tool

New source

Source type

- Competency questionnaire
- File (OXML, HTML, XML, DOC, TXT)

OK Cancel

3

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Competency questions

York Sure, 2005



Knowledge Engineer: York Sure

Domain Expert: Claus Boyens

Edition Date: 10-7-2001

Match Pattern! 4 letters Activate stemming Reset

Edit Question: Gibt es ein Luxushotel in Rostock?

Concepts: [] Relations: []

ADD TO LIST CHANGE REMOVE IMPORT...

#	Question
1	Gibt es ein Luxushotel in Rostock?
2	Welche touristischen Attraktionen gibt es in Schwerin?
3	Wo ist das beste Restaurant in Warnemünde?
4	Gibt es eine Surfschule auf Usedom?
5	Gibt es einen weißen Sandstrand auf Rügen?

DONE CANCEL

Slide 25



Competency questions

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Concept hierarchy

- Root
 - Ding
 - Immaterielles
 - Massen_Konzept
 - Mathematisches_Konzept
 - Raumliches_Konzept
 - Situation
 - Zaehlbare_Konzept

Knowledge Engineer: York Sure

Domain Expert: Claus Boyens

Edition Date: 10-7-2001

Match Pattern! 4 letters Activate stemming

Reset

Edit Question: Gibt es ein Luxushotel in Rostock?

Concepts:

Relations:

ADD TO LIST

CHANGE

REMOVE

IMPORT...

Question List

#	Question
1	Gibt es ein Luxushotel in Rostock?
2	Welche touristischen Attraktionen gibt es in Schwerin?
3	Wo ist das beste Restaurant in Warnemünde?
4	Gibt es eine Surfschule auf Usedom?
5	Gibt es einen weißen Sandstrand auf Rügen?

DONE CANCEL

Slide 26



Competency questions

York Sure, 2005



Concept hierarchy

- Root
- Ding
- Immaterielles
- Massen_Konzept
- Mathematisches_Konzept
- Raeumliches_Konzept
- Situation
- Zaehlbares_Konzept

Knowledge Engineer: York Sure

Domain Expert: Claus Boyens

Edition Date: 10-7-2001

Match Pattern! 4 letters Activate stemming

Reset

Edit Question: Gibt es ein Luxushotel in Rostock?

ADD TO LIST CHANGE REMOVE IMPORT...

ADD AS CONCEPT ADD AS RELATION SHOW SIMILAR CONCEPTS ADD AS SYNONYM ADD AS INSTANCE IGNORE

2	Welche to
3	Wo ist da:
4	Gibt es ei
5	Gibt es ei

Luxus
Hotelsafe
Tophotel
Flug_und_Hotel
Hotelgarten
Mittelklassehotel
Hotel
Motel

Schwerin?
de?
n?

DONE CANCEL

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Competency questions

York Sure, 2005



Concept hierarchy

Knowledge Engineer: York Sure

Domain Expert: Claus Boyens

Edition Date: 10-7-2001

Match Pattern! 4 letters

Activate stemming

Reset

Edit Question: Gibt es ein Luxushotel in Rostock?

ADD TO LIST

CHANGE

REMOVE

IMPORT...

Ignore

Show similar concepts

- Luxus
- Hotelsafe
- Tophotel
- Flug_und_Hotel
- Hotelgarten
- Mittelklassehotel
- Hotel
- Motel

2	Welche to
3	Wo ist da:
4	Gibt es ei
5	Gibt es ei

DONE CANCEL

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Competency questions

York Sure, 2005



Concept hierarchy

Knowledge Engineer: York Sure

Domain Expert: Claus Boyens

Edition Date: 10-7-2001

Match Pattern! 4 letters Activate stemming

Reset

Edit Question: Gibt es ein **Luxushotel** in Rostock?

ADD TO LIST CHANGE REMOVE IMPORT...

CONCEPTS: Schwerin? de? n?

RELATIONS

DONE CANCEL

3	Wo ist da:	Mittelklassehotel
4	Gibt es ei	Hotel
5	Gibt es ei	Motel

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Competency questions

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New competency questionnaire

Concept hierarchy

- Hafen
- Kindergarten
- Reiseveranstalter
- Unterkunft
 - Appartement
 - Appartementsanlage
 - Bauernhof
 - Camp
 - Campingplatz
 - Clubanlage
 - Feriedorf
 - Ferienhaus
 - Ferienwohnung
 - Gasthof
 - Hotel
 - Luxushotel
 - Mittelklassehotel
 - Tophotel
 - Jugendherberge
 - Motel
 - Pension
 - Sanatorium
 - Seminarhaus

Knowledge Engineer: York Sure

Domain Expert: Claus Boyens

Edition Date: 10-7-2001

Match Pattern! 4 letters Activate stemming Reset

Edit Question: Gibt es ein Luxushotel in Rostock?

Concepts: Luxushotel

Relations:

ADD TO LIST

CHANGE

REMOVE

IMPORT...

Question List

#	Question
1	Gibt es ein Luxushotel in Rostock?
2	Welche touristischen Attraktionen gibt es in Schwerin?
3	Wo ist das beste Restaurant in Warnemünde?
4	Gibt es eine Surfschule auf Usedom?
5	Gibt es einen weißen Sandstrand auf Rügen?

DONE CANCEL

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Traceability



The screenshot shows the 'New Ontology' application window. It features a tabbed interface with 'Concepts & Relations' selected. The main area is divided into three panes:

- Concept hierarchy:** A tree view showing a hierarchy of concepts. 'Luxushotel' is selected, and a context menu is open over it with options: 'Insert Concept', 'Delete Concept', 'Insert Relation', 'Show CQ', 'Reorganize', and 'Edit concept'.
- Relations:** A list of relations including 'Adresse', 'Anzahl_Betten', 'Haustiere_erlaubt', 'Klassifizierung', 'Name', 'Verpflegung', 'behindertenfreundlich', 'Aktivitaet', 'Dienstleistung', 'Ereignis', 'Freizeiteinrichtung', 'Kaub', 'Ausstattung', 'Sauberkeit', 'Abhaengigkeit', 'hat_Zimmer', 'in_Gebiet', and 'liegt_bei'.
- Range:** A list of ranges including 'Adresse', 'INTEGER', 'BOOLEAN', 'STRING', 'STRING', 'STRING', 'BOOLEAN', 'Aktion', 'Dienstleistung', 'Ereignis', 'Freizeiteinrichtung', 'Urlaub', 'Nichtprivate Ausstattung der Unterkunft', 'Raeumliches Konzept', 'Qualitatives Zeitkonzept', 'Zimmer', 'Gebiet', and 'Sehenswuerdigkeit'.



Traceability

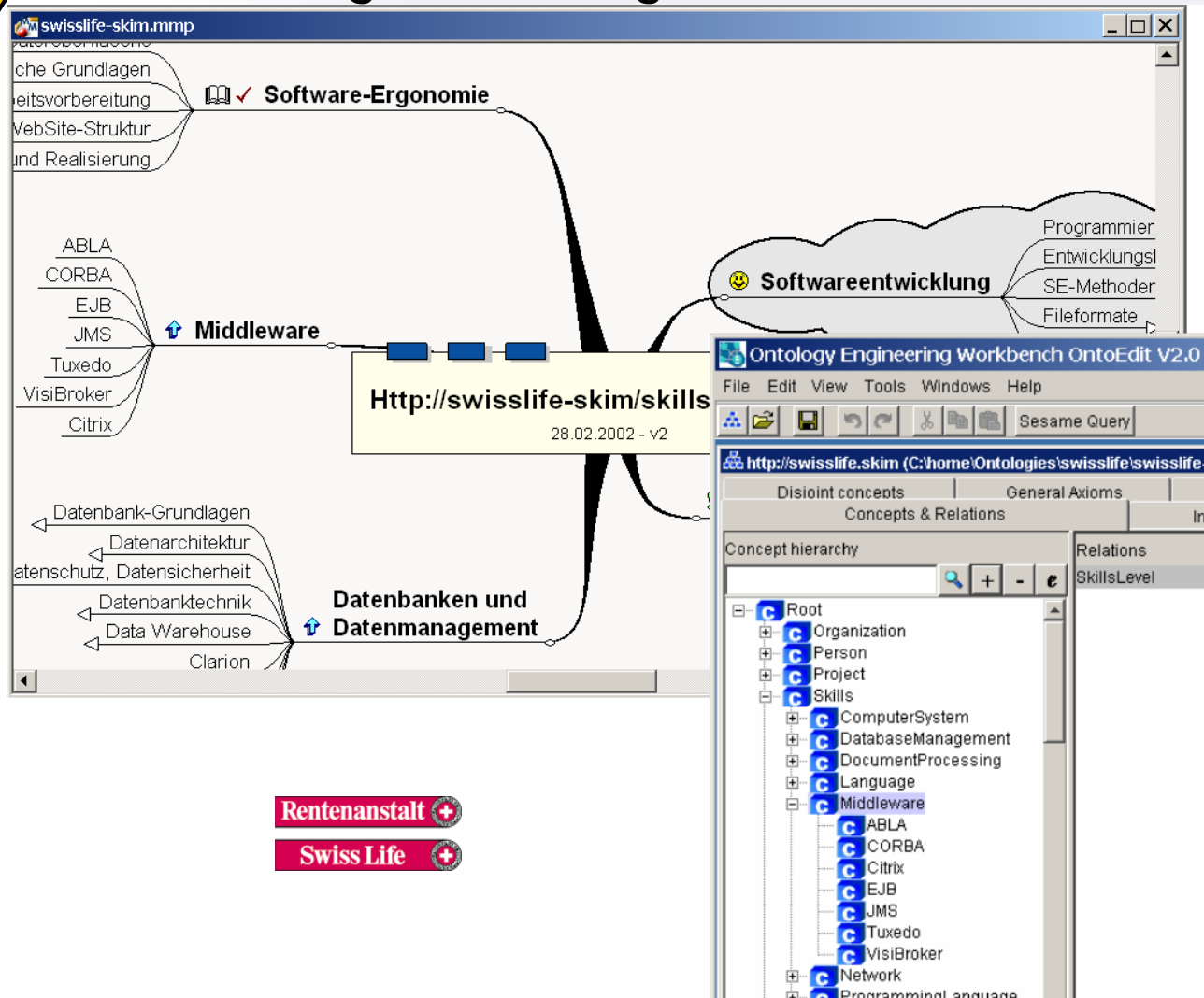


The screenshot shows the 'New Ontology' application interface. The 'Concept hierarchy' pane on the left lists various concepts, with 'Luxushotel' selected. A context menu is open over 'Luxushotel', with 'Show CQ' highlighted. The 'Relations' pane in the center lists properties like 'Adresse', 'Anzahl_Betten', and 'Haustiere_erlaubt'. The 'Range' pane on the right shows the corresponding data types. A 'Corresponding Competency' dialog box is displayed in the foreground, containing the text 'Expert: Claus Boyens', 'Date: 10-7-2001', and a text input field with the query 'Gibt es ein Luxushotel in Rostock?'. An 'OK' button is at the bottom of the dialog.



