Introduction to Ontological Engineering

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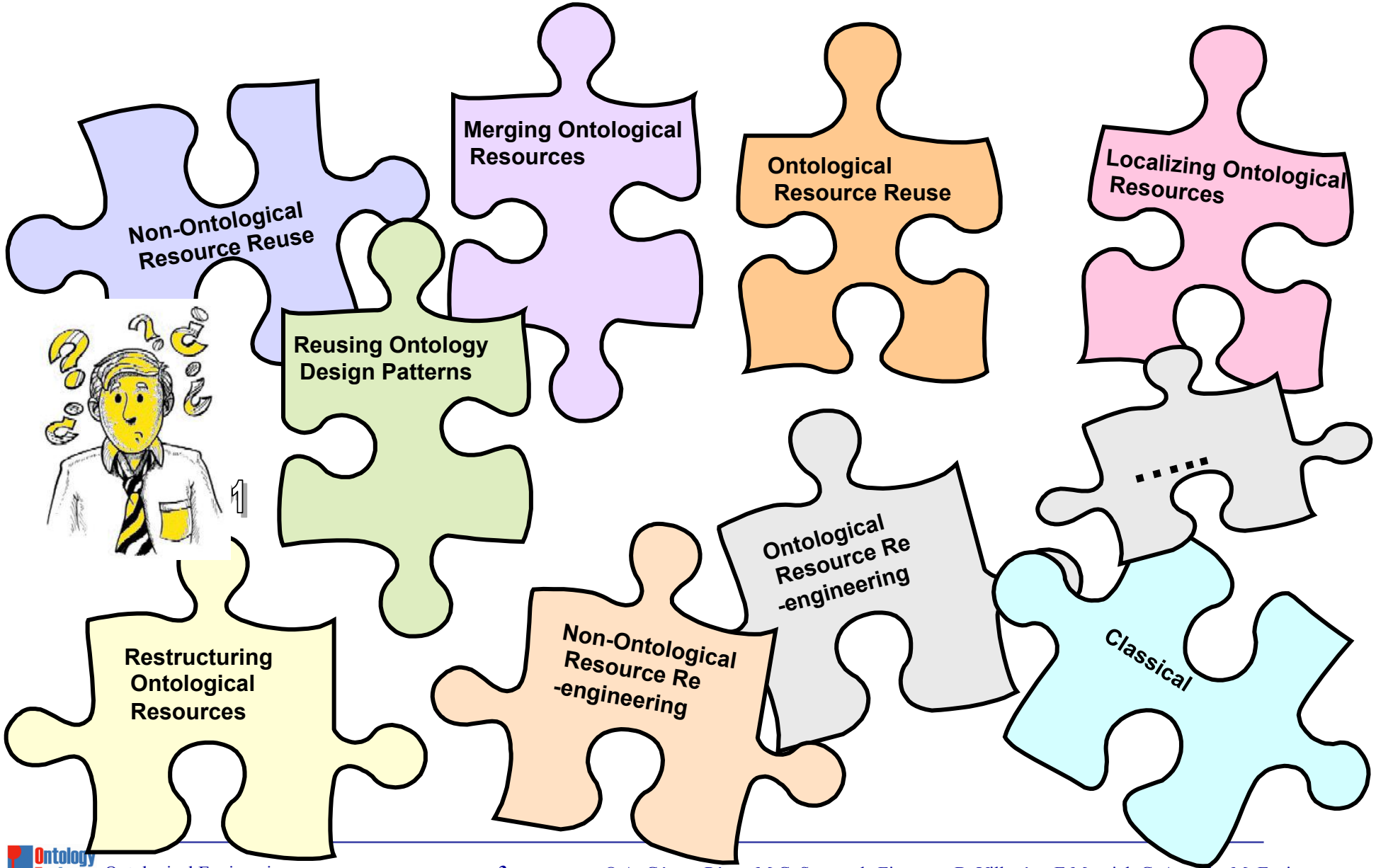
  - Non-Ontological Resource Reuse and Re-engineering
  - Ontology Reuse
  - Creating the Ontology Model
  - Localizing the Ontology
- Conclusions

Motivation



Motivation

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.

Classical

Non Ontological Resource Reuse

Non Ontological Resource Reengineering

Motivation

In our team, we want to build an ontology
human resources management domain.
ontology should include information ab
occupations and activity sectors, data must be k
in the original DBs, and we want to have
ntology in sev atural languages.

Classical

Ontology

Mappings

Ontology-DB mapping

Ontological Resource Reuse

Re-engineering Non-ontological resources

Localizing Ontological Resources

Building ontologies in the 90s

Methodologies for building single ontologies

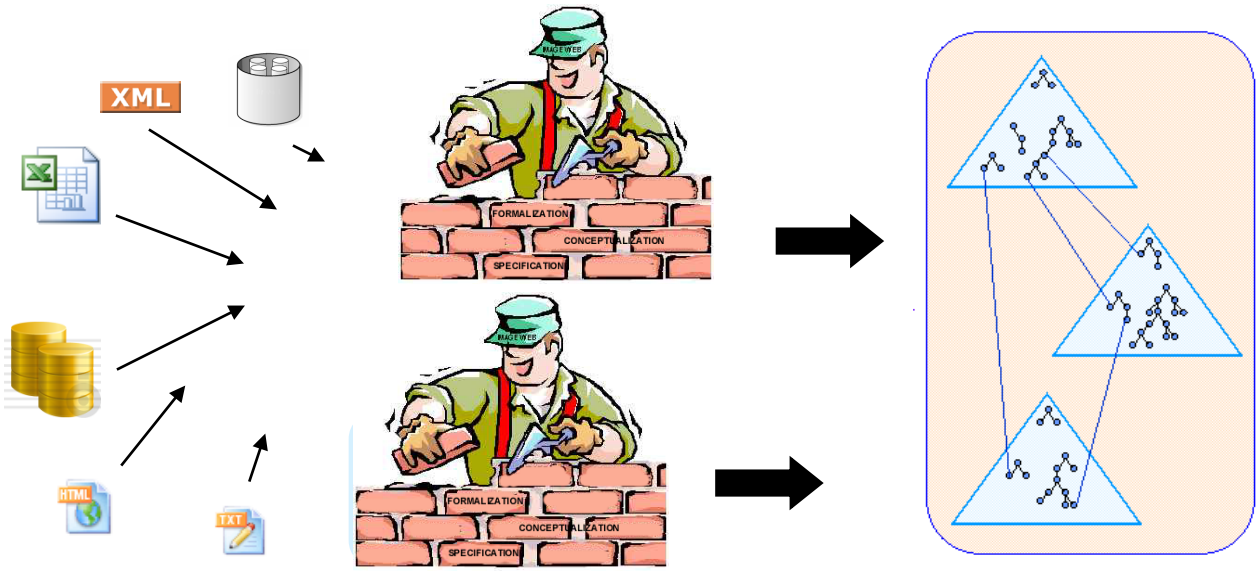
- Uschold and King's method
- Grüninger and Fox's methodology
- KACTUS approach
- METHONTOLOGY
- SENSUS method
- On-To-Knowledge
- DILIGENT

Ontology learning approaches for building ontologies from structured, semi-structured and non-structured data

