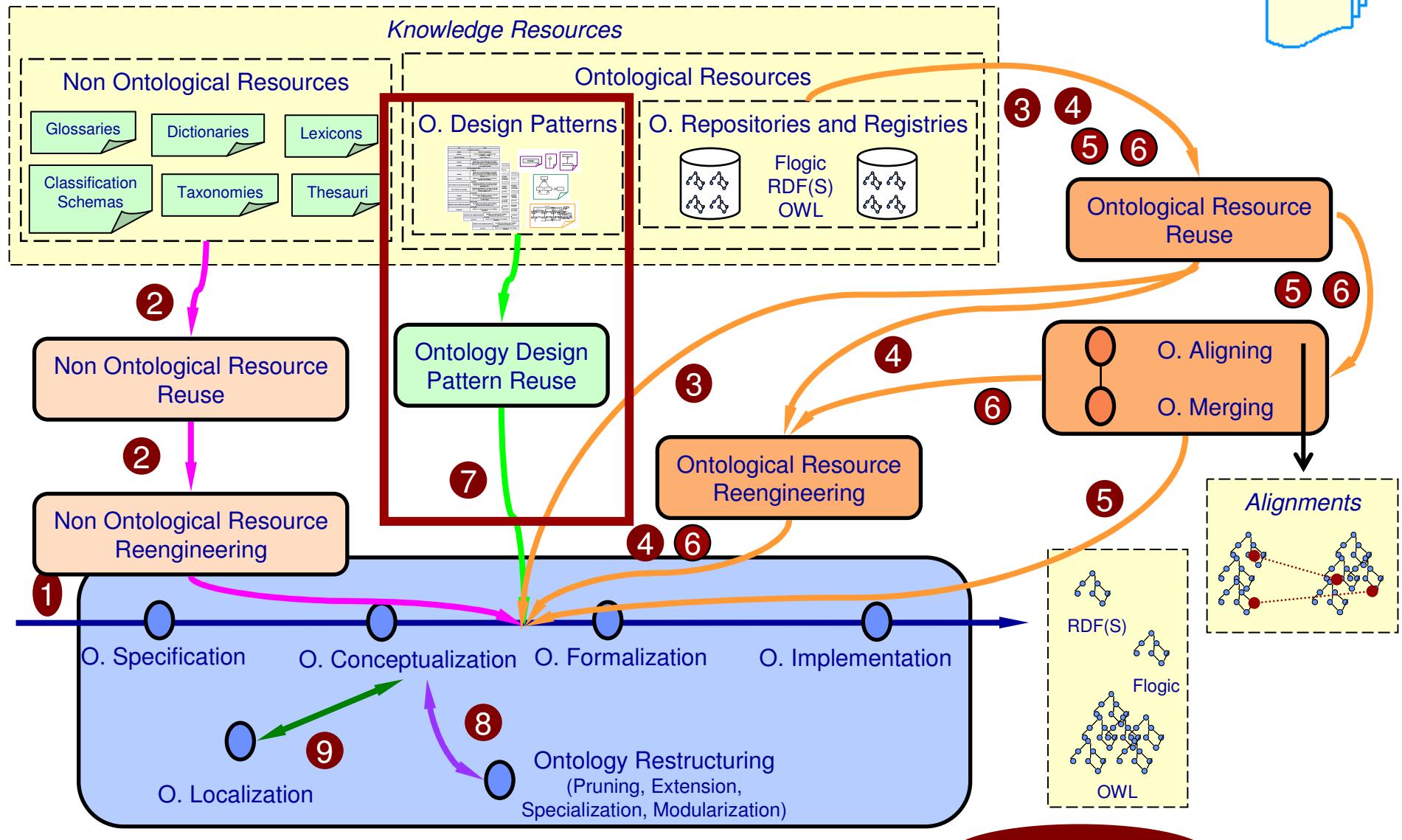


Index

- **Introduction**
- Scenarios in Ontology Building
- 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
- **Ontology Design Pattern Reuse**
- Methodological Guidelines for Ontology Reuse
- Creating the final Ontology Model

NeOn Scenarios



1,2,3,4,5,6,7,8, 9

Ontology Support Activities: Knowledge Acquisition (Elicitation); Documentation; Configuration Management; Evaluation (V&V); Assessment

A. Gómez Pérez, M.C. Suárez-Figueroa, B. Villazón

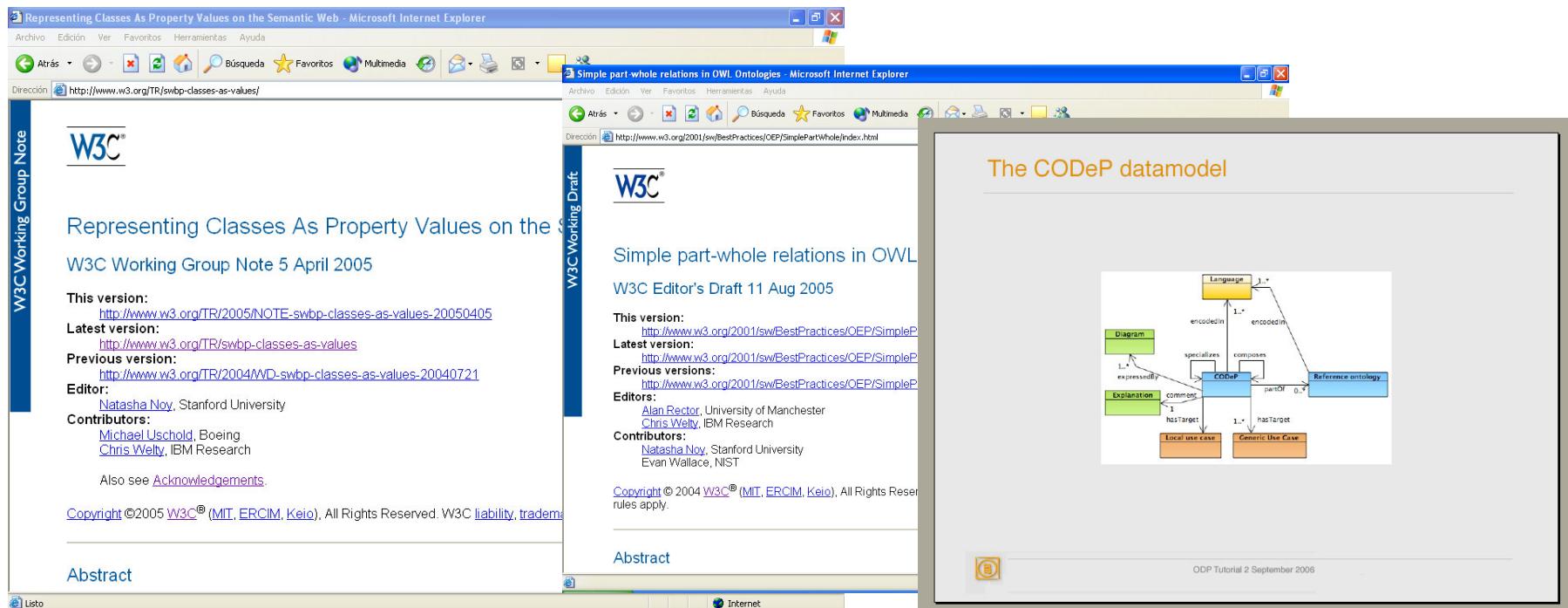
Patterns

Pattern is something proposed for imitation.

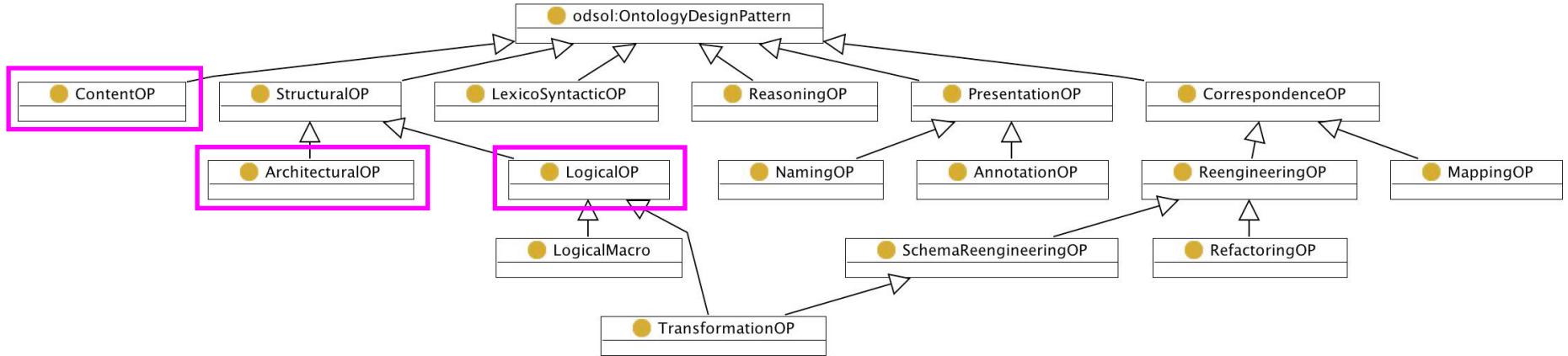
Design Pattern refers to shared guidelines that help solve design problems.

Ontology Design Pattern (ODP) is a modeling solution to solve a recurrent ontology design problem.

Our concept of “pattern” is associative with the wider “good/best practice” of software engineering. It includes a wider range of solution types. For example: naming conventions in software engineering are considered good practices, they are not design patterns.



Types of Ontology Design Patterns



Content OPs (CPs) encode conceptual, rather than logical design patterns.

Logical OPs solve design problems independently of a particular conceptualization.

CPs propose patterns for solving design problems for the domain classes and properties that populate an ontology. They address content problems.

A **Logical OP** is a formal expression, whose only parts are expressions from a logical vocabulary e.g., OWL DL, that solves a problem of expressivity.

Logical OPs are independent from a specific domain of interest i.e. they are content-independent

Architectural OPs affect the overall shape of the ontology: their aim is to constrain ‘how the ontology should look like’.

Inventory of Patterns (I)

- *General Information:*
 - Name
 - Identifier
 - Ontology modelling component type (LP, A)
- *Use Case*, or problem to be addressed.
- *Ontology Design Pattern*, or proposed solution in different formats.
- *Relations to other ontology model components*. This slot is optional.
- *Comments*. This slot is also optional.

Slot	Value
General/Information	
Name	Name of the component
Identifier	An acronym composed of component type + component identifier
Type of Component	Logical Pattern (LP)
Use Case	
General	Description in natural language of the general problem addressed by the modeling component.
Example	Description in natural language of some examples for the general problem.
Ontology Design Pattern	
General	
General	Description in natural language of the general solution covered by the modeling component, referring to the general Ontology Pattern defined in D5.1.1.
Example	Description in natural language of the solution applied to the example.
Graphical	
UML / Diagram for the General Solution	Graphical representation of the general solution provided, taking into account the UML Profile defined in D5.1.1.
UML / Diagram for Example	Graphical representation of the solution provided, using example and taking into account the UML Profile proposed in D5.1.1.
Formulation	
General	Formulation of the pattern in terms of the NeOn OML Ontology Metamodel.
Example	Formulation of the example using standard syntax for OML code.
Relationships	
Relations to other modeling components	Description of any relation to other modeling components (use, specialization, etc.).
Comments	
Comments	Remarks clarifying the use of the modeling component.



NeOn Deliverable D5.1.1

Inventory of Patterns (II)

<http://ontologydesignpatterns.org>

This screenshot shows a Wikipedia-style page for the category "ProposedContentOP".

The page has a navigation bar at the top with links for "category", "discussion", "view source", and "history". It also includes a user icon and the IP address "83.49.237.159 talk for this".

The main content area starts with a large image of a torus-like shape, followed by the title "Category:ProposedContentOP". Below the title, there is a note: "This category uses the form Content OP Proposal Form. Reviews about articles in this Category will use Form:Content OP Proposal Review Form".

A section titled "Pages in category \"ProposedContentOP\" " lists 41 pages. The first few items in this list are:

- Submissions:AgentRole
- Submissions:AquaticResourceObservation
- Submissions:AquaticResources
- Submissions:Biological Entities
- Submissions:Classification
- Submissions:Co-participation
- Submissions:CollectionEntity
- Submissions:Componency
- Submissions:Constituency
- Submissions:Description
- Submissions:GO Top
- Submissions:GearSpecies
- Submissions:GearVessel

Following this list are two columns of additional items, each starting with "S cont." and ending with "Submissions:SimpleTopic".

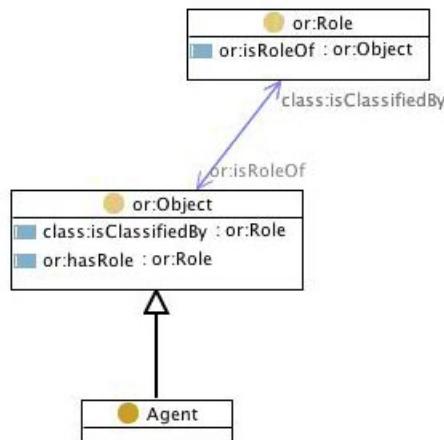
The left sidebar contains sections for "navigation", "help", and "contribute", each with a list of links.



NeOn Deliverable D2.5.1

Inventory of Patterns (III)

<http://ontologydesignpatterns.org>



Elements

The *AgentRole* Content OP locally defines the following ontology elements:



Agent (owl:Class)

Any agentive **Object**, either physical, or social.

[Agent page](#)

The *time indexed person role* CP allows to represent temporariness of roles played by persons. It can be generalized for including objects or, alternatively the *n-ary classification* CP can be specialized in order to obtain the same expressivity.

AgentRole

Submitted by: [ValentinaPresutti](#)

Name: agent role

Also Known As:

Intent: To represent agents and the roles they play.

Domains: Management, Organization, Scheduling

Competency Questions: which agent does play this role?, what is the role that played by that agent?

Reusable OWL Building Block: <http://www.ontologydesignpatterns.org/cp/owl/agentrole.owl>

Consequences: This CP allows designers to make assertions on roles played by agents without



NeOn Deliverable D2.5.1

ODP Reuse

Ontology Design Pattern Reuse

Definition

Ontology Design Patterns (OPs) Reuse is defined as the activity of using available ontology design patterns in the solution of different modeling problems during the development of new ontologies.

Goal

The goal is to allow the reuse of ODPs during the ontology development in order to facilitate the solution of modeling issues and to improve interoperability.

Input

Requirements from the Ontology Requirements Specification Document.

Output

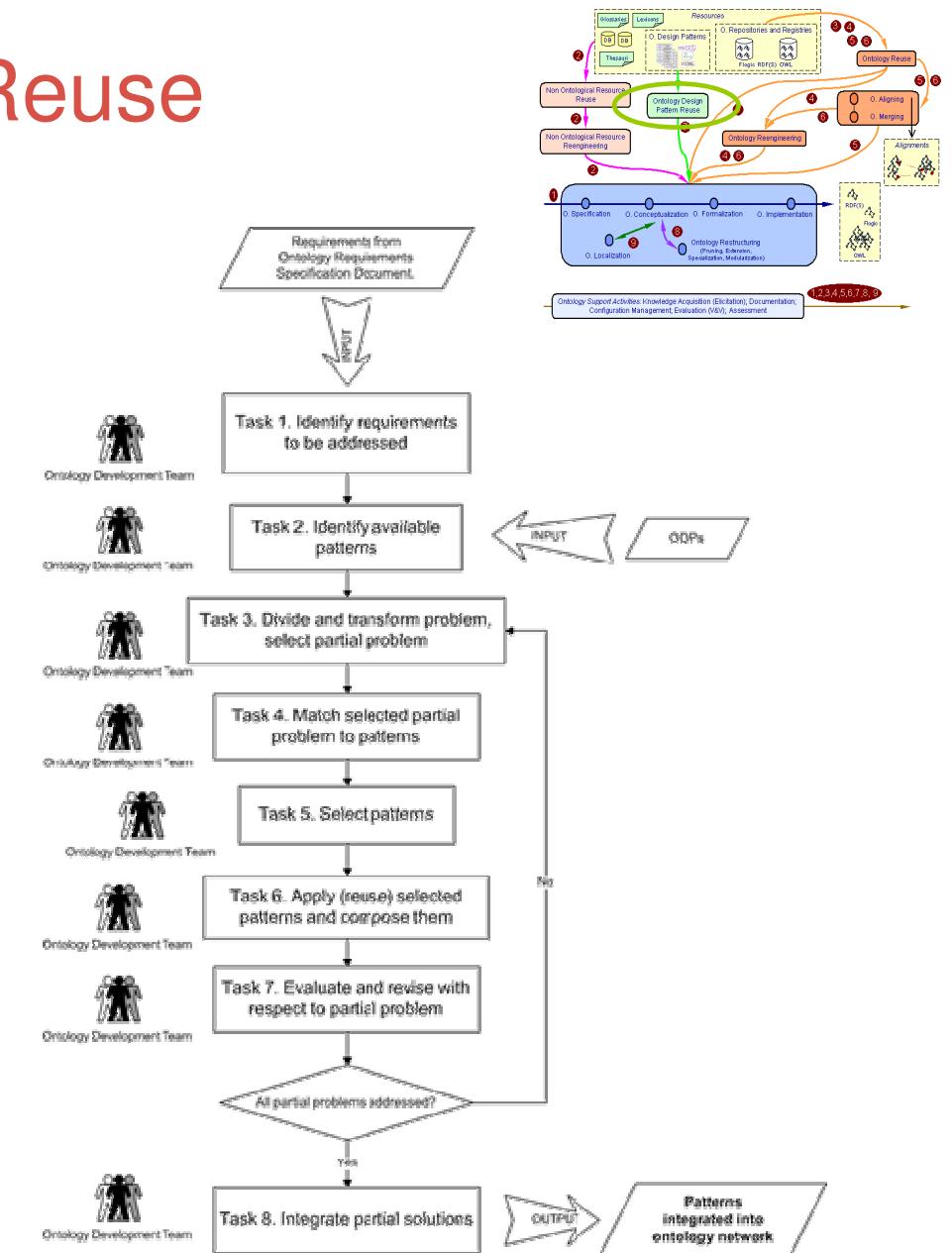
Ontology design patterns integrated into the ontology network being developed.

Who

The ontology development team.

When

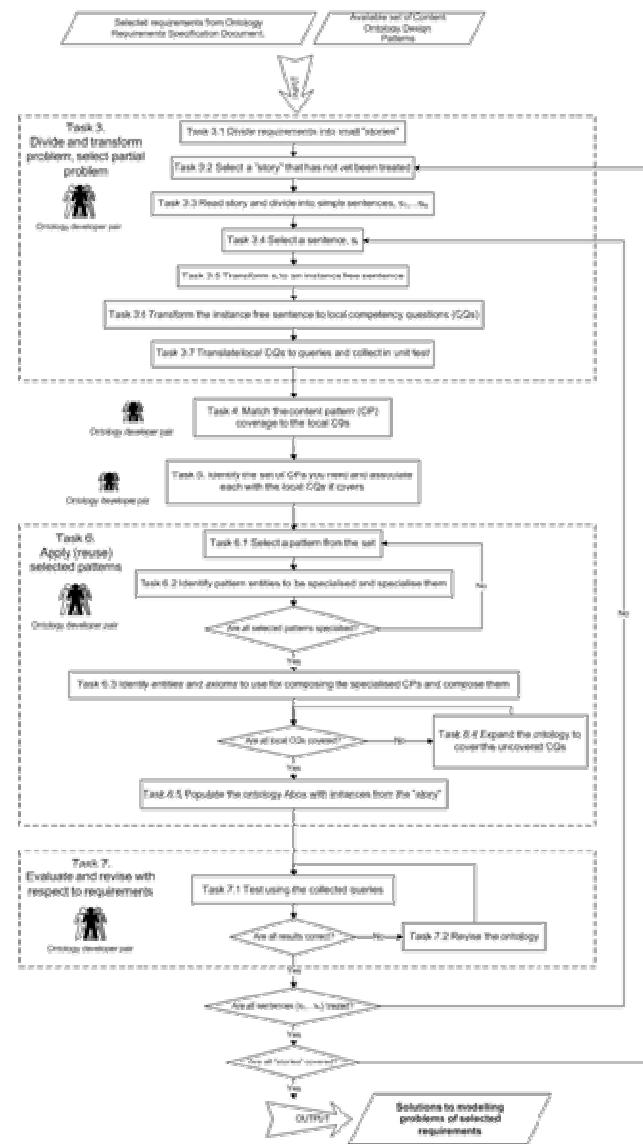
During the development of the Ontology Conceptualization activity, the Ontology Formalization activity, and/or the Ontology Implementation activity.