Brainstorming, Structuring, Formalisation

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Rentenanstalt

Swiss Life



Kickoff

Mind2Onto

York Sure, 2005



- **Task:** Collaborative capturing of domain knowledge through domain experts and modelling experts

- **Problem:** Collaboration with domain experts who have:
 - **No experience** with modelling
 - **No time** for modelling

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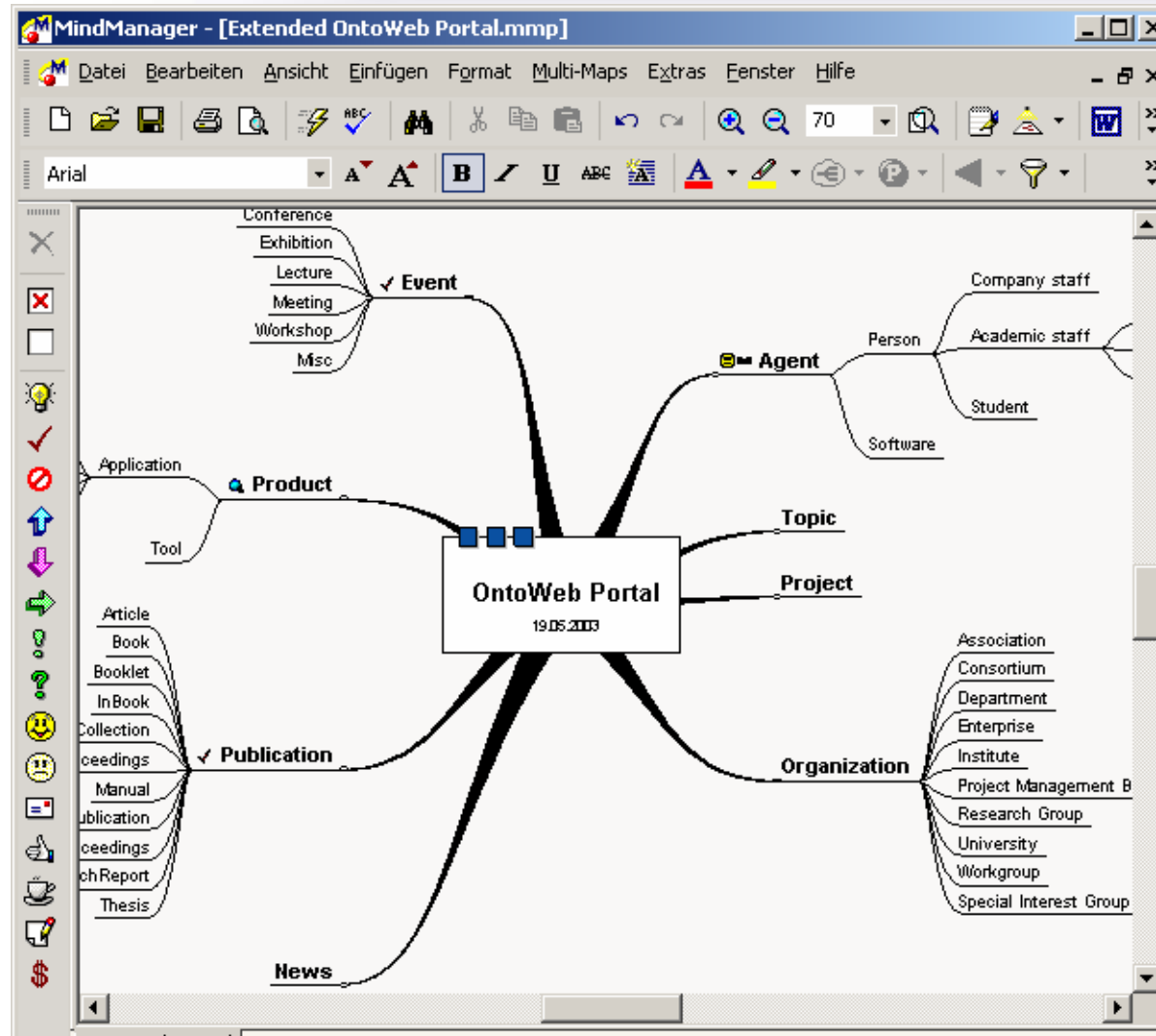


Mind2Onto

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AIFB



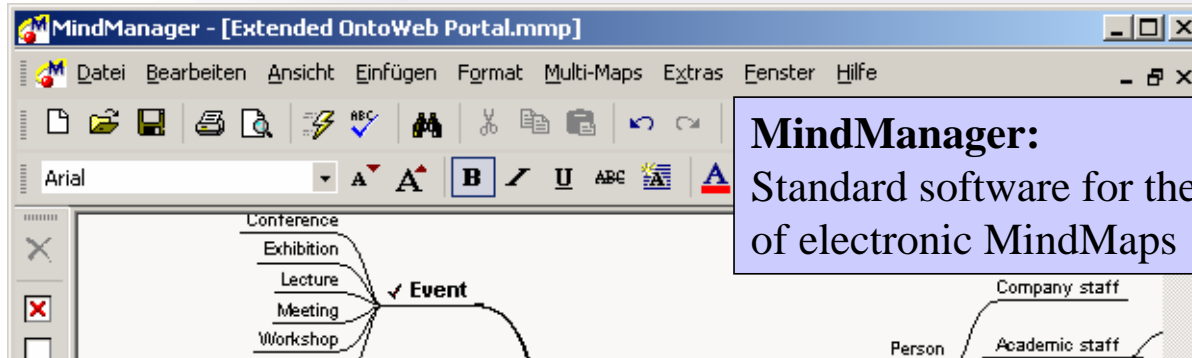
gh

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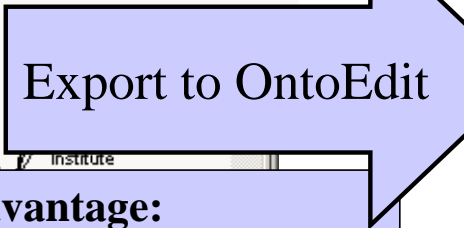
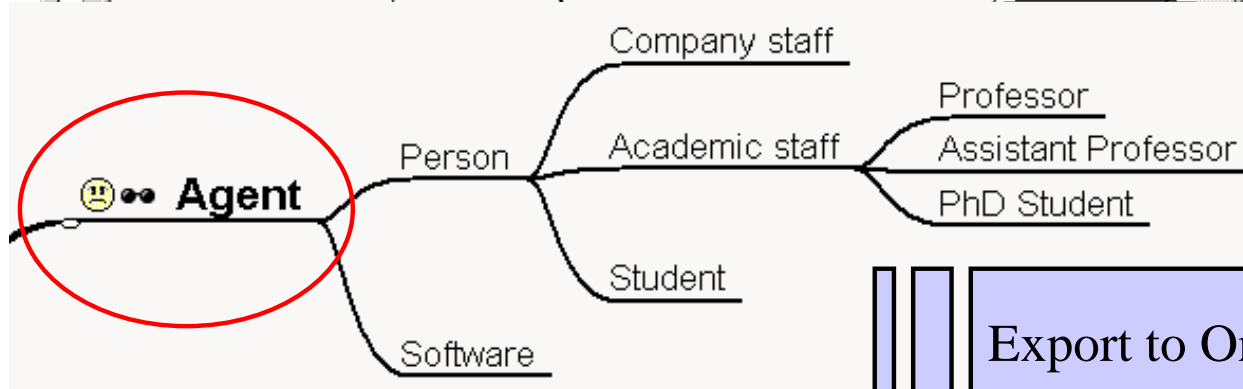


Mind2Onto

York Sure, 2005



MindManager:
Standard software for the creation of electronic MindMaps



Advantage:
Intuitive, understandable
Problem:
Semantics of MindMaps only vaguely defined



OntoEdit/OntoFiller

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The screenshot shows the Ontology Engineering Workbench OntoEdit V2.5 (inferencing edition) interface. The main window displays a table with columns for languages (de, en, fr) and various ontology concepts. The table is titled "http://btexact.ontoshare/review (C:\home\MindMaps\OntoShare Ontology.owl)". The table content is as follows:

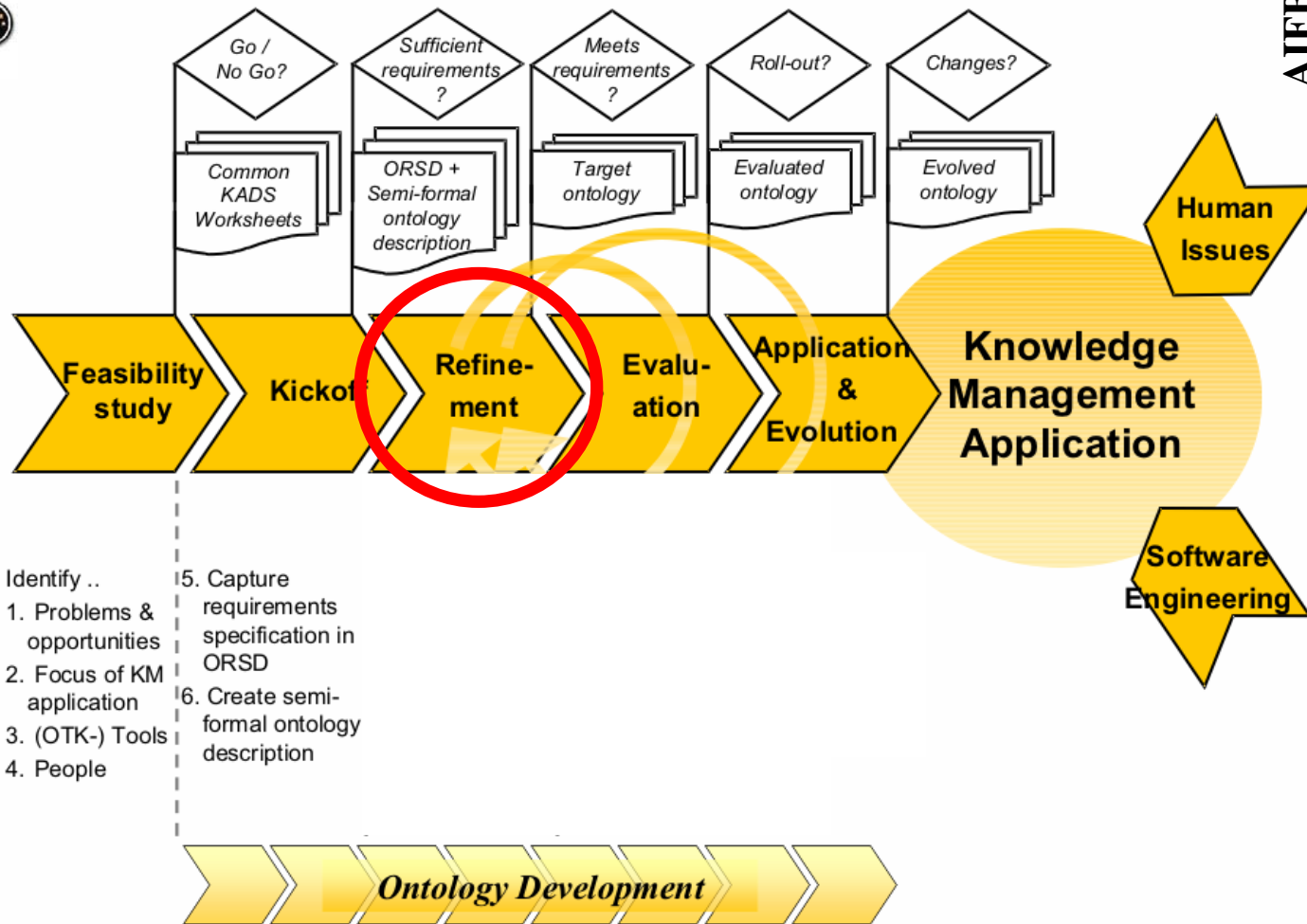
	de	en	fr
Wissens_und_Informatio...		Knowledge_and_Informa...	
Content_Matching		Content_Matching	
Agents		Agents	
Metadata_Extraction		Metadata_Extraction	
Portals		Portals	
Information_Discovery		Information_Discovery	
Searching		Searching	
Browsing		Browsing	
Indexing		Indexing	
Personalisation		Personalisation	
User_Profiling		User_Profiling	
Context_Analysis		Context_Analysis	
Content_Understanding		Content_Understanding	
E_Business		E_Business	
M_Commerce		M_Commerce	

At the bottom of the window, there are buttons for "Language tool", "Namespace tool", and "Translation tool". The "Show languages" section has checkboxes for "de" and "en", both of which are checked. The status bar at the bottom left shows "Ready."

OntoFiller: Support for translation and documentation of concepts and relations in multiple languages

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OTK Methodology: Knowledge Meta Process





Refinement



- Knowledge elicitation with domain experts
 - Refine concepts and relations
 - Typically axioms are identified

- Formalize
 - E.g. F-Logic, DAML+OIL
 - Axioms depend on language capabilities

- Develop and refine *ontology*



Mind2Onto

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OntoEdit for Beta Tester

File Edit View Tools Windows Help

Connect to Sesame Generate ontology

check

<http://www.OntoWeb.org/extended> (C:\home\projects\ontoweb\ExtendedOntoWeb.xml)

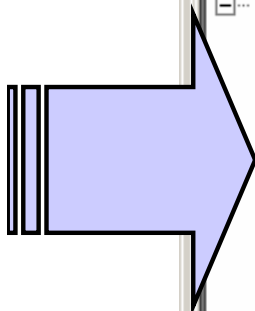
Inferencing Concepts & Relations Analyzer Instances Visualizer Relation axioms Debugger Query Tool Domain-Lexicon OntoFiller Disjoint concept

Concept hierarchy

- DEFAULT_ROOT_CONCEPT
 - OntoWebPortal
 - Agent
 - Person
 - Software
 - Event
 - News
 - Organization
 - Project
 - Publication
 - Topic
 - Methodology
 - BusinessScenario
 - Language
 - Ontology
 - EducationalResource
 - Product

Relations

Relations	Range
author	STRING
dcContributor	STRING
dcCoverage	STRING
dcCreator	STRING
dcDate	STRING
dcDescription	STRING
dcFormat	STRING
dcIdentifier	STRING
dcLanguage	STRING
dcPublisher	STRING
dcRelation	STRING
dcRights	STRING
dcSource	STRING
dcSubject	STRING
dcTitle	STRING
dcType	STRING



de 40



Mind2Onto

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OntoEdit for Beta Tester

File Edit View Tools Windows Help

Connect to Sesame Generate ontology

check

<http://www.OntoWeb.org/extended> (C:\home\projects\ontoweb\ExtendedOntoWeb.oxm)

