Introduction to the Semantic Web Tutorial

Ontological Engineering

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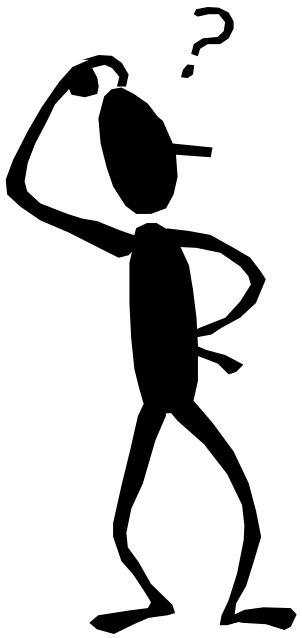
- Methodological Guidelines for Ontology Specification
- Quick Search of Existing Knowledge Resources
- Guidelines for Ontology development project Planning
- Methodological Guidelines for Non Ontological Resource Reuse and Reengineering
- Methodological Guideliness for Ontology Reuse
- Creating the final Ontology Model

I want to build my ontology



- Which are the key process and activities in ontology development?
- Which activities do I need in my development?
- When should I carry out each activity?
- Where is the relationship of one activity with the others?
- How do I collect the requirements of my ontology?
- Where can I find ontologies with the goal of reusing them?
- How can I reuse exiting knowledge resources?
- ...

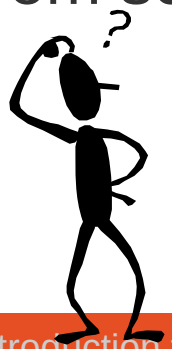
Limitations of current methodologies

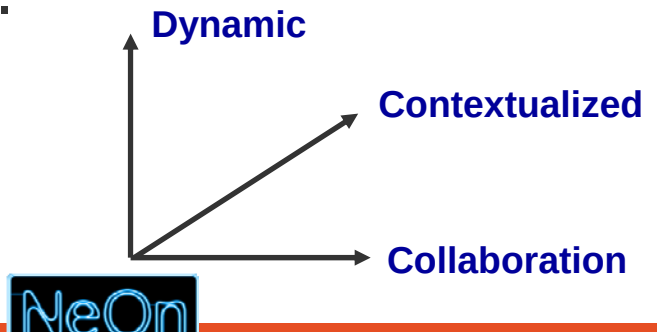
- Methontology, On-To-Knowledge are for building ontologies from scratch
- They lack guidelines for:
  - building ontologies by reusing and reengineering existing knowledge aware resources
  - for contextualizing an existing ontology and plugging it in with existing ontologies that might be in continuous evolution
  - Building ontologies in a collaborative way
  - software developers that need to include ontologies into their IT developments

New Ontology Development Paradigm

Whose emphasis is on

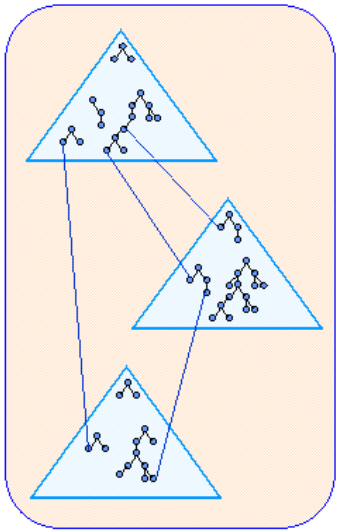
- the *reuse and reengineering of knowledge aware resources*
- the *collaborative and argumentative ontology development*
- the *building of ontology networks*, as opposed to custom-building new ontologies from scratch.

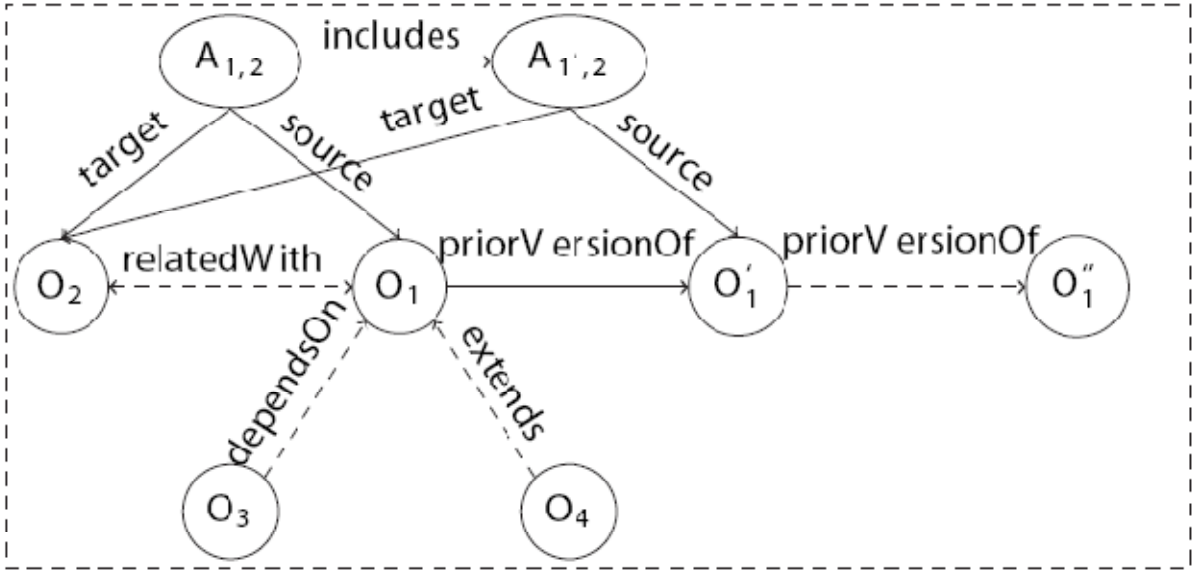




Ontology Networks

The Semantic Web of the future will be characterized by using a very large number of **ontologies embedded in ontology networks** built by distributed teams in a collaborative way.





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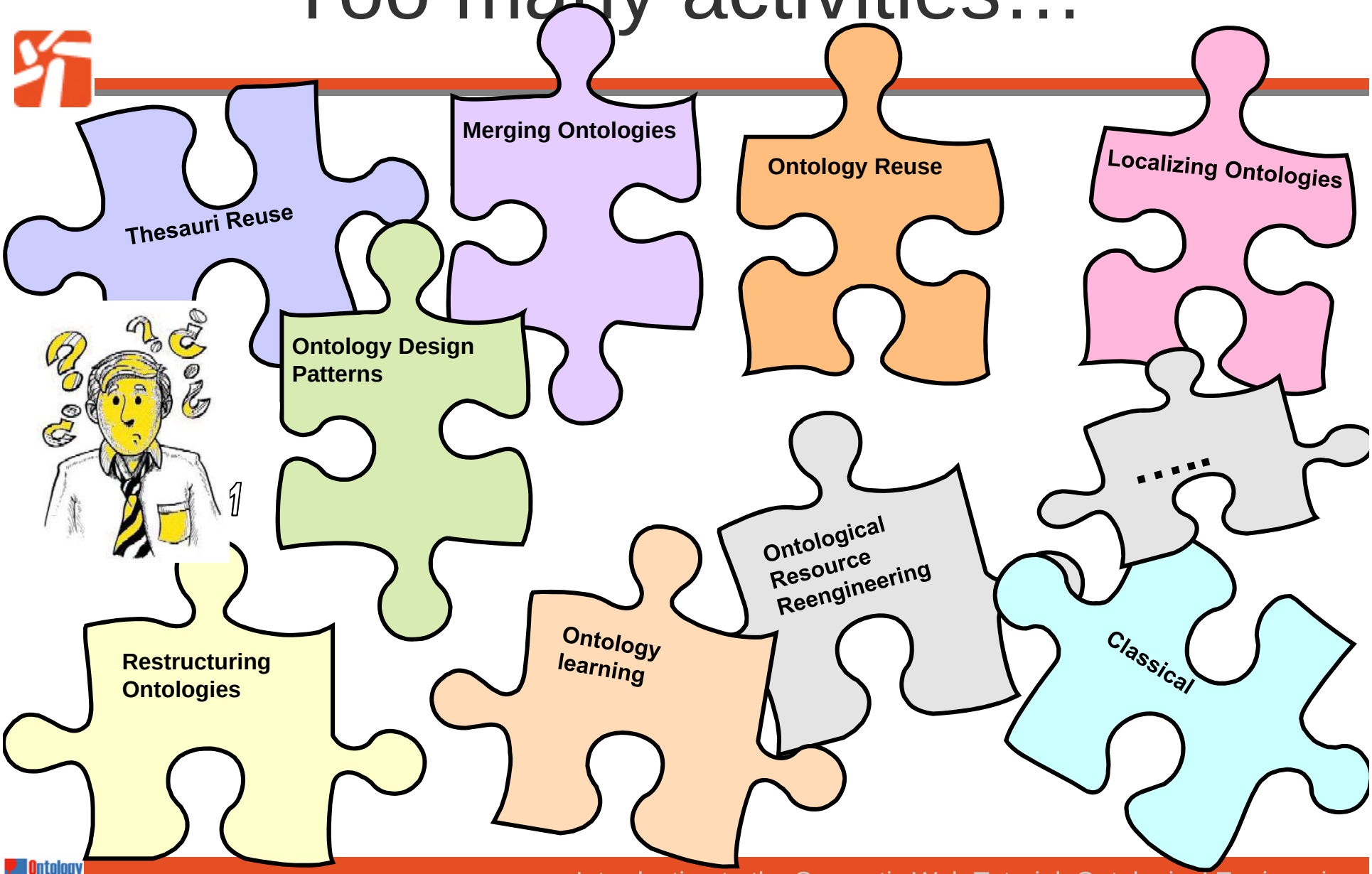
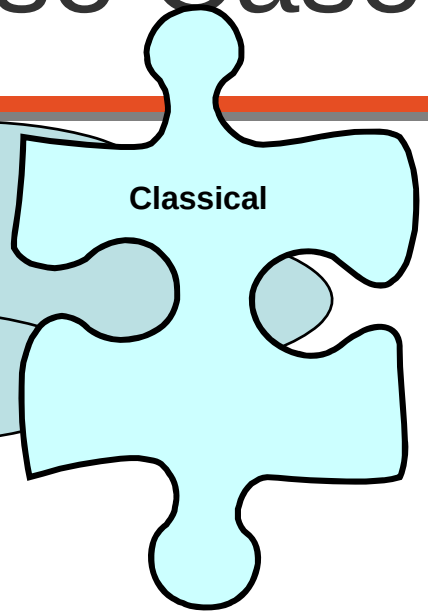
Too many activities…



Building Ontologies: Use Case

In our team, we want to build an OWL ontology in the pharmaceutical domain, but we want to use several pharmaceutical standards in XML and classification schemes in our own format.



Building Ontologies: Use Case

In our team, we want to build an OWL ontology in fishery domain. We want to base on our ontolog about species and commodities, and we want have the ontolog several natural languages.