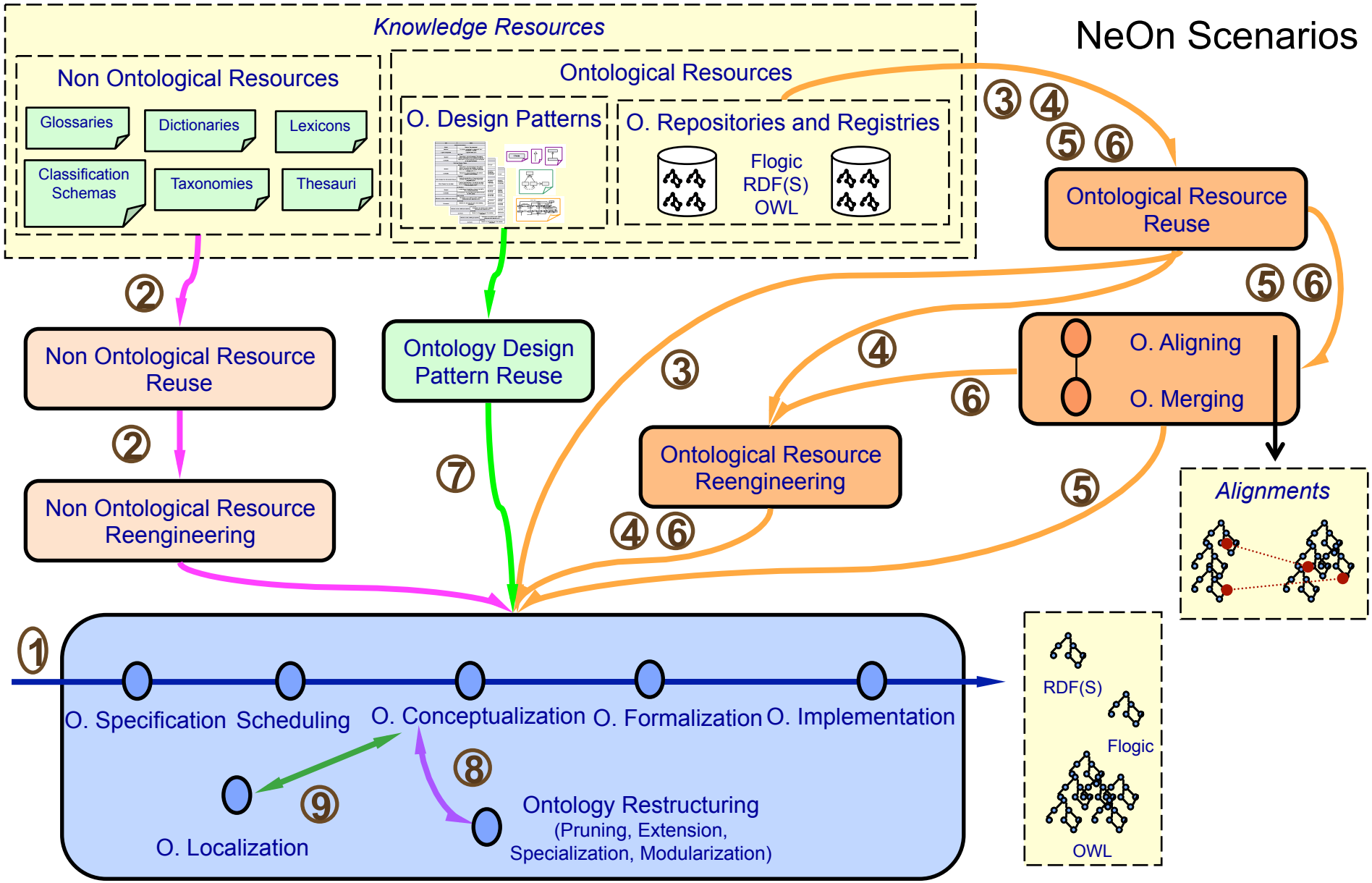
- Are not integrated with current methodologies
- Mainly from non-structured data using NLP techniques

Current situation

- Reuse of knowledge-aware resources
- Ontologies are built collaboratively
- Ontologies are connected in ontology networks
- Multilingual features



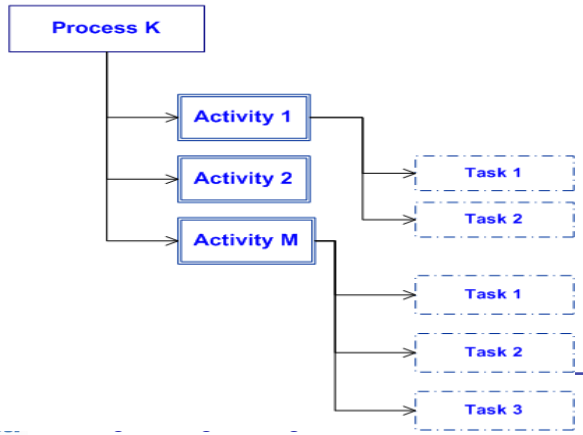
NeOn Scenarios



NeOn Methodology

Process and activities covered:

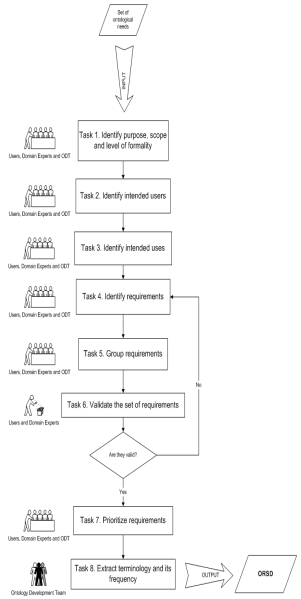
- Ontology Specification
- Scheduling
- Non-Ontological Resource Reuse
- Non-Ontological Resource Re-engineering
- Reuse General Ontologies
- Reuse Domain Ontologies
- Reuse Ontology Statements
- Reuse Ontology Design Patterns