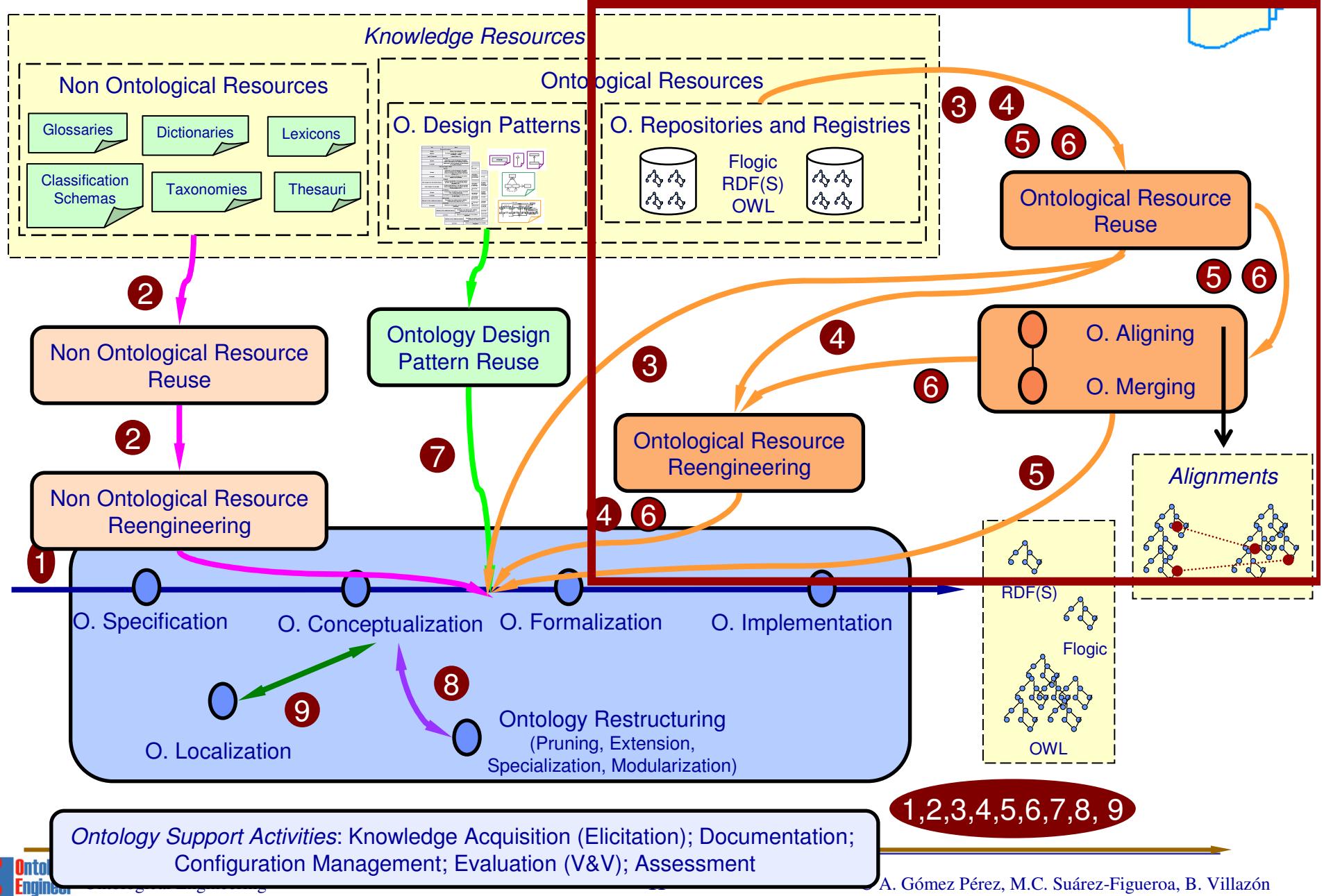
CP Reuse Basic Operations

- **Covering** is related to the requirements that are to be solved by a model, or a pattern. A pattern covers a set of requirements, if it is expressive enough to store the necessary knowledge to answer the full set of competency questions (CQs) representing the requirements.
- **Cloning** involves making a duplicate of an ontology element, in some cases including all axioms defining the element or in some cases only making a partial clone.
- **Composition** is the way of combining two or more patterns, where the result in case of content patterns is the union of the axioms of all the patterns together with any additional axioms used to link the elements of the different patterns.
- **Specialization** and generalization are relations among patterns, as well as among elements. Specialization is also a way of reusing a content pattern, when the elements are specialized and thereby form a new ontology tailored to some specific requirements.
- **Expansion** is when a pattern is extended with additional elements or axioms.
- **Importing** is a basic operator for content pattern reuse (since already available in OWL) and is the standard way of reusing such OPs.

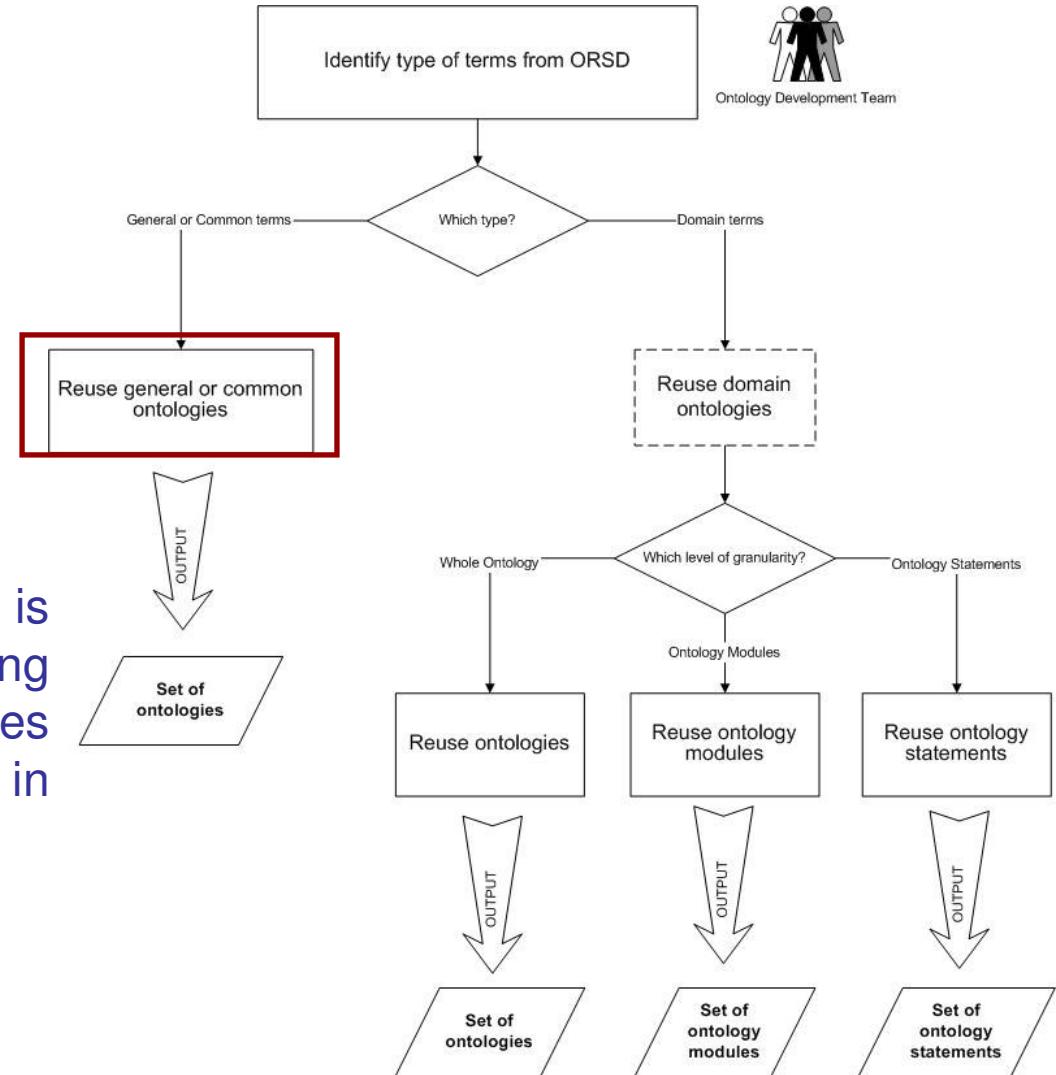
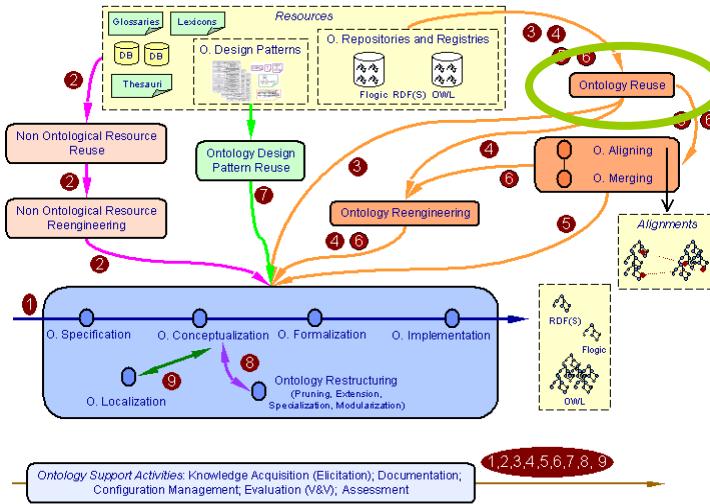
CP Reuse



NeOn Scenarios

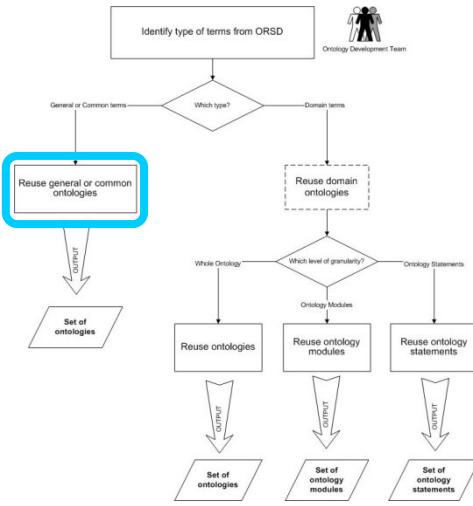


Ontological Resource Reuse Process



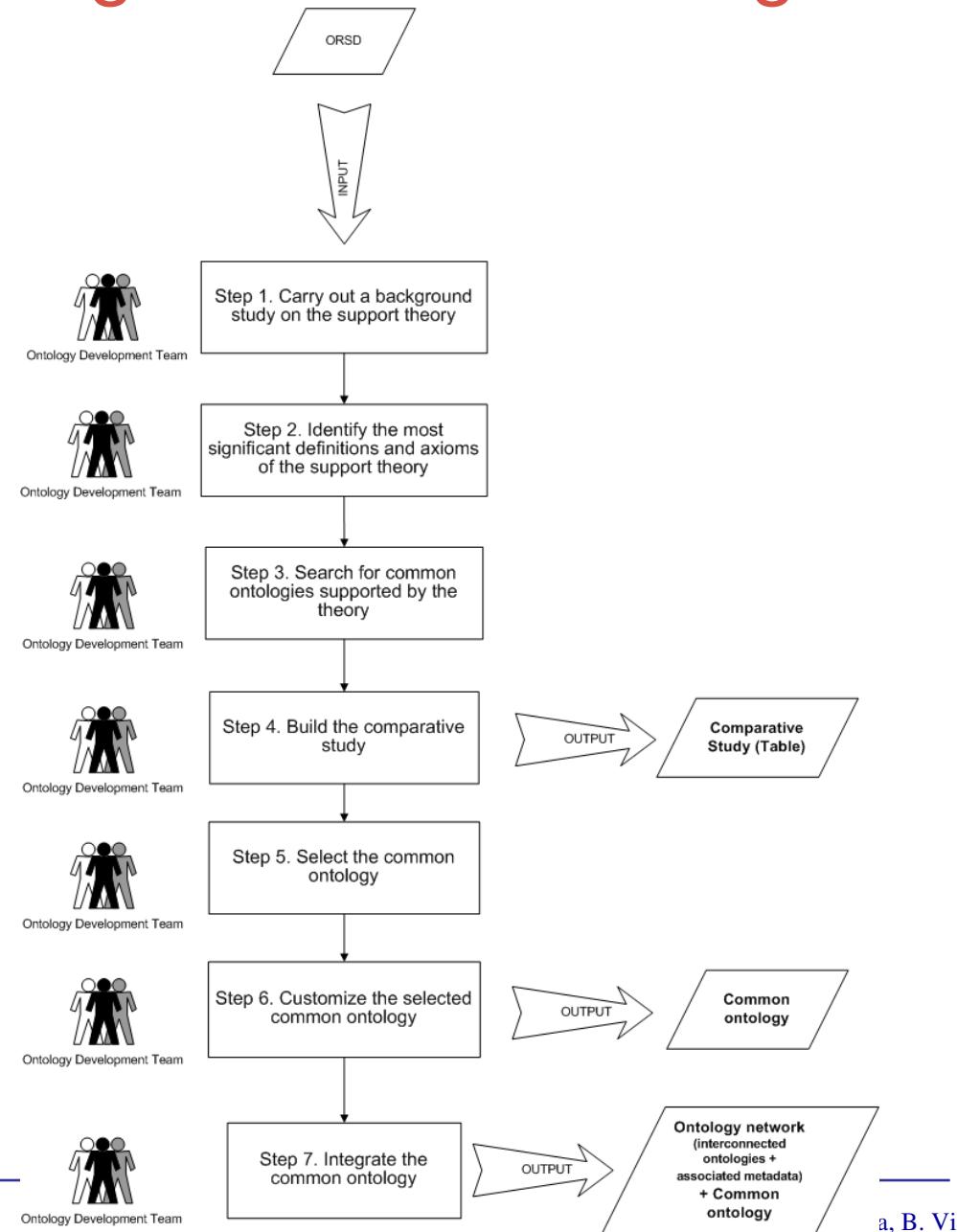
- **Ontological Resource Reuse** is defined as the process of using available ontological resources (ontologies, modules, statements) in the solution of different problems.

Reusing Common Ontologies



3 examples:

- SEEMP Project
- Invoice Use Case
- Nomenclature Use Case



Reusing Common Ontologies. Identification of Features

Steps 1 and 2. Carry out background study and identification of features.



Time Points	Distinction between open and closed intervals
Time Interval	Explicit modeling of proper intervals
Absolute and Relative Time	Concatenation of intervals
Relations between time intervals	Different temporal granularities
Convex and non convex intervals	

Reusing Common Ontologies.

Comparative Study

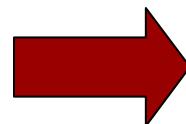
Step 3 and 4. Search for common ontologies and build the comparative table.

	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	<input checked="" type="checkbox"/>								
Time Interval	<input checked="" type="checkbox"/>				<input checked="" type="checkbox"/>				
Absolute and Relative Time			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>				<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Relations between time intervals					<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
Convex and non convex intervals				<input checked="" type="checkbox"/>				<input checked="" type="checkbox"/>	
Distinction between open and closed intervals				<input checked="" type="checkbox"/>			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
Explicit modeling of proper intervals								<input checked="" type="checkbox"/>	
Concatenation of intervals								<input checked="" type="checkbox"/>	
Different temporal granularities	<input checked="" type="checkbox"/>					<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Provides axioms		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	

Reusing Common Ontologies. Ontology Selection

Step 5. Select a common ontology:

- Checking which temporal properties are needed for answering the Competency questions
 - 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. Which job offers were posted in last



Time Points	a
Time Interval	b, c
Absolute and Relative Time	a,d,f,g
Relations between time intervals	
Convex and non convex intervals	h
Distinction between open and closed intervals	a,d,f,g
Explicit modeling of proper intervals	i
Concatenation of intervals	
Different temporal granularities	a,d,f,g

Reusing Common Ontologies.

Ontology Selection

	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 close intervals	●				✓		✓	✓	✓
Explicit modeling of proper intervals	●							✓	✓
Concatenation of intervals		✓					✓	✓	✓
Different temporal granularities			✓	✓	✓		✓	✓	✓
Provides axioms	●						✓	✓	✓

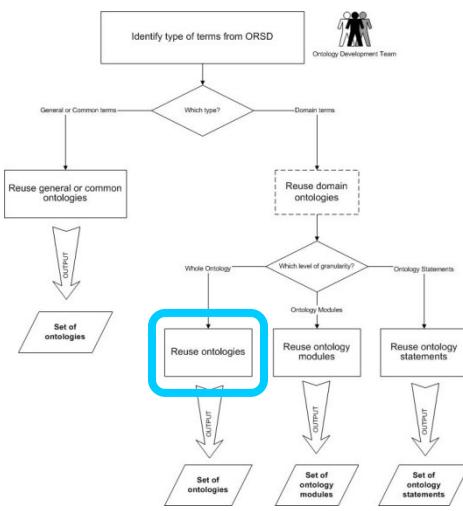
Reusing Common Ontologies. Ontology Customization and Integration

Step 6. Customize:

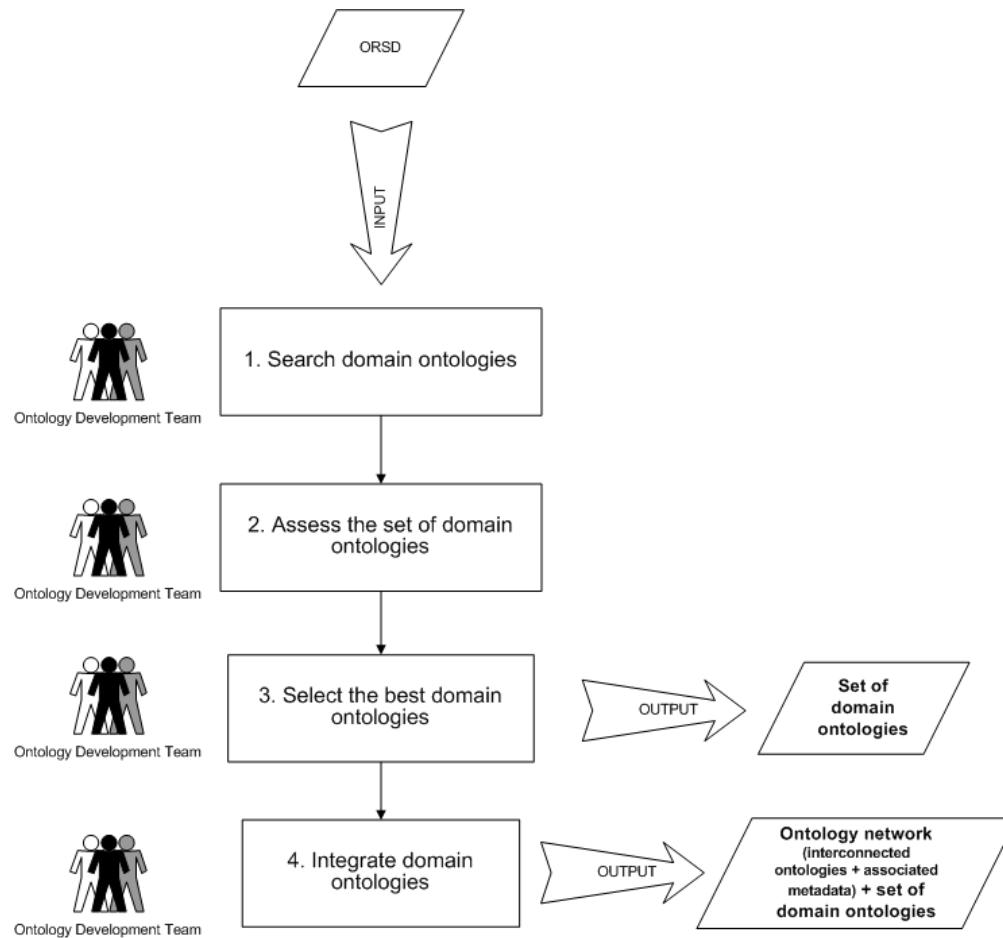
- *Prune the reused ontology according to the features that are really necessary (e.g. convex and not convex intervals).*
- *Enrich the ontology (not needed in time ontology).*
- *Translate (e.g. from KIF to OWL).*
- *Evaluate the obtaining ontology.*

Step 7. Integrate

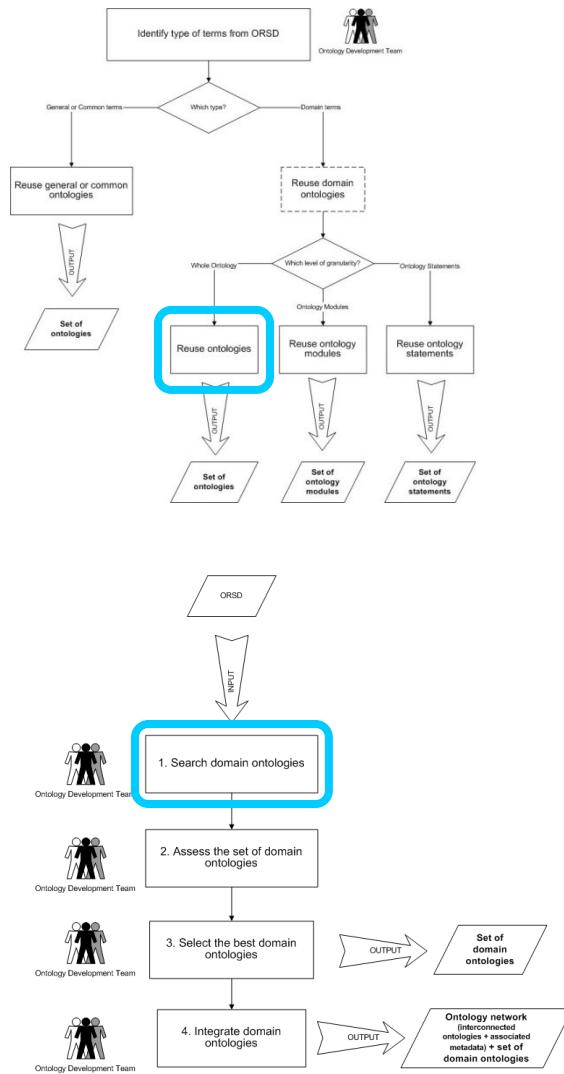
Reusing Ontologies as a Whole



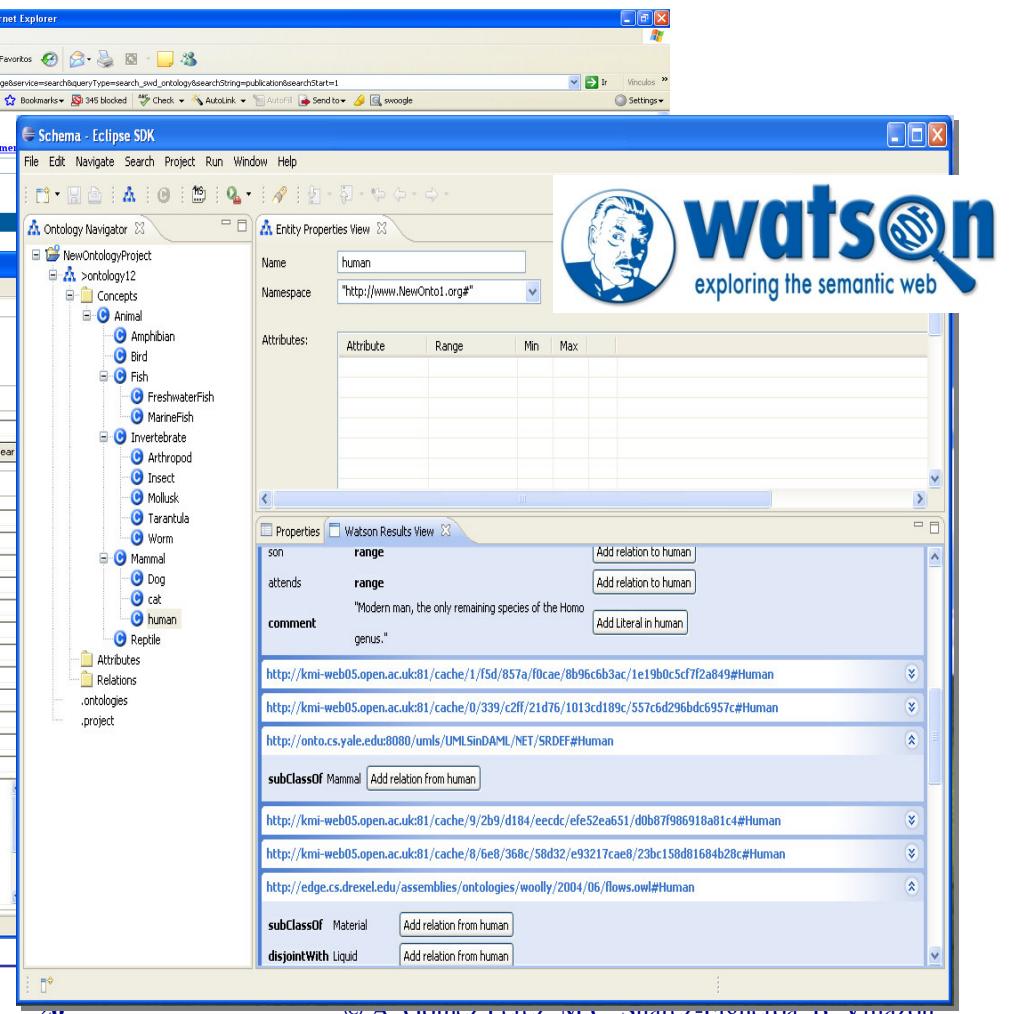
Ontology Reuse is redefined as the activity of using ontologies (in this case domain ontologies) in the solution of different problems.