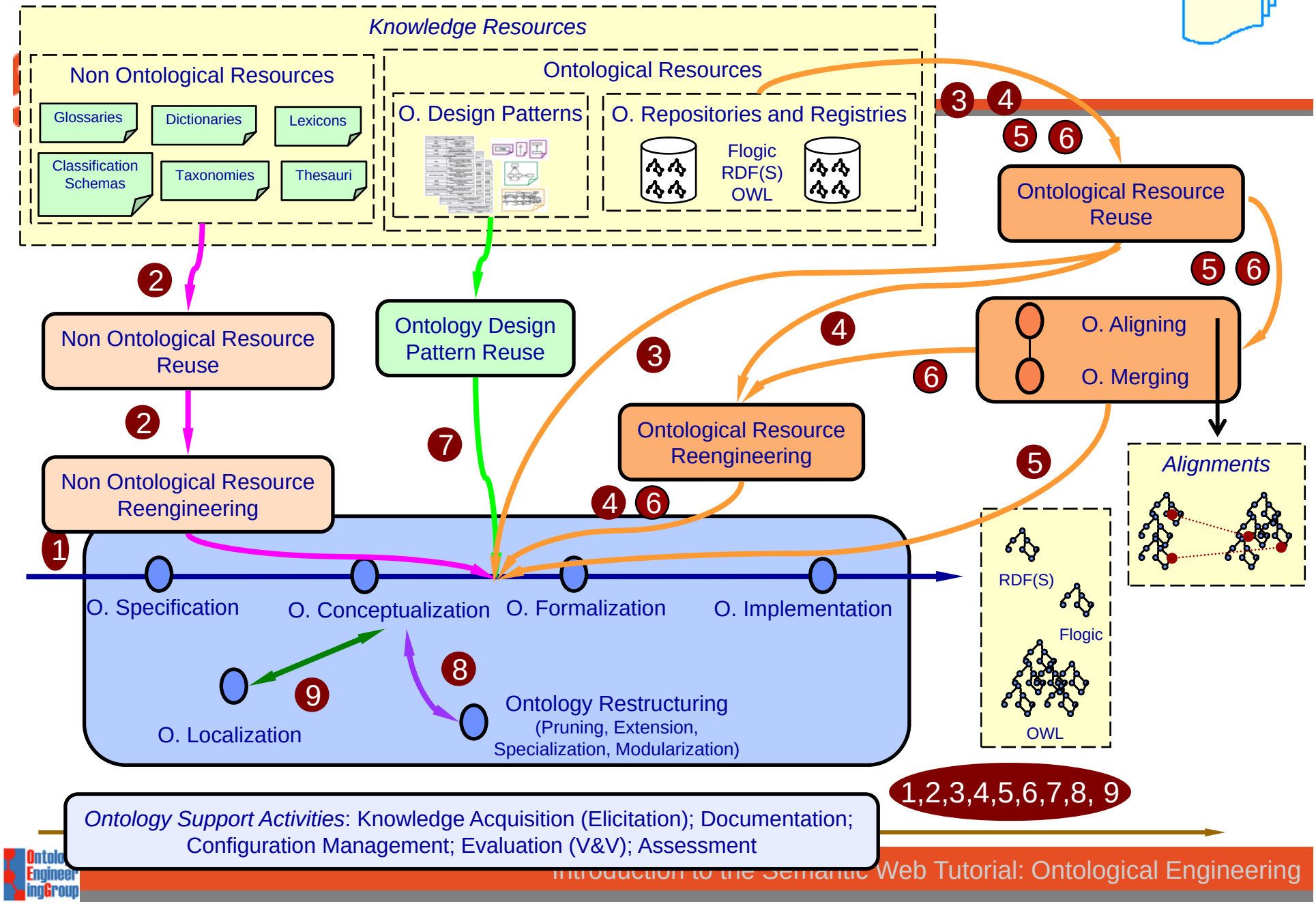
Classical

Ontological Resource Reuse

Ontological Resource Reengineering

Localizing Ontological Resources

NeOn Scenarios



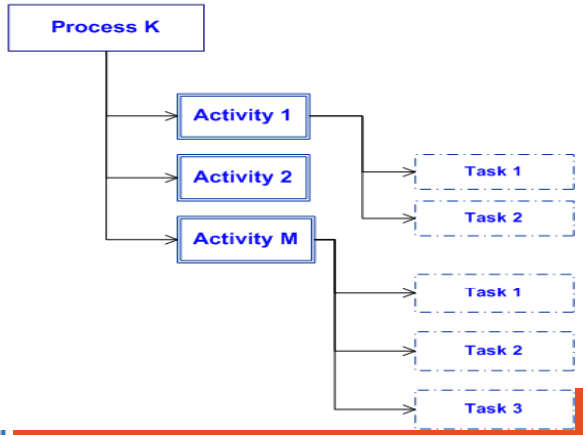
Scenarios

1. Building ontology networks from scratch without reusing existing resources.
2. Building ontology networks by reusing and reengineering non ontological resources.
3. Building ontology networks by reusing ontologies or ontology modules.
4. Building ontology networks by reusing and reengineering ontologies or ontology modules.
5. Building ontology networks by reusing and merging ontology or ontology modules.
6. Building ontology networks by reusing, merging and reengineering ontologies or ontology modules.
7. Building ontology networks by reusing ontology design patterns.
8. Building ontology networks by restructuring ontologies or ontology modules.
9. Building ontology networks by localizing ontologies or ontology modules.

NeOn Methodology

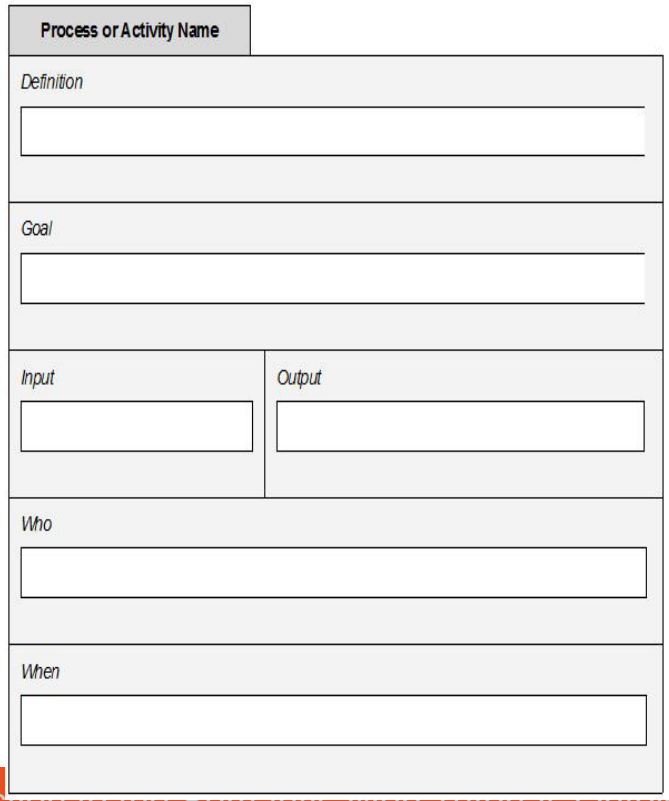
Process and activities covered:

- Ontology Specification
- Scheduling
- Non Ontological Resource Reuse
- Non Ontological Resource Reengineering
- Reuse General Ontologies
- Reuse Domain Ontologies
- Reuse Ontology Statements
- Reuse Ontology Design Patterns

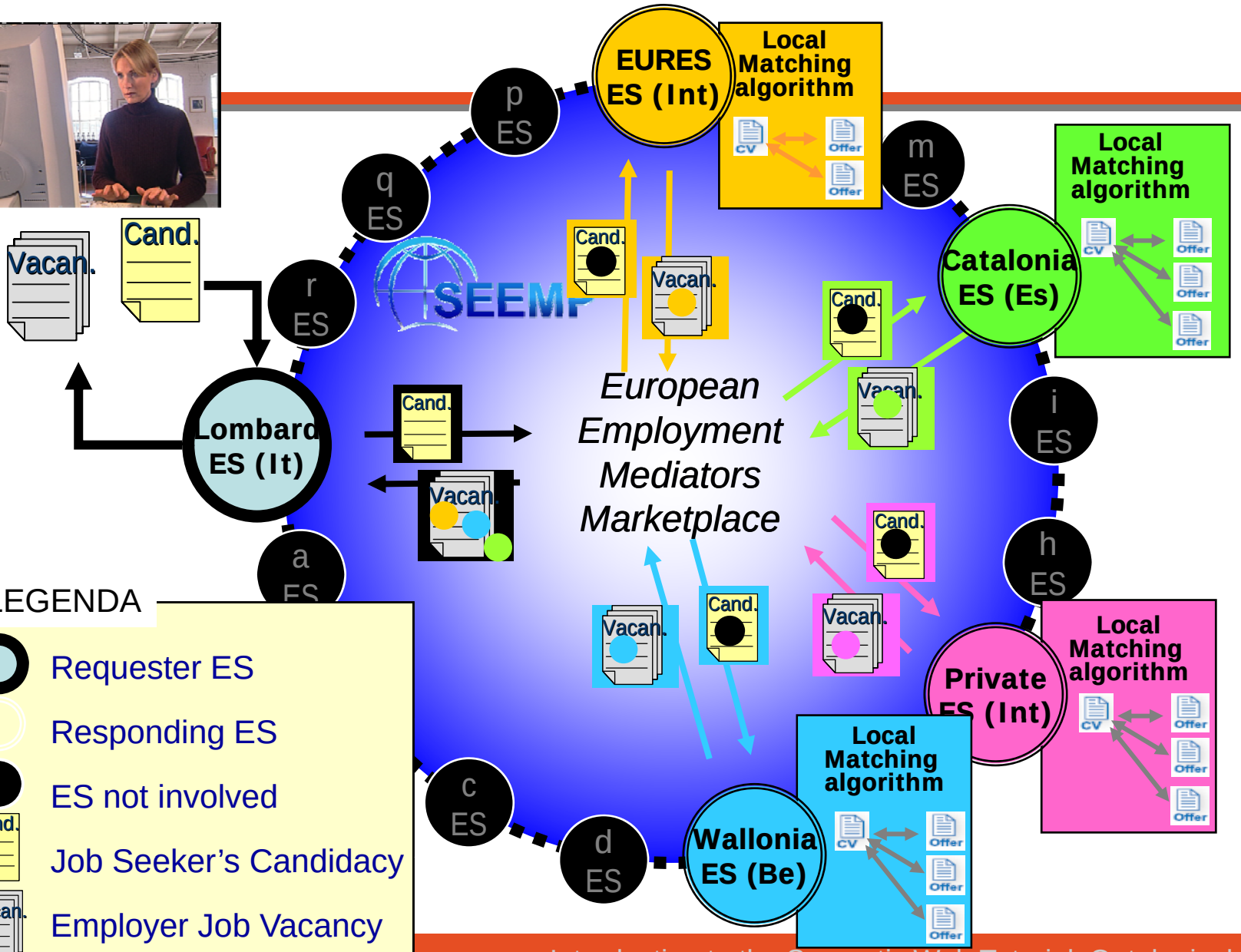


All processes and activities are described with:

- A filling card
- A workflow
- Examples



Helping Job Seekers on their way



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Ontology Requirements Specification

Ontology Specification

Definition

Ontology Specification refers to the activity of collecting the requirements that the ontology should fulfill, e.g. reasons to build the ontology, target group, intended uses, possibly reached through a consensus process.

Goal

The specification activity states why the ontology is being built, what its intended uses are, who the end-users are, and what the requirements the ontology should fulfill are.