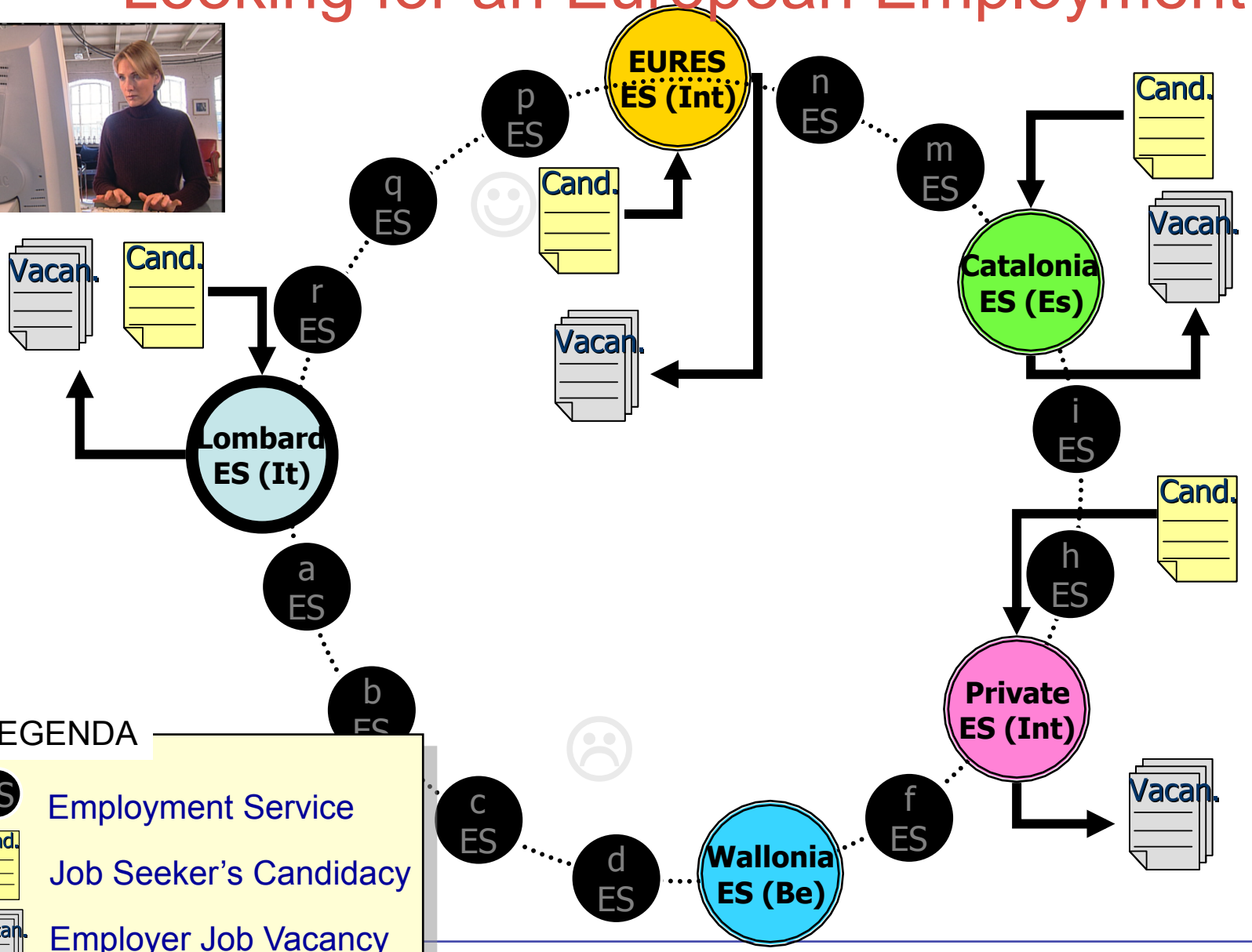
All processes and activities are described with:

- A filling card
- A workflow
- Examples

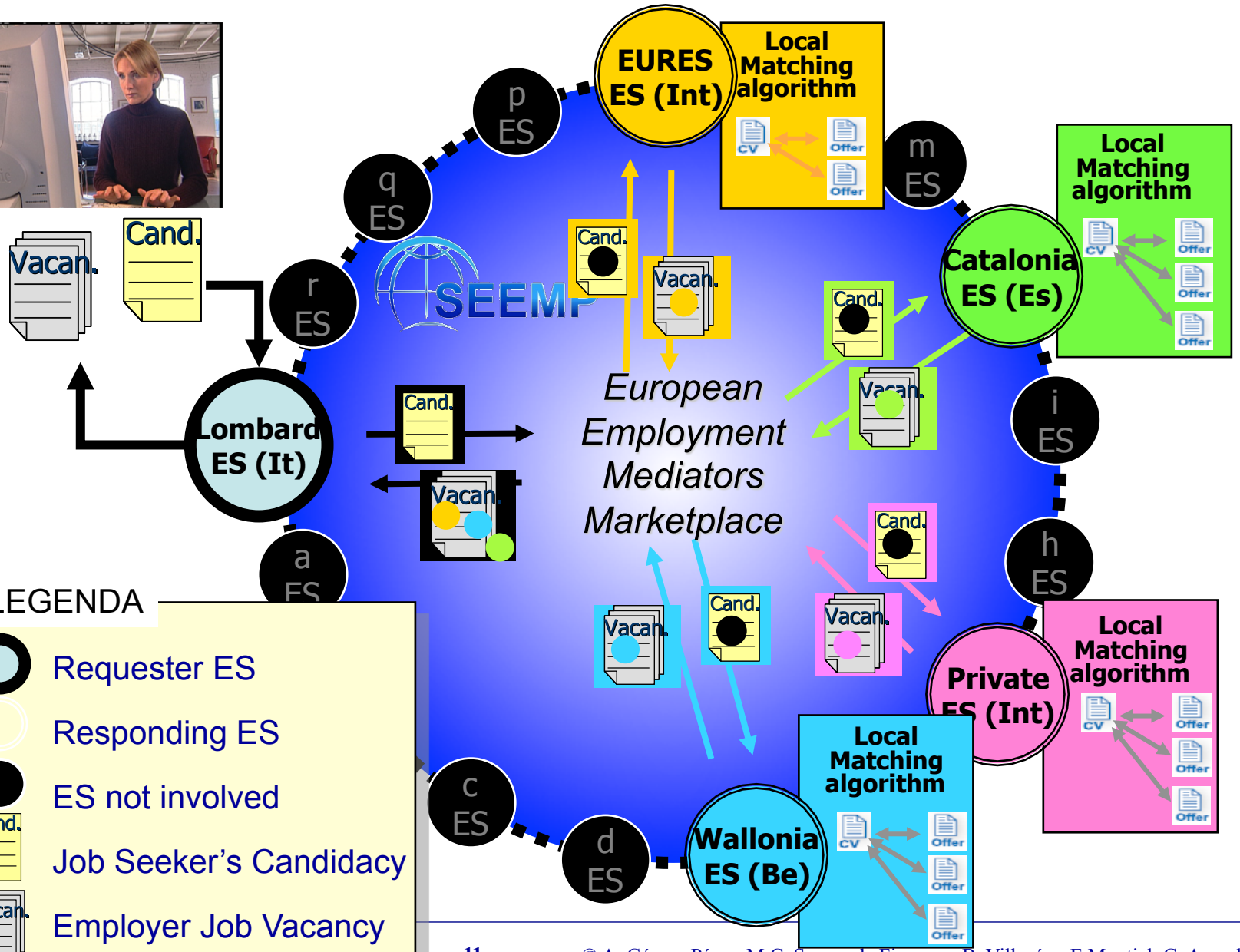
Process or Activity Name	
Definition	
Goal	
Input	*Output*
Who	
When	



Looking for an European Employment



Helping Job Seekers on their way



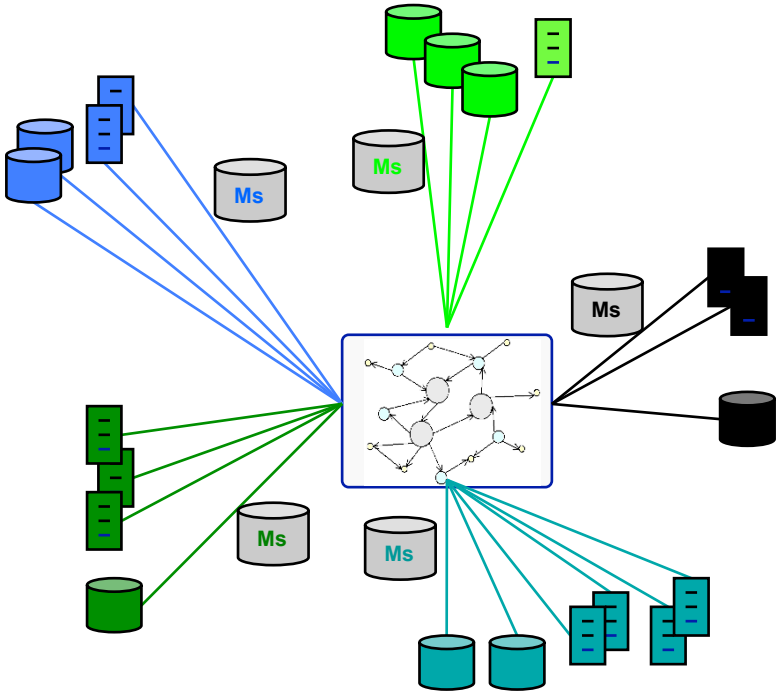
Key issues

- Reuse of proprietary knowledge-aware resources
- Heterogeneity
  - Terms are in different languages
  - Different conceptualization (different ways of organizing job categories)
  - Different DB schemas
- Data must be kept in the original sources and in their own language.