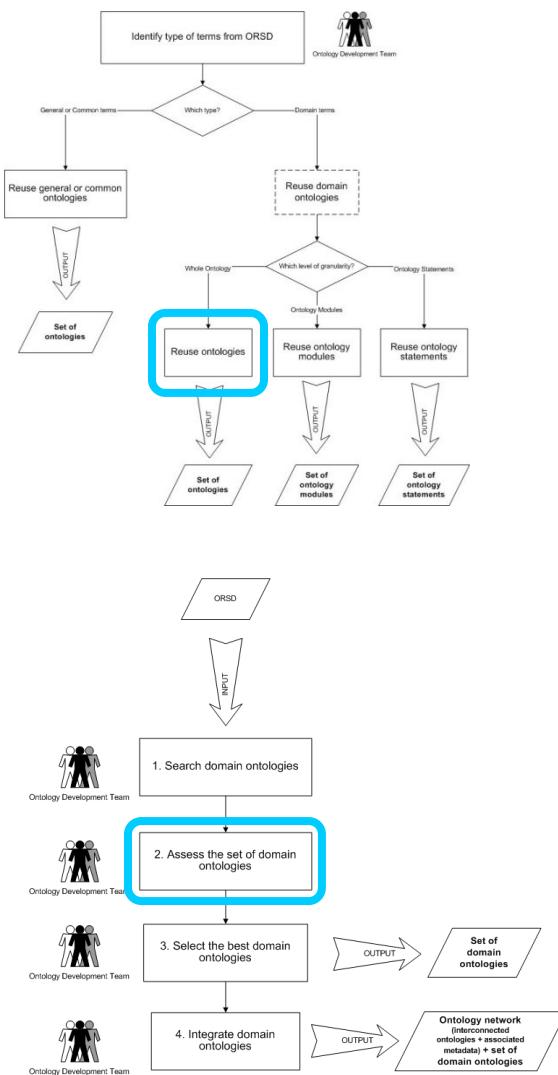
Reusing Ontologies as a Whole. Domain Ontology Search



Use ontology libraries and ontology repositories to search domain ontologies, using those terms that have a high frequency in the ORSD.



Reusing Ontologies as a Whole. Domain Ontology Assess

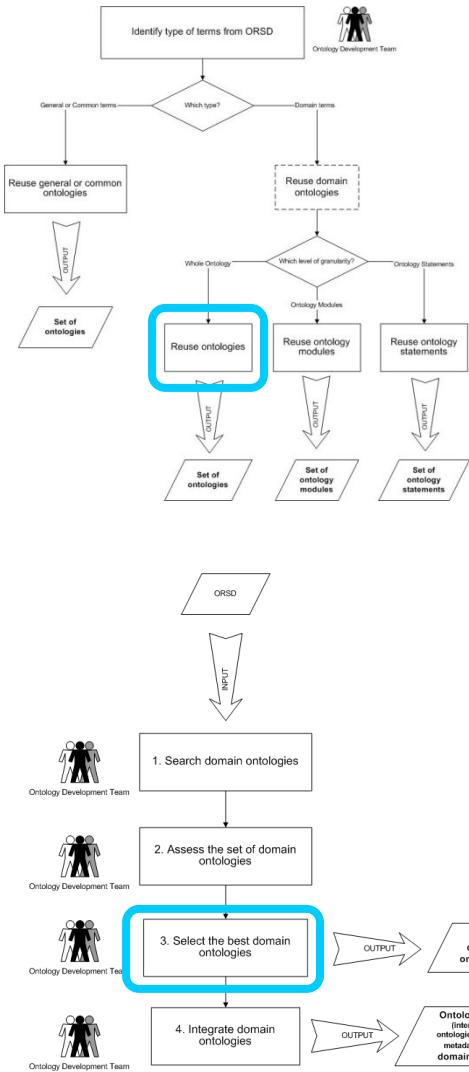


The question here is: **Are the found ontologies useful?**

- Ontology requirements, such as ontology language (Syntactic Level), if terms are from standards, if multilinguality is needed, etc.
- Checking the CQs with respect to the found ontologies:
 - Terminological Level: using the terminology from CQs.
 - Precision
 - Recall
 - Semantic Level: answering the CQs.

	Publication Ontology 1	Publication Ontology 2	Publication Ontology 3	
<i>Ontology Requirements</i>				
O. Language	OWL-DL	OWL-DL	KIF	OWL-DL
Standards	No needed	--	--	--
Multilinguality	Yes	Yes	Yes	Yes
<i>Checking CQs</i>				
Terminological Level	Precision	80%	90%	80%
	Recall	100%	90%	100%
Semantic Level: answering CQs		Yes	Yes	Yes

Reusing Ontologies as a Whole. Domain Ontology Select

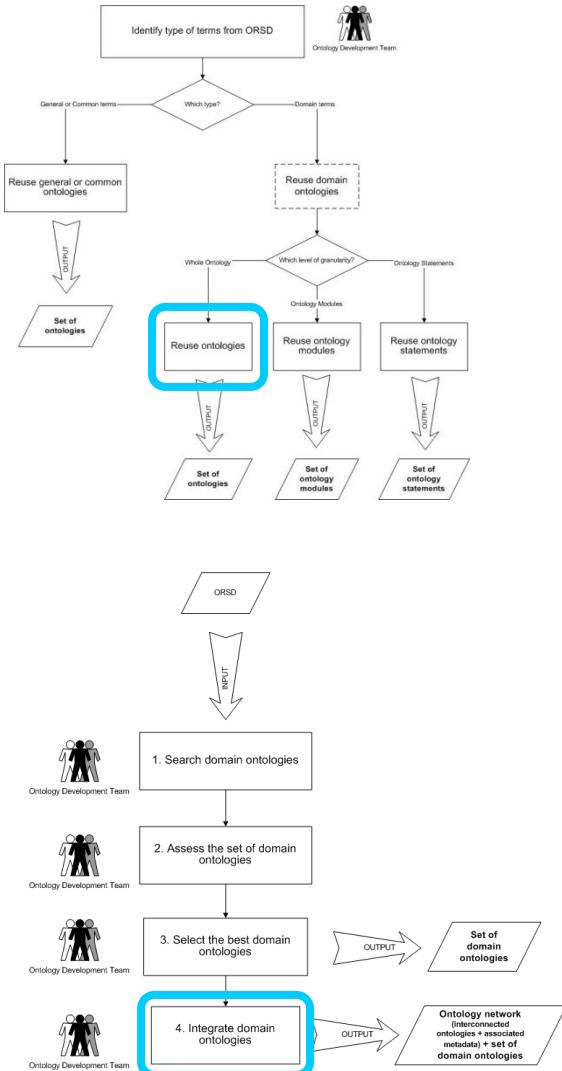


The question here is: **Which ones are the best?**

- Good documentation of the ontology.
- Ontology is good modularized.
- Integration effort is low.
- Ontology is reused by others.
- If the ontology used naming conventions.
- If the ontology have been evaluated.

	Publication Ontology 1	Publication Ontology 3
Documentation	Good	Good
Modularized	Yes	Yes
Integragion Effort	Low	Low
Naming Conventions	Yes	No
Evaluated	Yes	Yes

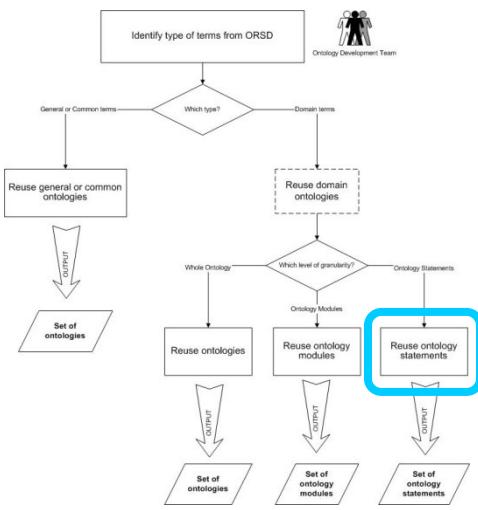
Reusing Ontologies as a Whole. Domain Ontology Integrate



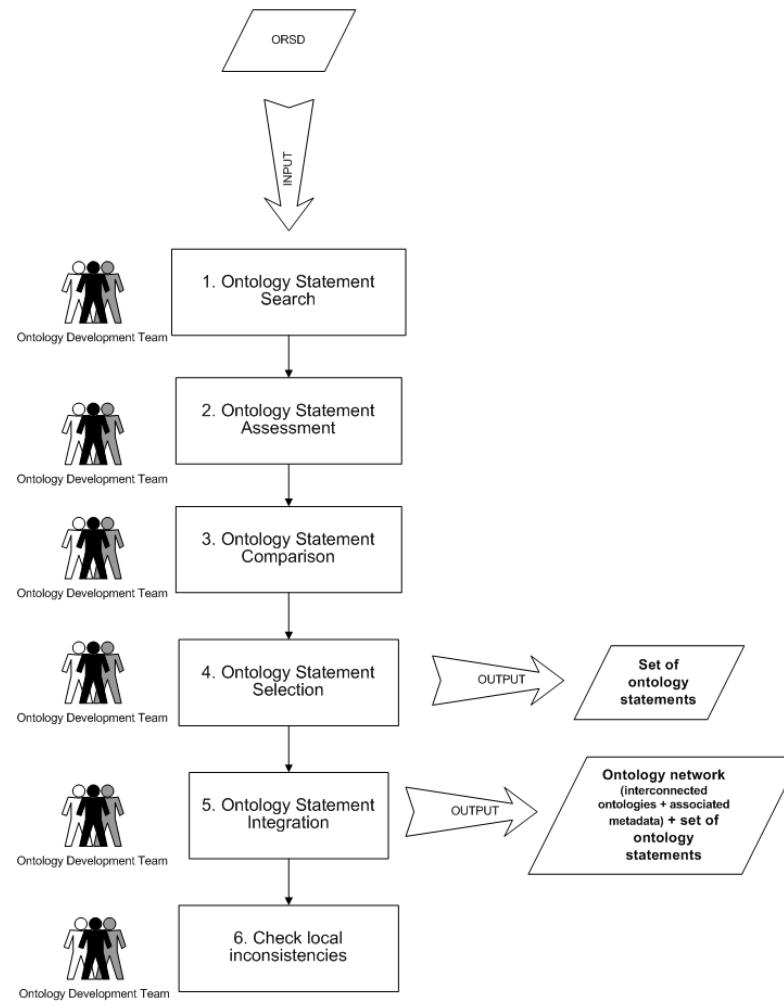
Integrate the selected ontologies. There are three different possibilities:

- The selected ontology will be reused as it is.
- The ontology reengineering activity should be carried out with the selected ontologies.
- Selected ontologies will be merged to obtain a new ontology network.

Reusing Ontology Statements

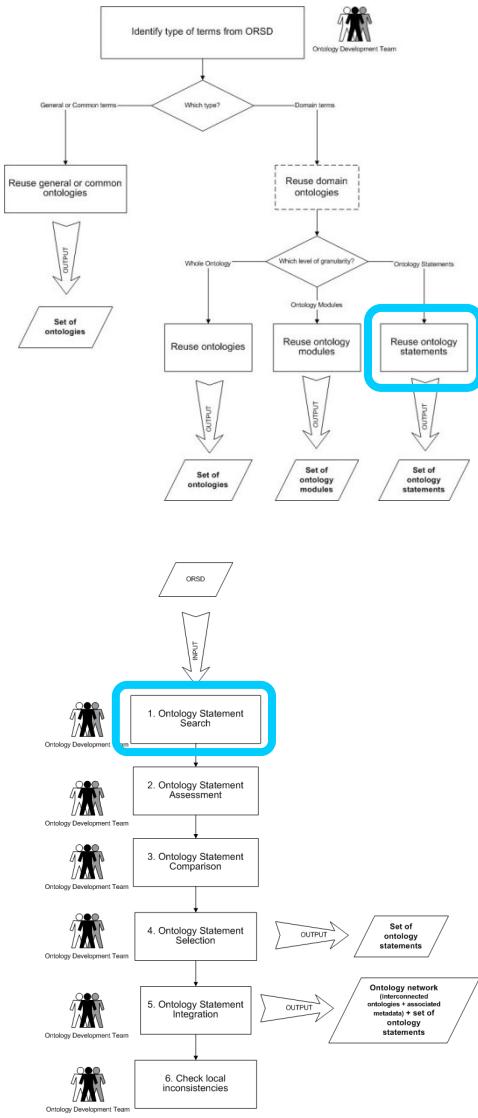


Ontology Statement Reuse is defined as the activity of using ontology statements in the solution of different problems.

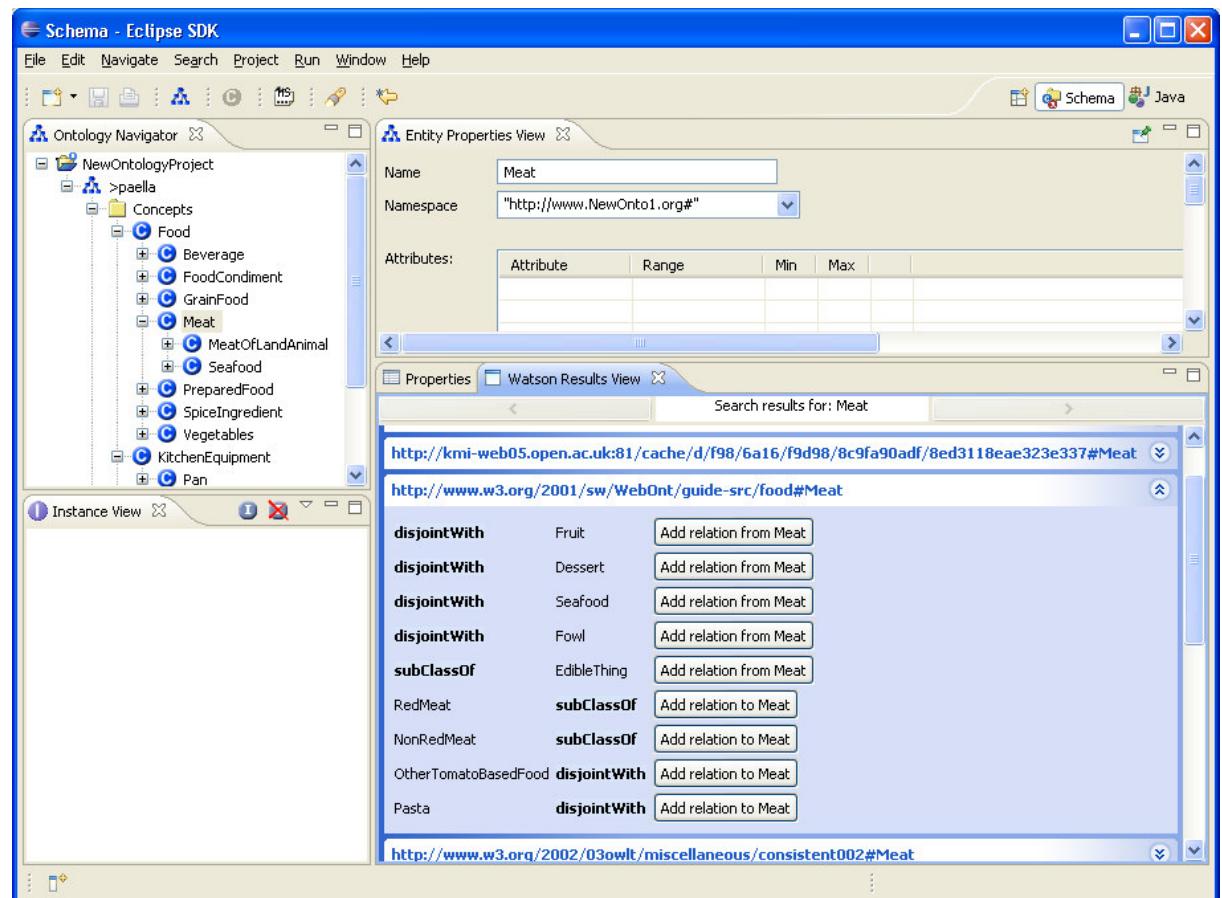


Reusing Ontology Statements.

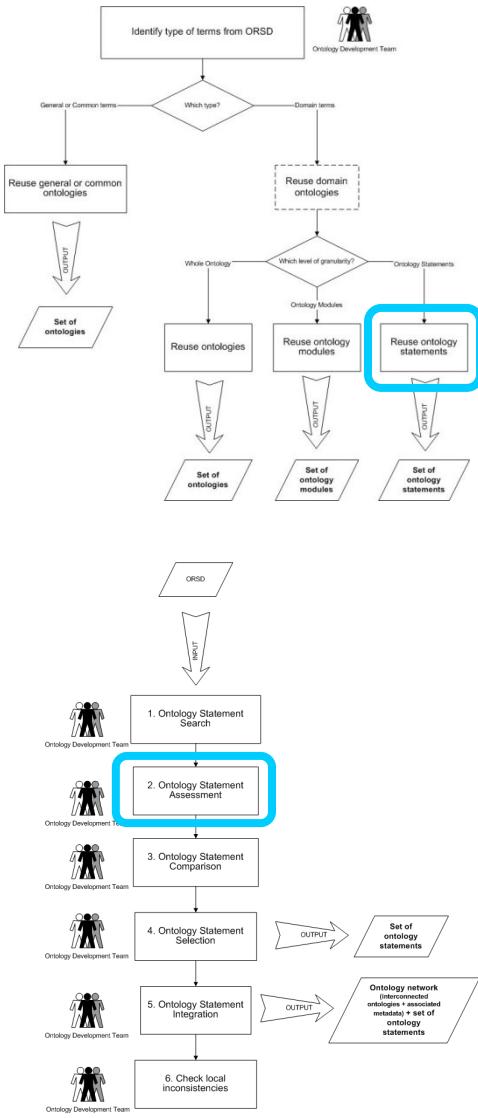
Ontology Statement Search



Use **WATSON** (<http://watson.kmi.open.ac.uk/WatsonWUI/>)



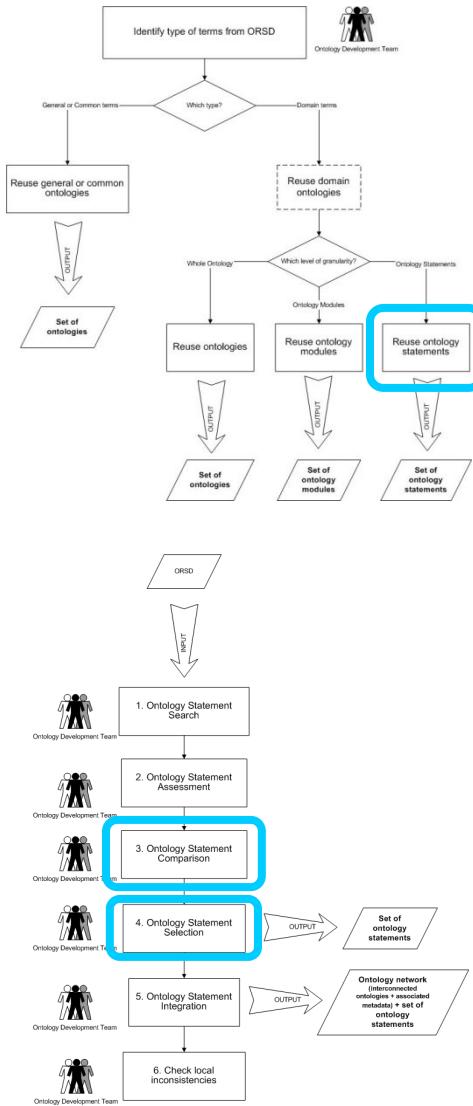
Reusing Ontology Statements. Ontology Statement Assessment



The question here is: **how to decide if a concrete ontology statement is useful or not for the ontology network being developed.**

- Check scope.
 - “Meat subclass of ‘_anon699’”
- Check purpose.
 - “Seafood is subclass of Root”
- Check clarity.
 - “Conference is subclass of Pear” (conference = conferencePear)
- Check information content.
 - “Fruit is subclass of FruitSalad” (subclass of = part of)
- Assess the correctness from a (formal) modeling perspective.
 - Check that the naming reflects the intended meaning.
 - “Conference is subclass of Pear” (conference = conferencePear)
 - Check if the ontology statement is not invalid from a formal perspective.
 - “Fruit is subclass of FruitSalad” (subclass of = part of)

Reusing Ontology Statements. Ontology Statement Comparison and Selection

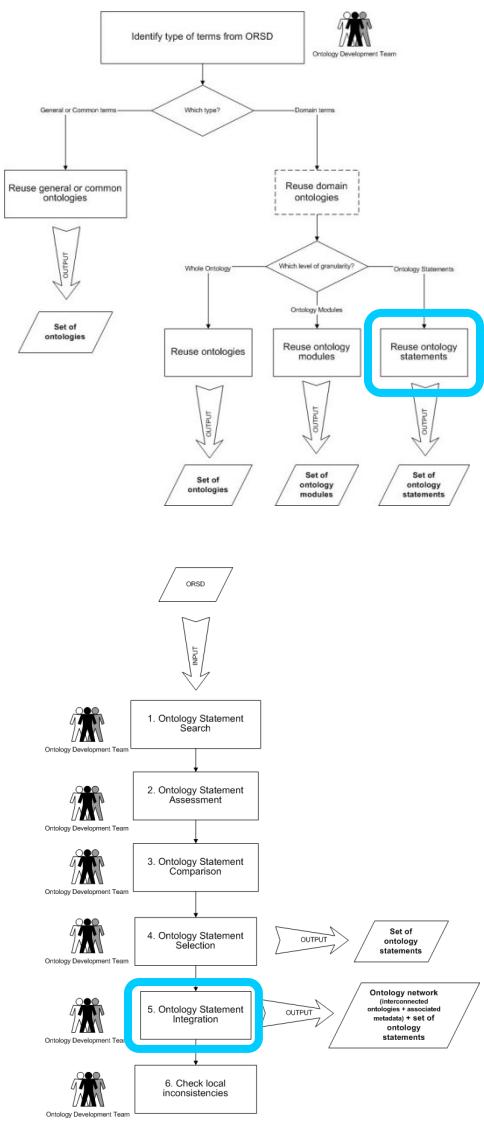


The question in this case is: **how to decide between the useful ontology statements which ones are the best / the most convenient for the ontology network being developed.**

- ❑ Reuse one using the same naming convention as you, for avoiding the work of adapting the statement to your ontology network.