Inferencing Concepts & Relations Analyzer Instances Visualizer Relation axioms Debugger Domain-Lexicon Query Tool OntoFiller Disjoint concept

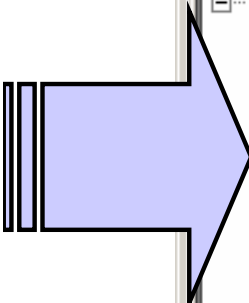
Concept hierarchy

- DEFAULT_ROOT_CONCEPT
 - OntoWebPortal
 - Agent (with sad face icon)
 - Person
 - Software
 - Event (with checkmark icon)
 - News
 - Organization
 - Project
 - Publication (with checkmark icon)
 - Topic
 - Methodology (with lightbulb icon)
 - BusinessScenario (with down arrow icon)
 - Language
 - Ontology
 - EducationalResource (with down arrow icon)
 - Product (with globe icon)

Relations	Range
author	STRING
dcContributor	STRING
dcCoverage	STRING
dcCreator	STRING
dcDate	STRING
dcDescription	STRING
dcFormat	STRING
dcIdentifier	STRING
dcLanguage	STRING
dcPublisher	STRING

Agent (with sad face icon)

- Person
- Software



de 41



Theoretical Issues

- F-Logic
 - Object-oriented
 - Deductive Database-oriented
 - Well-founded semantics

Practical Issues

- Namespace mechanism: Ontologies/Ontology Parts -> modules
- Switch-off definitions:
 - For testing
 - For fast executions without consistency checks
- DB Connectors: map DB tables via JDBC
- User-definable built-Ins
- Extensive API:
 - remotely connect to the inference engine
 - import and export several standards (e.g., RDF(S))



Exploit Inferencing

York Sure, 2005



- Hook in existing resources with inferencing
 - Jdbc
 - Rules

- Construct axiom libraries
 - Temporal reasoning
 - PartWhole reasoning
 - ...

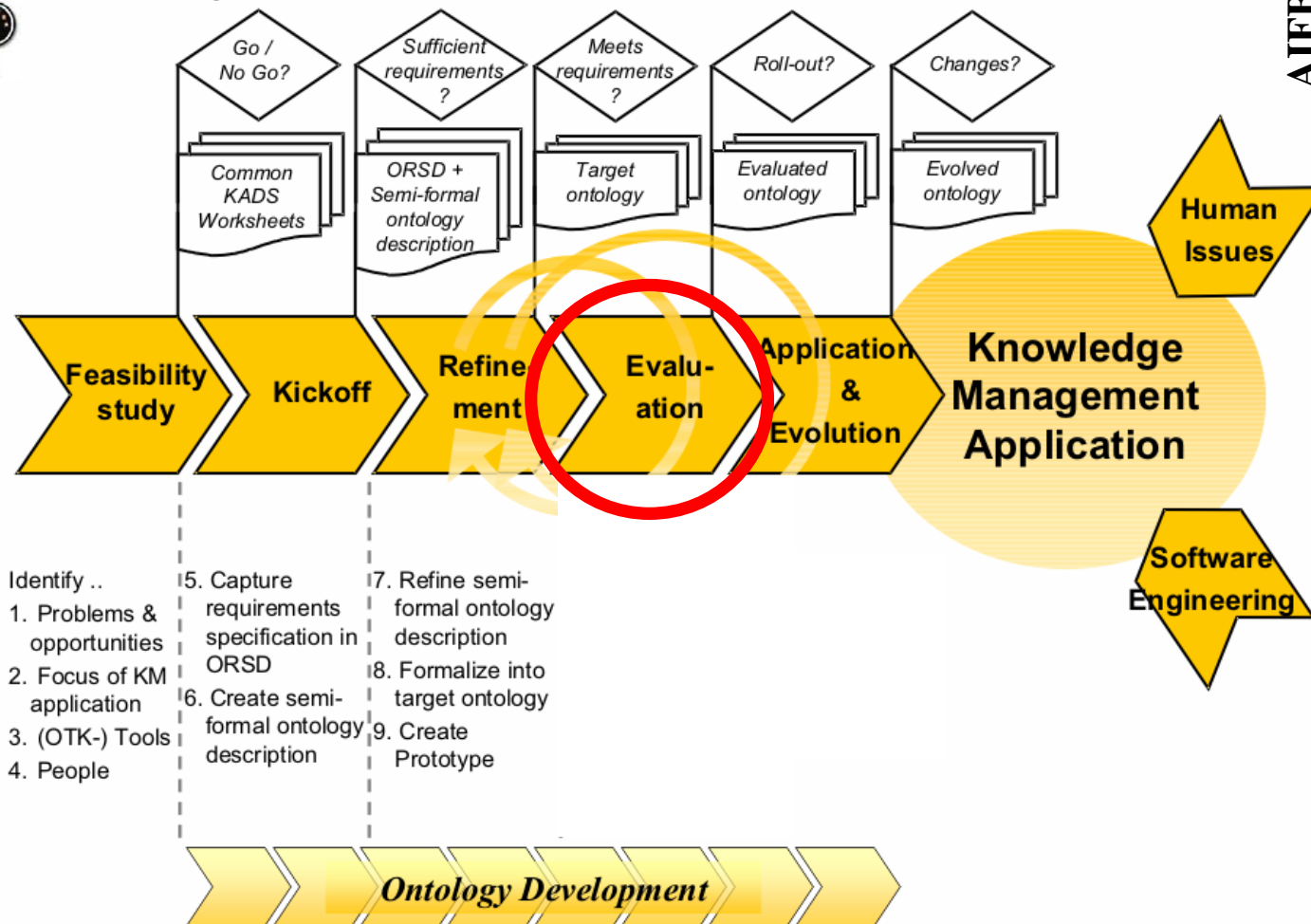
- Selective axiom applications
 - F-Logic semantics: E.g. type coercion at concept level
 - Domain specific consistency: non-cyclic hasPart
 - Axioms for modeling policies
 - Debugging



Contrast: OilEd

Slide 43

OTK Methodology: Knowledge Meta Process





Evaluation



- Check requirements (ORSD)
 - Are all CQs answered?
 - Is the ontology within the scope?

- Test in target application
 - Analyze usage patterns

- Deploy application(s)





OntoClean

York Sure, 2005



- **Task:** Formal evaluation of ontologies
- Well-known methodology:
OntoClean [Welty & Guarino, 2001]
 - Aims at „**cleaning**“ of hierarchies
 - Based on philosophical notions
„essence“, „rigidity“, „identity“, „unity“ ... etc.
- **Implementations:** For F-Logic & OWL

Slide 46

- „Essence“: A property is essential for an individual *iff.* it necessarily holds for that individual.

Example: York is *necessarily* a person.

- „Rigidity“

- A property is „rigid“ (+R) *iff.* it is **necessarily essential for all** its individuals.
- A property is „non-rigid“ (-R) *iff.* it is **not essential for some** of its individuals.
- A property is „anti-rigid“ (\sim R) *iff.* it is **not essential for all** its individuals.

Example: „Person“ is necessarily an essential property for all its individuals.

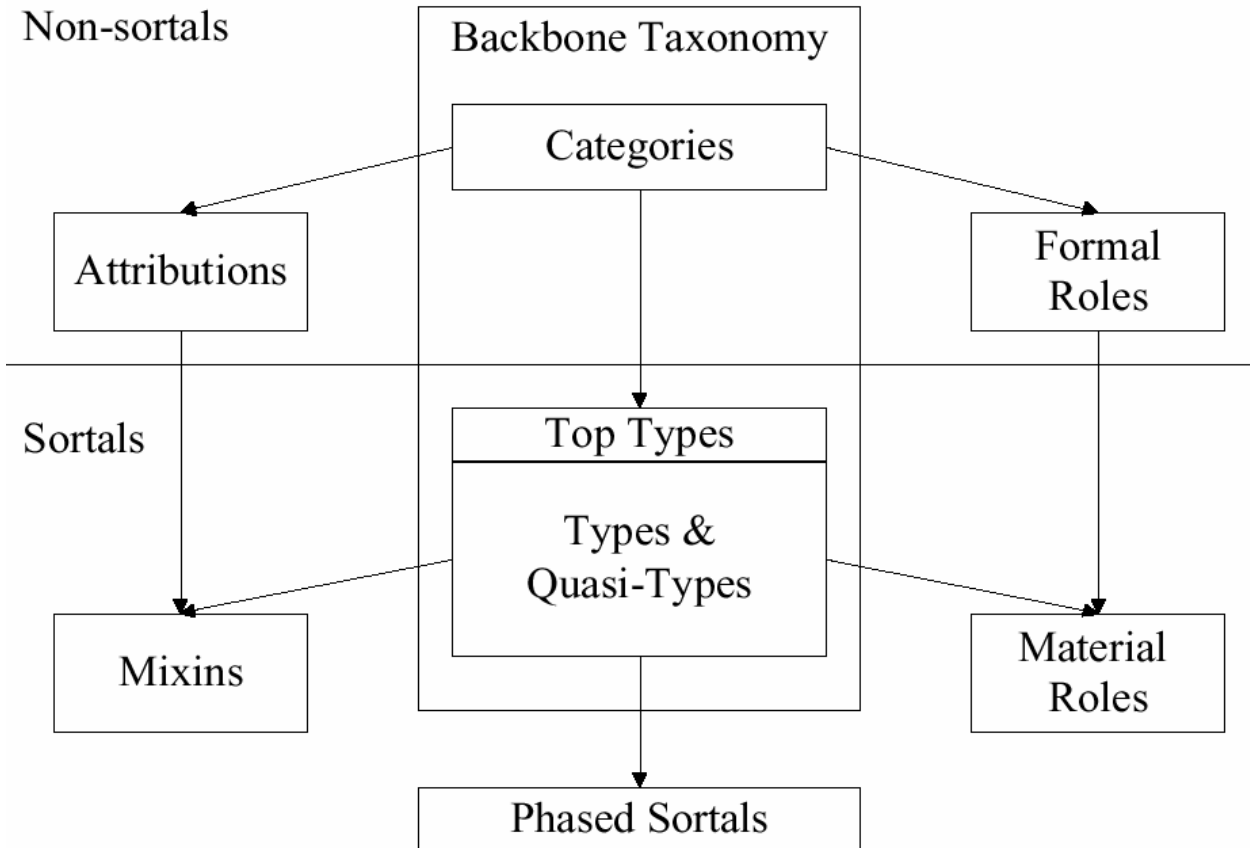
- There exist similar definitions for „identity“ (+I, -I, +O, -O), „unity“ (+U, -U, \sim U), „dependency“ (+D, -D), ... etc. ...

OntoClean: Classification & ideal structure

+O	+I	+R	+D	Type	Sortal	
			-D			
-O	+I	+R	+D	Quasi-type		
			-D			
-O	+I	~R	+D	Material role		
-O	+I	~R	-D	Phased sortal		
-O	+I	-R	+D	Mixin		
			-D			
-O	-I	+R	+D	Category		Non-sortal
			-D			
-O	-I	~R	+D	Formal Role		
-O	-I	~R	-D	Attribution		
		-R	+D			
		-R	-D			
+O	-I				incoherent	
+O	+I	~R				
		-R				

See: [Welty & Guarino, 2001]

OntoClean: Classification & ideal structure



See: [Welty & Guarino, 2001]



OntoClean: Layering

York Sure, 2005



meta ontology

Type

Formal Role

Instance of

Instance of

ontology

...