Input

A set of ontological needs.

Output

Ontology Requirements Specification Document (ORSD).

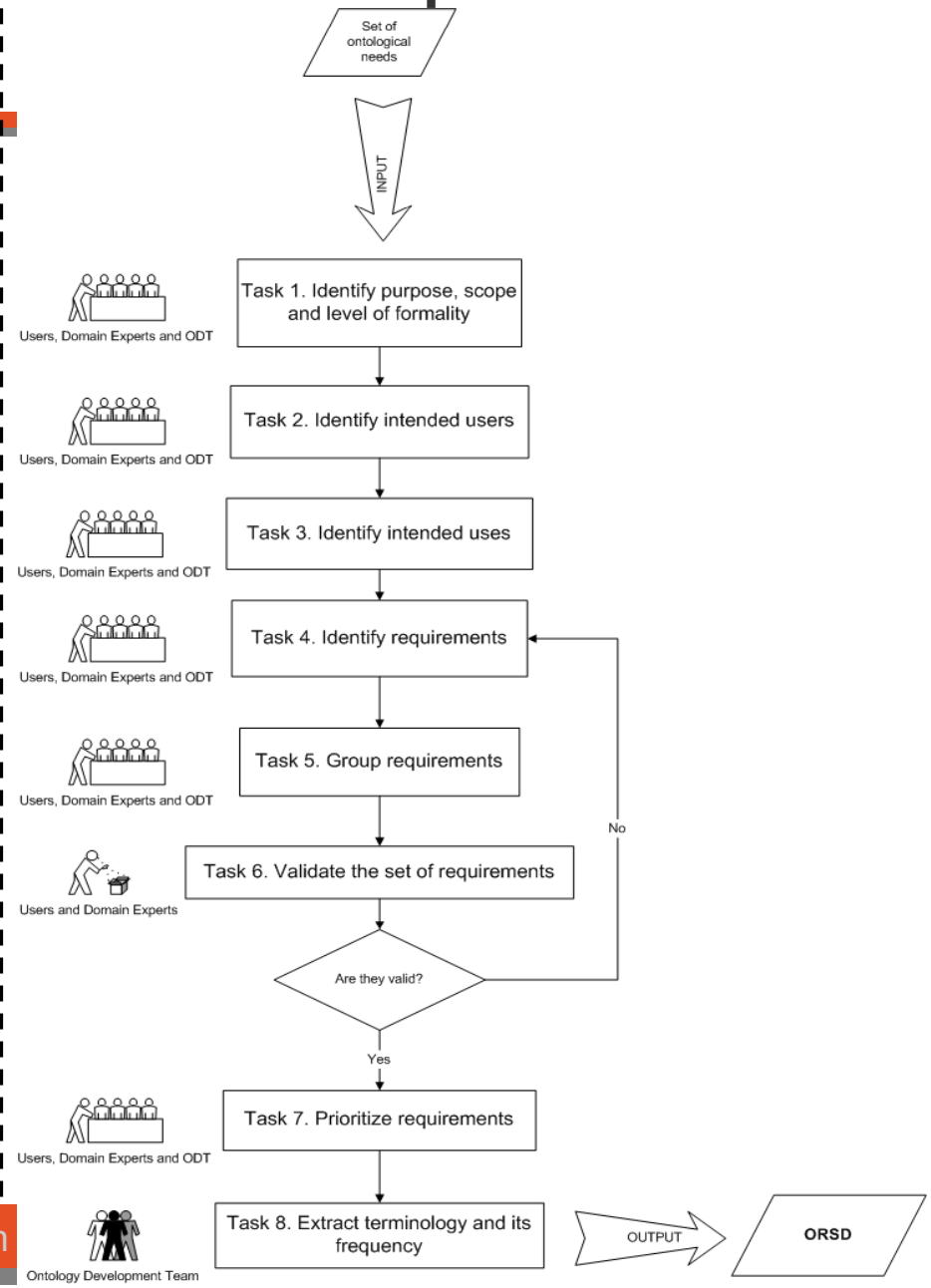
Who

Software developers and ontology practitioners, who form the ontology development team (ODT), in collaboration with users and domain experts.

When

This activity must be carried out in parallel with the knowledge acquisition activity.

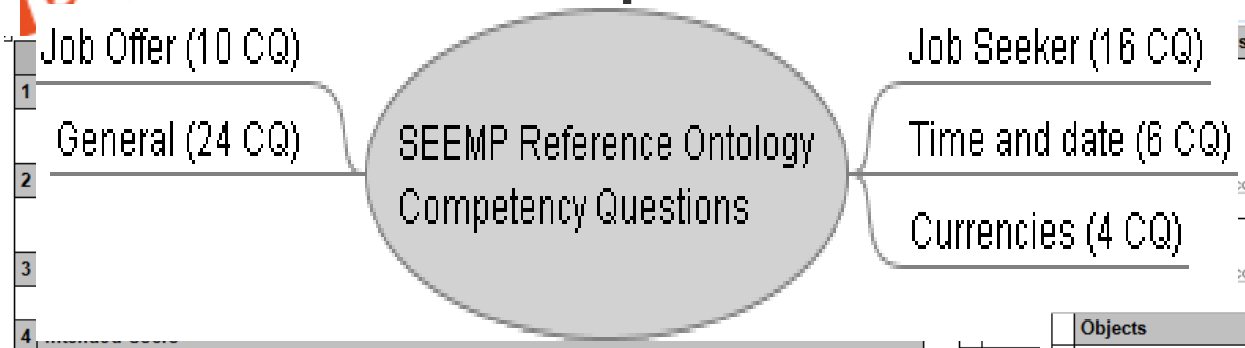
NeOn Deliverable D5.4.1 (2008)

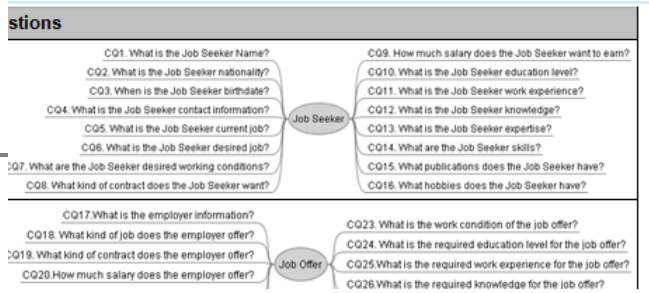


Ontology Requirement Specification Document. Template

1	**Purpose**
	"Software developers and ontology practitioners should include in this slot the purpose of the ontology"
2	**Scope**
	"Software developers and ontology practitioners should include in this slot the scope of the ontology"
3	**Level of Formality**
	"Software developers and ontology practitioners should include in this slot the level of formality of the ontology"
4	**Intended Users**
	"Software developers and ontology practitioners should include in this slot the intended users of the ontology"
5	**Intended Uses**
	"Software developers and ontology practitioners should include in this slot the intended uses of the ontology"
6	**Groups of Competency Questions**
	"Software developers and ontology practitioners should include in this slot the groups of competency questions and their answers, including priorities for each group"
7	**Pre-Glossary of Terms**
	Terms
	"Software developers and ontology practitioners should include in this slot the list of terms included in the CQs and their frequencies"
	Objects
	"Software developers and ontology practitioners should include in this slot a list of objects and their frequencies"

SEEMP Ontology Requirement Specification Document





CQ17.What is the employer information?

7	Pre-Glossary of Terms		
	Terms		**Frequency**
	a.	Job Seeker	27
	b.	CV	2
	c.	Personal Information	3
	d.	Name	5
	e.	Gender	1
	f.	Birth date	1
	g.	Address	2
	h.	Nationality	1
	i.	Contact (phone, fax, mail)	4
	j.	Objective	3
	k.	Job Category	6
	l.	Job Offer	27
	m.	Employer Information	1
	n.	Vacancy	1
	o.	Activity Sector	1
	p.	Location	3
	q.	Work Condition	3
	r.	Contract Type	3
	s.	Salary	3
	t.	Education	3
	u.	Work Experience	3

Objects

Objects in the universe of discourse, which are instances of:

- Job Category
  - O1. Computer System Designer
  - O2. Computer System Analyst
  - O3. Programmer
  - O4. Computer Engineer
  - O5. Computer Assistant
  - O6. Computer Equipment Operator
  - O7. Industrial Robot Controller
  - O8. Telecommunication Equipment Operator
  - O9. Medical Equipment Operator
  - O10. Electronic Equipment Operator
  - O11. Image Equipment Operator
- Nationality
  - O12. Austrian
  - O13. Belgian
  - O14. Danish
  - O15. Estonian
  - O16. Finnish
  - O17. French
  - O18. German
  - O19. Greek
  - O20. Italian
- Activity Sector
  - O21. Telecommunication
  - O22. Justice and Judicial
  - O23. Public Security and law
  - O24. Manufacture of machine tools
  - O25. Research and Development
  - O26. Hardware Consultancy
  - O27. Software Consultancy and Supply
  - O28. Data processing
- Education
  - O29. Life Science
  - O30. Mathematics
  - O31. Computer Science
  - O32. Computer Use
  - O33. Statistics
  - O34. Physics
  - O35. Network Administration
- Languages
  - O36. Swedish
  - O37. Spanish
  - O38. Slovenian
  - O39. Portuguese
  - O40. English
  - O41. French
  - O42. German
- Currency
  - O43. Euro
  - O44. Krone
  - O45. Great British Pound
  - O46. Zlote
  - O47. US Dollar
  - O48. Franc
- Location
  - O49. Austria
  - O50. Belgium
  - O51. Danmark
  - O52. Estonia
  - O53. Finland
  - O54. France
  - O55. Germany
  - O55. Greece

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Searching Resources

- Use the terminology from the ORSD

Objects

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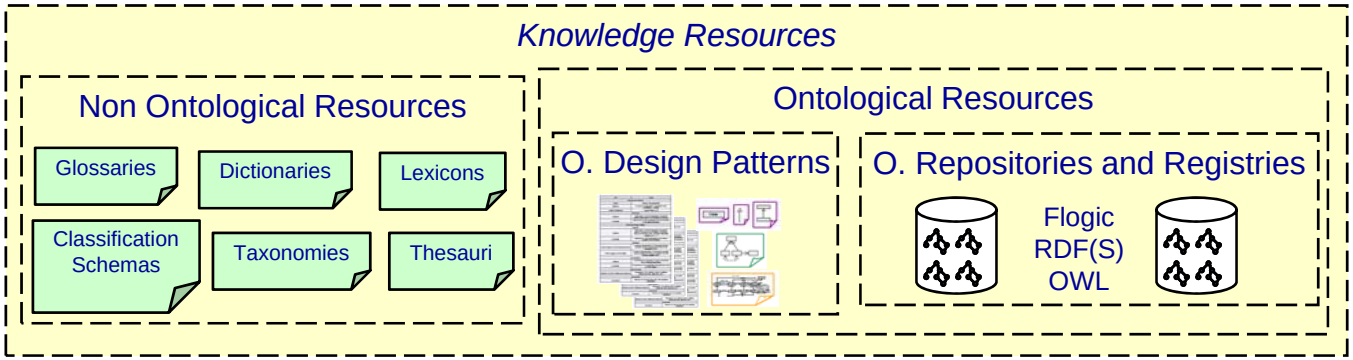
  - O17. French
  - O18. German
  - O19. Greek
  - O20. Italian

- Find resources covering the terminology



- Where:
  - Internet
  - Standardization bodies (ISO,…)
  - Intranet of the organization
  - Ontology Registries

Searching non ontological resources

- *We select the most appropriate standards and taxonomies for:*
  - Occupation Classification
    ISCO-88 (COM), SOC, ISCO-88, ONET, Eures Taxonomy.
  - Classification of Economic Activities
    ISIC Rev. 3.1, NACE Rev. 1.1, NAICS
  - Apprenticeship classifications
    ISCED 97, FOET
  - Currency Classification
    ISO 4217
  - Geography Classification
    ISO 3166, Eures Taxonomy

Language Classification
ISO 6392, CEF
Driving License Classification
European Legislation
Skill Classification
Eures Taxonomy
Contract Types Classification
LE FOREM, Eures and BLL Classification
Work Condition Classification
LE FOREM, Eures and BLL Classification

Is the terminology included in the Ontology Requirements Specification Document covered by the resources?