Ontology Statement	Same Naming Convention
“ReadMeat is subclass of Meat”	Yes
“Read-Meat is subclass of Meat”	No
“Read_Meat is subclass of Meat”	No

Reusing Ontology Statements. Ontology Statement Integration



The question here is: **how to reuse the selected ontology statements.**

There are three modes:

- Import the selected ontology statements.
- Copy the selected ontology statements.
- Map the selected ontology statements.

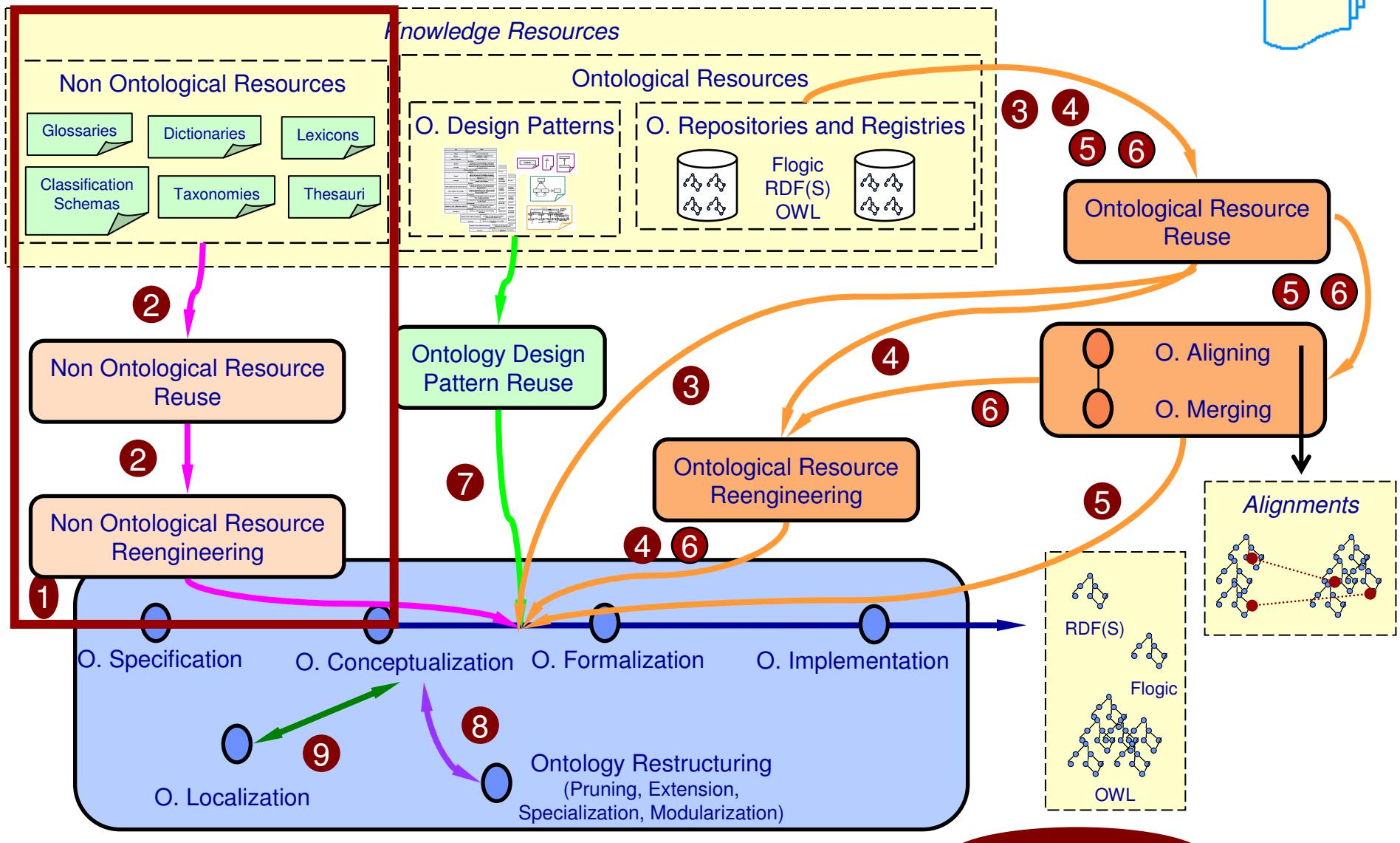
After reusing an ontology statement, the following work must be probably done:

- changing names (concepts, properties) to adapt them to the naming conventions used in the ontology network being developed.
- adding range in properties; and changing cardinalities.
- restrictions should be added too.
- check local inconsistencies in the ontology network.

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- Methodological Guideliness for Ontology Reuse
- Creating the final Ontology Model

NeOn Scenarios



Ontology Support Activities: Knowledge Acquisition (Elicitation); Documentation; Configuration Management; Evaluation (V&V); Assessment

1,2,3,4,5,6,7,8, 9

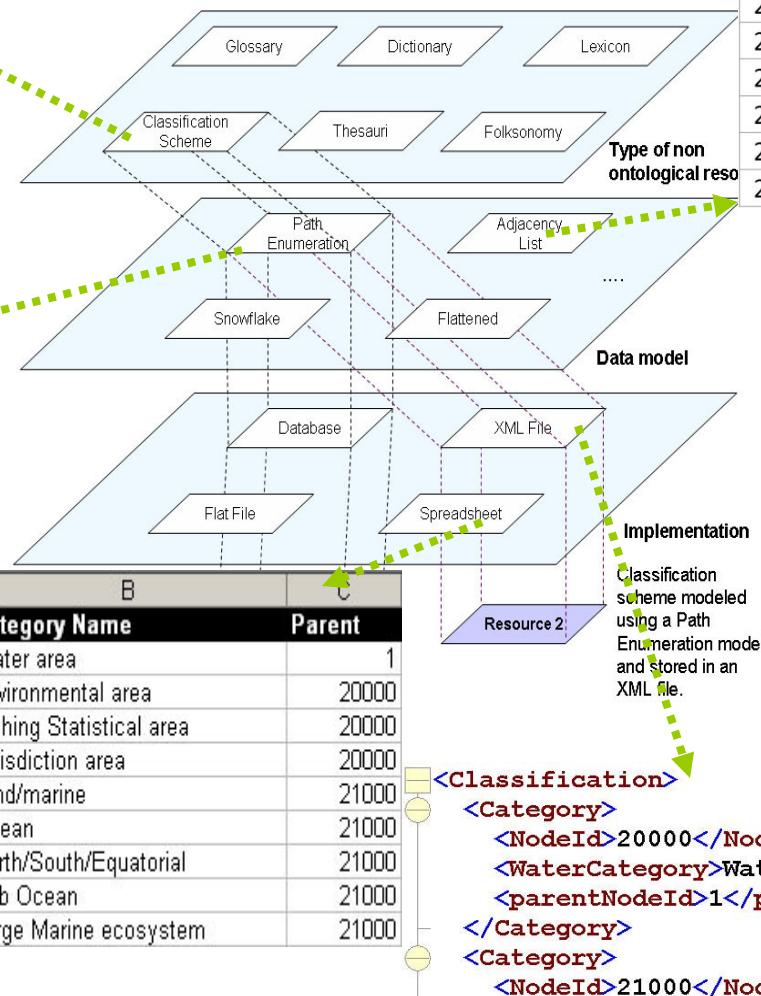
A. Gómez Pérez, M.C. Suárez-Figueroa, B. Villazón

Types of non ontological resources

●	Water area
□	Environmental area
□	Inland/marine
□	Ocean
□	North/South/Equatorial
□	Sub-Ocean
□	Large Marine Ecosystem
□	Fishing Statistical area
□	Jurisdiction area
□	Fishery Management area
□	Reporting area

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/Equatorial
21000.21004	Sub Ocean
21000.21005	Large Marine ecosystem

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

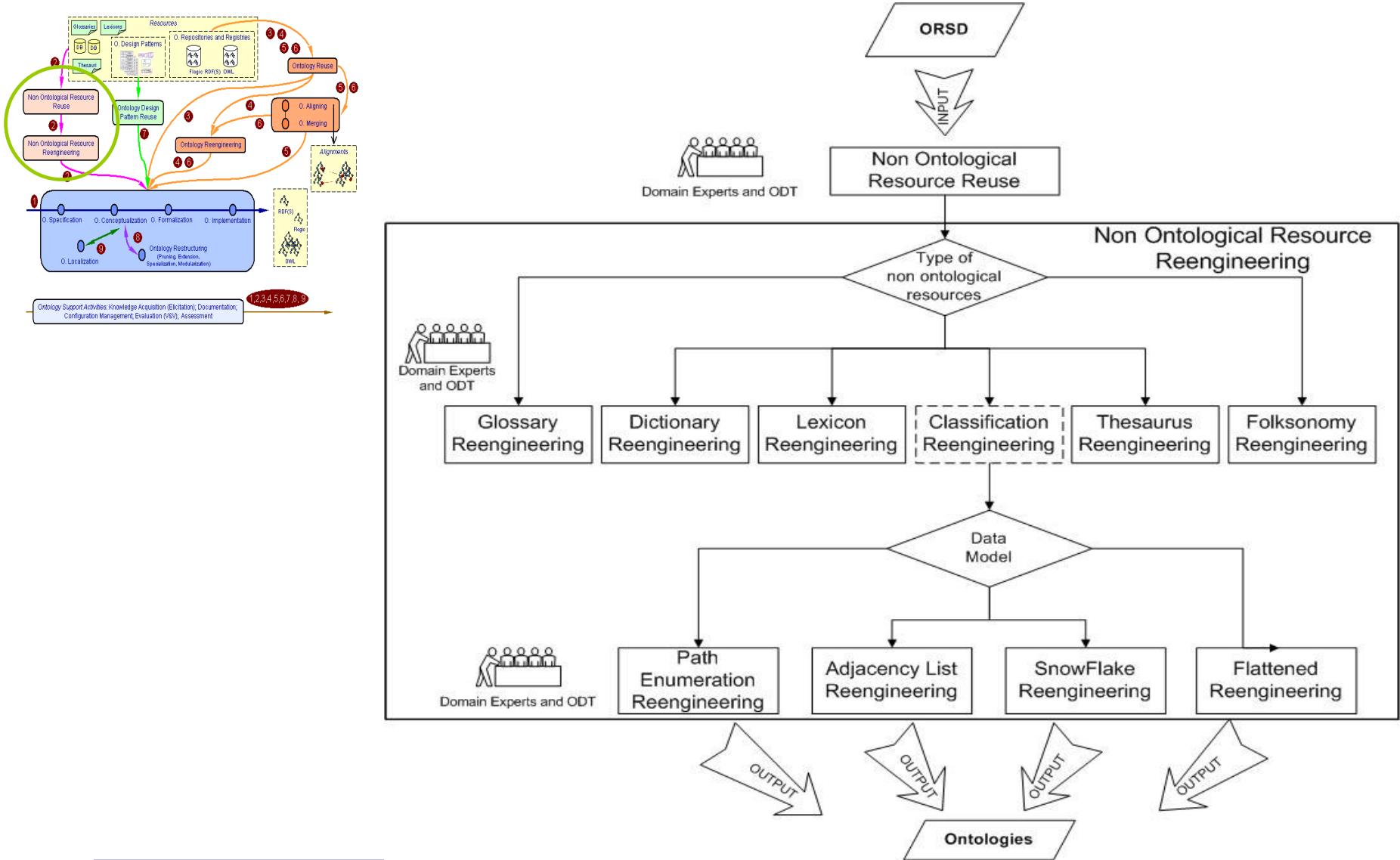


```

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

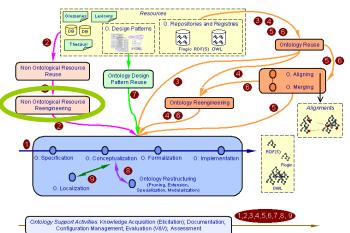
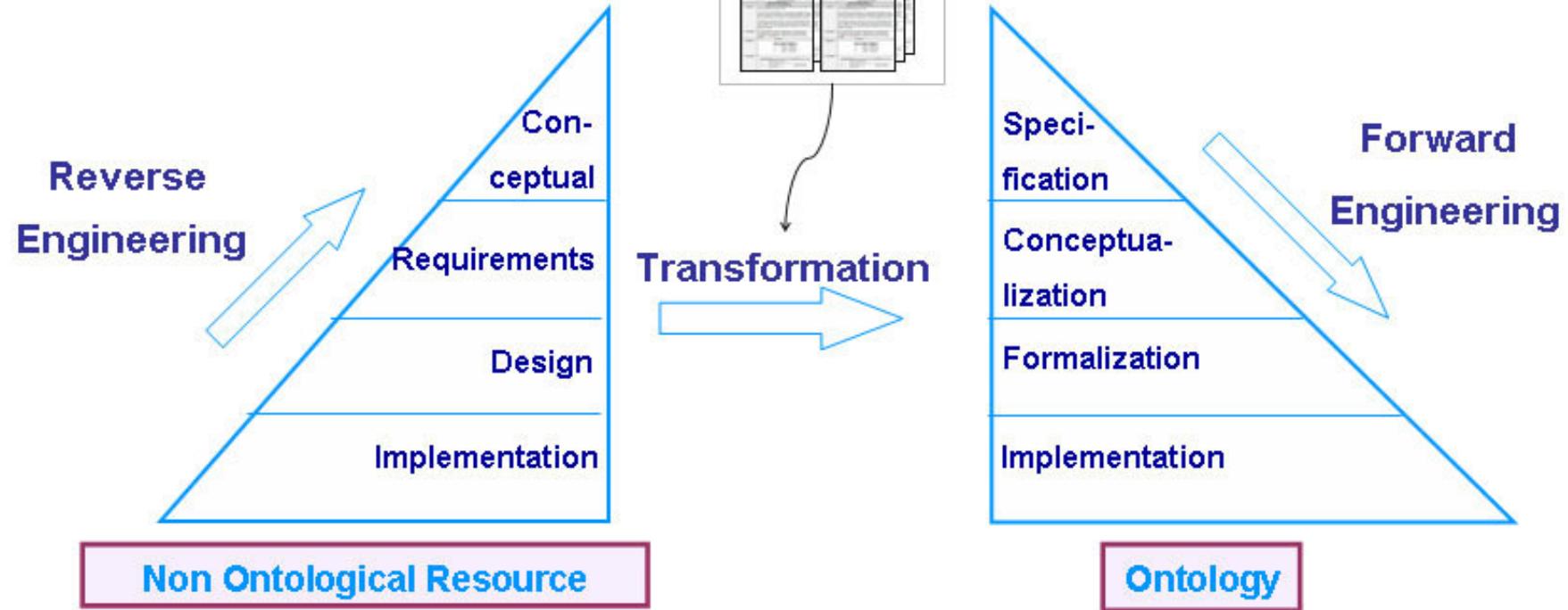
```

The resource type and its data model influence the reengineering process



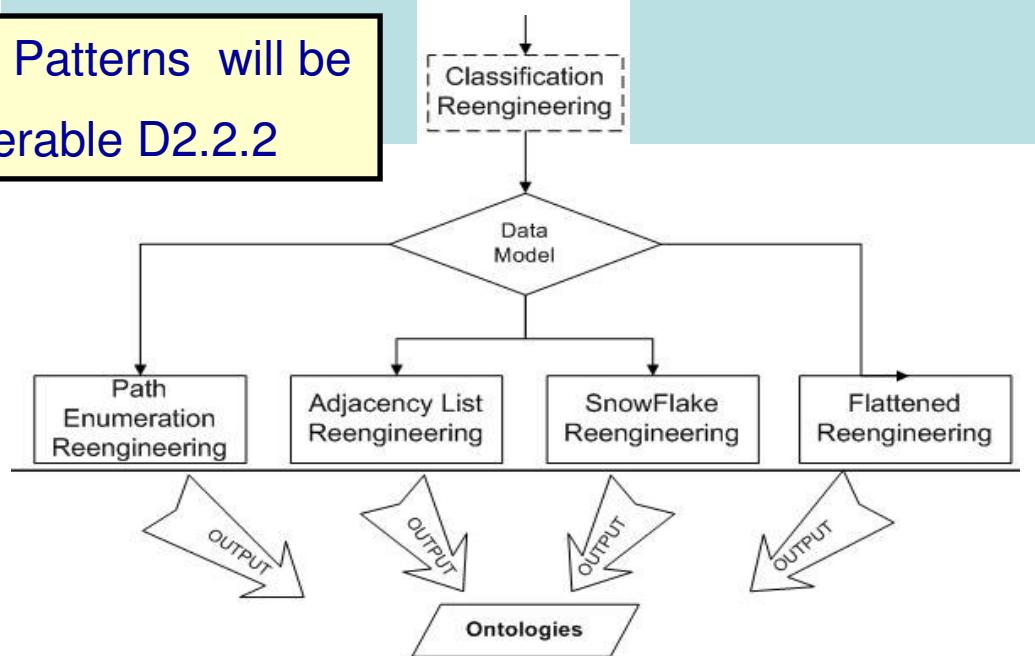
Approach for Reengineering Non Ontological Resources

Patterns for Reengineering
Non Ontological Resources
(PR-NOR)



A pattern for each resource data model

NOR Reengineering Patterns will be included in Deliverable D2.2.2



Classification to Taxonomy (Adjacency List)

Classification to Taxonomy (Path Enumeration Model)

Name	Description	Value
Name	Name of the contractor	Contractor's name
Type of contract	An annual extension of agreement period is under consideration	Annual extension of agreement period
Period	Dependent on the time of the negotiation period addressed by the negotiation system	Dependent on the time of the negotiation period
Example	Description of relevant example of the negotiation system	Parties to the Negotiation: Two Strategic Resources
General	Description of a value language of the negotiation dialogue	General
Example	Description of relevant example of the value language dialogue	Example
General	Description of the initial state of the negotiation dialogue	General
Example	Description of relevant example of the initial state dialogue	Example
General	Description of the target state of the negotiation dialogue	General
Example	Description of relevant example of the target state dialogue	Example
General	Description of the strategy of the negotiation dialogue	General
Example	Description of relevant example of the strategy dialogue	Example
General	Description of the policy of the negotiation dialogue	General
Example	Description of relevant example of the policy dialogue	Example
General	Description of the mechanism of the negotiation dialogue	General
Example	Description of relevant example of the mechanism dialogue	Example
General	Description of the rules of the negotiation dialogue	General
Example	Description of relevant example of the rules dialogue	Example
General	Description of the constraints of the negotiation dialogue	General
Example	Description of relevant example of the constraints dialogue	Example
General	Description of the termination condition of the negotiation dialogue	General
Example	Description of relevant example of the termination condition dialogue	Example
General	Description of the termination condition of the negotiation dialogue	General
Example	Description of relevant example of the termination condition dialogue	Example