Key aspects of Ontological Engineering

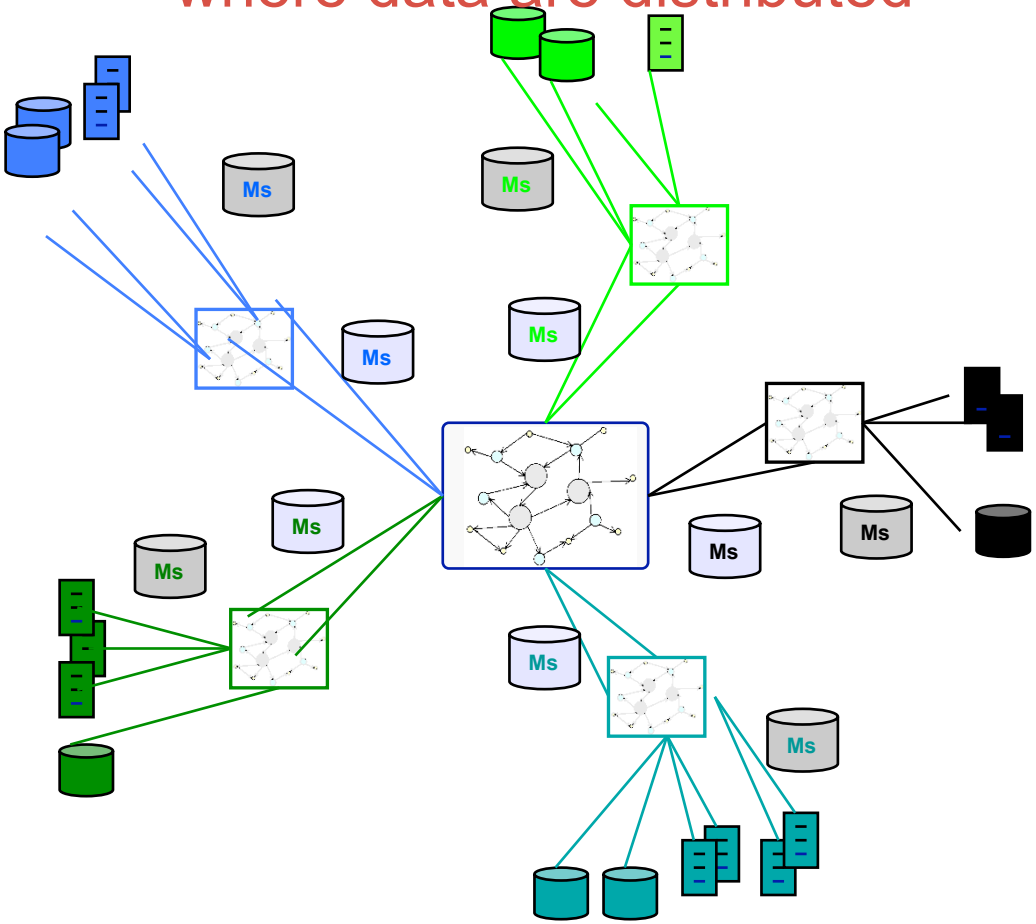
- Ontologies
  - Single versus network of ontologies?
  - Are ontologies built from scratch or reusing knowledge-aware resources?
  - Are mappings used for solving conceptual mistmaches?
- Instances
  - Where are the data/instances?
    - Instances are in the ontology
    - Instances are in RDF files 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



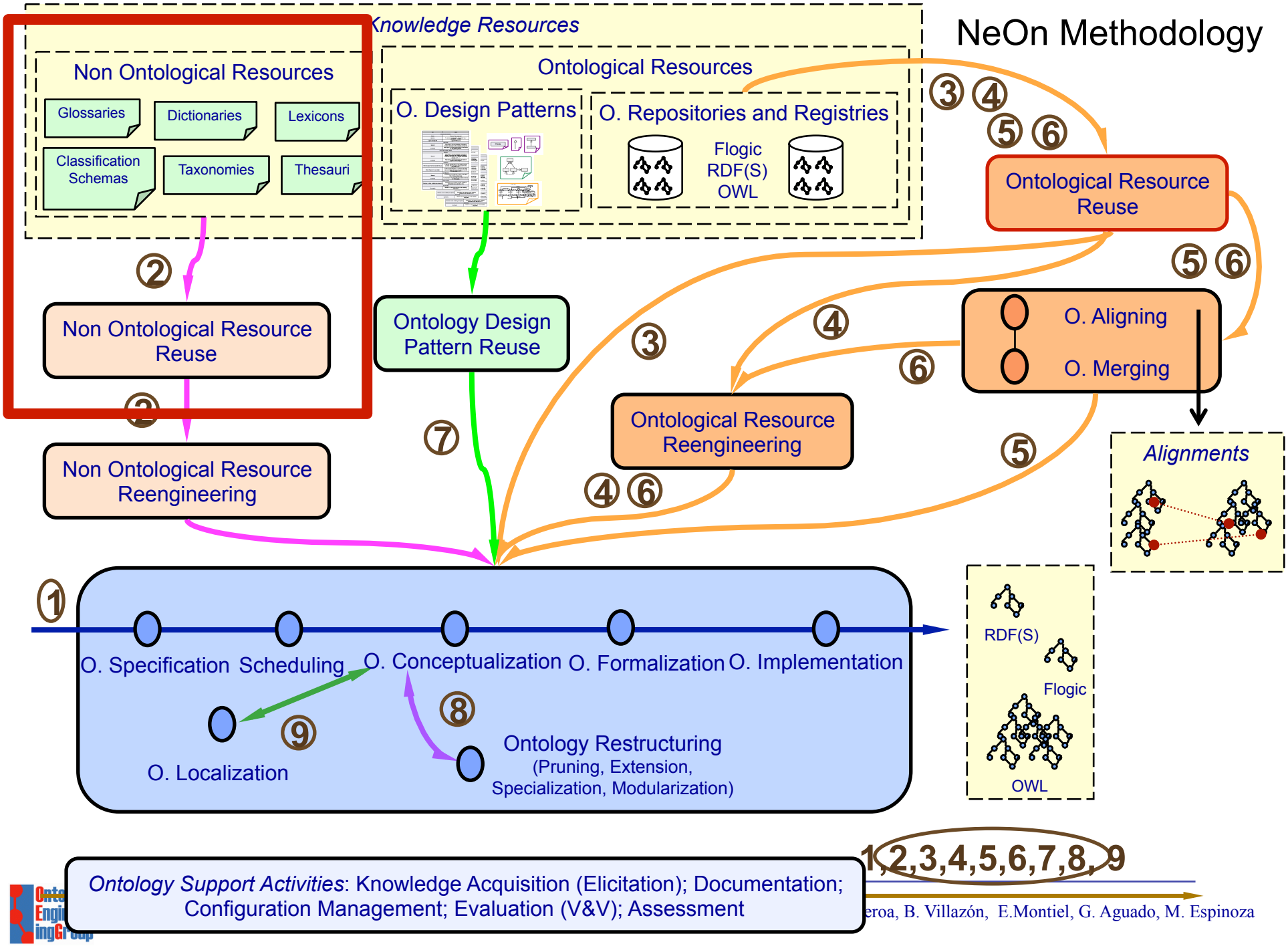
1. Build a reference ontology
2. Build mappings between the reference ontology and the data sources