Selection of Ontologies

- Search ontologies
- Compare ontologies in the same domain using a set of criteria
- Assess if the ontologies cover the set of competency questions
- Select the best ontology based on
  - Coverage of the domain
  - Expressivity of the Implementation language

Searching Ontologies in Watson

Ontology Requirement Specification Document

Objects

Objects in the universe of discourse, which are instances of:

- Job Category
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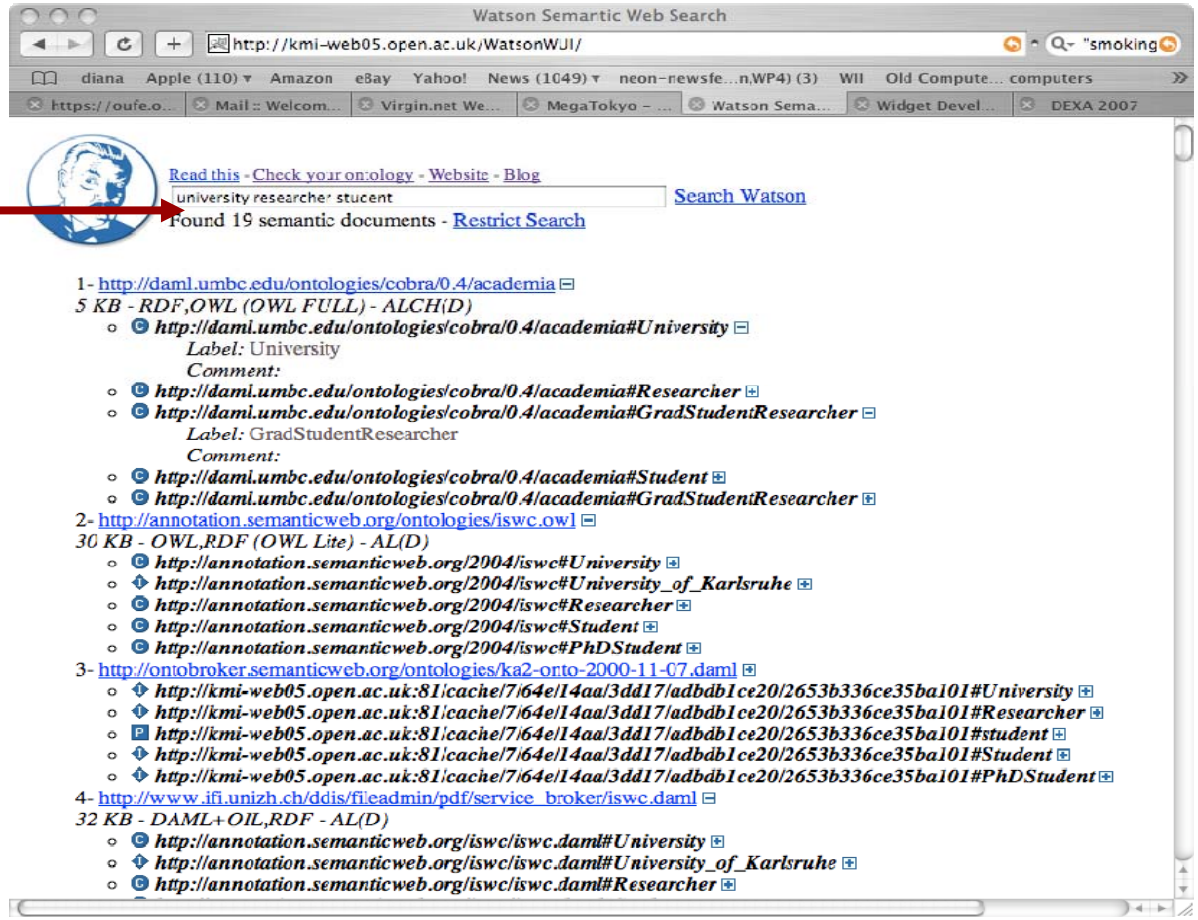

The Time Ontology Selection

Checking which temporal properties are needed for answering the CQ

a. When the job seeker completed his/her first degree?
b. Is the job seeker older than 30 years?
c. How much time did the job seeker spend completing his/her first degree?
d. How long is the duration of the contract?
e. Which job offers were posted in last 24 hours?
f. ……

	Cyc's Upper Ontology	Unrestricted Time Ontology	Simple Time Ontology	Reusable Time Ontology	Kestrel Time Ontology	SRI's Time Ontology	SUMO Time Ontology	DAML Time Ontology	AKT Time Ontology
Time Points	☑	☑	☑	☑	☑	☑	☑	☑	☑
Time Interval	☑				☑	☑	☑	☑	☑
Absolute and Relative Time			☑	☑				☑	☑
Relations between time intervals					☑		☑	☑	
Convex and non convex intervals				☑				☑	
Distinction between open and closed intervals				☑			☑	☑	
Explicit modeling of proper intervals								☑	
Concatenation of intervals								☑	
Different temporal granularities	☑					☑	☑	☑	☑
Provides axioms		☑	☑	☑			☑	☑	

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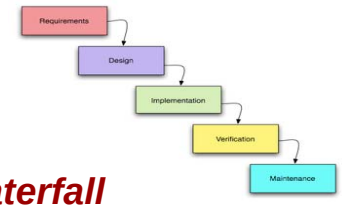
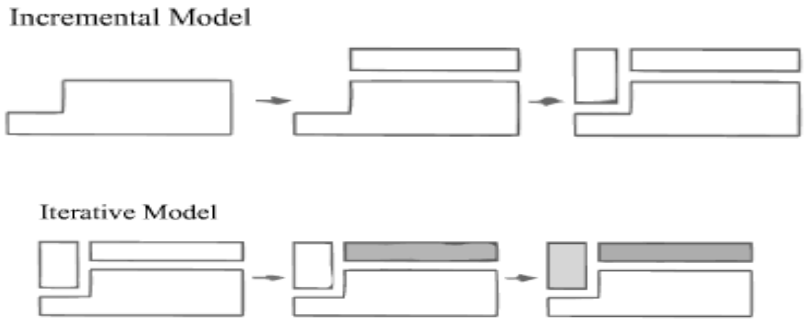
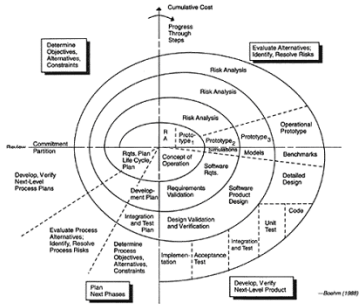
Life Cycle Models and Life Cycles

- An **ontology life cycle model** is the framework (waterfall, evolving prototyping, spiral, etc.), selected by each using organization, on which to map the activities identified in the ontology development process.



Waterfall





- The **ontology life cycle** is the specific sequence of activities that the ontology practitioners carry out for developing an ontology.

- There is **no a unique life cycle model** valid for all the ontology development projects

How software developers and ontology practitioners select the *ontology life cycle model* and the *particular ontology life cycle* for developing his/her ontology?

Step 1: Identify ontology network development requirements

Step 2. Select the ontology network life cycle model (ONLCM) to be used

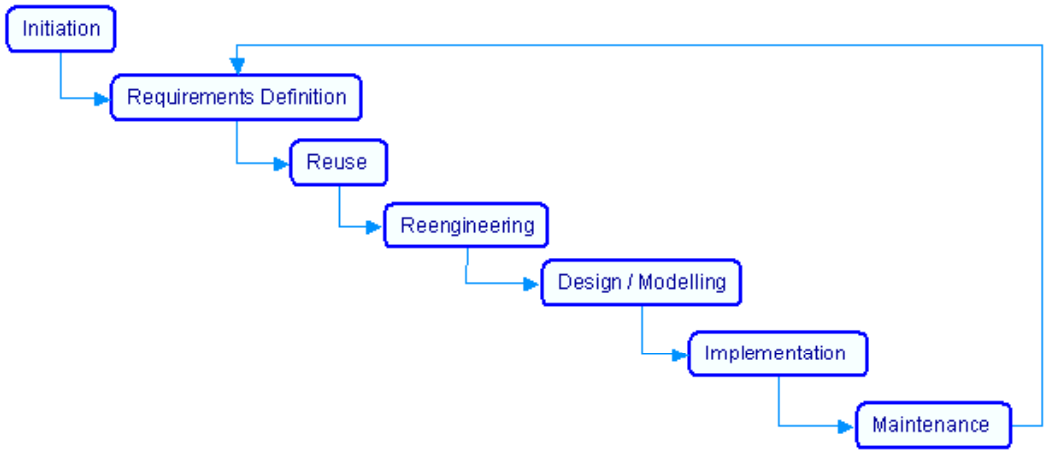
Step 3. Select activities to be carried out