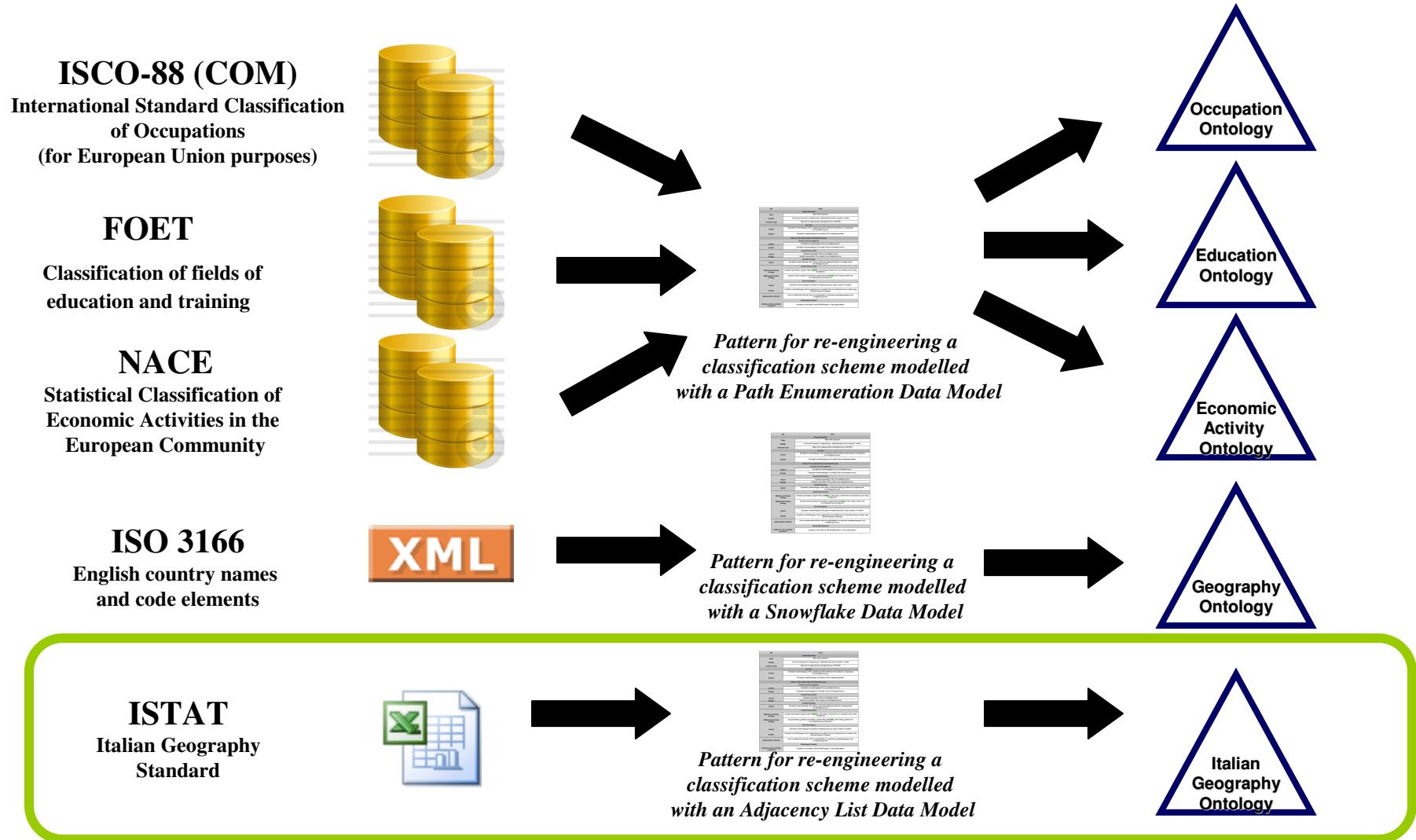
Classification to Taxonomy (Flattened Model)

Item	General Information
Name	Name of the Company
Identifier	An unique identifier of each bank account
Type of account	Current account or savings account
Detail	Description of the bank account to be mapped against the bank account in the beneficiary's file.
Example	Description of the bank account of the beneficiary chosen for mapping.
Pattern for Recognizing File Designate Requests	
General	Description of a single language that describes the original source.
Example	Description of the original language from which the original source was derived.
General	Descriptive representation of the non-integer values.
Example	Descriptive representation of the non-integer values.
Detail	Description of the bank account to be mapped against the bank account in the beneficiary's file.
(DR) General/Detail	Descriptive representation of the integer values from the original source being mapped.
(DR) Example	Description of a particular integer value being mapped from the original source.
Example	Description of a particular integer value being mapped from the original source.
Detail	Description or explanation of the integer values being mapped from the original source.
Example	Description of integer values being mapped from the original source.
Relationships	
Attribute Relation Identifier	Description of the relationship between the two objects.
Detail	Description of the relationship between the two objects.

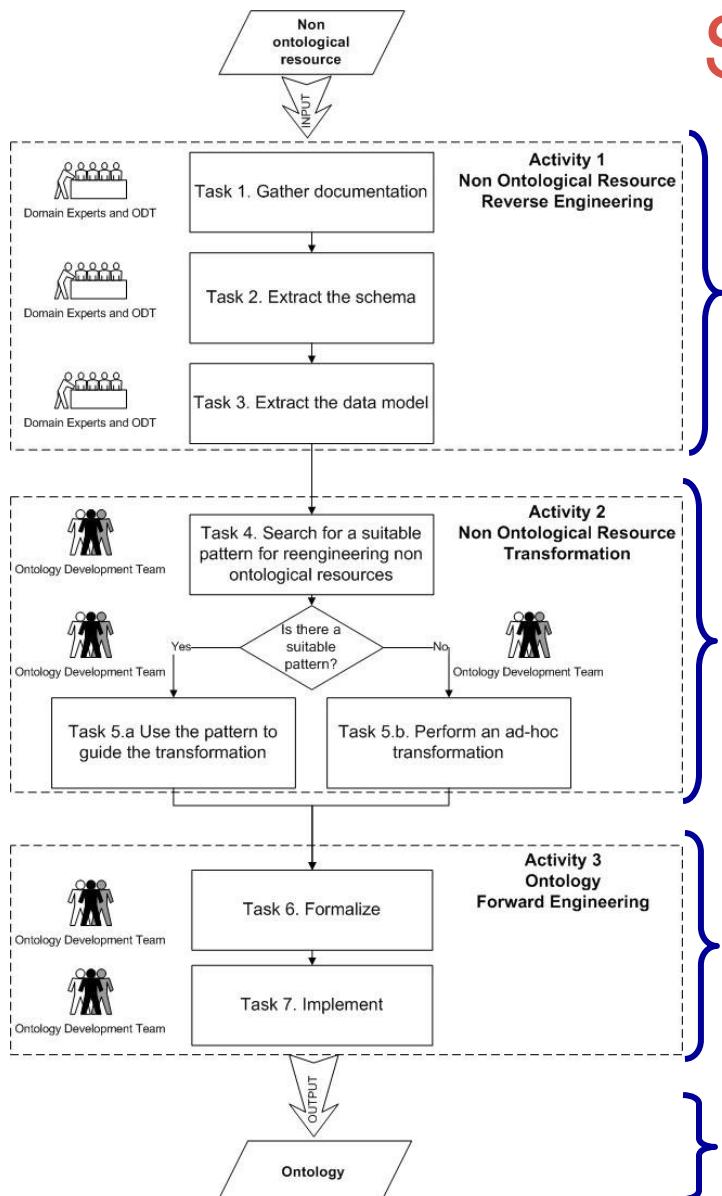
Classification to Taxonomy (Snowflake Model)

Stat	General Description	Value
Name	Name of the character	
Item	An item or weapon owned by the character	
Level	Character's current level	
Level	Describes the difficulty of the encounter	Very Easy
Experience	Describes the amount of experience the player gains from defeating the enemy	Very Low
Potions	Recovering health or magical resources	
General	Description of a general language of the party	English
Example	Description of the language of the party's non-magical resources	English
General	General description of the non-magical resources	
General	Describes the party's combat style	Defensive
General	Describes the party's combat style after using the party's best strategy	Defensive
(DRG) General	Describes how much of the damage is avoided by the party's magic resistance	Very High
(DRG) Defense	Describes how much of the damage is avoided by the party's defense	Very High
General	Describes the party's attack style	Melee
Example	Description of the attack style of the party's non-magical resources	Melee
General	Describes the attack style of the party	Melee
Resistance	Describes the party's resistance to the enemy's attacks	Very High
Resistance	Describes the party's resistance to the enemy's magic	Very High
Resistance	Describes the party's resistance to the enemy's poisons	Very High

SEEMP Use Case

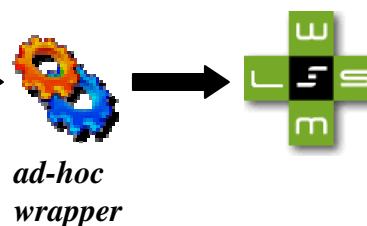


SEEMP Use Case - ISTAT

Adjacency list

- Search criteria:
- NOR Type: **classification scheme**
 - Data model: **adjacency list**
 - Target ontology: **lightweight**
 - The semantics of the relations between classification scheme items: *subClassOf*



- Search
- Assessment
- Select
- Reengineer

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>  
...  
....
```

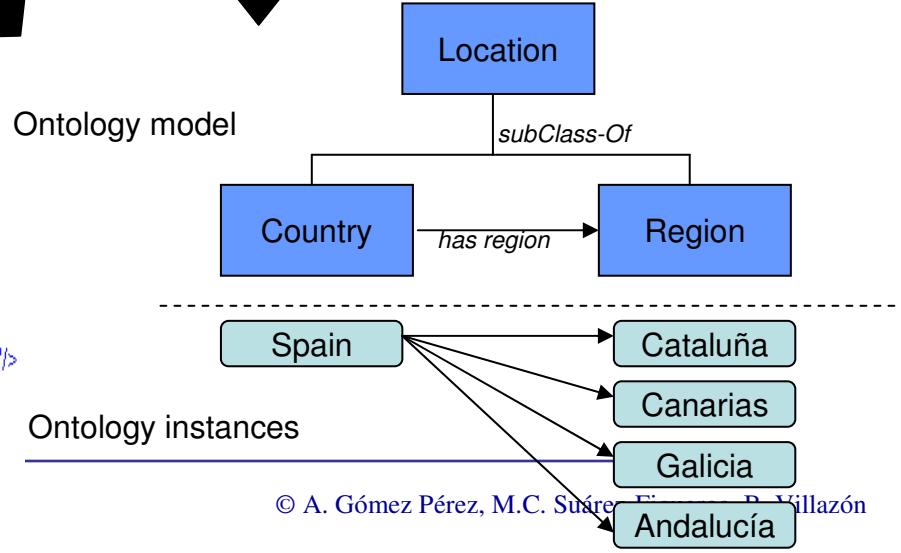
Excerpt of the Geography Ontology