Federated network of ontologies where data are distributed



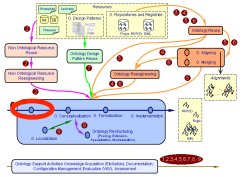
1. Build a reference ontology for the domain
2. Build local ontologies
3. Build mappings between the core and local ontologies
4. Build mappings between the local ontologies and the data sources

NeOn Methodology



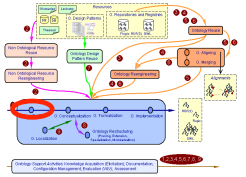
Ontology Support Activities: Knowledge Acquisition (Elicitation); Documentation; Configuration Management; Evaluation (V&V); Assessment

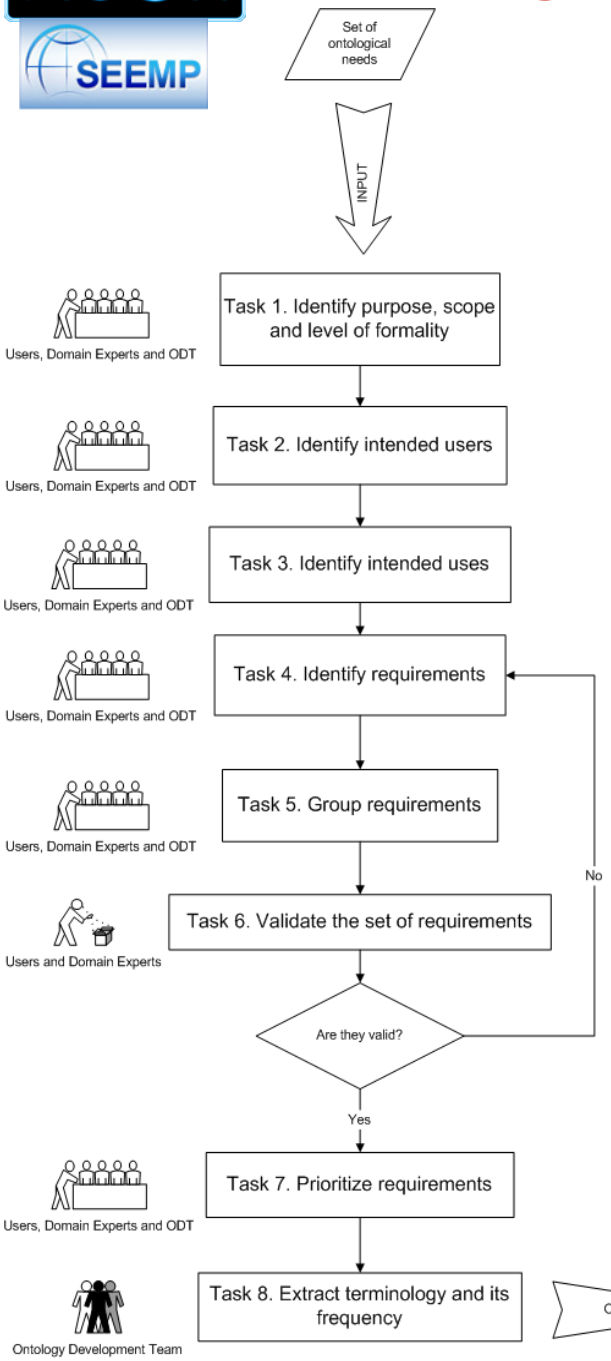
Ontology Requirement Specification Document



Ontology Requirements 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"

Ontology Specification





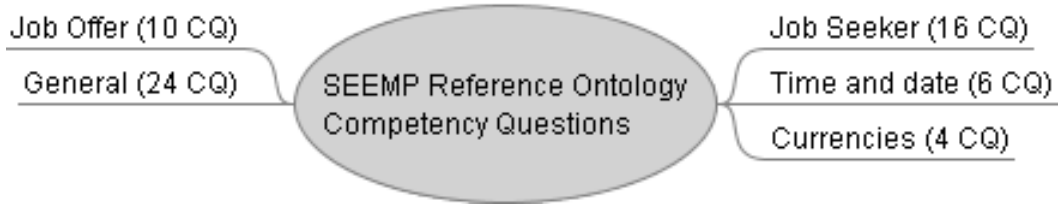
1	**Purpose**
	The purpose of building the Reference Ontology is to provide a consensual knowledge model of the employment domain that could be used by public e-Employment services (PES).
2	**Scope**
	The ontology has to focus just on the ICT (Information and Communication Technology) domain. The level of granularity is directly related to the competency questions and terms identified.
4	**Intended Users**
	1. Candidate who is unemployed and searching for a job or searching another occupation for immediate or future purposes 2. Employer who needs more human resources. 3. Public or private employment search service which offers services to gather CVs or job postings and to prepare some
5	**Intended Uses**
	1. Publish CV. Job seeker places his/her CV on the PES Portal. 2. Publish Job Offer. An Employer places a Job Offer on the PES Portal. 3. Search for Job Offers. The Employer looks for candidates for the Job Offer through PES Portal. 4. Search for Employment information. Job Seeker looks for of general information about employment in a given location at the PES Portal. 5. Provide Job Statistics. The PES Portal provides employment statistics to the Job Seeker and Employer.

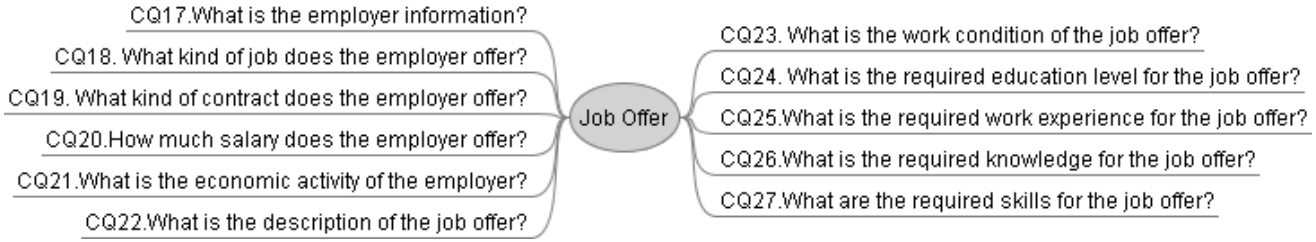
Ontology Specification: Identify requirements using competency questions