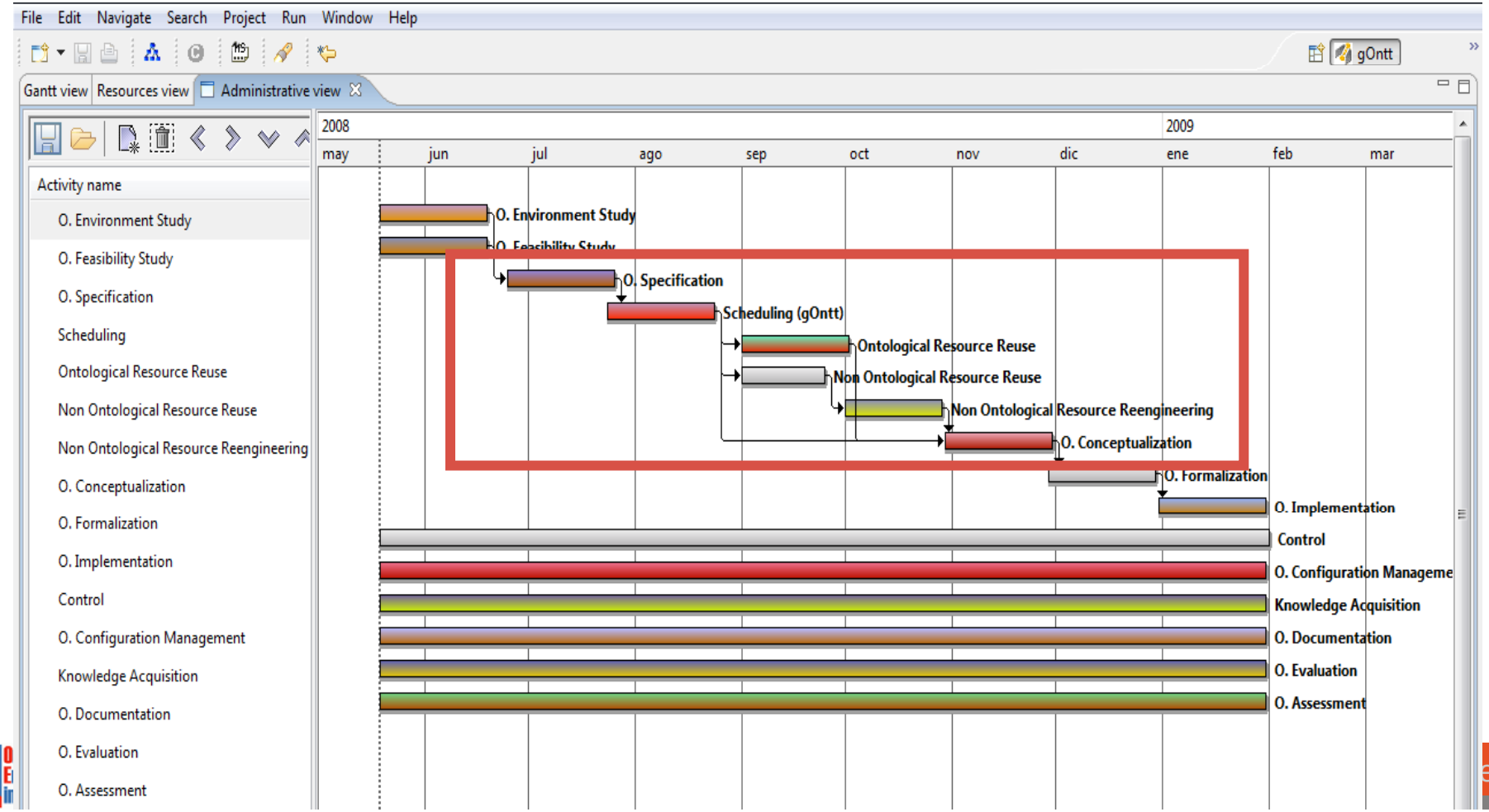
Step 4. Map the selected activities into the selected ontology network life cycle model

Step 5. Set the order of the activities: the result is the ontology network life cycle for the ontology network

NeOn Deliverable D5.3.1 (2007)

I-SEMANTICS 2008


Initiation
Requirements Definition
Reuse
Reengineering
Design / Modelling
Implementation
Maintenance


File Edit Navigate Search Project Run Window Help
gOntt
Gantt view
Resources view
Administrative view
2008
2009
may jun jul ago sep oct nov dic ene feb mar
Activity name
O. Environment Study
O. Feasibility Study
O. Specification
Scheduling
Ontological Resource Reuse
Non Ontological Resource Reuse
Non Ontological Resource Reengineering
O. Conceptualization
O. Formalization
O. Implementation
Control
O. Configuration Management
Knowledge Acquisition
O. Documentation
O. Evaluation
O. Assessment
O. Environment Study
O. Specification
Scheduling (gOntt)
Ontological Resource Reuse
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O. Formalization
O. Implementation
Control
O. Configuration Manageme
Knowledge Acquisition
O. Documentation
O. Evaluation
O. Assessment

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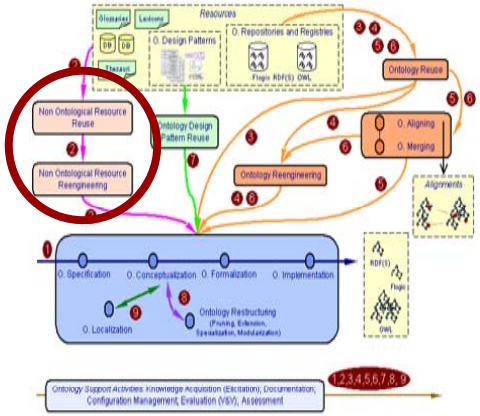
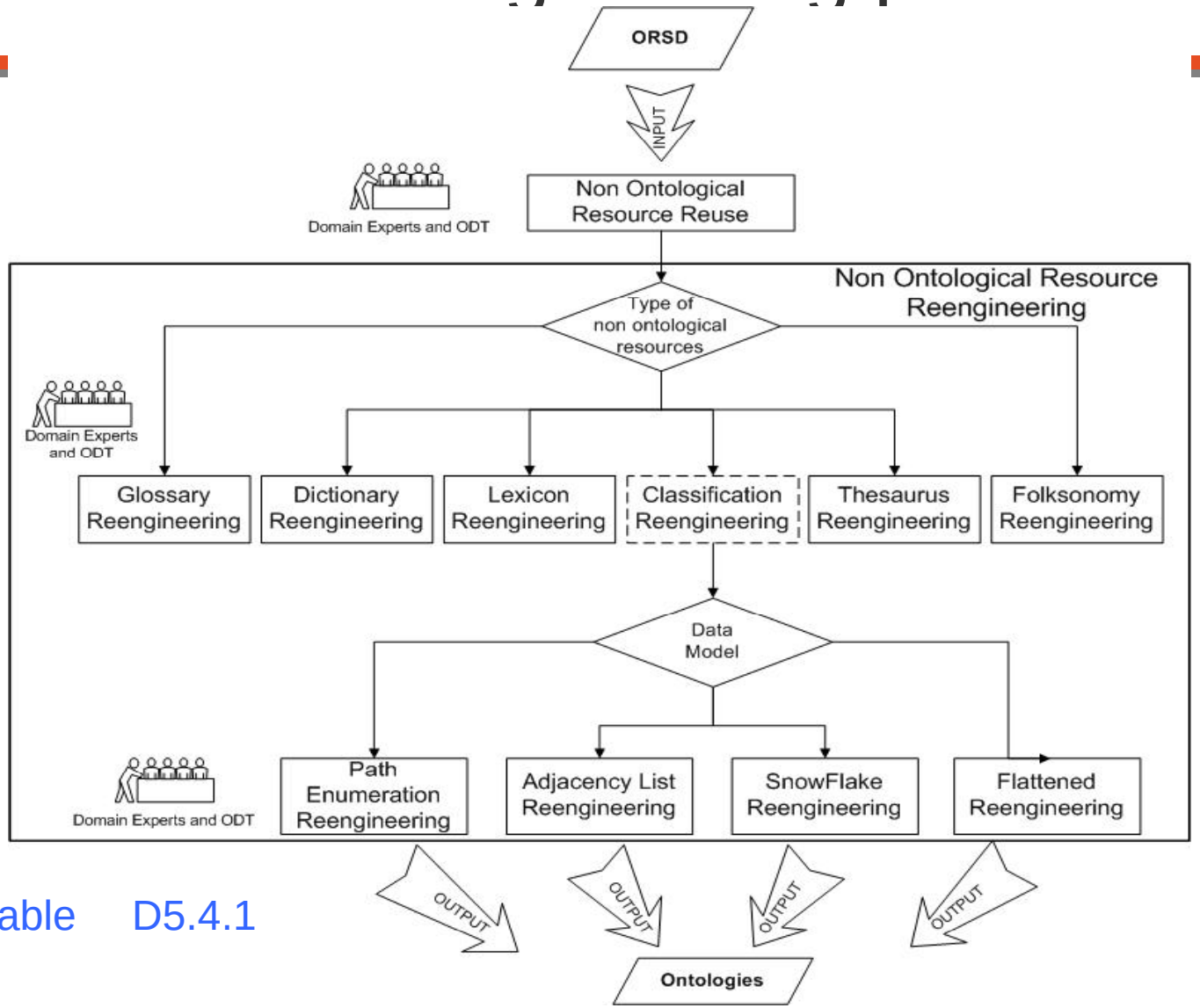
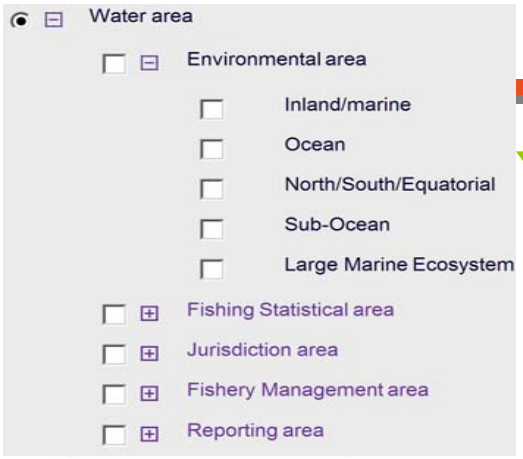
The resource type and its data model influence the reengineering process



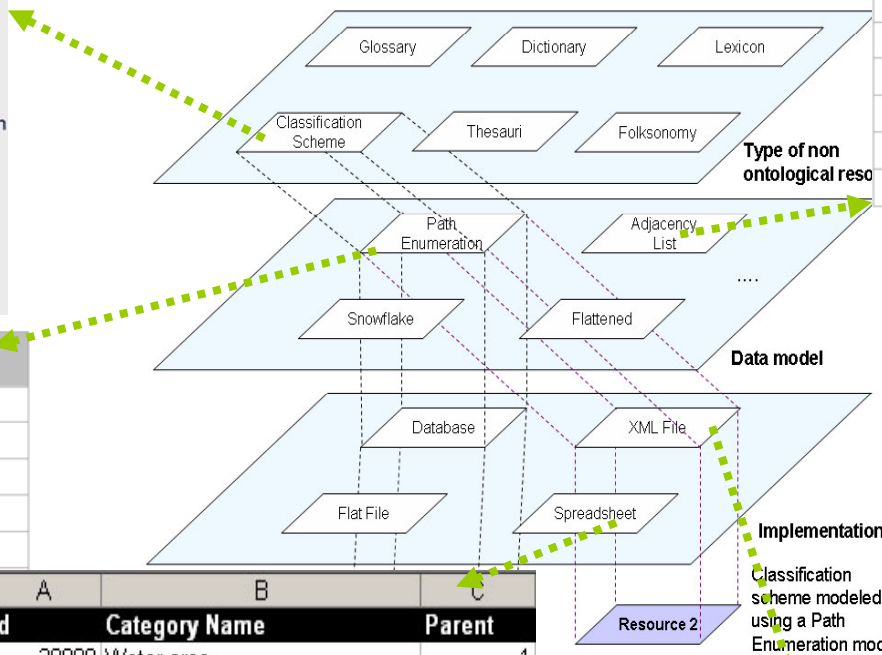


NeOn Deliverable D5.4.1 (2008)

Types of non ontological resources



Id	Category Name	Parent
20000	Water area	1
21000	Environmental area	20000
22000	Fishing Statistical area	20000
24020	Jurisdiction area	20000
21001	Inland/marine	21000
21002	Ocean	21000
21003	North/South/Equatorial	21000
21004	Sub Ocean	21000
21005	Large Marine ecosystem	21000