```
<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>
```

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

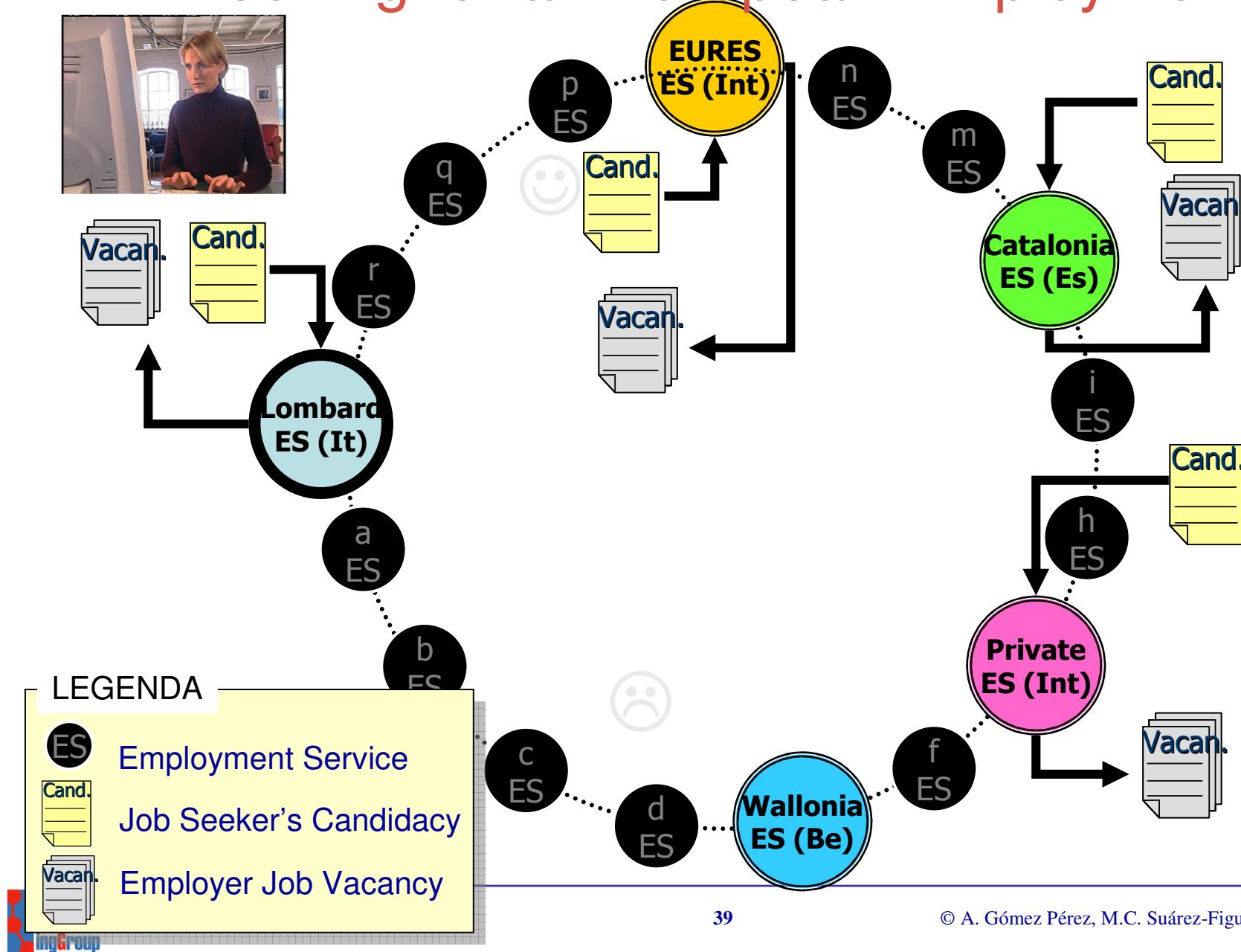
Ontology model



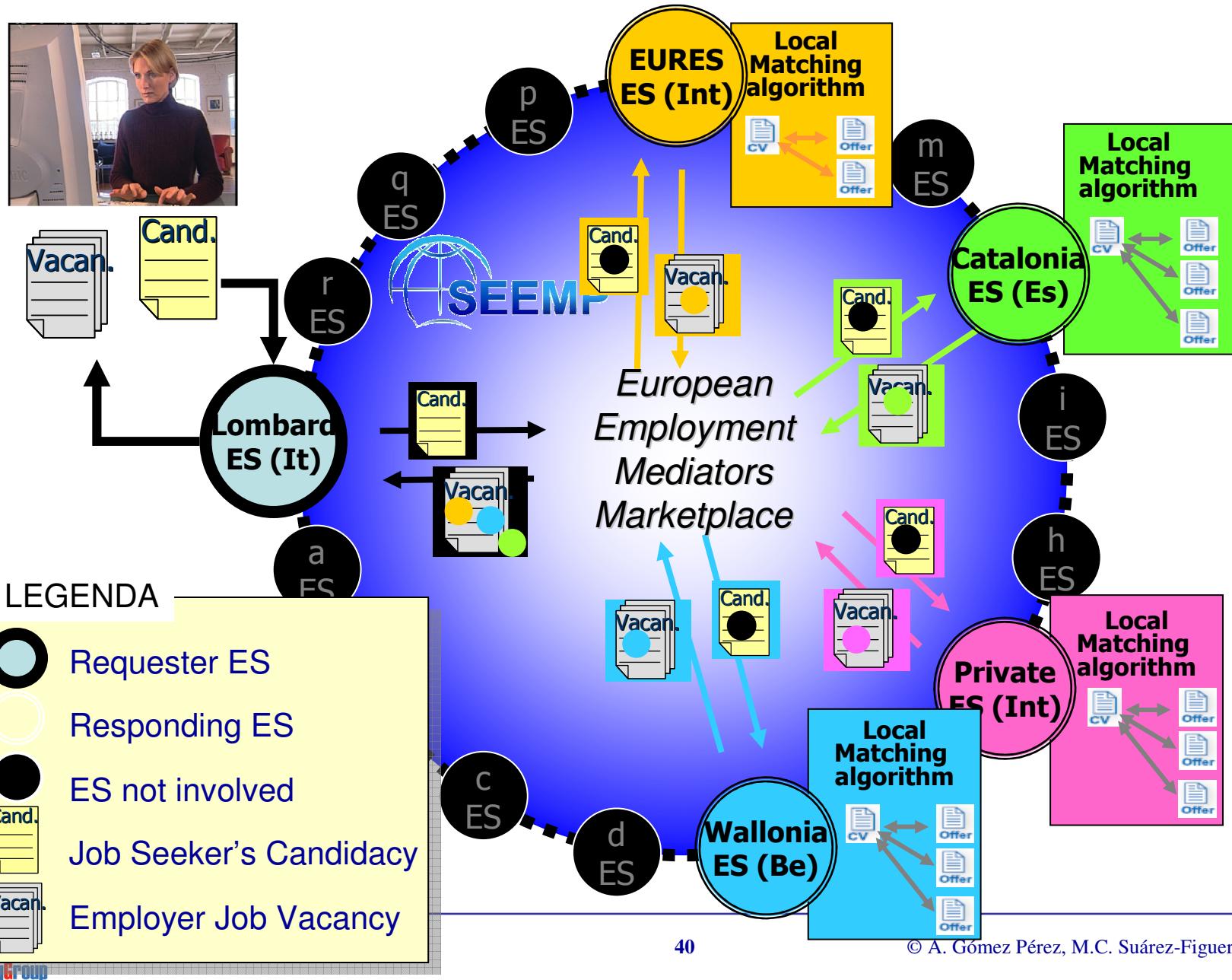
Index

- **Introduction**
- Scenarios in Ontology Building
- 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**

Looking for an European Employment



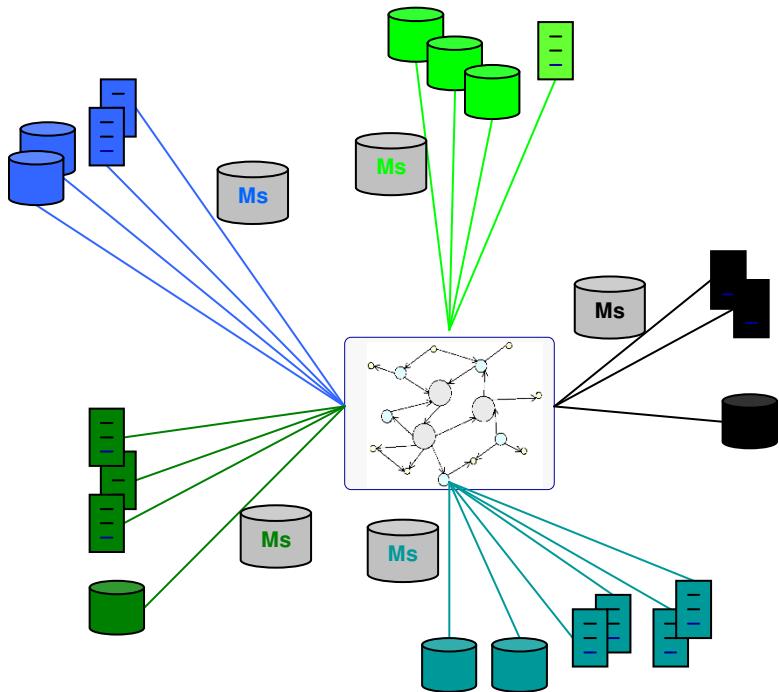
Helping Job Seekers on their way



Key aspects of Ontological Engineering

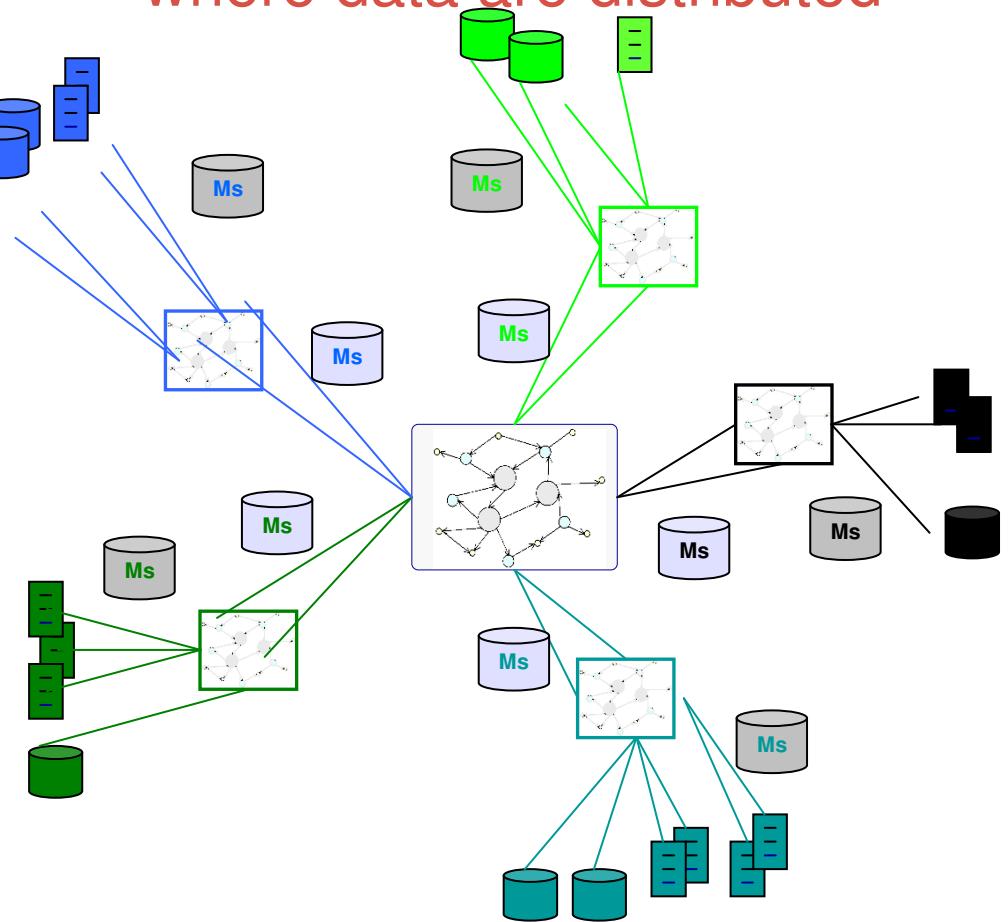
- **Ontologies**
 - Single versus network of ontologies?
 - Are ontologies built from scratch or reusing knowledge-aware resources?
 - Are mappings used for solving conceptual mismatches?
- **Instances**
 - Where are the data/instances?
 - Instances are in the ontology
 - Instances are in RDF files independently of the ontology
 - Data are kept in the original sources
 - Are instances distributed or centralized?
 - Have instances a very high rate of changes?
 - Heterogeneous provenance of instances
 - Degrees of data quality
 - Permissions

Centralized network of ontologies where data are distributed



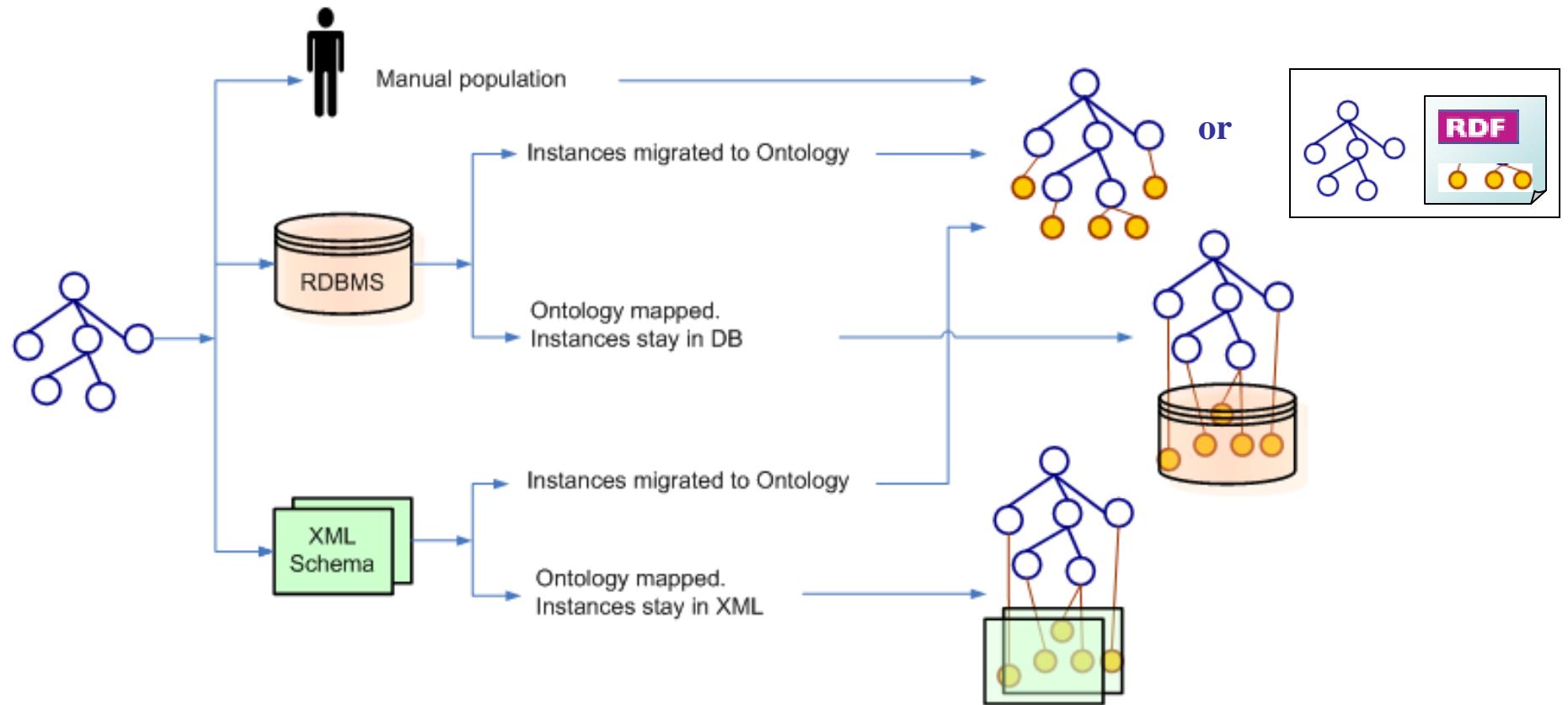
1. Build a reference ontology
2. Build mappings between the reference ontology and the data sources

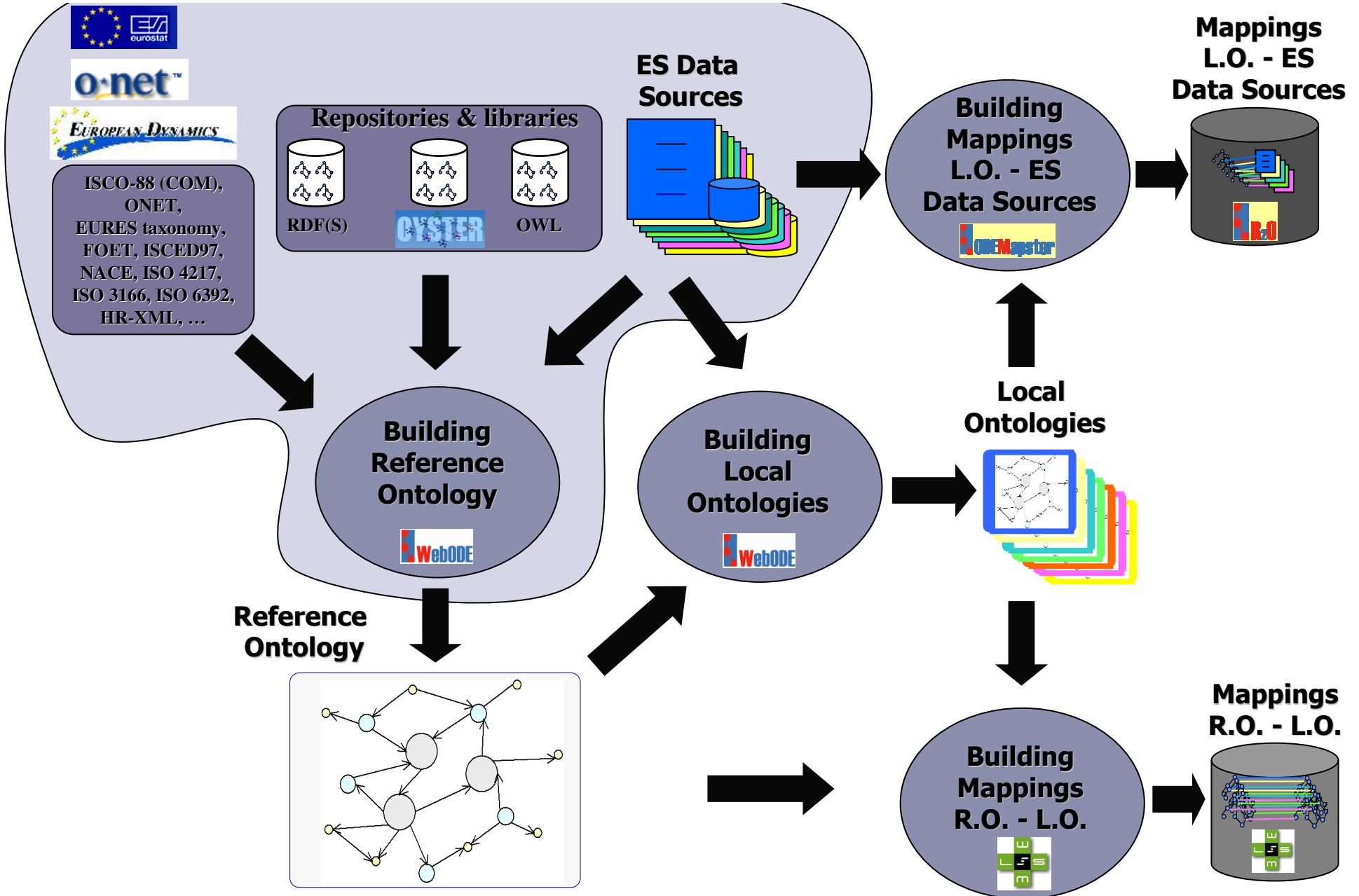
Federated network of ontologies where data are distributed

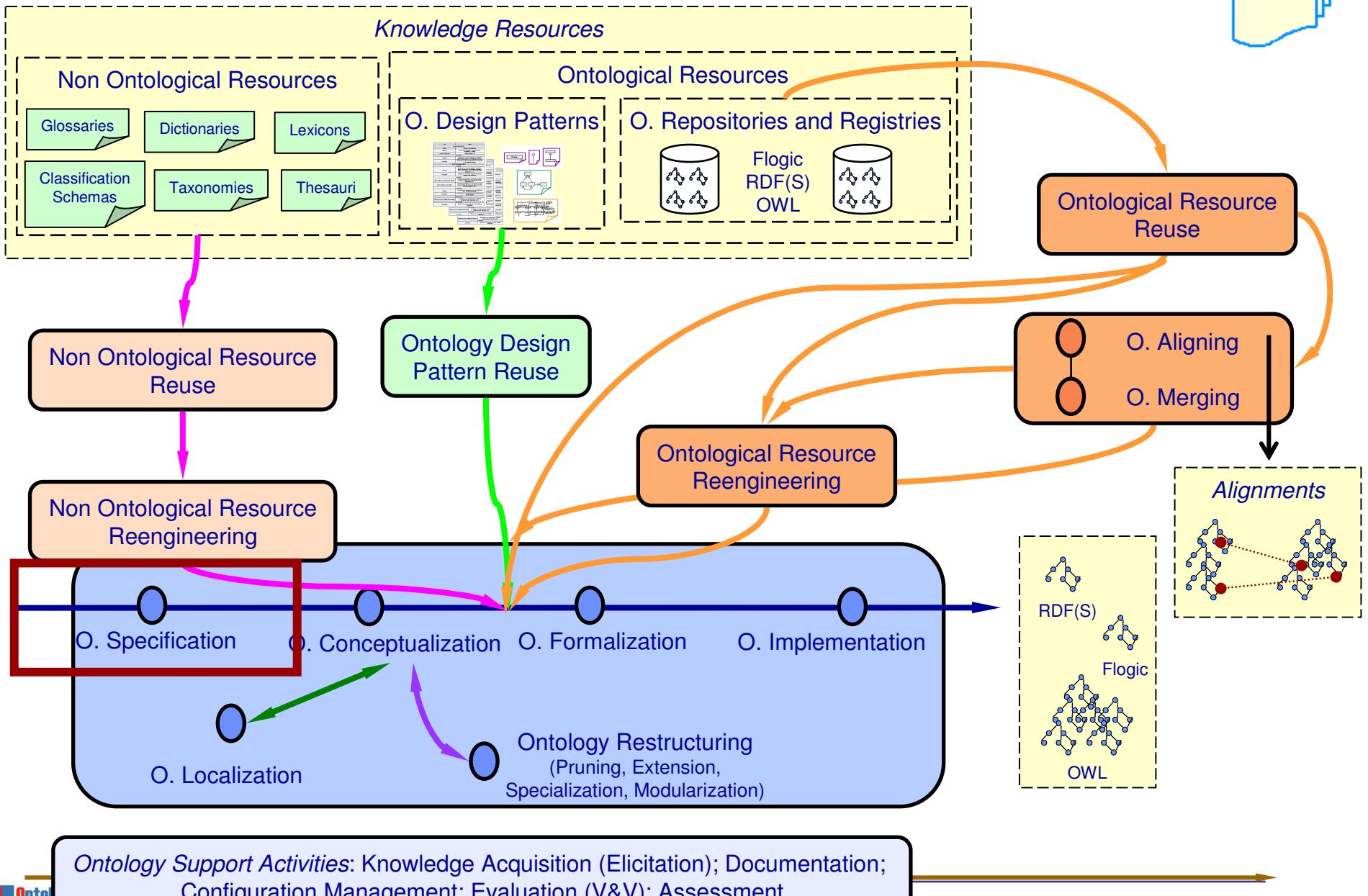


1. Build a reference ontology for the domain
2. Build local ontologies
3. Build mappings between the core and local ontologies
4. Build mappings between the local ontologies and the data sources

Where are the instances?

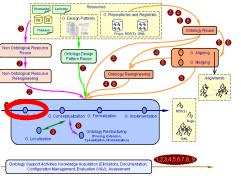






Ontology Specification.

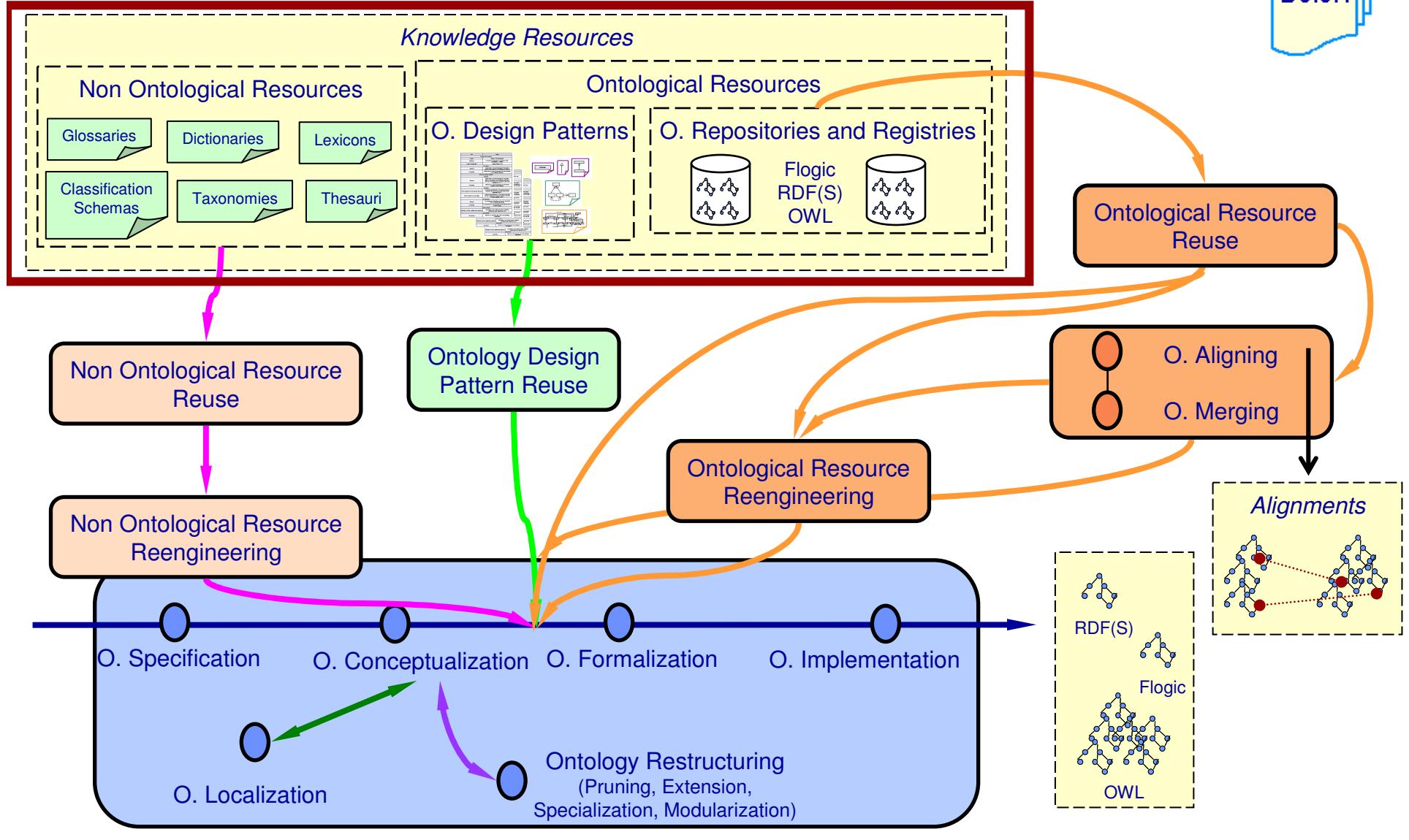
SEEMP Ontology Requirement Specification Document



SEEMP Reference Ontology Requirements Specification	
1 Purpose	The purpose of building the Reference Ontology is to provide a consensual knowledge model of the employment domain that could be used by public e-Employment services (PES).
2 Scope	The ontology has to focus just on the ICT (Information and Communication Technology) domain. The level of granularity is directly related to the competency questions and terms identified.
3 Level of Formality	The ontology has to be implemented in WSML language
4 Intended Users	<p>User 1. Candidate who is unemployed and searching for a job or searching another occupation for immediate or future purposes</p> <p>User 2 . . .</p> <p>User 3 . . .</p> <p>User 4 . . .</p> <p>User 5 . . .</p>

7 Pre-Glossary of Terms		
	Terms	Frequency
User 1.	a. Job Seeker	27
User 2.	b. CV	2
User 3.	c. Personal Information	3
User 4.	d. Name	5
User 5.	e. Gender	1
Use 1.	f. Birth date	1
Use 2.	g. Address	2
Use 3.	h. Nationality	1
Use 4.	i. Contact (phone, fax, mail)	4
Use 5.	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

6 Groups of Competency Questions		
CQG1. Job Seeker (16 CQ)	<p>CQ1. What is the Job Seeker Name? CQ2. What is the Job Seeker nationality? CQ3. When is the Job Seeker birthday? CQ4. What is the Job Seeker contact information? CQ5. What is the Job Seeker current job? CQ6. What is the Job Seeker desired job? CQ7. What are the Job Seeker desired working conditions? CQ8. What kind of contract does the Job Seeker want?</p> <p>Job Seeker</p>	<p>CQ9. How much salary does the Job Seeker want to earn? CQ10. What is the Job Seeker education level? CQ11. What is the Job Seeker work experience? CQ12. What is the Job Seeker knowledge? CQ13. What is the Job Seeker expertise? CQ14. What are the Job Seeker skills? CQ15. What publications does the Job Seeker have? CQ16. What hobbies does the Job Seeker have?</p>