Subclass of

Agent

+D -I ~R -U

Subclass of

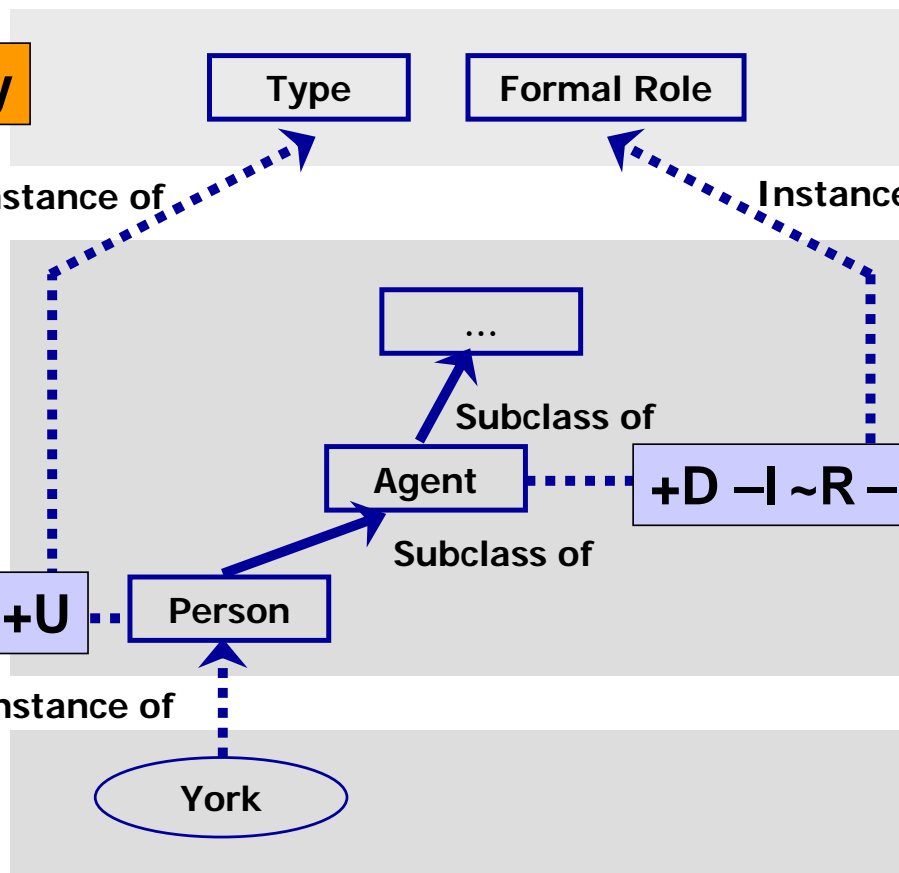
Person

-D +O +R +U

Instance of

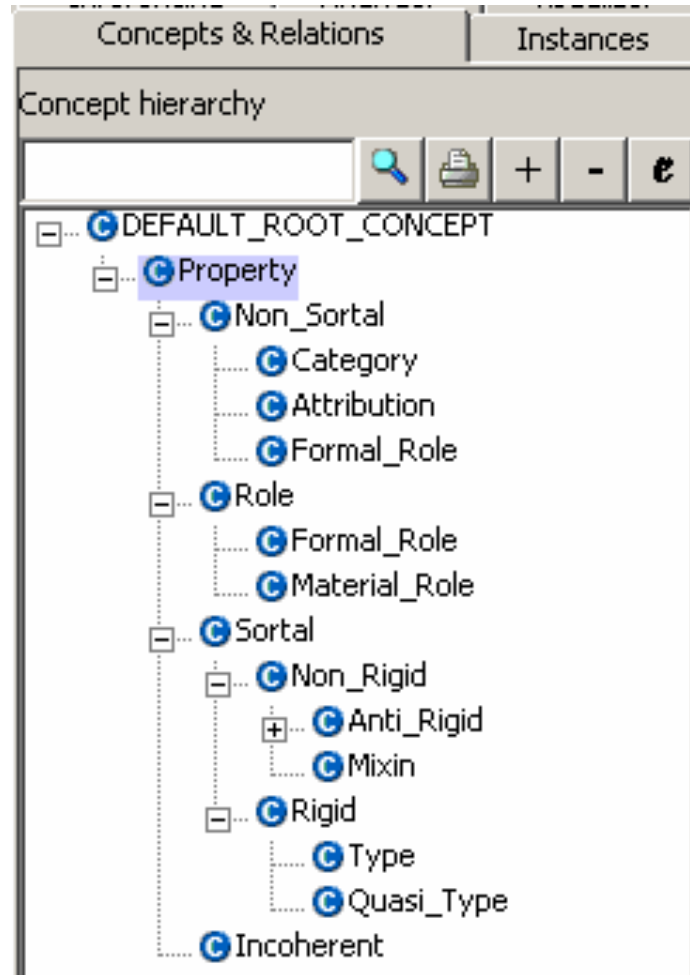
metadata

York



OntoCleanPlugin: Formalisation of meta ontology

1

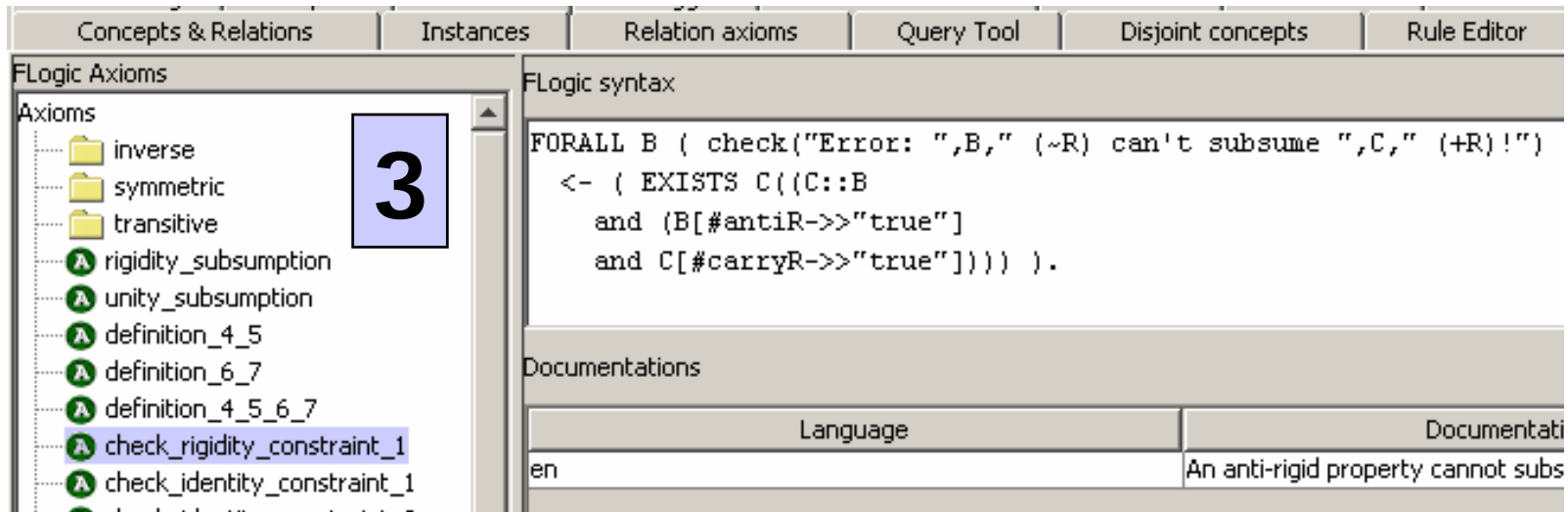


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OntoCleanPlugin: Formalisation of meta ontology

Concept hierarchy	Relations	Range
<div style="border: 1px solid black; padding: 5px; width: 30px; text-align: center; font-weight: bold; margin-bottom: 5px;">2</div> <ul style="list-style-type: none"> ... C DEFAULT_ROOT_CONCEPT <ul style="list-style-type: none"> ... C Property <ul style="list-style-type: none"> ... C Non_Sortal <ul style="list-style-type: none"> ... C Category 	antiR antiU carryD carryI carryNotD carryNotI	BOOLEAN BOOLEAN BOOLEAN BOOLEAN BOOLEAN BOOLEAN

Uppermost concept „Property“ of the *meta ontology* has attached all relations necessary for classifying concepts of an *ontology*



Language	Documentati
en	An anti-rigid property cannot subs

- Anti-rigid concepts ($\sim R$) cannot have rigid subconcepts ($+R$)
- *Etc.*



OntoCleanPlugin: Cleaning example



OntoEdit for Beta Tester

File Edit View Tools Windows Help

check Connect to Sesame Generate ontology

http://www.OntoWeb.org/extended (C:\home\projects\ontoweb\ExtendedOntoWeb.owl)

Concepts & Relations Instances Relation axioms Query Tool Disjoint concepts Rule Editor General Axioms













Inferencing Analyzer Visualizer Debugger Domain-Lexicon OntoFiller OntoClean Identification Metadata

Clean ontology	ID	en	+D	-D	+I	-I	+O	-O	+R	-R	~R	~U	+U	-U
	DEFA...			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Onto...	OntoWebPortal		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Agent	Agent		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Event	Event		<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
News	News		<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Organi...	Organization		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Person	Person		<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Project	Project		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Public...	Publication		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Topic	Topic		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Applic...	Application		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Tool	Tool		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Metho...	Methodology		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Busine...	BusinessScen...		<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Langu...	Language		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ontology	Ontology		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Educa...	EducationalRe...		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Confe...	Conference		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Exhibit...	Exhibition		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Lecture	Lecture		<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Meeting	Meeting		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Works...	Workshop		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Misc	Misc		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Associ...	Association		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Conso...	Consortium		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Depar...	Department		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Enterp...	Enterprise		<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Institute	Institute		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Projec...	ProjectManag...		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Resea...	ResearchGroup		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Univer...	University		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Weda	Webpage		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Ready. 2507.0k free

Concepts & Relations	Instances	Relation axioms	Query Tool	Disjoint concepts
Inferencing	Analyzer	Visualizer	Debugger	Domain-Lexicon
			OntoFiller	OntoCle

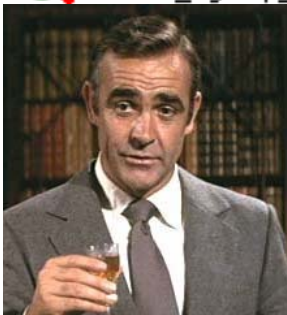
Axioms

- inverse
- symmetric
- transitive
-   rigidity_subsumption
-   unity_subsumption
-   definition_4_5
-   definition_6_7
-   definition_4_5_6_7
-   check_rigidity_constraint_1

```
FORALL V,W,X,Y,Z <- check(V,W,X,Y,Z).
```

Evaluating the query FORALL V,W,X,Y,Z <- check(V,W,:

Error: Agent (~R) can't subsume Person (+R)!



„Is James an agent?“

Concepts & Relations	Instances	Relation axioms	Query Tool	Disjoint concepts
Inferencing	Analyzer	Visualizer	Debugger	Domain-Lexicon
OntoFiller	OntoCle			