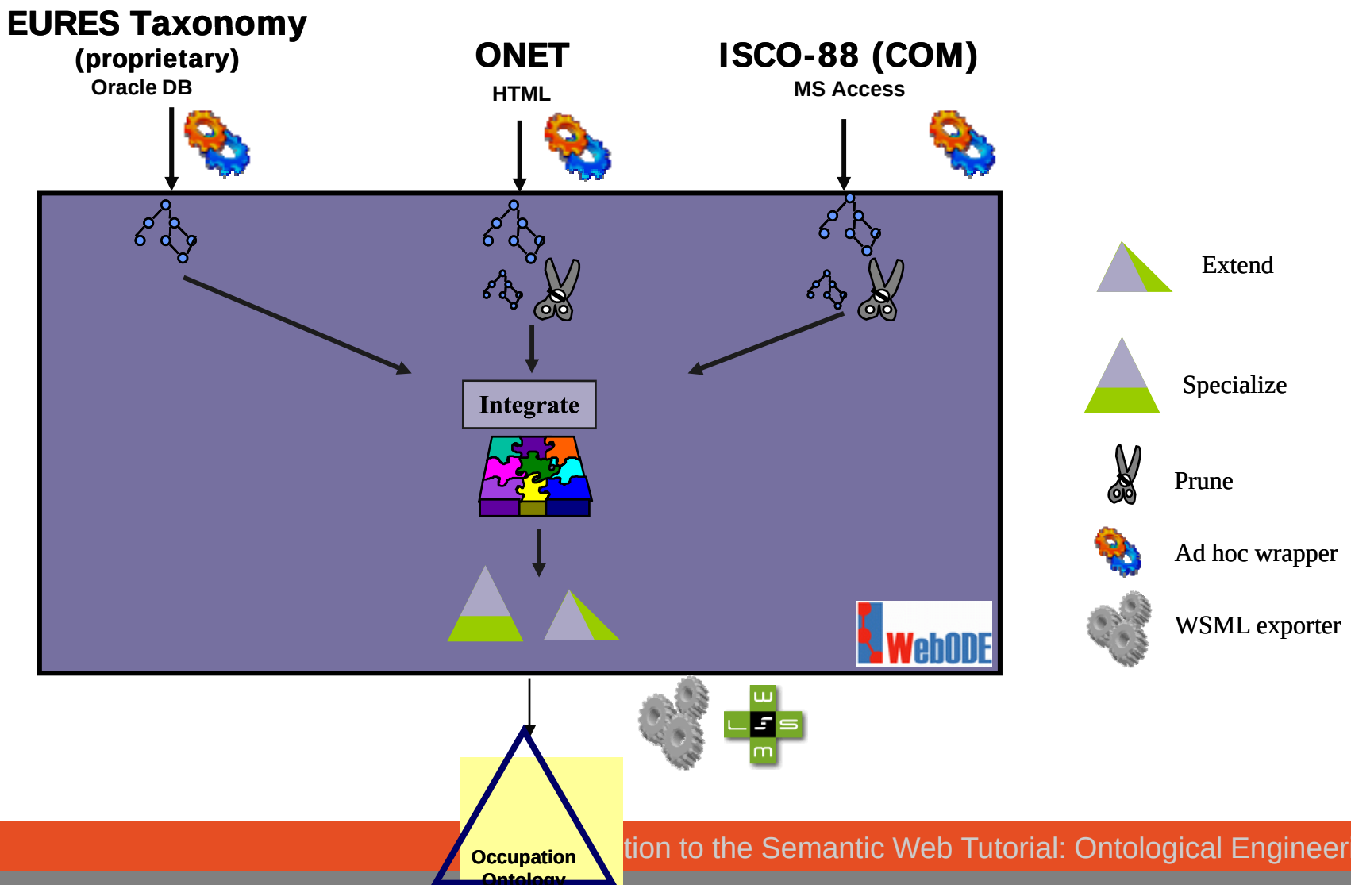


Id	Category Name
20000	Water area
20000. 21000	Environmental area
20000.22000	Fishing Statistical area
20000. 24020	Jurisdiction area
21000.21001	Inland/marine
21000.21002	Ocean
21000.21003	North/South/Equatc
21000.21004	Sub Ocean
21000.21005	Large Marine ecosys

	A	B	C
1	Id	Category Name	Parent
2	20000	Water area	1
3	21000	Environmental area	20000
4	22000	Fishing Statistical area	20000
5	24020	Jurisdiction area	20000
6	21001	Iland/marine	21000
7	21002	Ocean	21000
8	21003	North/South/Equatorial	21000
9	21004	Sub Ocean	21000
10	21005	Large Marine ecosystem	21000

```
<Classification>
  <Category>
    <NodeId>20000</NodeId>
    <WaterCategory>Water Area</WaterCategory>
    <parentNodeId>1</parentNodeId>
  </Category>
  <Category>
    <NodeId>21000</NodeId>
```

Reengineering resources



Knowledge Resource Reengineering

ISO 3166-1 (XML)

....

```
<ISO_3166-1_Entry>
    <ISO_3166-1_Country_name>SPAIN</ISO_3166-1_Country_name>
    <ISO_3166-1_Alpha-2_Code_element>ES</ISO_3166-1_Alpha-
2_Code_element>
  </ISO_3166-1_Entry>
...
```

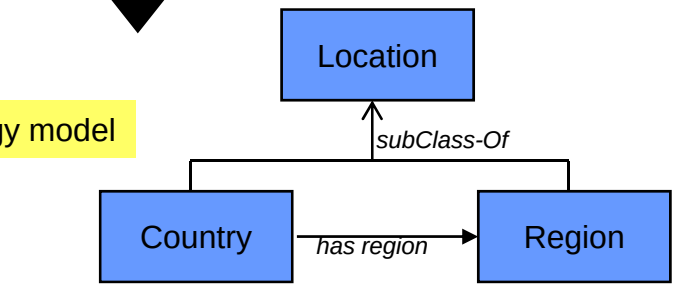
Regions Table (Eures Oracle DB)

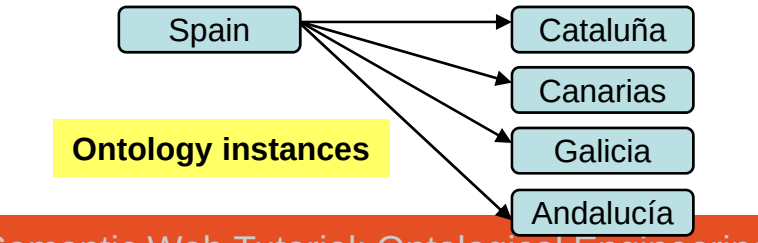
N	ISO31661 Code	Region
100	ES	Cataluña
101	ES	Canarias
102	ES	Galicia
103	ES	Andalucia
104	ES	Navarra
105	ES	Asturias
106	ES	Baleares
107	ES	Murcia
108	ES	Aragon

Excerpt of the Geography Ontology

```
<rdf:Description rdf:about="webode://mccarthy.dia.fi.upm.es/Geography_Ontology#Country_SPAIN">
  <rdf:type rdf:resource="webode://mccarthy.dia.fi.upm.es/Geography_Ontology#Country"/>
  <GeoOnt:Code rdf:datatype="http://www.w3.org/2001/XMLSchema#string">ES</GeoOnt:Code>
  <GeoOnt:Name rdf:datatype="http://www.w3.org/2001/XMLSchema#string">SPAIN</GeoOnt:Name>
  <GeoOnt:is_located_in_Continent rdf:resource="webode://mccarthy.dia.fi.upm.es/Geography_Ontology#EU_Europe"/>
  <GeoOnt:has_region_Region rdf:resource="webode://mccarthy.dia.fi.upm.es/Geography_Ontology#Catalunya"/>
  <GeoOnt:has_region_Region rdf:resource="webode://mccarthy.dia.fi.upm.es/Geography_Ontology#Canarias"/>
  <GeoOnt:has_region_Region rdf:resource="webode://mccarthy.dia.fi.upm.es/Geography_Ontology#Galicia"/>
  <GeoOnt:has_region_Region rdf:resource="webode://mccarthy.dia.fi.upm.es/Geography_Ontology#Andalucia"/>
</rdf:Description>
```

Ontology model





Ontology instances

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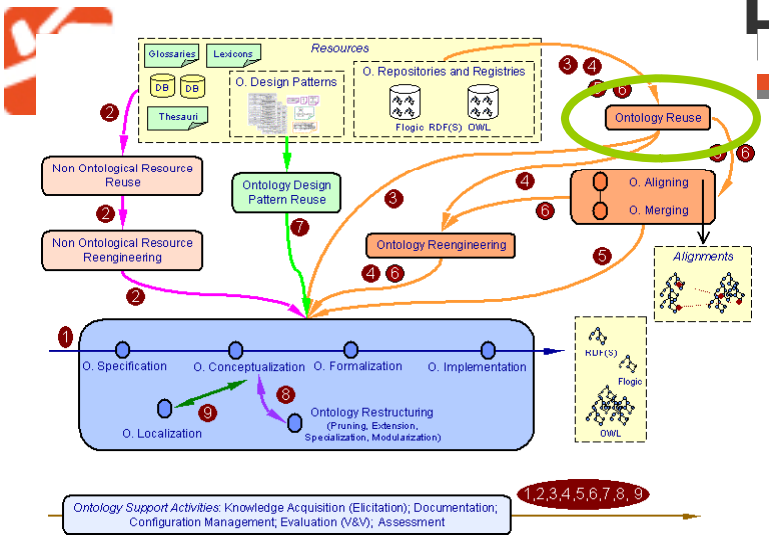
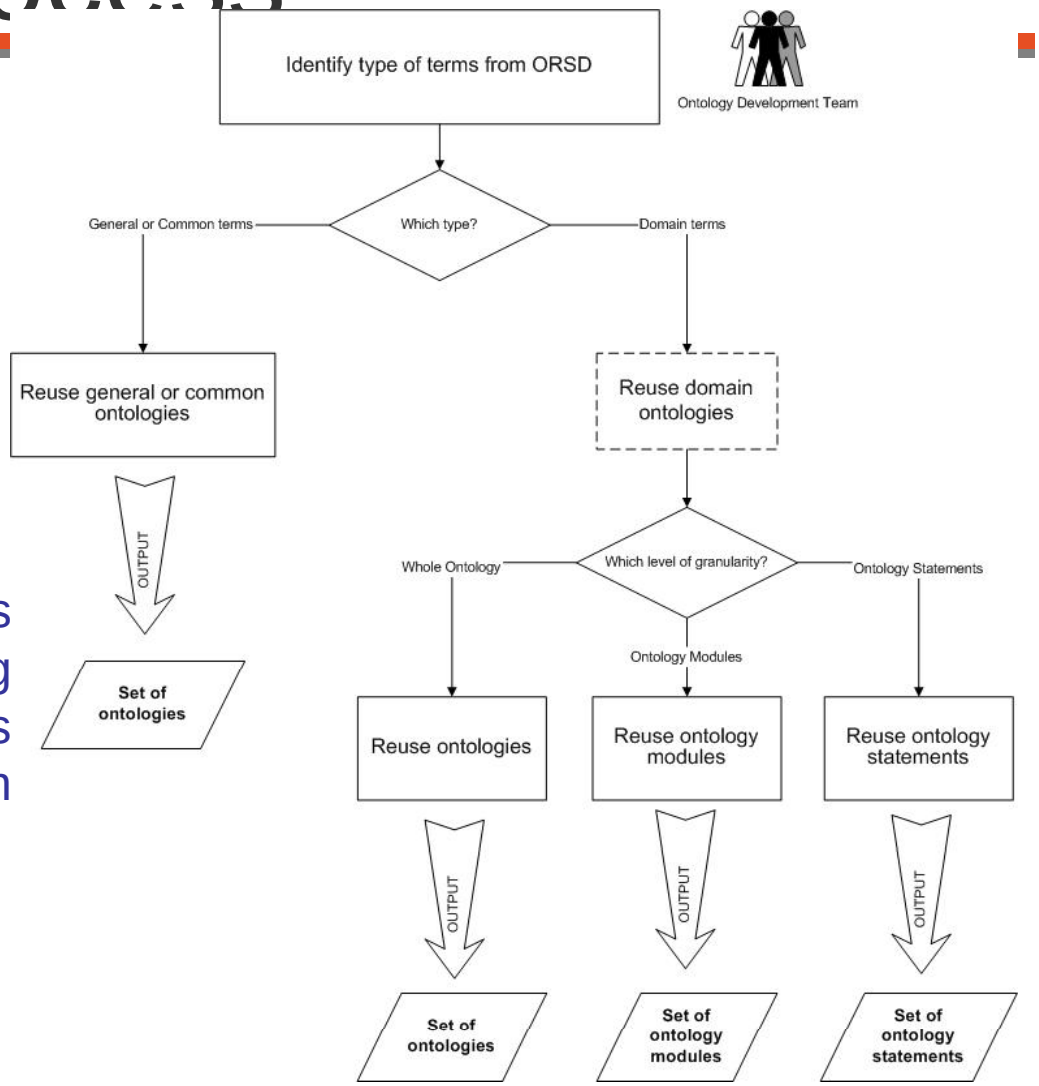
- Creating the final Ontology Model