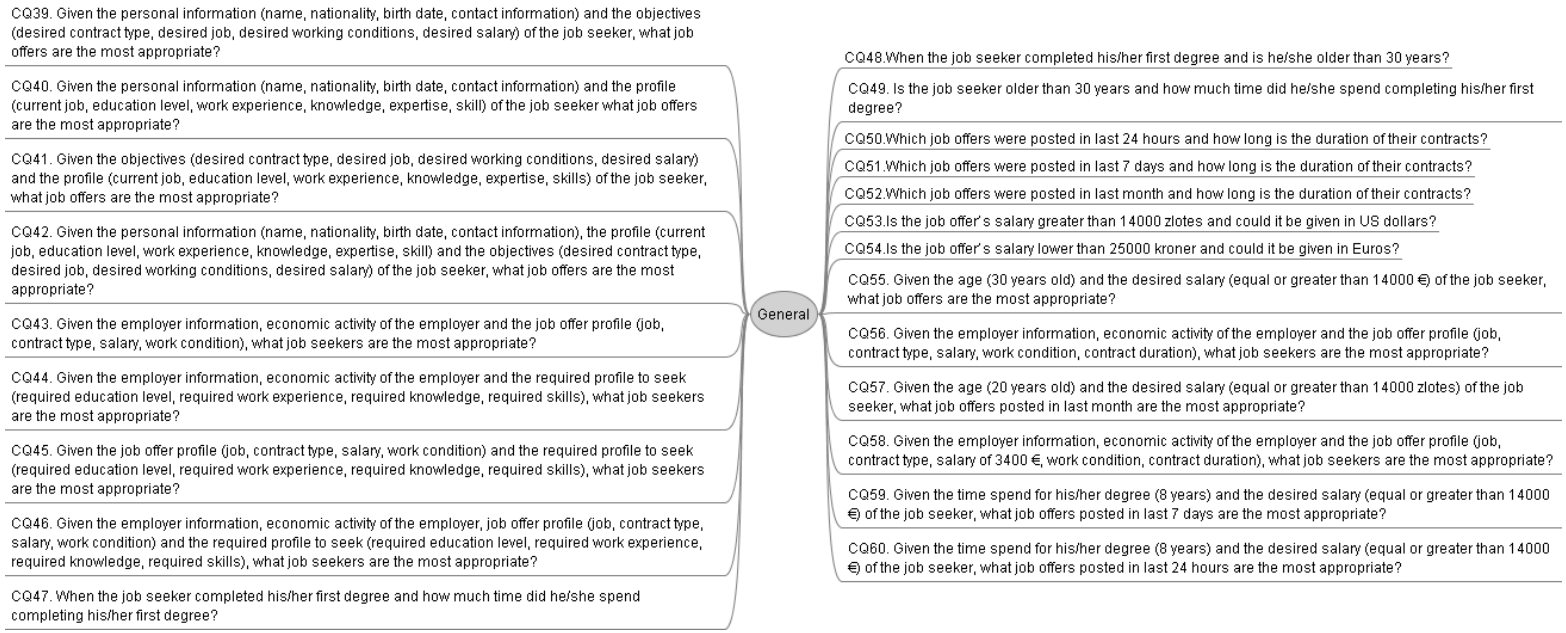
	A	B	C
1	N	Competency Questions	Answers
2	CQ1	What is the Job Seeker Name?	Lewis Hamilton
3	CQ2	What is the Job Seeker nationality?	British; Spanish; Italian; French; German
4	CQ3	When is the Job Seeker birthdate?	13/09/1984; 30/03/1970; 15/04/1978
5	CQ4	What is the Job Seeker contact information?	
6	CQ5	What is the Job Seeker current job?	Programmer; Computer Engineer; Computer Assistant
7	CQ6	What is the Job Seeker desired job?	Radio engineer; Hardware designer; Software Engineer
8	CQ7	What are the Job Seeker desired working conditions?	Autonomous; Seasonal Job; Traineeship;Consultant
9	CQ8	What kind of contract does the Job Seeker want?	
10	CQ9	How much salary does the Job Seeker want to earn?	
11	CQ10	What is the Job Seeker education level?	Basic education; Higher education/University
12	CQ11	What is the Job Seeker work experience?	3 months, 6 months, 1 year, 2, years, 3 years
13	CQ12	What is the Job Seeker knowledge?	
14	CQ13	What is the Job Seeker expertise?	
15	CQ14	What are the Job Seeker skills?	SQL programming, network administration
16	CQ15	What publications does the Job Seeker have?	
17	CQ16	What hobbies does the Job Seeker have?	
18	CQ17	What is the employer information?	CEFRIEL Research Company, Milano, Italy
19	CQ18	What kind of job does the employer offer?	Java Programmer; C Programmer, Database administration
20	CQ19	What kind of contract does the employer offer?	
21	CQ20	How much salary does the employer offer?	3500 euros, 3000 USD, 2000 euros
22	CQ21	What is the economic activity of the employer?	Research; Financial; Education; Industrial
23	CQ22	What is the description of the job offer?	Sun Certified Java Programmer
24	CQ23	What is the work condition of the job offer?	Full time; Partial time; Autonomous; Seasonal Job;
25	CQ24	What is the required education level for the job offer?	Basic education; Higher education/University
26	CQ25	What is the required work experience for the job offer?	1 year, 2 years, 3 years, 4 yerars, 5 or more years
27	CQ26	What is the required knowledge for the job offer?	Java, Object oriented design, Haskell, Windows
28	CQ27	What are the required skills for the job offer?	ASP Programmer, Data warehouse, Hardware programming
29	CQ28	When the Job Seeker completed his/her first degree?	2001; March 1999; 23/10/1970
30	CQ29	Is the Job Seeker older than 30 years?	
31	CQ30	How much time did the Job Seeker spend completing his/her first degree?	4 years, 6 years, 7 years and 6 months
32	CQ31	How long is the duration of the contract?	1 month, 6 months, 1 year, 2 years, 3 years
33	CQ32	Which job offers were posted in the last 24 hours?	
34	CQ33	Which job offers were posted in the last 7 days?	
35	CQ34	Which job offers were posted in the last month?	

Competency Questions

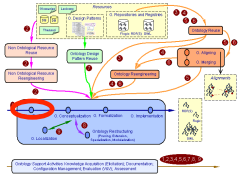
Ontology Specification: Group requirements.







Ontology Specification. The 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**
	User 1. Candidate who is unemployed and searching for a job or searching another occupation for immediate or future purposes
	User 2.
	User 3.
	User 4.
	User 5.
5	**Intend**
	Use 1.
	Use 2.
	Use 3.
	Use 4.
	Use 5.

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

6	Groups of Competency Questions	
	CQG1. Job Seeker (16 CQ)	CQ1. What is the Job Seeker Name? CQ2. What is the Job Seeker nationality? CQ3. When is the Job Seeker birthdate? 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? Job Seeker 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?
	CQG2. Job Offer (10 CQ)	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 activity of the employer? Job Offer 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?
	CQG3	