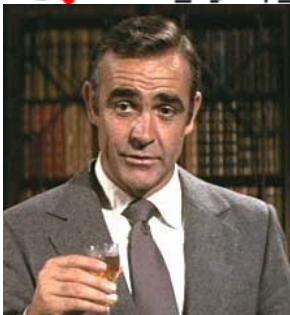
Axioms

- inverse
- symmetric
- transitive
- rigidity_subsumption
- unity_subsumption
- definition_4_5
- definition_6_7
- definition_4_5
- check_rigidity_

```
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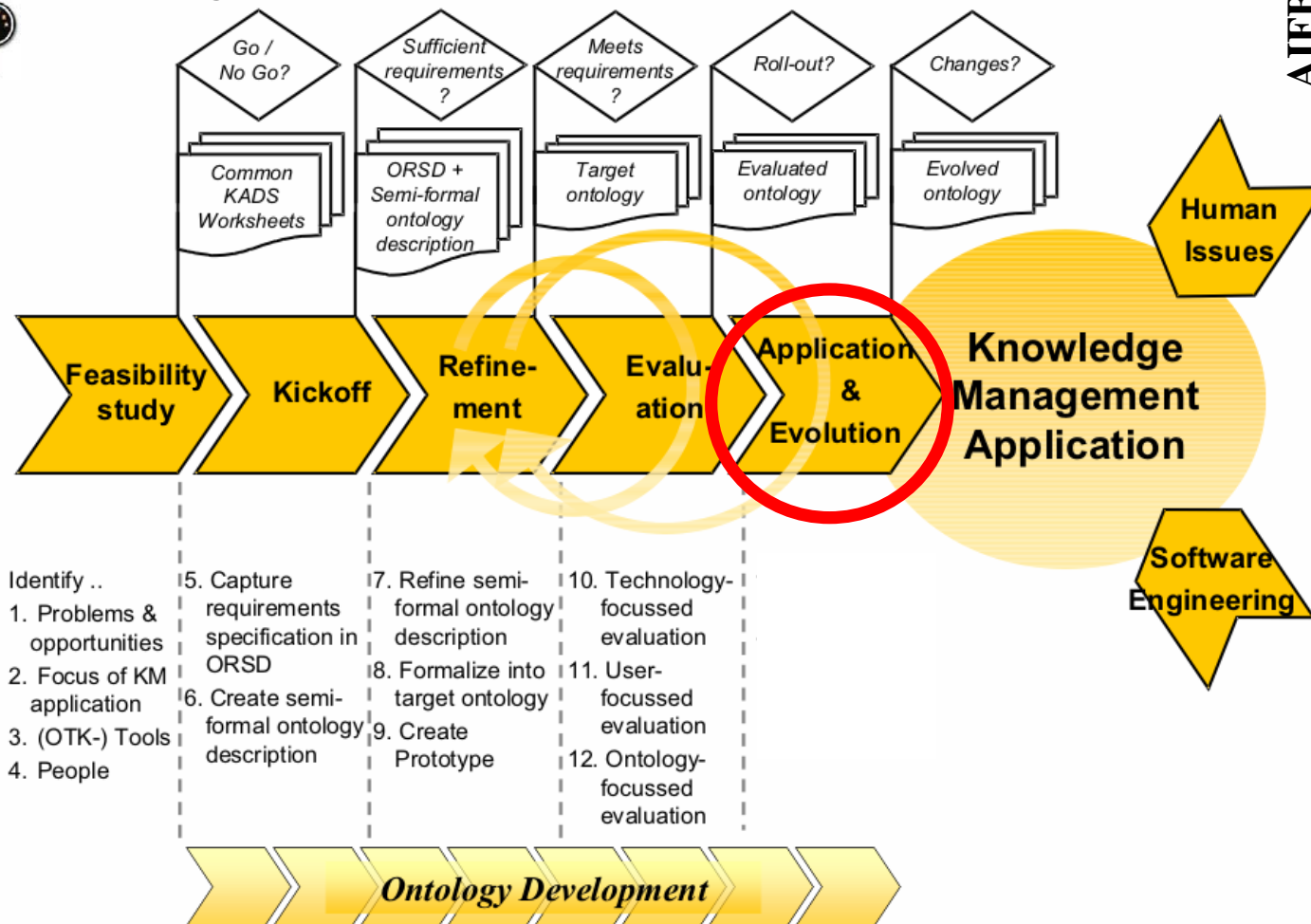


Person should not be a subconcept of Agent!

Interpretation: Persons *can be* agents, but persons are not necessarily agents.

„Is James an agent?“

OTK Methodology: Knowledge Meta Process





Evolution

Worksheet for life cycle aspects of ontology

York Sure, 2005



- Who is going to maintain it?
- Who is going to pay for it?
- What is the resulting quality (increase, decrease)?
- How large are the network costs (cost of negotiation grows quadratic with number of participants)?
- What is the expected life time of the ontology?
- How brittle is it with regard to updates?
- What error types will occur/are relevant?

Slide 59



Evo-
lution

Worksheet for life cycle aspects of metadata

York Sure, 2005



- ala ontology
- Co-ordinated change of data and metadata?
- Co-ordinated change of ontology and metadata?
- Cold start (chicken-and-egg) problem: A problem? How to overcome?
- Granularity of metadata envisaged: classification, identification of people/events/relationships/etc.

Faustregel – Kosten:

- Hardware 1
- Software 10
- Daten 100

Slide 60



Evo-
lution

Coordination of metadata & ontology

York Sure, 2005



- Match or mismatch between the two,
 - E.g. classification only, but ontology about transitive relationships

Slide 61



Evo-
lution

Type-1 Error

York Sure, 2005



- False Positive
 - Often dominating problem in company internal IR

 - It can be more costly to learn about all low-price provider of pens than to just select from a sample

Slide 62



- False negative: Positive example not detected as such
 - Often not critical for information retrieval
 - „show me bookstores who sell the `CommonKADS` book“
 - Often critical for B2B operations
 - „whether `6000 computer` is mapped to `IBM RS/6000 SP system` or to `HP OmniBook Laptop 6000` is a large difference with regard to price and performance“



Refined Error types (Halo Project)

- 1. (MOD) Knowledge Modeling: the ability of the knowledge engineer to model information/write axioms
- 2. (IMP) Knowledge Implementation/Modeling Language: the ability of the representation language to accurately represent axioms
- 3. (INF) Inference and Reasoning: the ability of the inference engine to “find the needle in the haystack”
- 4. (KFL) Knowledge Formation and Learning: the ability of the system (KB + inference engine) to acquire and merge knowledge through automated and semi-automated techniques
- 5. (SCL) Scalability: the ability of the KB to scale

- <http://www.haloproject.com>



Evo-
lution

Refined Error types II (Halo Project)

York Sure, 2005



- 6. (MGT) Knowledge Management: the ability of the system to maintain, track changes, test, organize, document; the ability of the knowledge engineer to search for knowledge
- 7. (QMN) Query Management: the ability of the system to robustly answer queries
- 8. (ANJ) Answer Justification: the ability of the system to provide justifications for answers in the correct context and resolution
- 9. (QMT) Quality Metrics: the ability of the developers to determine how “good” the knowledge base is at any given point in its evolution
- 10. (MTA) Meta Capabilities: the system's ability to utilize meta-reasoning or meta-knowledge

Slide 65



Evo-
lution

Ontology Evolution: Technical aspects

York Sure, 2005



- Ontology development is necessarily an **iterative** and a **dynamic process**
- Ontologies must be able to **evolve** for a number of reasons:
 - **Application domains and user's needs are changing**
 - **System can be improved**
- Developing ontologies is expensive, but evolving them is even **more expensive**

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Requirements for ontology evolution

York Sure, 2005



- Basic requirement {
 - **Functional requirement:**
 - enable the handling of the required changes
 - ensure the consistency of the underlying ontology and all dependent artifacts

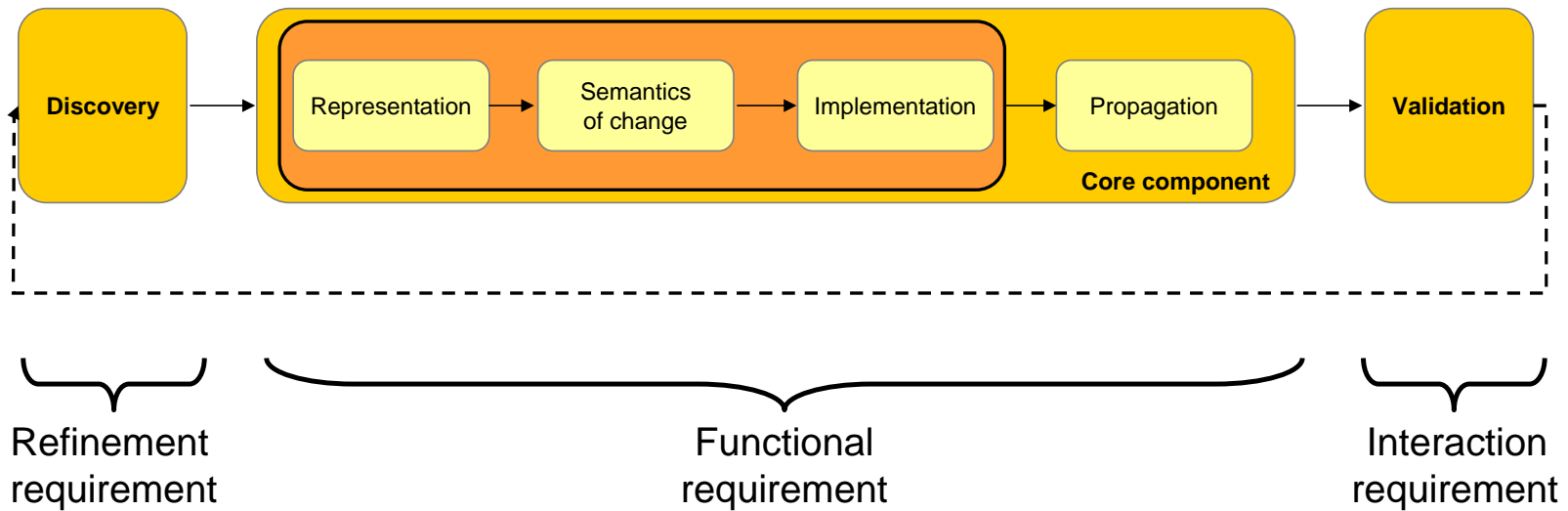
- Extended requirements {
 - **Interaction requirement** – supports the user to manage changes more easily
 - **Refinement requirement** – offers advice to the user for continual system refinement

Slide 67

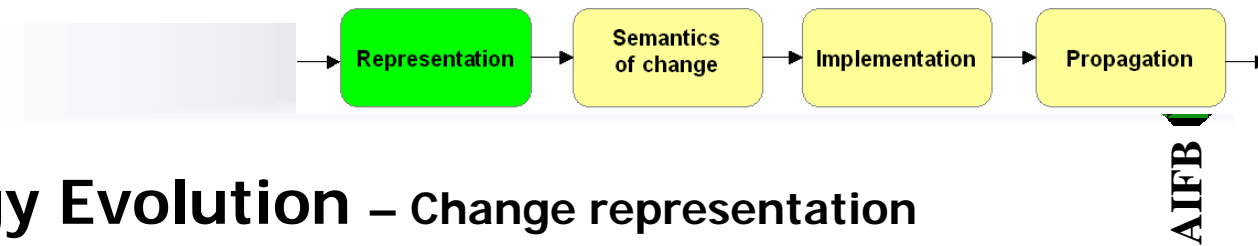


Ontology Evolution Process

York Sure, 2005



Slide 68

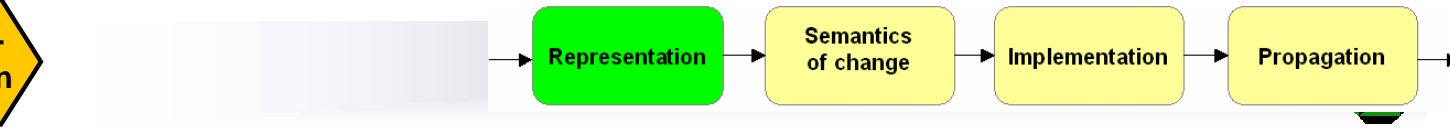


Ontology Evolution – Change representation

- Elementary changes