Ontological Resource Reuse Process



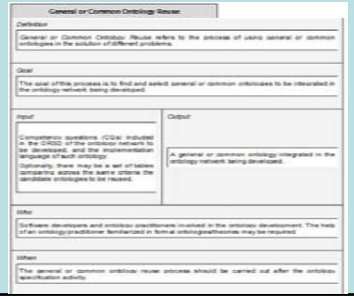


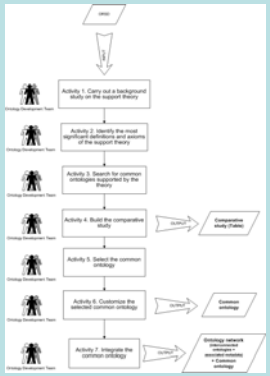
- **Ontological Resource Reuse** is defined as the process of using available ontological resources (ontologies, modules, statements) in the solution of different problems.

NeOn Deliverable D5.4.1 (2008)

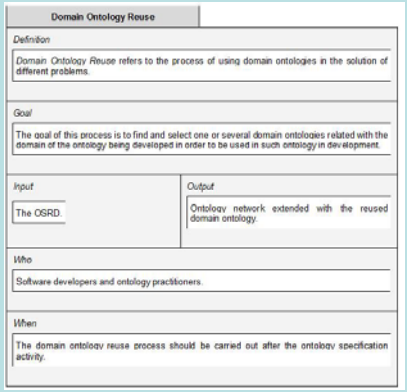
Detailed descriptions in D5.4.1

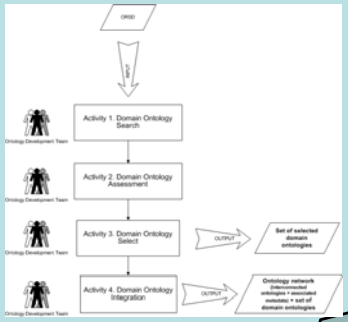
Reuse Common Ontologies



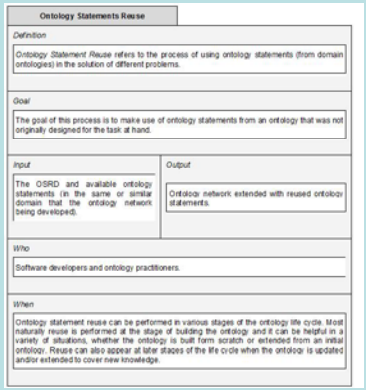


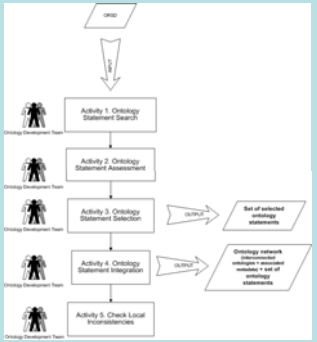
Reuse Domain Ontologies





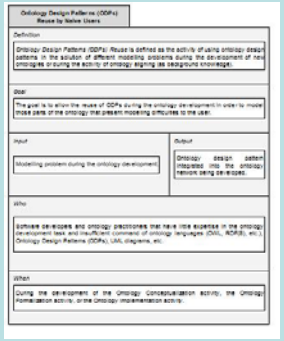
Reuse Ontology Statements

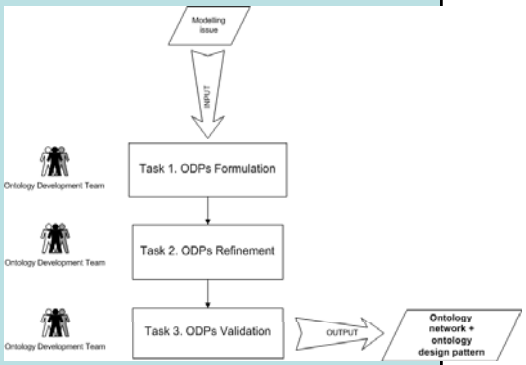




Watson plug-in

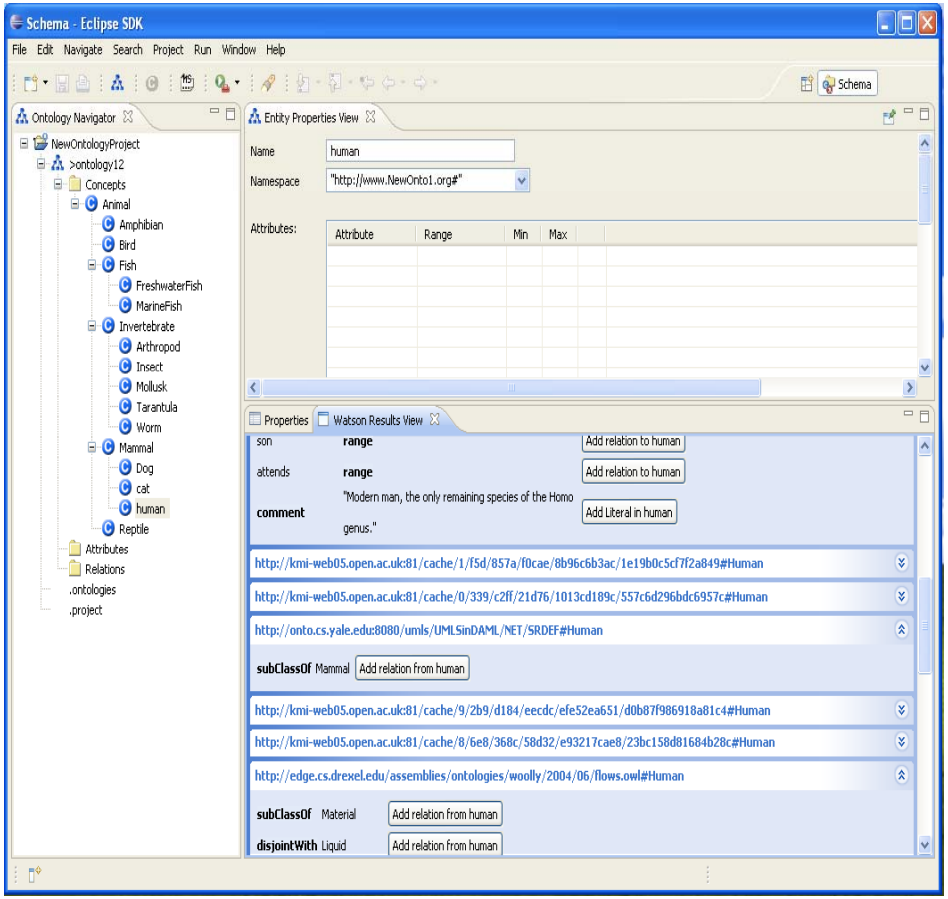
Reuse ODPs by naive users





Watson NeOn Toolkit plugin

- While building an ontology with the Neon toolkit
- Find descriptions of existing entities in Web ontologies
- Integrate these descriptions into the edited ontology
- Thus allowing knowledge reuse at the scale of the Semantic Web
- In one simple, integrated, and interactive tool