	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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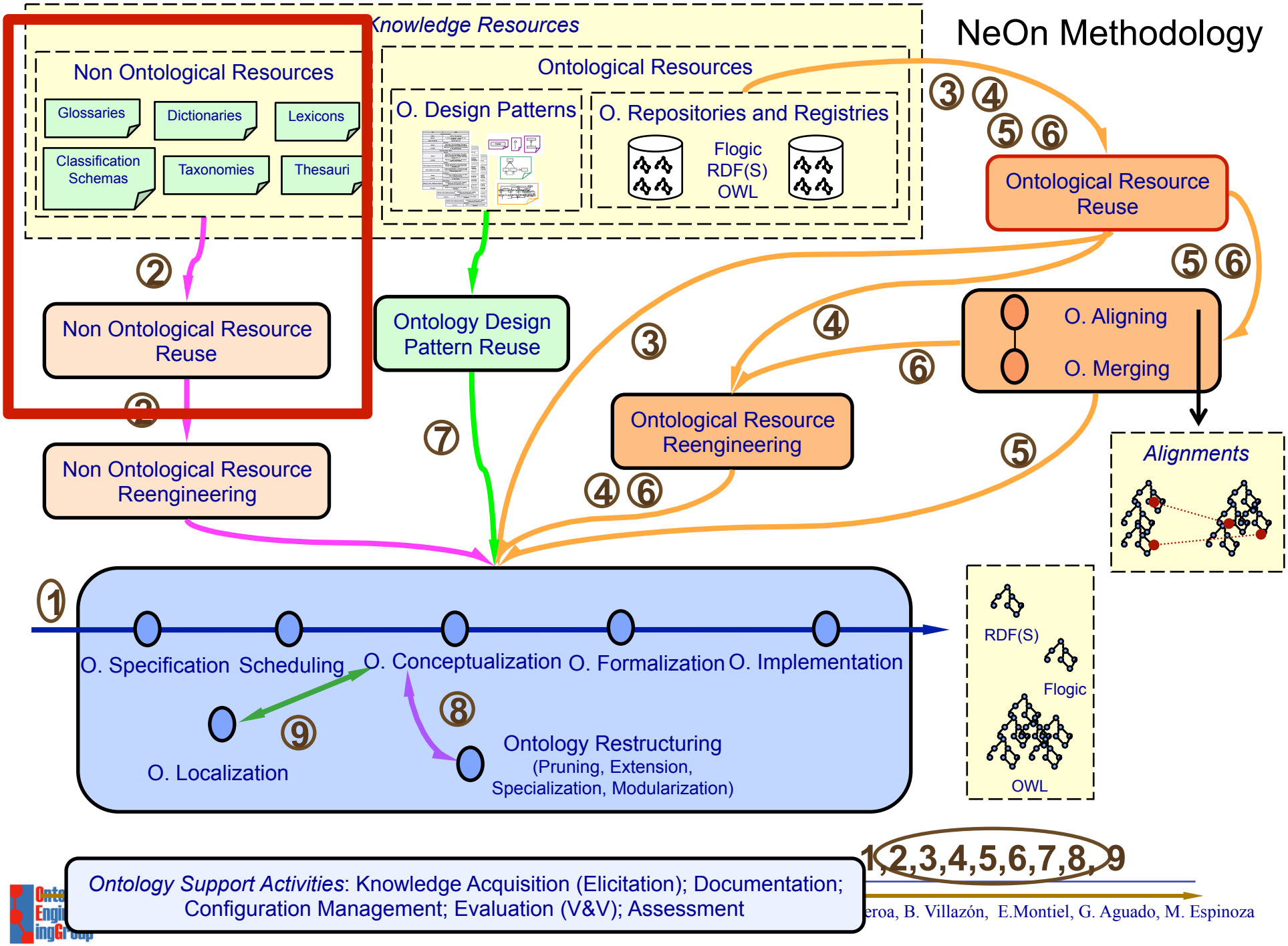
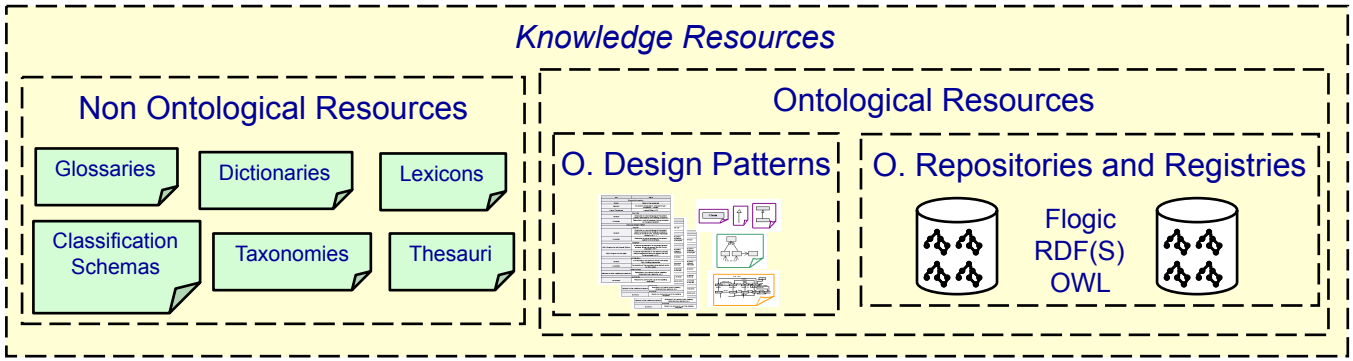
NeOn Methodology



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

Searching Resources

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



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

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

Swoogle semantic web search 2006

watson exploring the semantic web

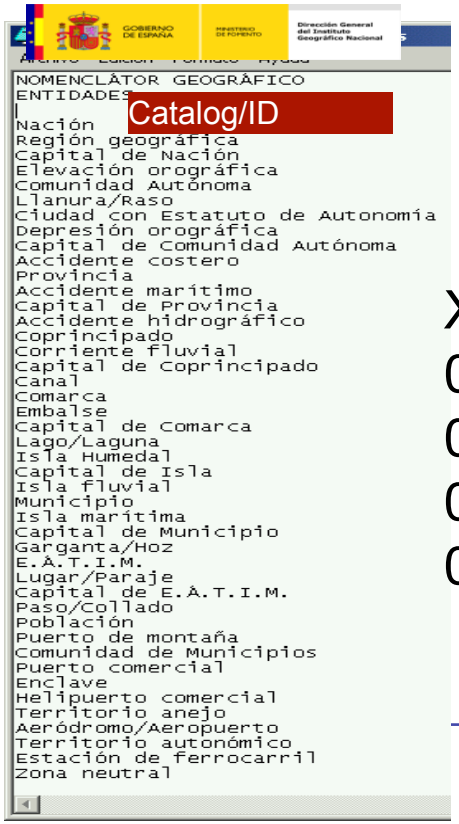
Catalog/ID — Glossary — Thesaurus — Informal is-a

Term	BT	NT	RT	UF
Rice	Cereals	Broken rice Basmati rice	Rice straw Oryza	Paddy
Oryza	Poaceae	Oryza sativa Oryza perennis Oryza rufipogon Oryza longistaminata Wetland rice Oryza glaberrima Upland rice Oryza punctata	Rice fields Cereal crops Rice	