 - They can not be decomposed into simpler ones
 - They heavily depend on the underlying ontology model

MoveConcept \neq (RemoveSubConcept + AddSubConcept)

- Composite changes
 - They are more powerful
 - They have coarser granularity
 - They have often more meaningful semantics

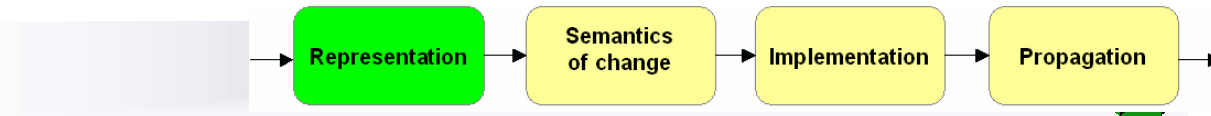


AIFB

Ontology Evolution – Change representation

Composite change	Description
Move concept	Move a concept from one parent to another.
Merge concepts	Replace several concepts with one and aggregate all instances.
Extract subconcepts	Split a concept into several subconcepts and distribute properties among them.
Extract superconcept	Create a common superconcept for a set of unrelated concepts and transfer common properties to it.
Extract related concept	Extract related information into a new concept and relate it to the original concept.
Shallow concept copy	Duplicate a concept with all its properties.
Deep concept copy	Recursively apply shallow copy to all subconcepts of a concept.
Pull up properties	Move properties from a subconcept to a superconcept.
Pull down properties	Move properties from a superconcept to a subconcept.
Move properties	Move properties from one concept to another concept.
Shallow property copy	Duplicate a property with same domain and range.
Deep property copy	Recursively apply shallow copy to all subproperties of a property.
Move Instance	Moves an instance from one concept to another.

Slide 70

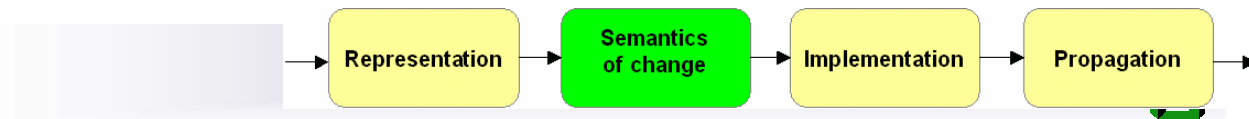


AIFB

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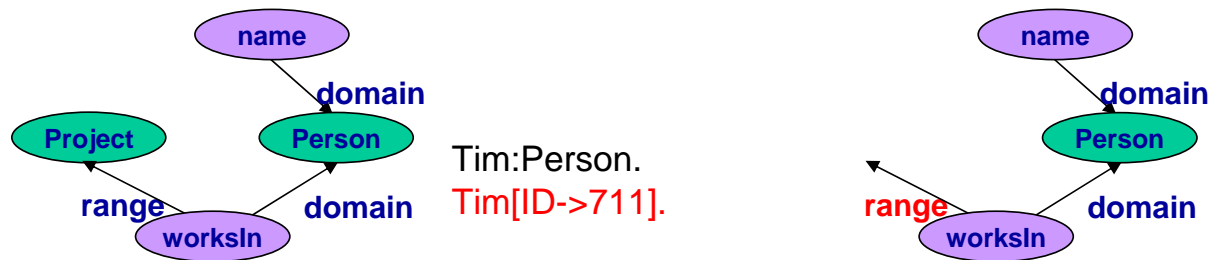
Slide 71



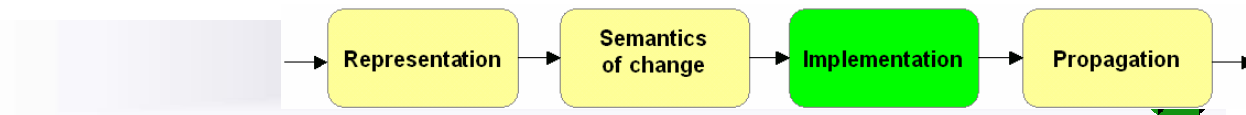
AIFB

Ontology Evolution – Semantics of change

- Enables resolution of changes in a systematic manner, ensuring consistency of the whole ontology

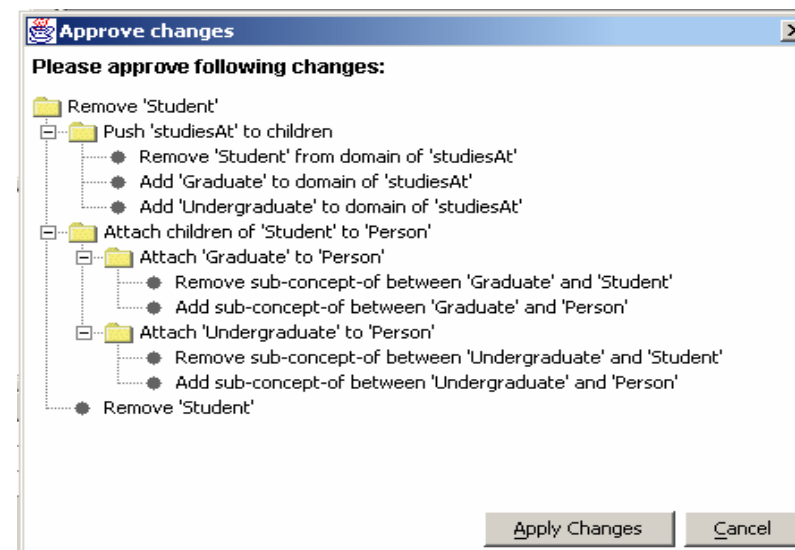


Slide 72

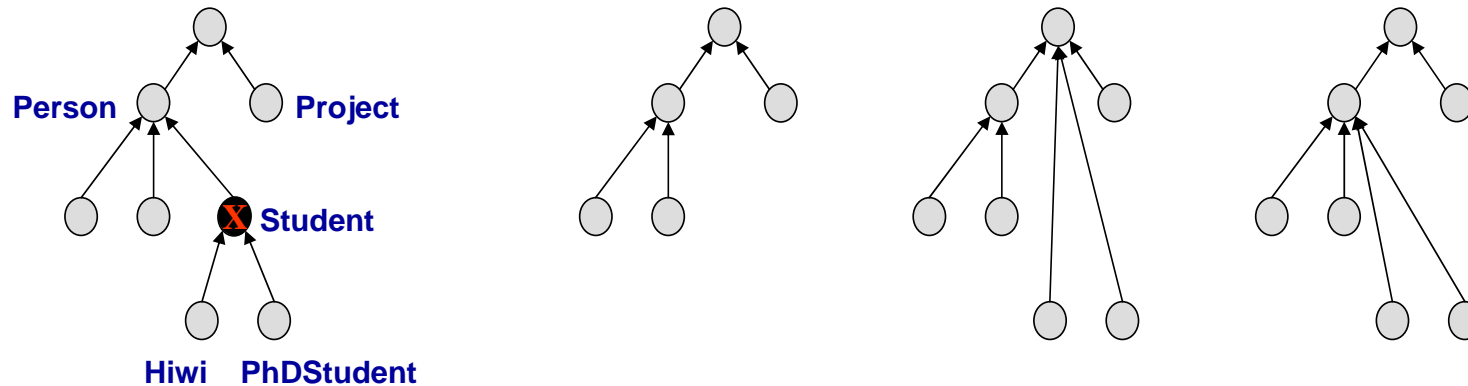
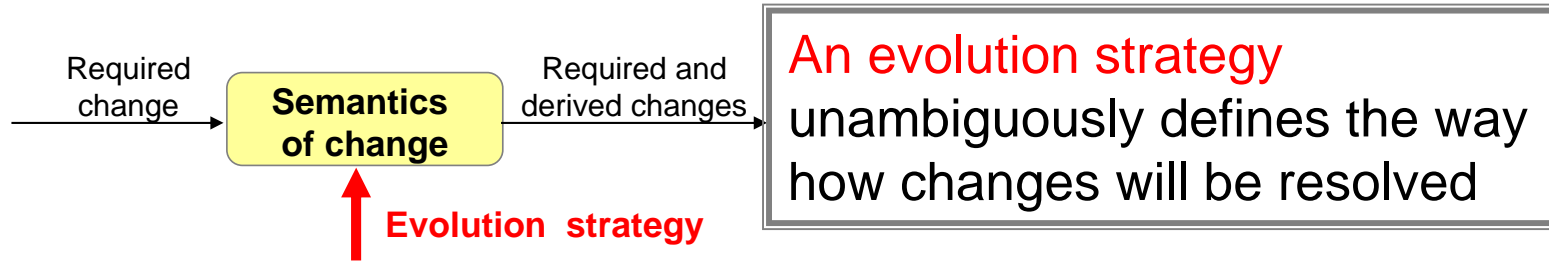


Ontology Evolution – Change implementation

- After **user's approval** all changes are applied to the ontology
- Since it is necessary to perform several changes together, the **transaction server** is needed.



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Evolution Strategies

York Sure, 2005



AIFB

Elementary evolution strategies

Resolution points:

- how to handle orphaned concepts;
- how to handle orphaned properties;
- how to propagate properties to the concept whose parent changes;
- what constitutes a valid domain of a property;
- what constitutes a valid range of a property;
- whether a domain (range) of a property can contain a concept that is at the same time a subconcept of some other domain (range) concept;
- the allowed shape of the concept hierarchy;
- the allowed shape of the property hierarchy;
- ...

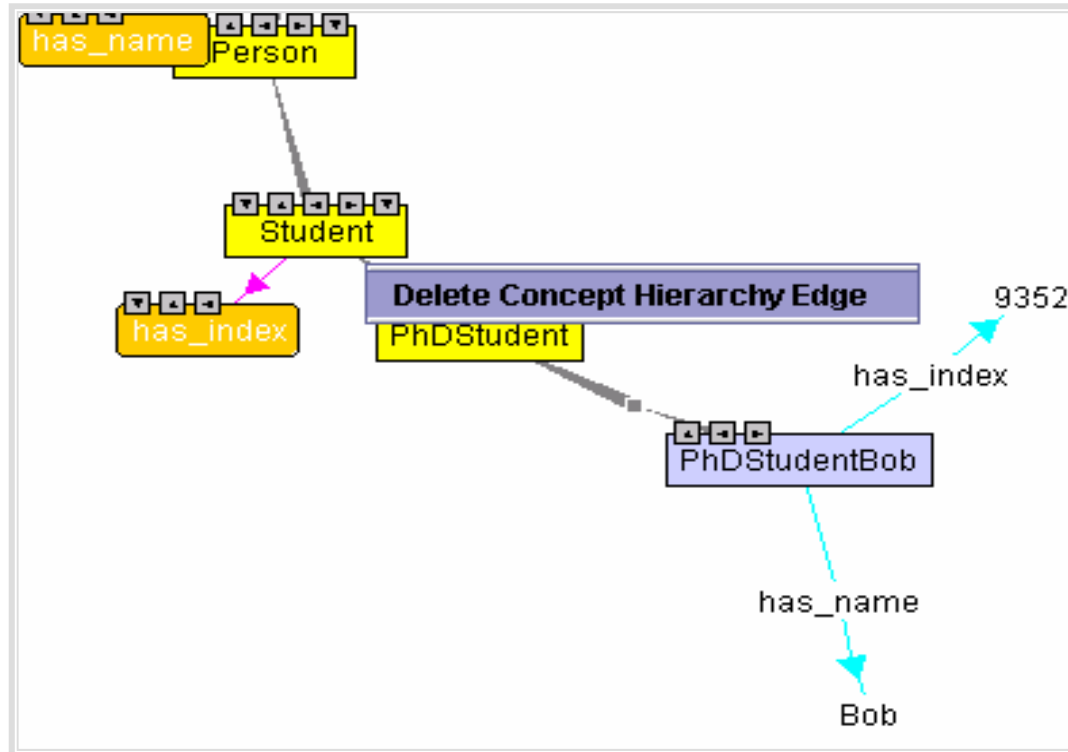
- delete
- reconnect to the root
- reconnect to the superconcepts

Common policy consisting of a set of elementary evolution strategies, each giving an answer for one resolution point, is an *evolution strategy*

Slide 75

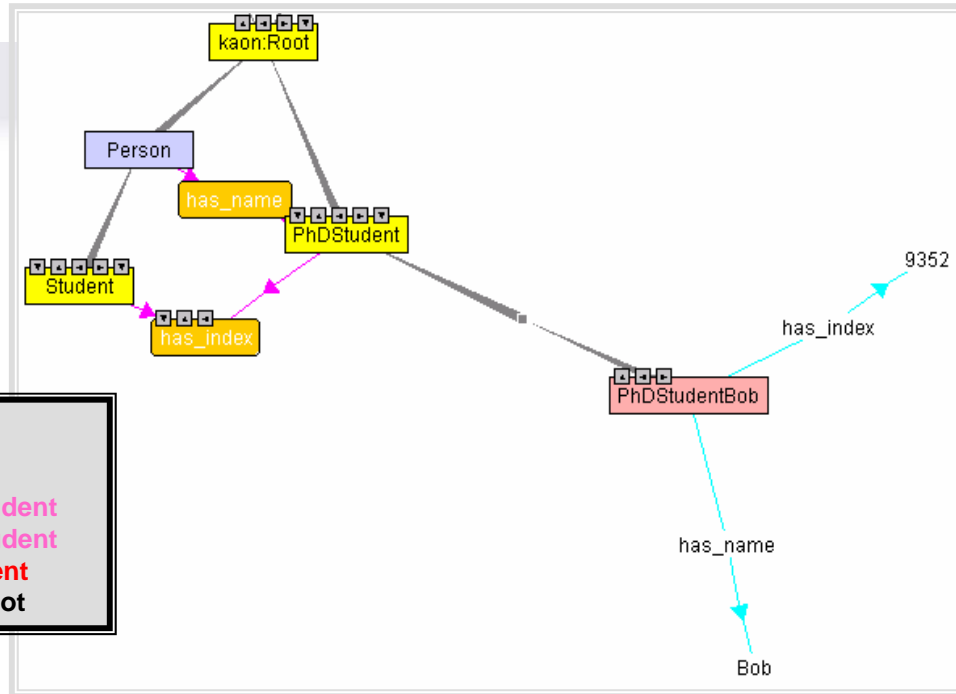


Example



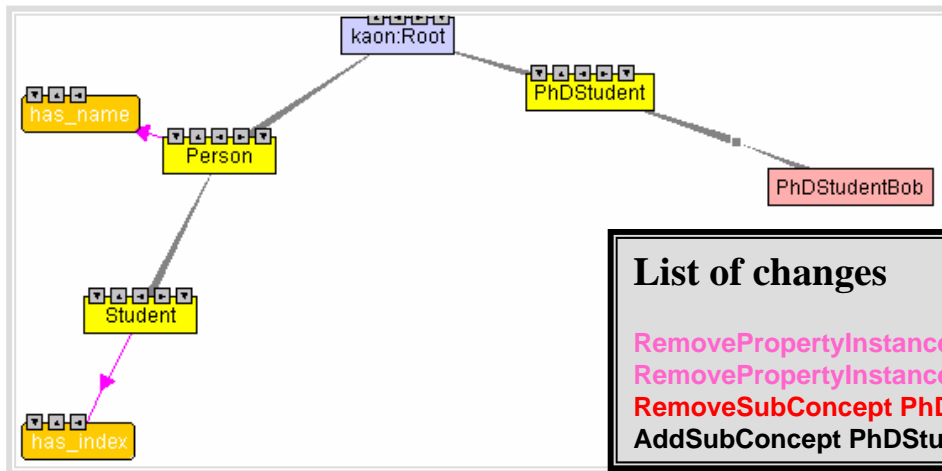


Example



List of changes

- AddPropertyDomain has_name, PhDStudent
- AddPropertyDomain has_index, PhDStudent
- RemoveSubConcept PhDStudent, Student
- AddSubConcept PhDStudent, KAON:Root

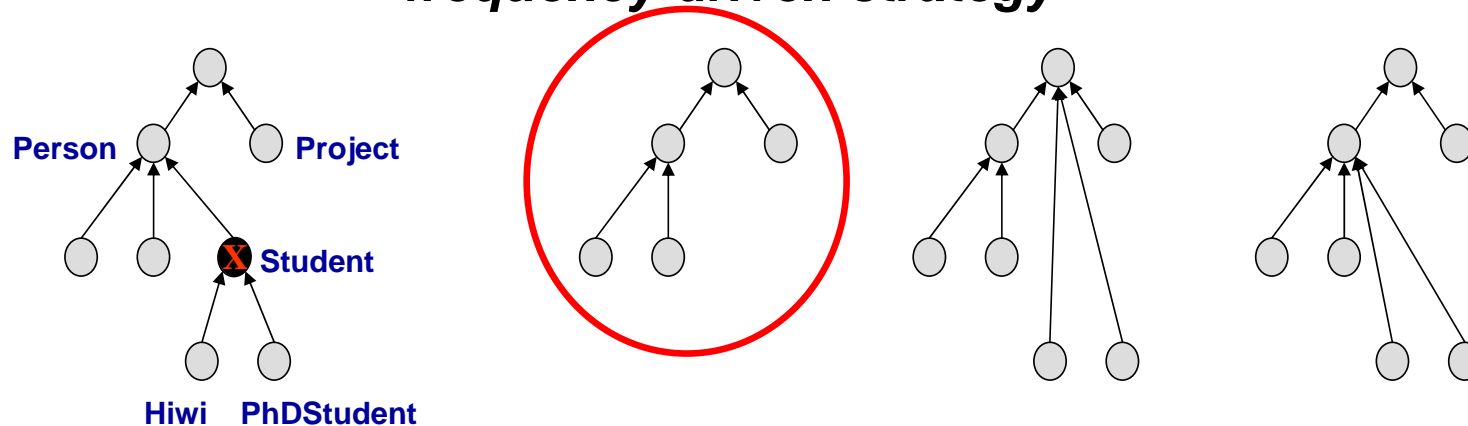


List of changes

- RemovePropertyInstance has_name, PhDStudentBob, Bob
- RemovePropertyInstance has_index, PhDStudentBob, 9352
- RemoveSubConcept PhDStudent, Student
- AddSubConcept PhDStudent, KAON:Root

Mechanism to prioritize and arbitrate among different evolution strategies, relieving the user of choosing them individually:

- ***structure-driven strategy***
- ***process-driven strategy***
- ***instance-driven strategy***
- ***frequency-driven strategy***





Implementation

York Sure, 2005



<http://kaon.semanticweb.org>

**Applications
& Services**

OIModeler - Ontology and Metadata Engineering Tool	KAON Portal and other User Interface Applications and Services
---	---

Middleware

KAON Access Interface			
		Change Discovery	Interaction Logging
Evolution Strategy	Reversibility Services	Evolution Logging	
KAON API			
RDF API		KAON RDF Server	

Data and Remote Services

Persistence, Transactions, Security
--

Slide 79

KAON Workbench

File Edit View Procedures

Ol-modeler - file:C:/MyDocuments/Konferencije/EKAW2002/Final/EKAWExample.kaon

Zoom: [Slider]

Search for:

Search

Name

file:C:/MyDocuments/Konferencije/EKAW2002/Final/EKAWExample#Person

Superconcepts

Person

<http://kaon.semanticweb.org/2001/11/kaon-lexical#Root>