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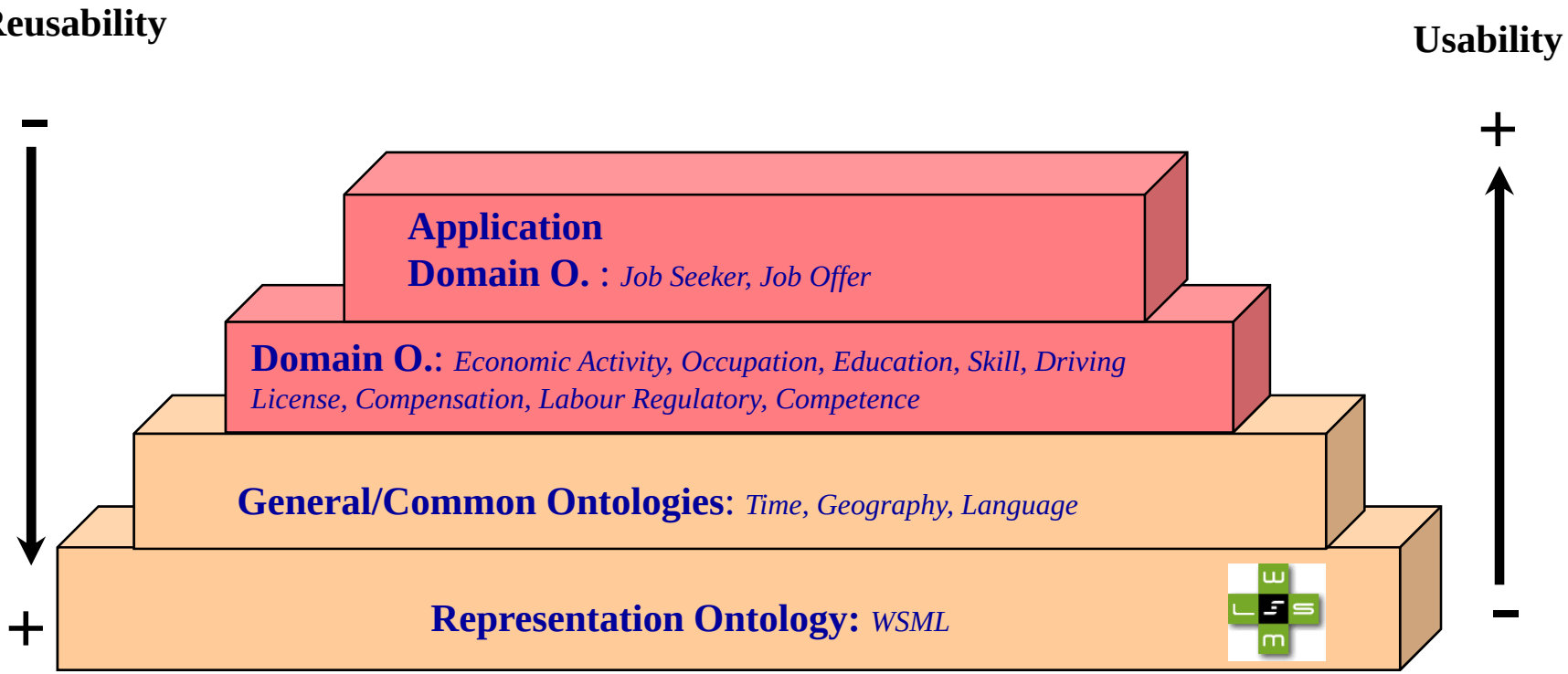
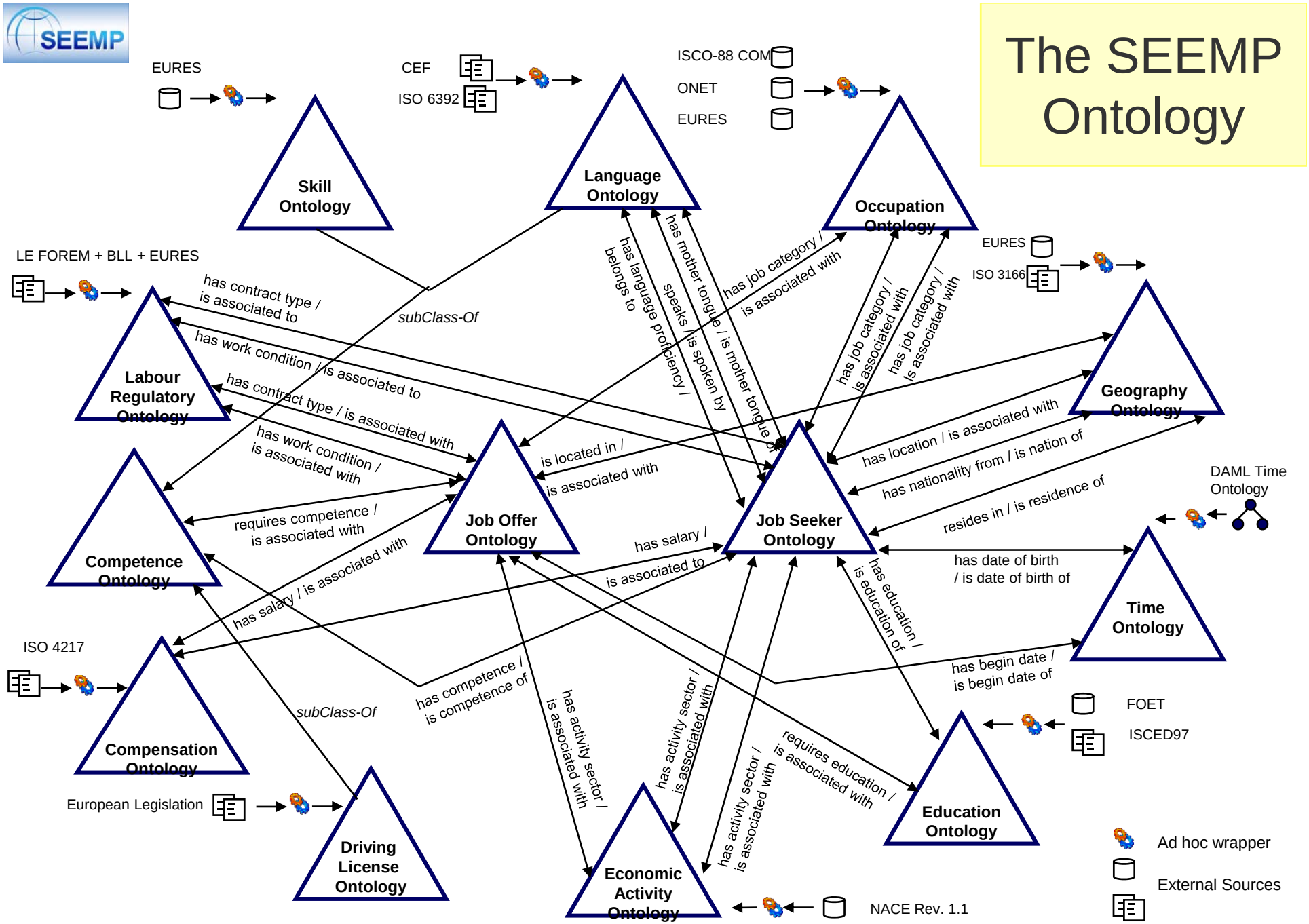
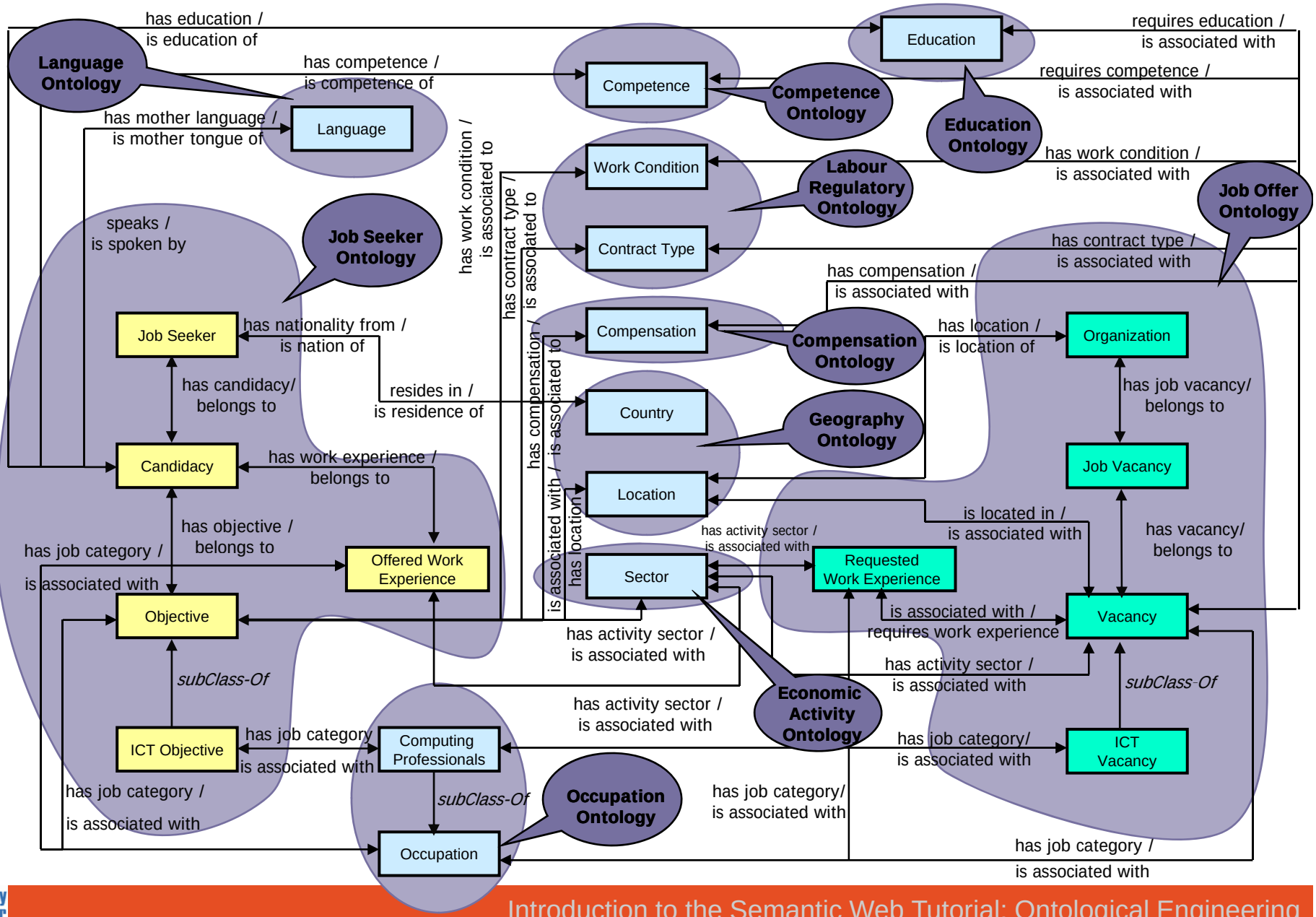
Conceptualization: Modular approach for ontology construction



The SEEMP Ontology



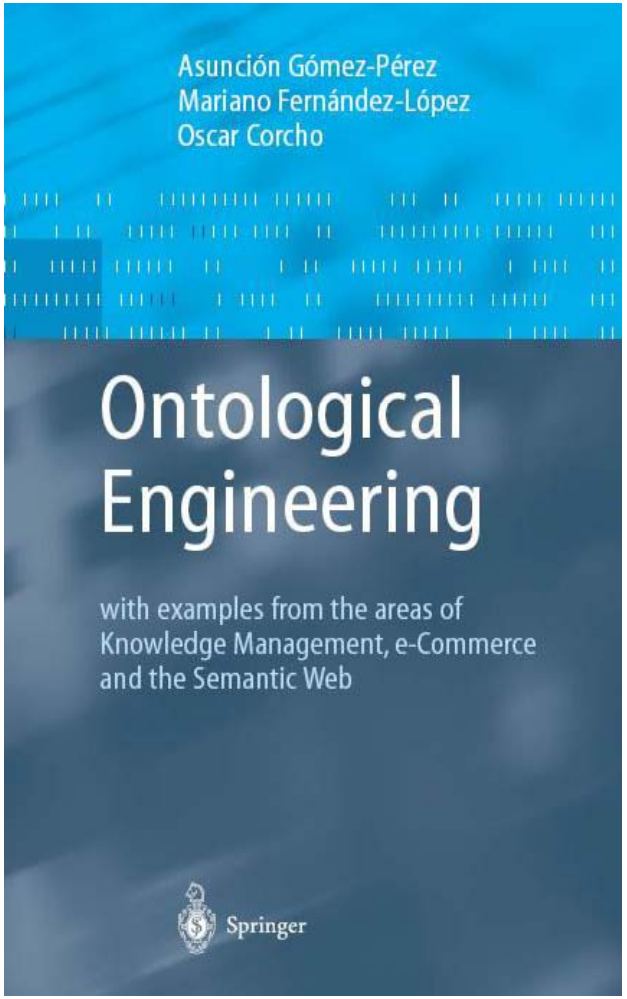
Details of the ontology



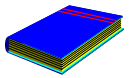
Conclusions

- The NeOn methodology leads the way to a new paradigm for ontology development
- Guidelines are focused on engineering for software developers
- Reuse and reengineering of knowledge aware resources
  - decreases the time spent in ontology development
  - eases sharing
  - improves quality and consensus because agreement was previously reached by domain experts
- There are more enabling technologies that support this new paradigm

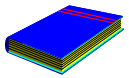
Main References



http://www.neon-project.org



D5.3.1. NeOn Development Process and Ontology Life Cycle



D5.4.1. NeOn Methodology for Building Contextualized Ontology Networks

Introduction to the Semantic Web Tutorial

Ontological Engineering

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