CQG2. Job Offer (10 CQ)	<p>CQ17. What is the employer information? CQ18. What kind of job does the employer offer? CQ19. What kind of contract does the employer offer? CQ20. How much salary does the employer offer? CQ21. What is the economic activit of the employer?</p> <p>Job Offer</p>	<p>CQ23. What is the work condition of the job offer? CQ24. What is the required education level for the job offer? CQ25. What is the required work experience for the job offer? CQ26. What is the required knowledge for the job offer?</p>
CQG3. Objects (1)	<p>Objects in the universe of discourse, which are instances of:</p> <ul style="list-style-type: none"> Job Category <ul style="list-style-type: none"> 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 <ul style="list-style-type: none"> O12. Austrian O13. Belgian O14. Danish O15. Estonian O16. Finnish O17. French O18. German O19. Greek O20. Italian Activity Sector <ul style="list-style-type: none"> 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 	<ul style="list-style-type: none"> Education <ul style="list-style-type: none"> O29. Life Science O30. Mathematics O31. Computer Science O32. Computer Use O33. Statistics O34. Physics O35. Network Administration Languages <ul style="list-style-type: none"> O36. Swedish O37. Spanish O38. Slovenian O39. Portuguese O40. English O41. French O42. German Currency <ul style="list-style-type: none"> O43. Euro O44. Krone O45. Great British Pound O46. Złote O47. US Dollar O48. Franc Location <ul style="list-style-type: none"> O49. Austria O50. Belgium O51. Danmark O52. Estonia O53. Finland O54. France O55. Germany O55. Greece

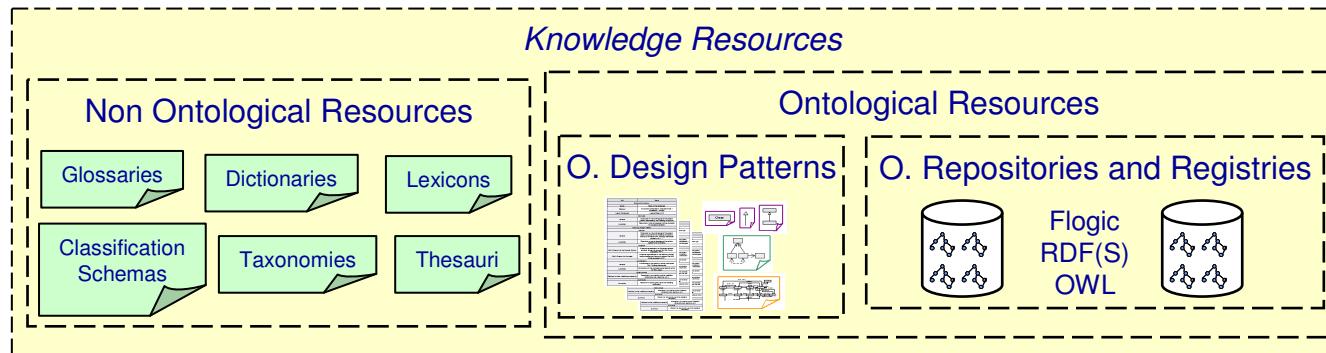


Ontology Support Activities: Knowledge Acquisition (Elicitation); Documentation; Configuration Management; Evaluation (V&V); Assessment

A. Gómez Pérez, M.C. Suárez-Figueroa, B. Villazón

Searching Resources

- Use the terminology from the ORSD
- Find resources covering the terminology

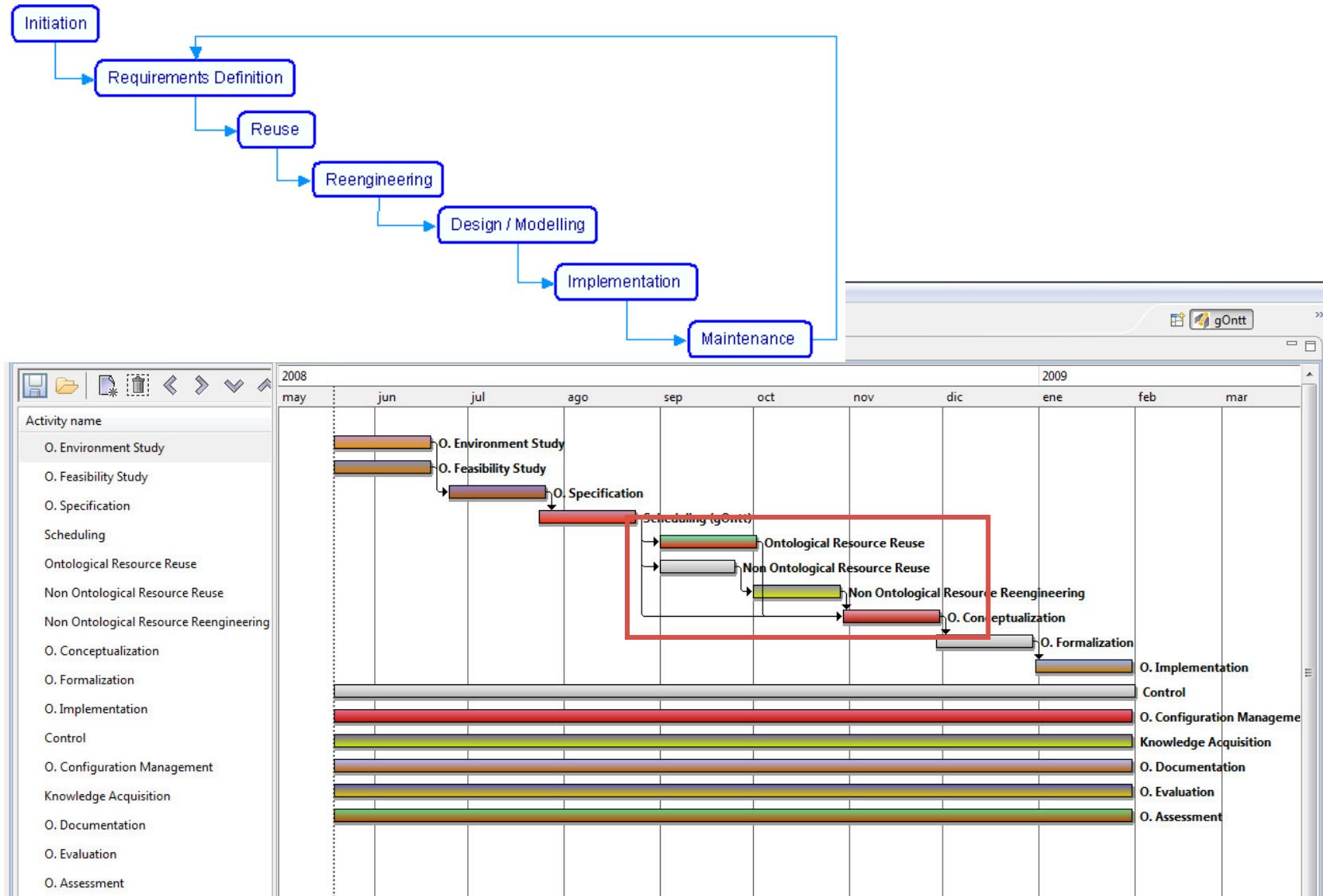


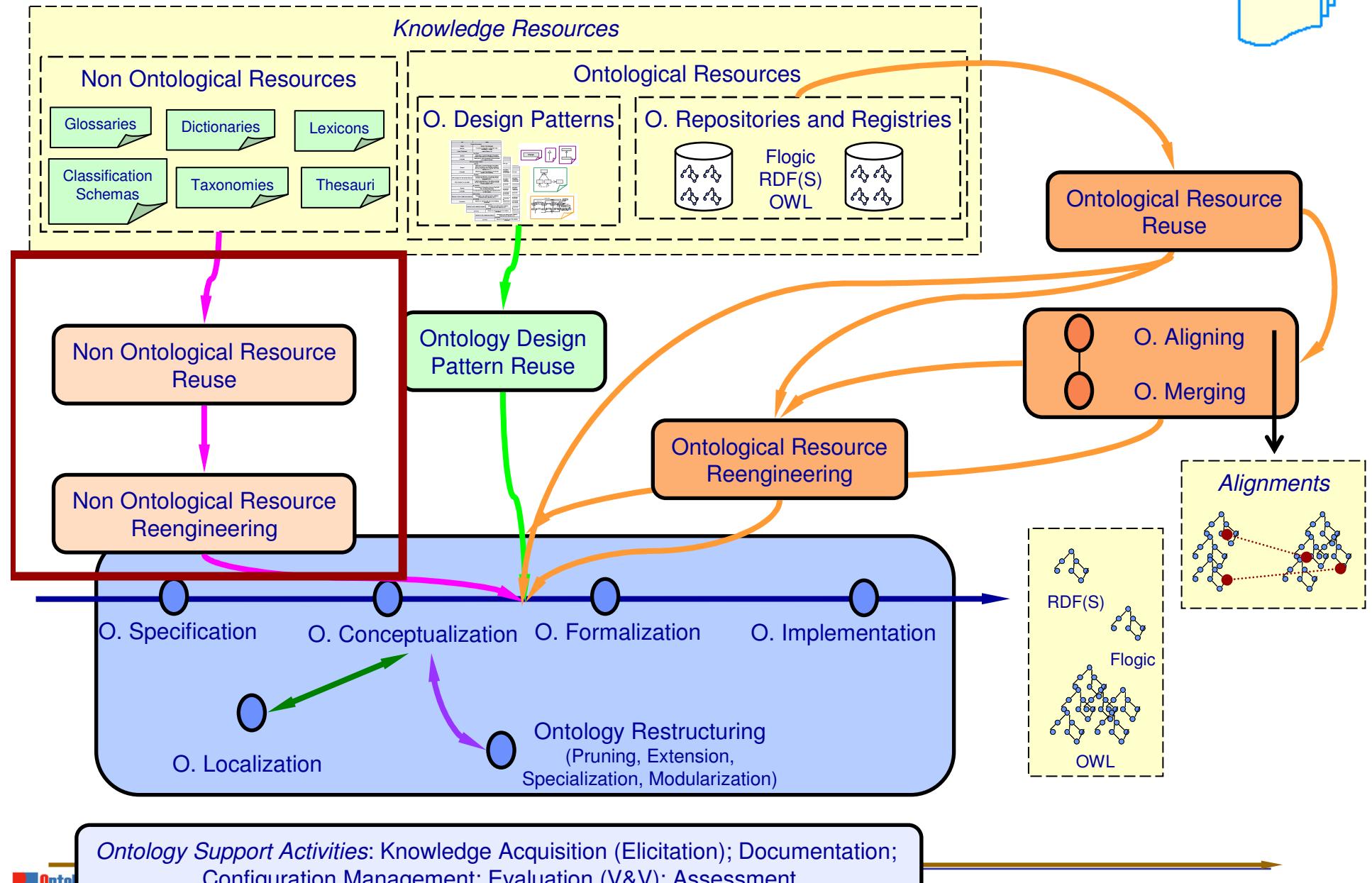
Objects
Objects in the universe of discourse, which are instances of:
<ul style="list-style-type: none"> Job Category <ul style="list-style-type: none"> O1. Computer System Designer O2. Computer System Analyst O3. Programmer O4. Computer Engineer O5. Computer Assistant O6. Computer Equipment Operator O7. Industrial Robot Controller O8. Telecommunication Equipment Operator O9. Medical Equipment Operator O10. Electronic Equipment Operator O11. Image Equipment Operator Nationality <ul style="list-style-type: none"> O12. Austrian O13. Belgian O14. Danish O15. Estonian O16. Finnish O17. French O18. German O19. Greek O20. Italian

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

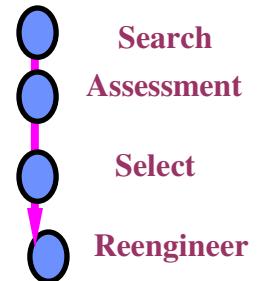


Reuse and Reengineering + Waterfall





Search and Assess Standards and Taxonomies



- 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

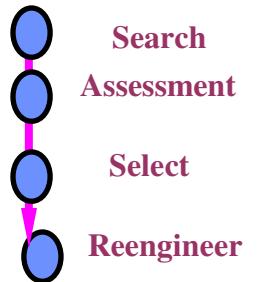
LE FOREM, Eures and BLL Classification

Work Condition Classification

LE FOREM, Eures and BLL Classification

**Assessment activity: Matching terminology
from Competency Questions against the Standards**

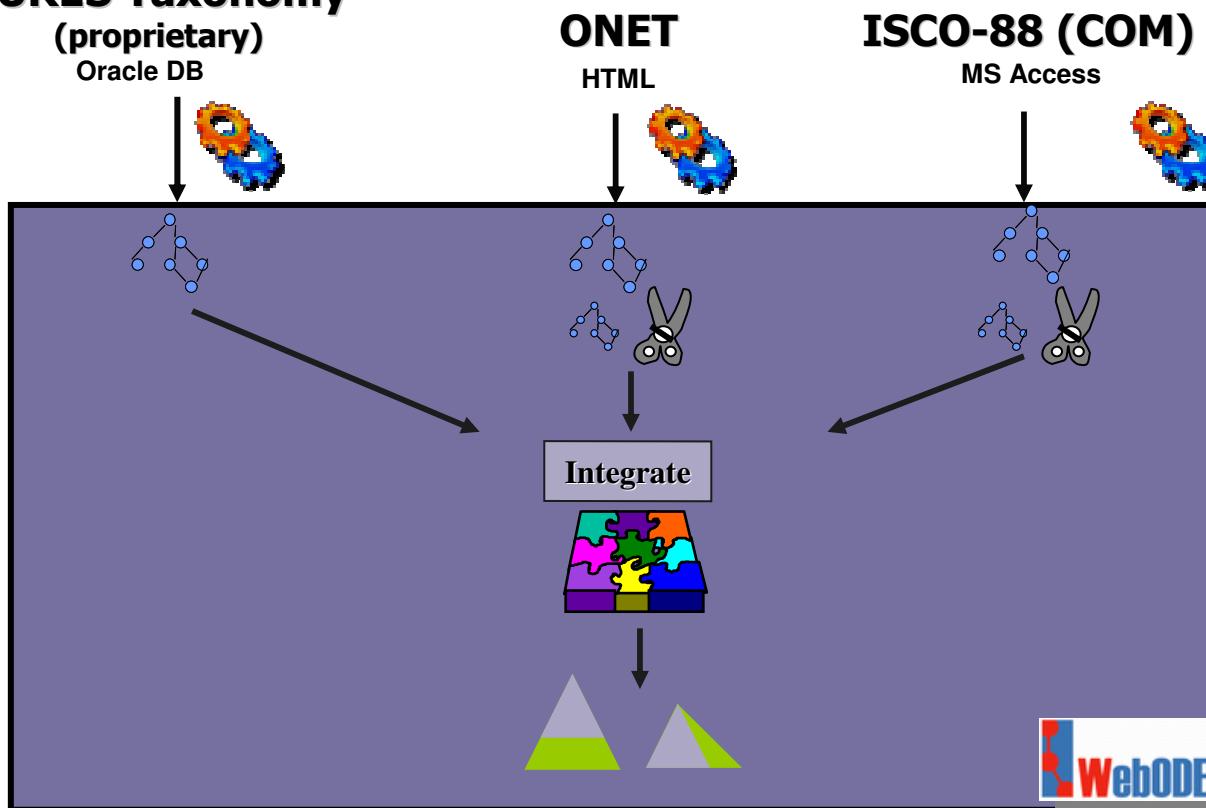
Reengineering resources



EURES Taxonomy

(proprietary)

Oracle DB



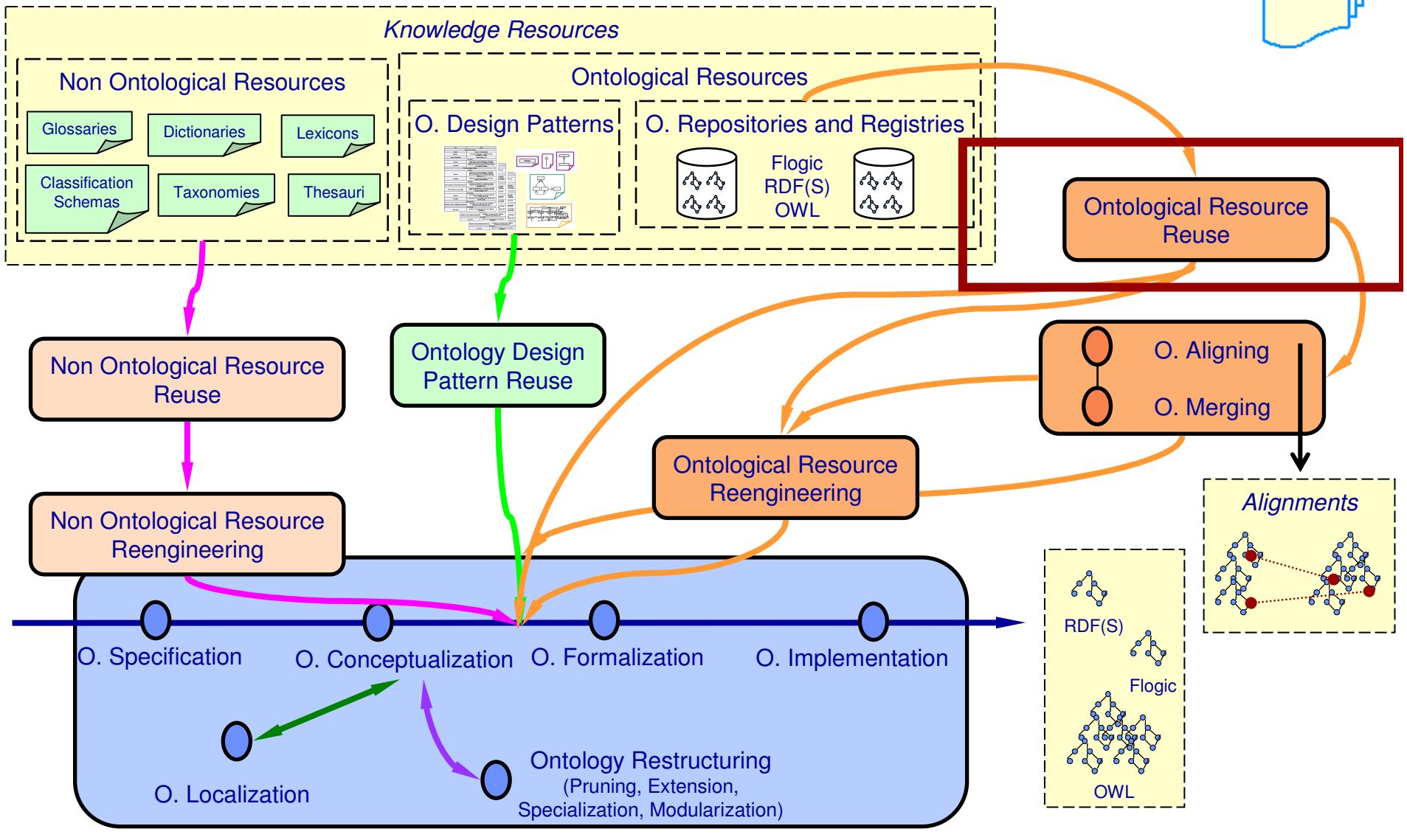
ONET

HTML

ISCO-88 (COM)

MS Access

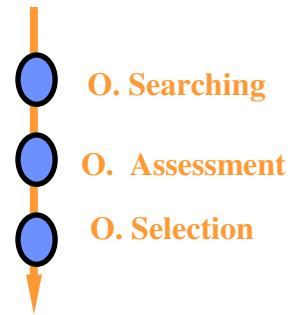
- Extend
- Specialize
- Prune
- Ad hoc wrapper
- WSML exporter



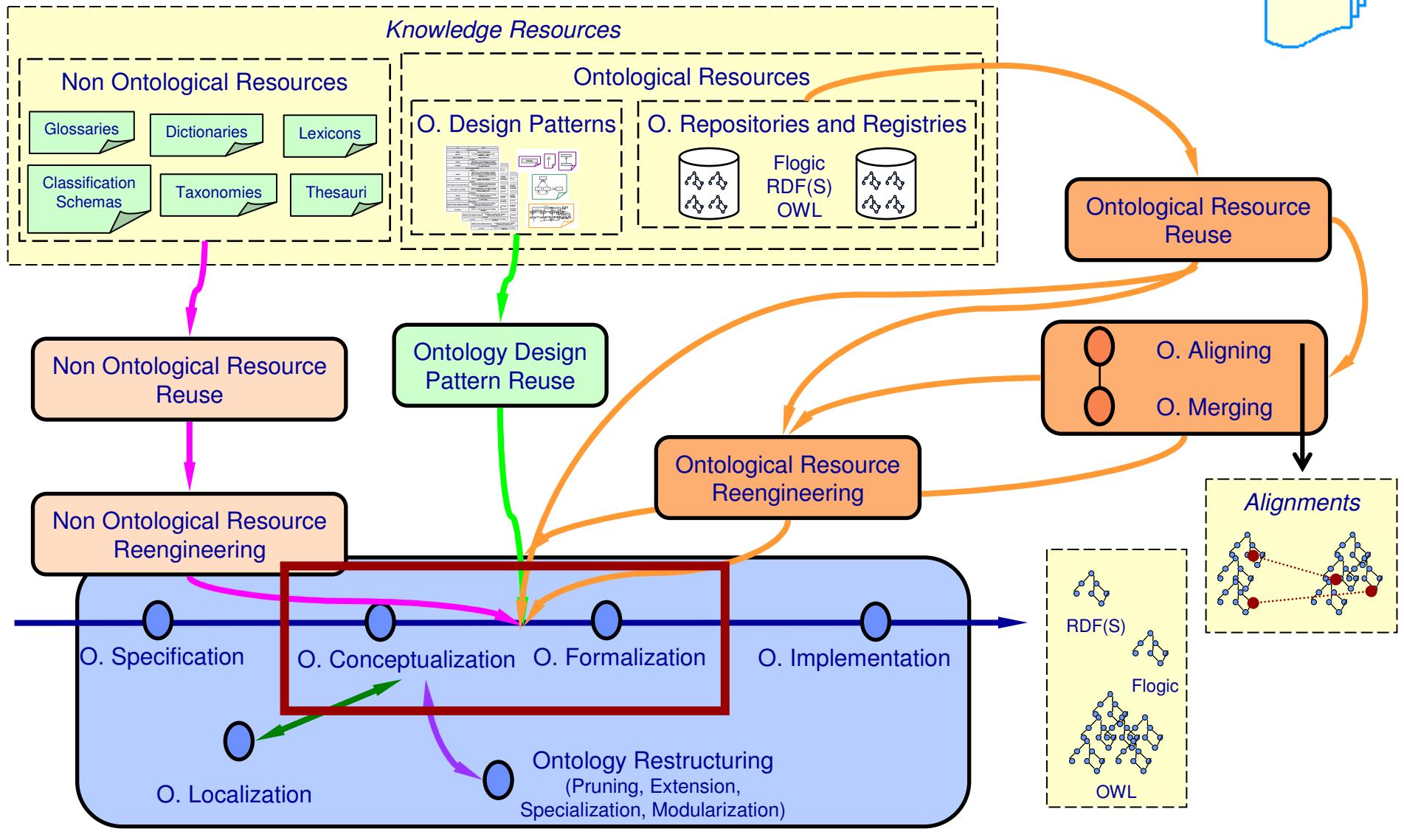
Ontology Support Activities: Knowledge Acquisition (Elicitation); Documentation; Configuration Management; Evaluation (V&V); Assessment

A. Gómez Pérez, M.C. Suárez-Figueroa, B. Villazón

The Time Ontology Selection



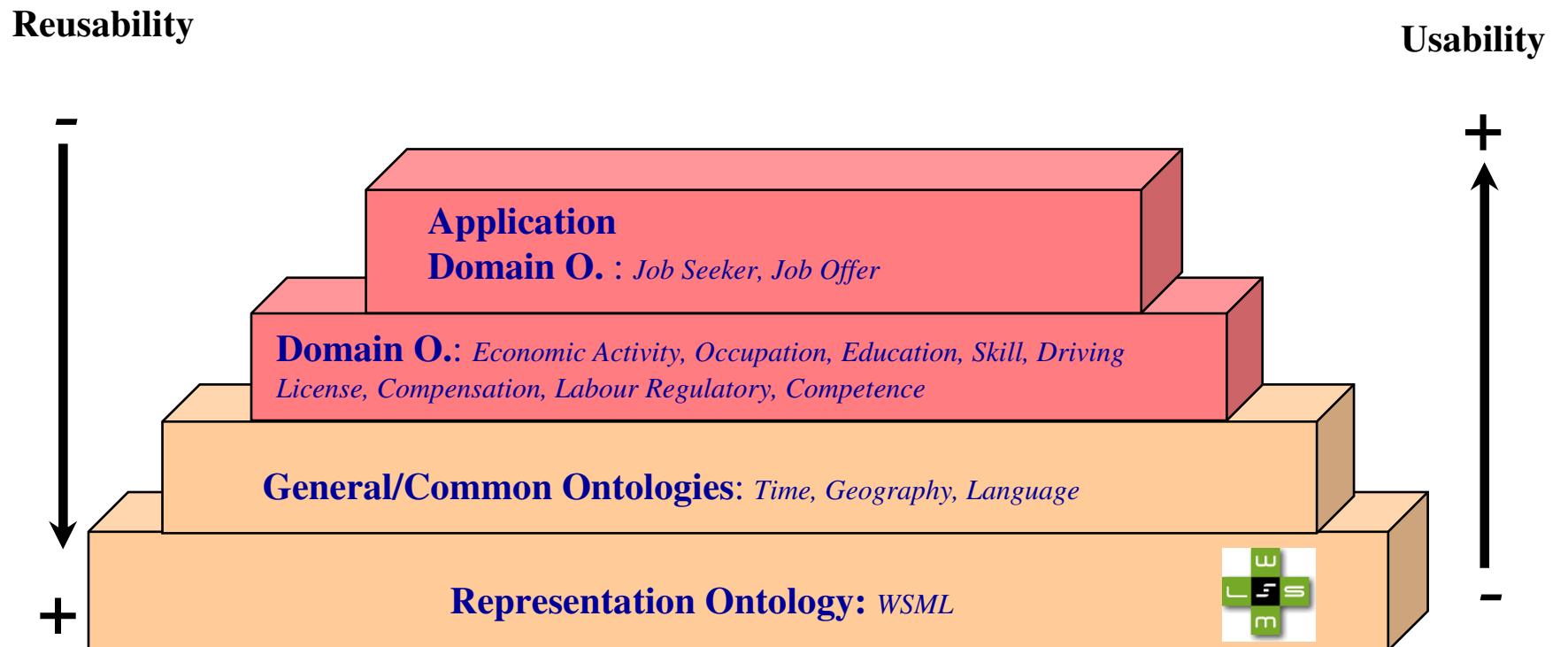
	Cyc's Upper Ontology	Unrestricted Time Ontology	Simple Time Ontology	Reusable Time Ontology	Kestrel Time Ontology	SRI's Time Ontology	SUMO Time Ontology	DAML Time Ontology	AKT Time Ontology
Time Points	●	✓				✓	✓	✓	✓
Time Interval	●	✓			✓	✓		✓	✓
Absolute and Relative Time	●			✓				✓	✓
Relations between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



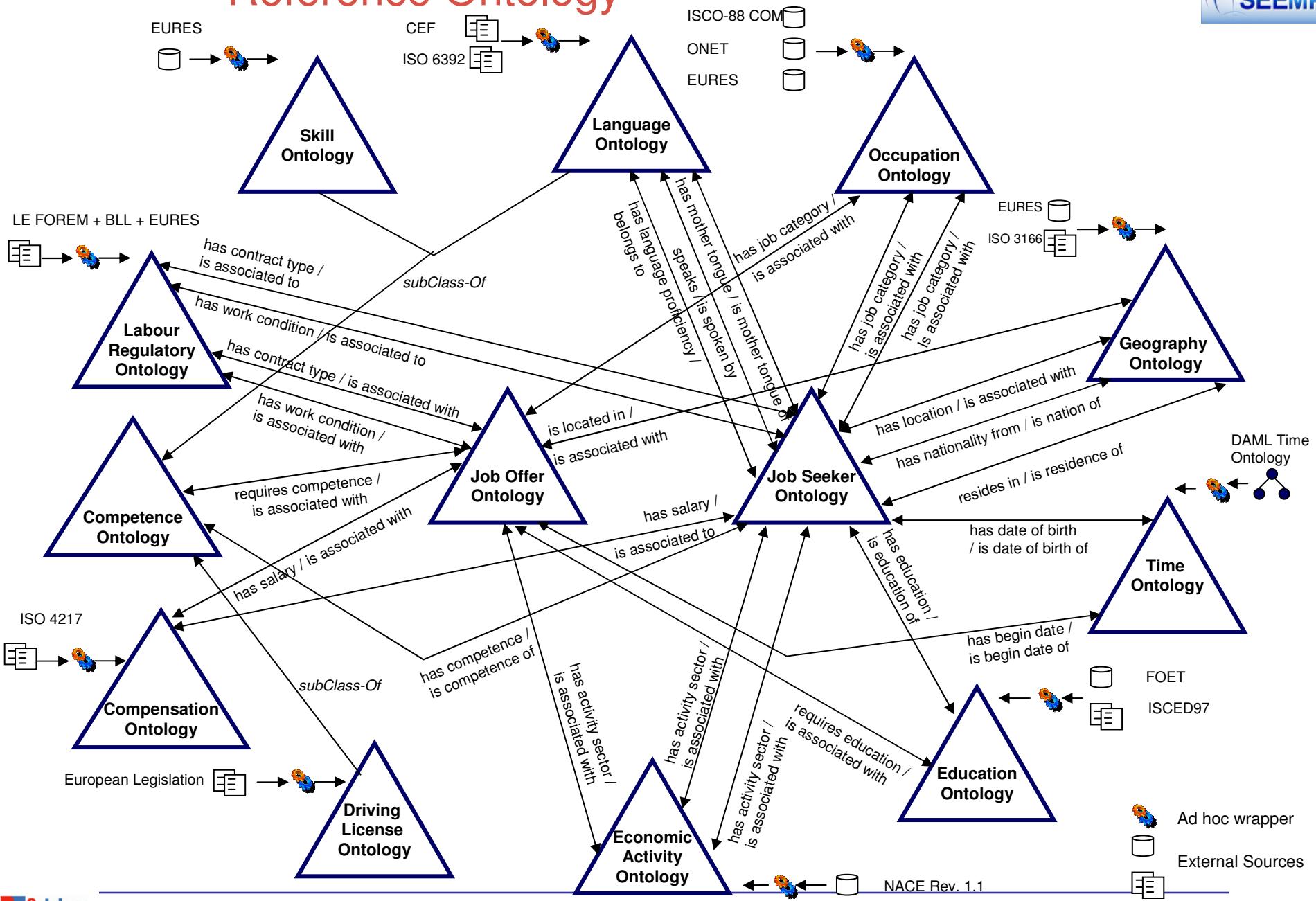