Subconcepts

- Person
- Assistant
- Student
- PhDStudent
- Professor

Properties From Concept

Property Name	Minimum Cardinality	Maximum Cardinality
has_name	0	2147483647

Properties To Concept

Property Name
http://kaon.semanticweb.org/2001/11/kaon-lexical#references

Clipboard:

Name

Clear

Resolution points

The screenshot shows the 'Evolution Strategy Set-up' dialog box in KADON Workbench. The dialog box contains several sections with radio button options:

- Orphaned concepts will be...**
 - ...deleted.
 - ...reconnected to ontology root.
 - ...reconnected to superconcepts.
- When concept's parent is removed...**
 - ...properties will not be propagated.
 - ...all inherited properties will be added to the concept.
 - ...only parent's properties will be added to the concept.
- Properties without any domain concepts...**
 - ...may exist in the OI-model.
 - ...should be deleted from the OI-model.
- Instance consistency...**
 - ...should be enforced.
 - ...should not be enforced.
- Orphaned properties should be...**
 - ...deleted.
 - ...reconnected to superproperties.
 - ...left as they are.
- Domain/range of a property...**
 - ...may contain subconcepts of other domain/range concepts.
 - ...may not contain subconcepts of other domain/range concepts.
- Properties without any range concepts...**
 - ...may exist in the OI-model.
 - ...should be deleted from the OI-model.
- When creating a hierarchy path which already exists...**
 - ...nothing special should be done.
 - ...the shorter path should be removed.
 - ...an error should be raised.

At the bottom of the dialog box are 'OK' and 'Cancel' buttons. Below the dialog box, there are two tables:

Properties From Concept

Property Name	Minimum Cardinality	Maximum Cardinality
has_name	0	2147483647

Properties To Concept

Property Name
http://kaon.semanticweb.org/2001/11/kaon-lexical#references

At the bottom right of the dialog box is a 'Clear' button.

Resolution points

Elementary evolution strategies

Orphaned concepts will be...

- ...deleted.
- ...reconnected to ontology root.
- ...reconnected to superconcepts.

Properties without any domain concepts...

- ...properties will not be propagated.
- ...all inherited properties will be added to the concept.
- ...only parent's properties will be added to the concept.
- ...may exist in the OI-model.
- ...should be deleted from the OI-model.

Properties without any range concepts...

- ...may contain subconcepts of other domain/range concepts.
- ...may not contain subconcepts of other domain/range concepts.
- ...may exist in the OI-model.
- ...should be deleted from the OI-model.

Instance consistency...

- ...should be enforced.
- ...should not be enforced.

When creating a hierarchy path which already exists...

- ...nothing special should be done.
- ...the shorter path should be removed.
- ...an error should be raised.

OK Cancel

Properties From Concept			
Property Name	Minimum Cardinality	Maximum Cardinality	
has_name	0	2147483647	

Properties To Concept	
Property Name	
http://kaon.semanticweb.org/2001/11/kaon-lexical#references	

Clear

The image shows a screenshot of the KADN Workbench interface. In the background, there is a window titled "Ol-modeler" showing a hierarchical ontology diagram with a node labeled "kaon:Root". A red box labeled "Resolution points" is overlaid on the diagram, with red arrows pointing to specific nodes.

In the foreground, there are two dialog boxes:

- Orphaned concepts will be...:** This dialog box contains three radio button options:
 - ...deleted.
 - ...reconnected to ontology root.
 - ...reconnected to superconcepts.
 A red bracket on the right side of these options is labeled "Elementary evolution strategies".
- Evolution Details:** This dialog box lists "All Changes" in a tree view:
 - Delete concept **Student**.
 - Remove value **Student** of property **kaon:references** for instance **o:1033038854508-915157117**.
 - Delete instance **o:1033038854508-915157117**.
 - Remove value **kaon:en** of property **kaon:inLanguage** for instance **o:1033038854508-915157117**.
 - Remove value **Student** of property **kaon:value** for instance **o:1033038854508-915157117**.
 - Remove instance **o:1033038854508-915157117** from concept **kaon:Label**.
 - Remove instance **o:1033038854508-915157117** from concept **kaon:Root**.
 - Remove instance **Student** from concept **kaon:Root**.
 - Add concept **PhDStudent** to the domain of property **has_name**.
 - Add concept **PhDStudent** to the domain of property **has_index**.
 - Remove concept **Student** from the domain of property **has_index**.
 - Remove value **9352** of property **has_index** for instance **PhDStudentBob**.
 - Remove concept **PhDStudent** from subconcepts of **Student**.
 - Make concept **PhDStudent** subconcept of **kaon:Root**.
 - Remove concept **Student** from subconcepts of **Person**.

Buttons for "Apply Changes" and "Cancel" are visible at the bottom of the "Evolution Details" dialog.

KAON Workbench

File Edit View Procedures

Ol-modeler - file:/C:/MyDocuments/Konferenc

Zoom:

kaon.Root

Orphaned concepts will be...

- ...deleted.
- ...reconnected to ontology root.
- ...reconnected to parent.
- ...properties will not be deleted.

Elementary evolution strategies

Resolution points

Evolution Details

All Changes

- Delete concept **Student**.
 - Remove value **Student** of property **kaon:ref**
 - Delete instance **o:1033038854508-915**
 - Remove value **kaon:en** of property **kaon:en**
 - Remove value **Student** of property **kaon:en**
 - Remove instance **o:1033038854508-915**
 - Remove instance **o:1033038854508-915**
 - Remove instance **Student** from concept **kaon:en**
 - Add concept **PhDStudent** to the domain of property **kaon:en**
 - Add concept **PhDStudent** to the domain of property **kaon:en**
 - Remove concept **Student** from the domain of property **kaon:en**
 - Remove value **9352** of property **has_index**
 - Remove concept **PhDStudent** from subconcepts
 - Make concept **PhDStudent** subconcept of **kaon:en**
 - Remove concept **Student** from subconcepts

o:Change

o:RemoveChan...

o:RemoveEntity

o:causesChange

Remove Studen...

Remove value S...

AddSubConcept...

RemoveSubCo...

Remove instanc...

causesChange

Add PhDStudent...

Add PhDStudent...

RemoveSubCo...

Delete concept ...

o:has_Reference

Student

o:time

o:date

25/09/02

02:43 CEST

The image shows a screenshot of the KAON Workbench interface. The main window displays an ontology graph with a central node 'kaon.Root' and several child nodes. A dialog box titled 'Orphaned concepts will be...' is open, showing three radio button options: '...deleted.', '...reconnected to ontology root.', and '...reconnected to parent.' (which is selected). A red bracket on the right side of the dialog is labeled 'Elementary evolution strategies'. A black box with the text 'Resolution points' is overlaid on the left side of the dialog. Below the dialog, the 'Evolution Details' window is open, showing a list of changes under the heading 'All Changes'. The first change is 'Delete concept Student', which is expanded to show a series of sub-changes including removing values and instances of properties, and adding/removing concepts and subconcepts. To the right of the evolution details, a graph of changes is shown, with a central node 'Delete concept ...' connected to several other nodes representing different types of changes like 'o:Change', 'o:RemoveChan...', 'o:RemoveEntity', 'o:causesChange', 'Remove Studen...', 'Remove value S...', 'AddSubConcept...', 'RemoveSubCo...', 'Remove instanc...', 'causesChange', 'Add PhDStudent...', 'Add PhDStudent...', and 'RemoveSubCo...'. The graph also shows nodes for 'o:has_Reference', 'Student', 'o:time', 'o:date', and '25/09/02'. The time '02:43 CEST' is displayed at the bottom of the graph.



Evolution wrap-up

York Sure, 2005



OntoLogging:

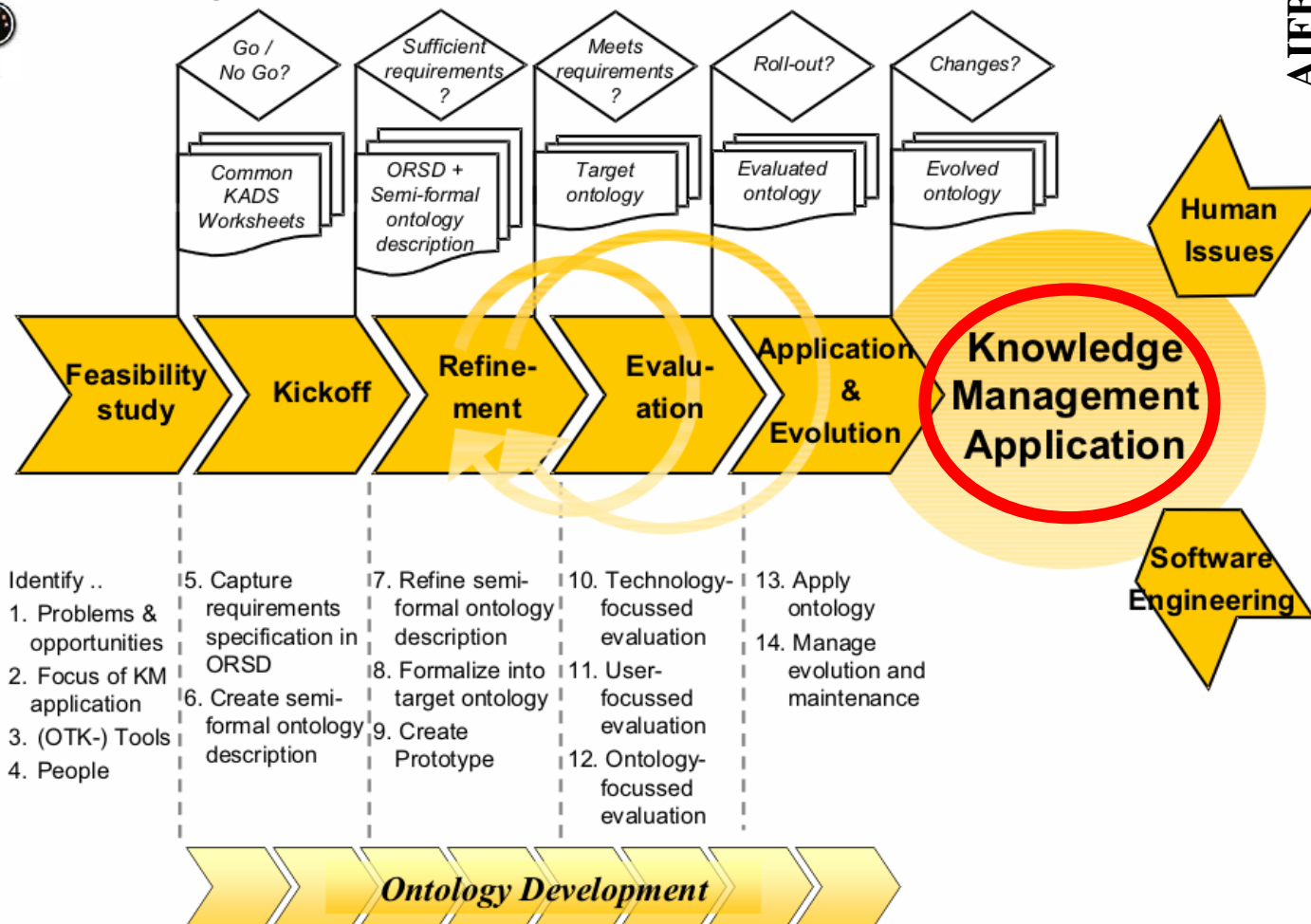
- process-based approach for ontology evolution
- Evolution strategies that enable the customisation of the ontology evolution process
- Implementation in KAON framework

Ongoing work:

- Evolution between distributed ontologies
- Change discovery

Slide 85

OTK Methodology: Knowledge Meta Process



Conclusions on Knowledge Meta Process

Experiences from OTK Case Studies

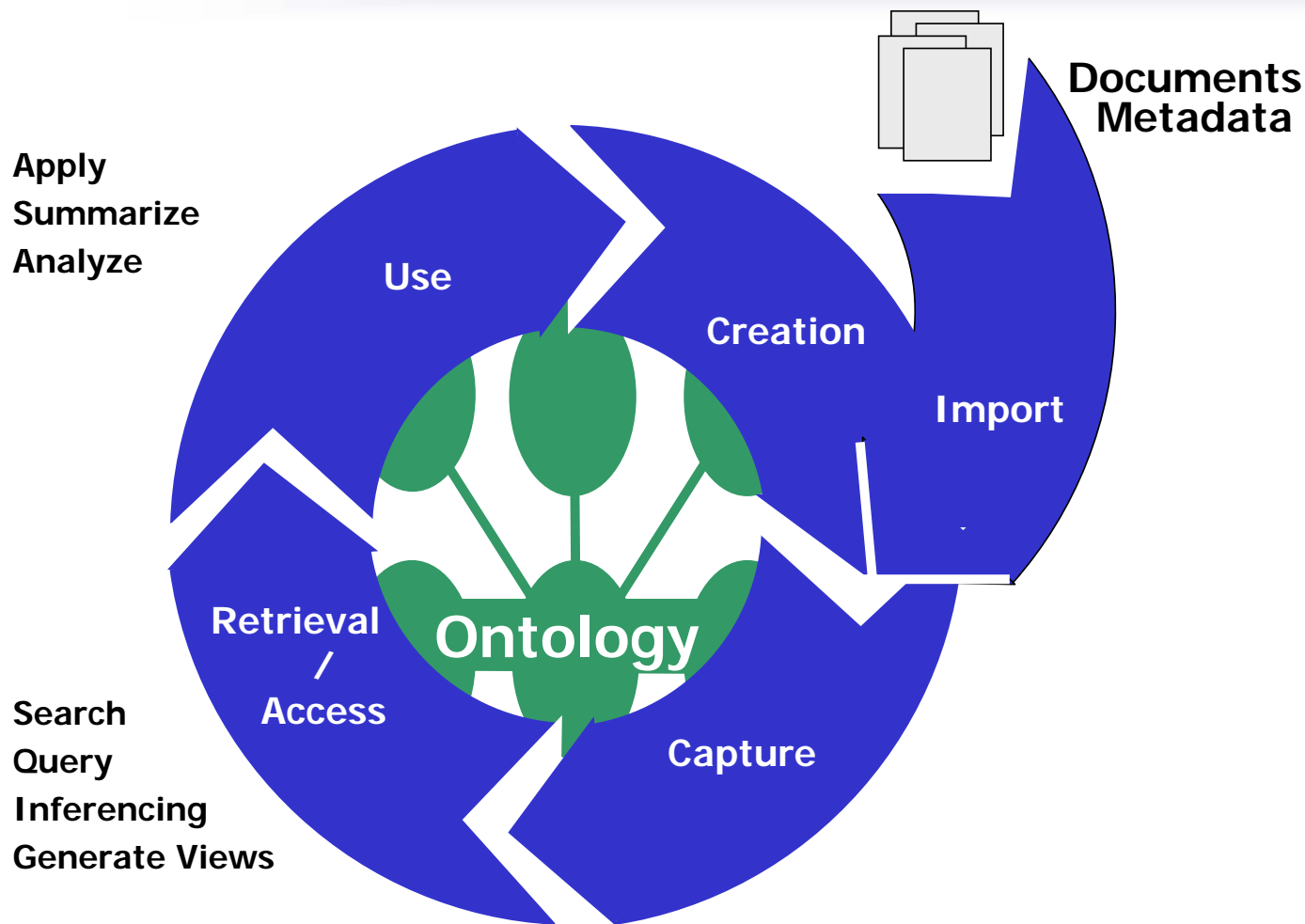
- **Guidelines** for domain experts from industry have to be pragmatic
 1. Train the user about ontologies
 2. Show the concrete advantage of the KMS
 3. Model precisely – but allow for imprecise views (most users cannot distinguish classes vs instances or isa vs partOf)
- **Plan for Maintenance**
- **Avoid/Reduce chicken-and-egg problem**
 1. Plan für content that makes KMS interesting
 2. Show quick win
- **Collaborative ontology engineering** requires sophisticated tool support *and* physical presence
- **Brainstorming** is a valuable add-on during the early stages of ontology engineering

Knowledge Process

York Sure, 2005



AIFB



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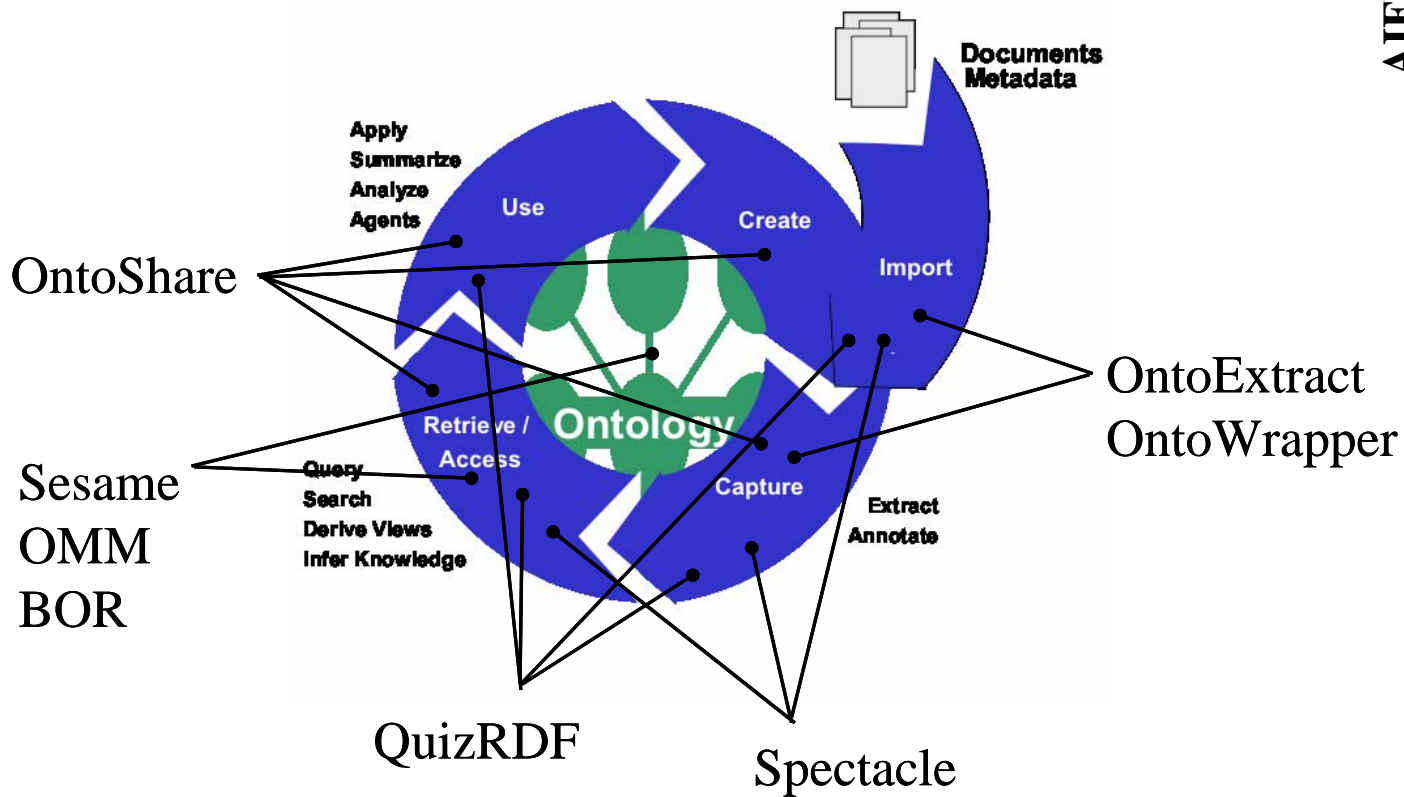
OTK Case Study @ BT

Users Portal

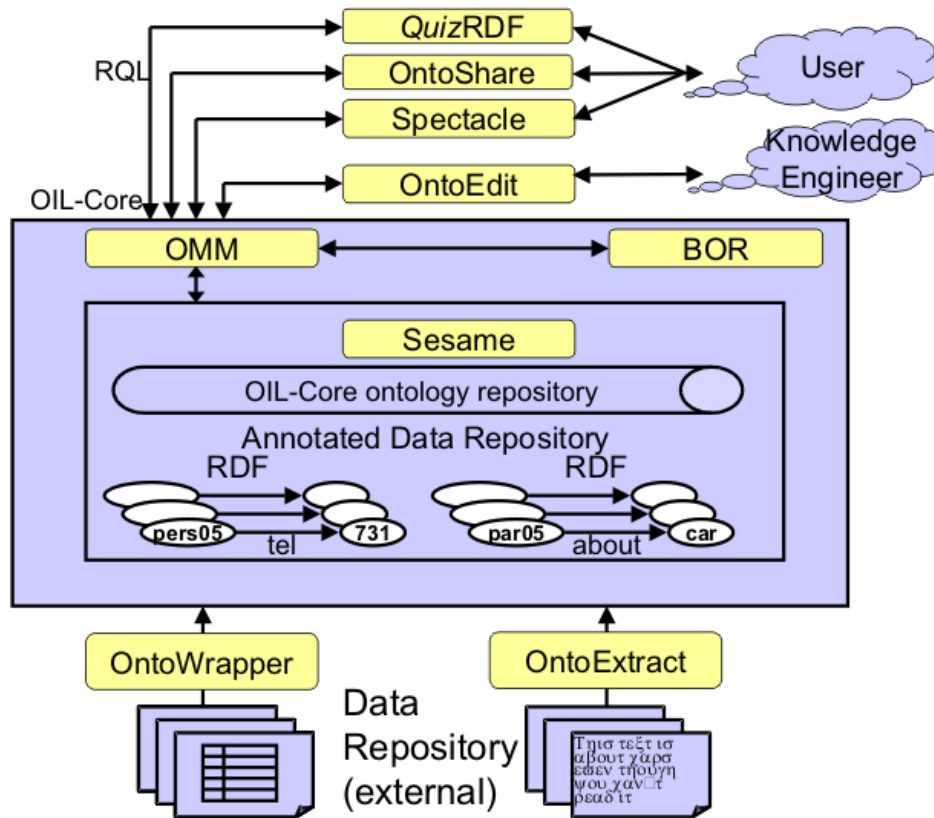
York Sure, 2005



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OTK Architecture