Ontology Support Activities: Knowledge Acquisition (Elicitation); Documentation; Configuration Management; Evaluation (V&V); Assessment

A. Gómez Pérez, M.C. Suárez-Figueroa, B. Villazón

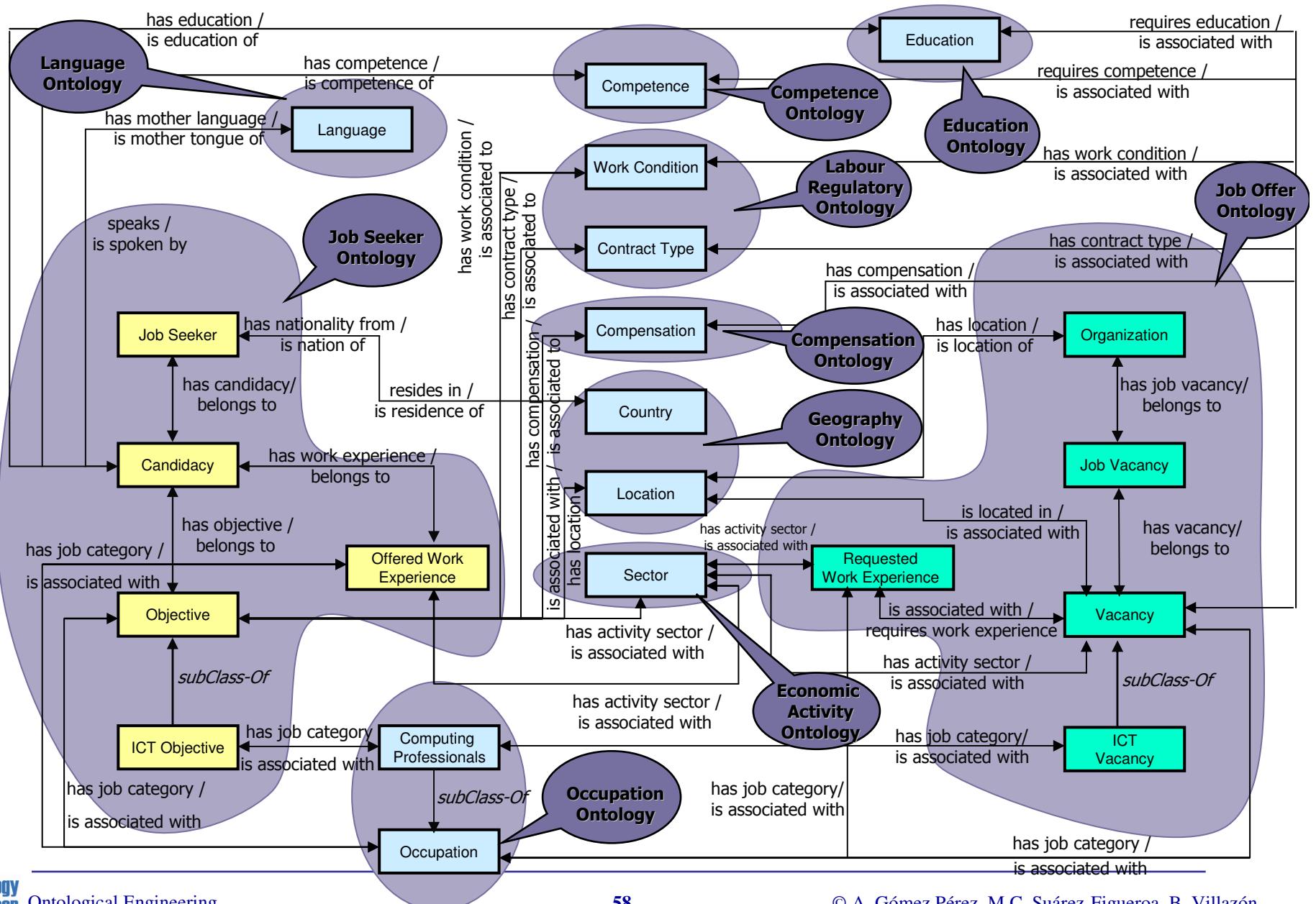
Conceptualization: Modular approach for ontology construction



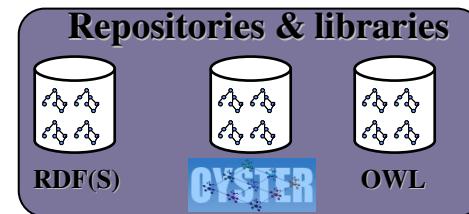
Reference Ontology



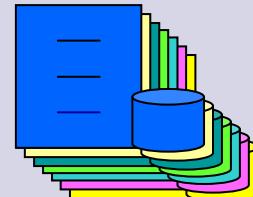
Details of the ontology



ISCO-88 (COM),
ONET,
EURES taxonomy,
FOET, ISCED97,
NACE, ISO 4217,
ISO 3166, ISO 6392,
HR-XML, ...



ES Data Sources



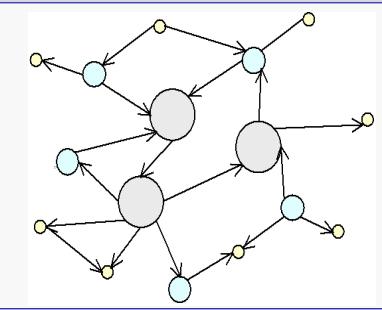
Building Reference Ontology



Building Local Ontologies

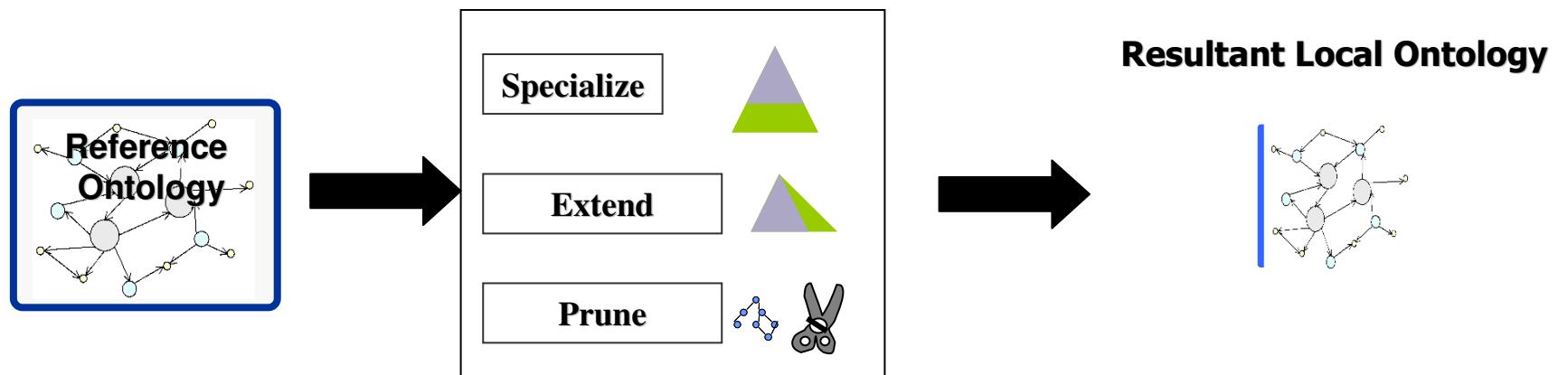


Reference Ontology

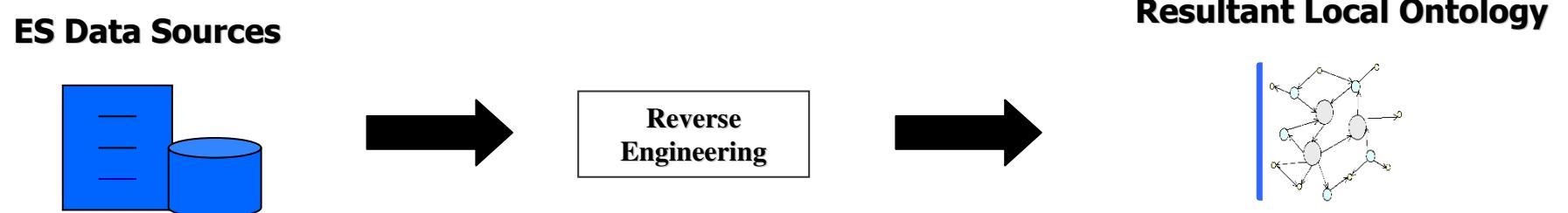


Local Ontologies Building Process

- Option 1: *Building Local Ontologies from the Reference Ontology.*



- Option 2: *Building Local Ontologies as a reverse engineering process from ES Data Sources.*



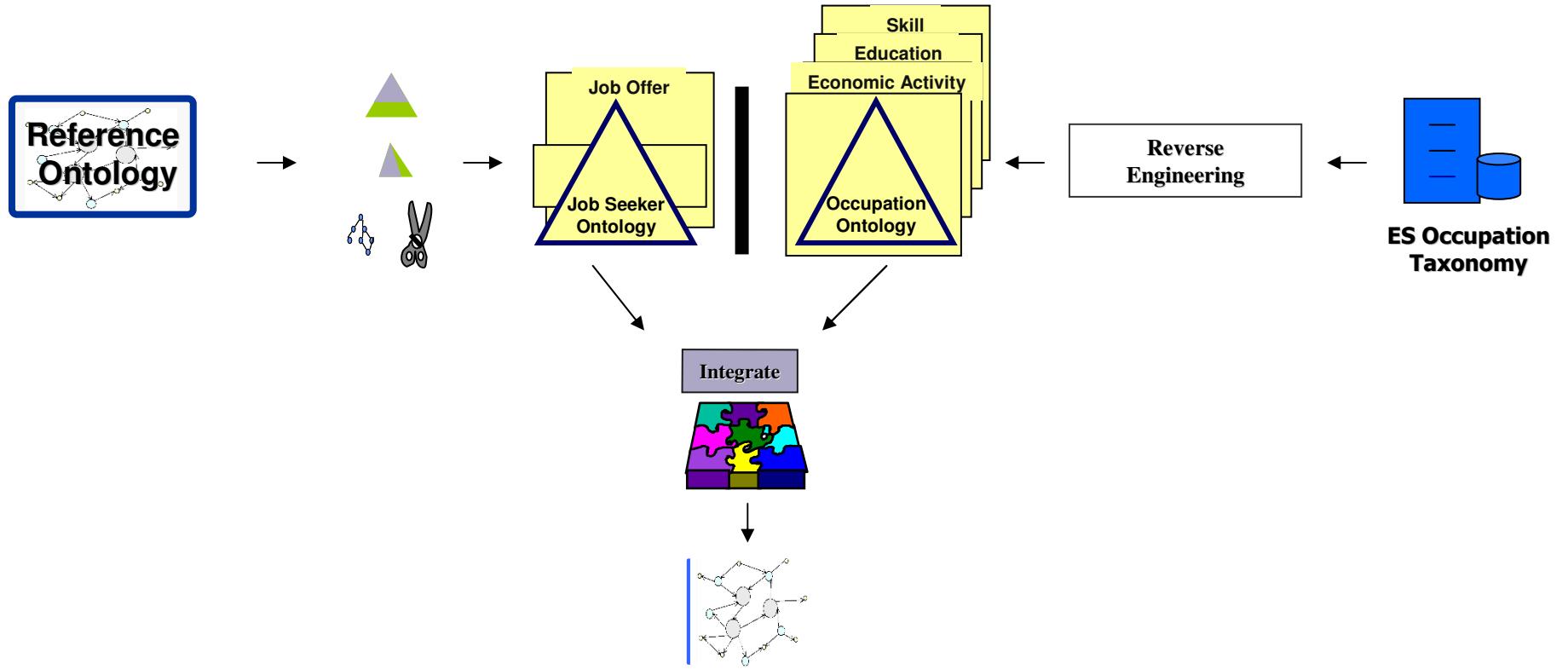
Which option is the most appropriate for the use case?

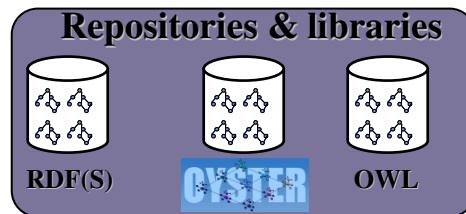
	Option 1: Building Local Ontologies from the Reference Ontology.	Option 2: Building Local Ontologies as a reverse engineering process from ES Data Sources.
Mappings between Local Ontologies and Reference Ontology	Mappings are not complex. They use the same terms.	Complex mappings due to terminology heterogeneity.
Mappings between Local Ontologies and ES schema sources	Complex mappings due to terminology and structural heterogeneity.	Mappings are not complex. They use the same terms.
Building process	Structured/guided by the architecture of the Reference Ontology and scoped with applications needs.	Requires more sophistication of knowledge engineering and good acquaintance of all the data and their structures of the application.
Changes in the Reference Ontology	Imply changes in <ul style="list-style-type: none"> · the mappings between local and reference ontologies. · the mappings between the local ontologies and the ES schema sources. · the Local Ontology. 	Imply changes in <ul style="list-style-type: none"> · the mappings between Local Ontologies and the Reference Ontology.
Changes in the ES schema sources	Imply changes in <ul style="list-style-type: none"> · its Local Ontology (probably the part that is not a mirror of the Reference Ontology). · the mappings between Local Ontologies and ES schema sources. · in the mappings between Local Ontology and the Reference Ontology. 	Imply changes in <ul style="list-style-type: none"> · the Local Ontologies. · in mappings between ES sources and Local Ontologies. · mappings between local and the Reference Ontology.

Approach followed by SEEMP for building Local Ontologies

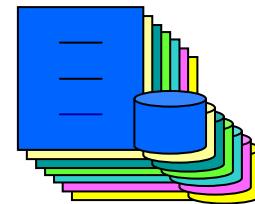
A hybrid approach

- Option 1 for Job Seeker and Job Offer Ontologies
- Option 2 for Occupation, Education, etc.





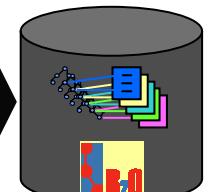
ES Data Sources



Building Mappings L.O. - ES Data Sources



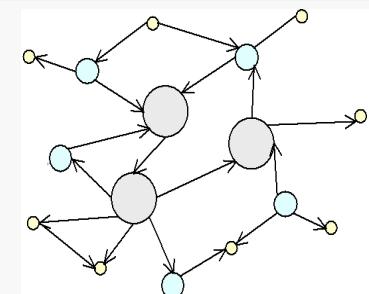
Mappings L.O. - ES Data Sources



Building Reference Ontology



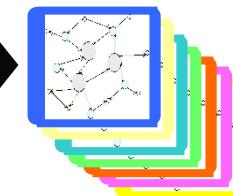
Reference Ontology



Building Local Ontologies



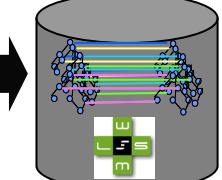
Local Ontologies



Mappings R.O. - L.O.



Building Mappings R.O. - L.O.

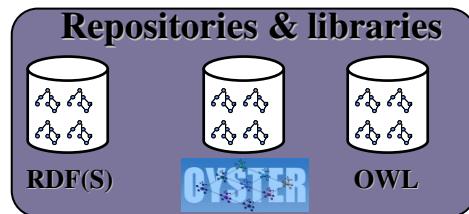




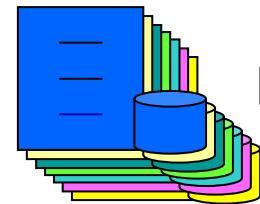
o-net™

EUROPEAN DYNAMICS

ISCO-88 (COM),
ONET,
EURES taxonomy,
FOET, ISCED97,
NACE, ISO 4217,
ISO 3166, ISO 6392,
HR-XML, ...



ES Data Sources



Building Mappings L.O. - ES Data Sources (ODEMapster)

ODEMapster
Mapping Editor

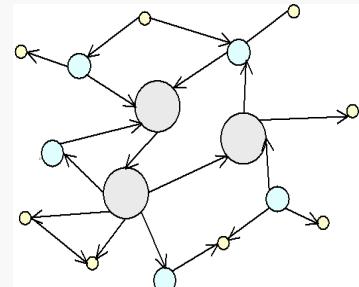
Mappings ES-LO

R₂O
Mappings

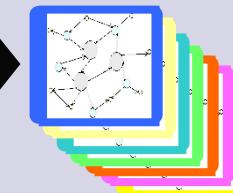
Building Reference Ontology



Building Local Ontologies



Local Ontologies



Building Mappings R.O. - L.O.

© A. Gómez-Pérez

Mappings R.O. - L.O.

WSMT