Thesaurus

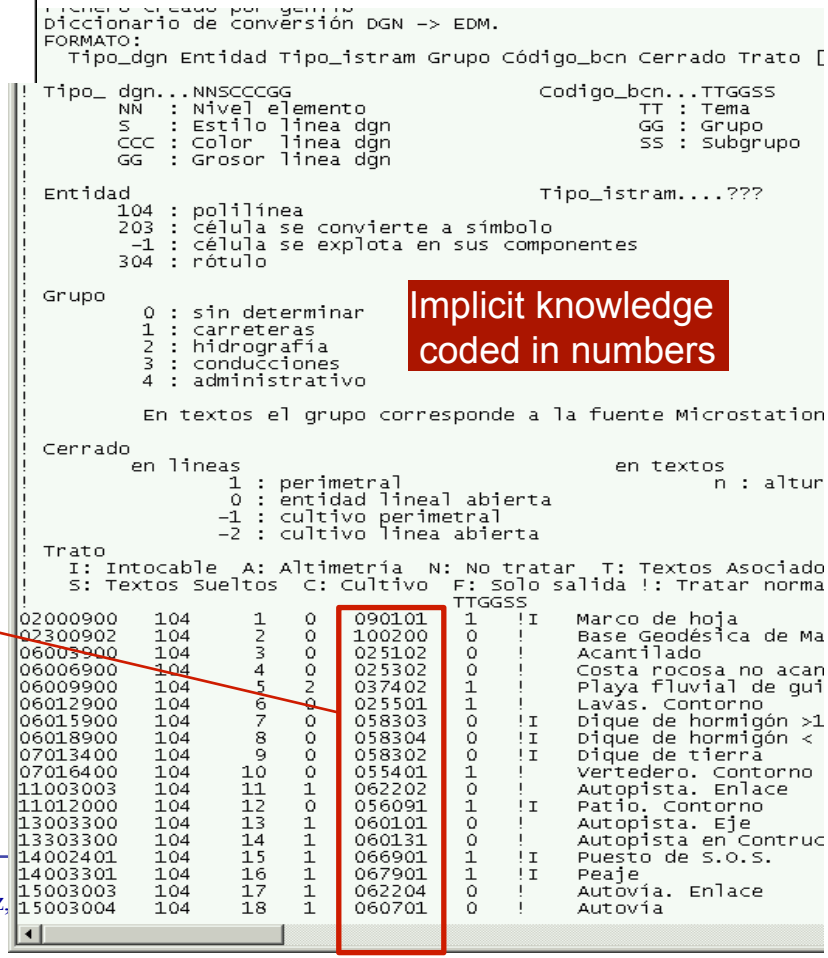
Informal is-a

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



Catalog/ID

XX-YY-ZZ
02-01-02
02: transportation
01: road
02: 3-lines highway



Implicit knowledge coded in numbers

ISO 4217 (currencies)

Entitiy	Currency	Code	
		Alphabetic	Numeric
AFGHANISTAN	Afghani	AFN	971
ALBANIA	Lek	ALL	008
ALGERIA	Algerian Dinar	DZD	012
AMERICAN SAMOA	US Dollar	USD	840
ANDORRA	Euro	EUR	978
ANGOLA	Kwanza	AOA	973
ANGUILLA	East Caribbean Dollar	XCD	951
ANTARCTICA	No universal currency		
ANTIGUA AND BARBUDA	East Caribbean Dollar	XCD	951
ARGENTINA	Argentine Peso	ARS	032
ARMENIA	Armenian Dram	AMD	051
ARUBA	Aruban Guilder	AWG	533
AUSTRALIA	Australian Dollar	AUD	036
AUSTRIA	Euro	EUR	978
AZERBAIJAN	Azerbaijanian Manat	AZN	944
BAHAMAS	Bahamian Dollar	BSD	044
BAHRAIN	Bahraini Dinar	BHD	048
BANGLADESH	Taka	BDT	050
BARBADOS	Barbados Dollar	BBD	052
BELARUS	Belarussian Ruble	BYR	974

ISO 3166 (countries)

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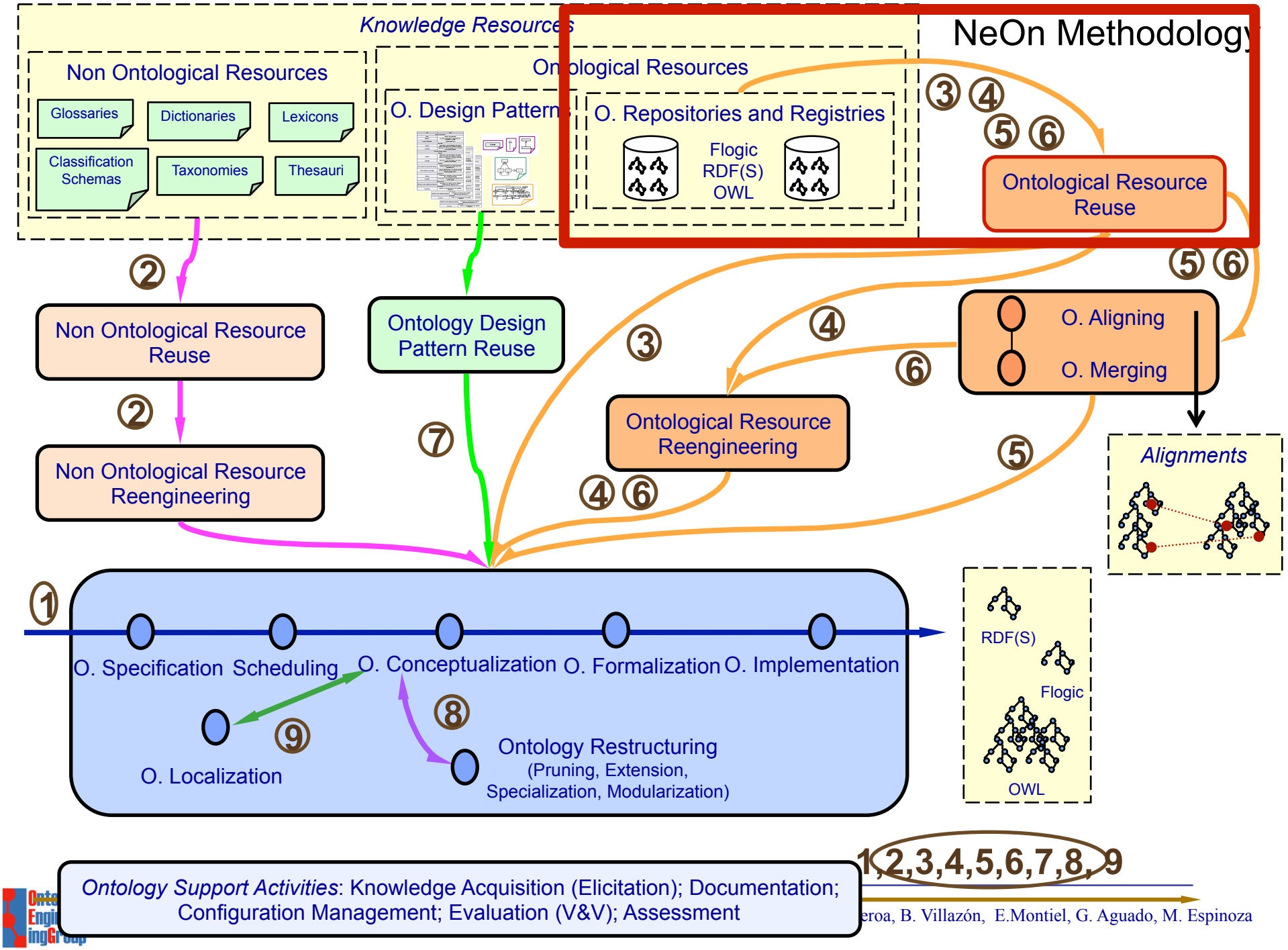

Knowledge Resources
Non Ontological Resources
Glossaries
Dictionaries
Lexicons
Classification Schemas
Taxonomies
Thesauri
Ontological Resources
O. Design Pattern
O. Repositories and Registries
Flogic
RDF(S)
OWL
NeOn Methodology
Ontological Resource Reuse
Non Ontological Resource Reuse
Non Ontological Resource Reengineering
Ontology Design Pattern Reuse
Ontological Resource Reengineering
O. Aligning
O. Merging
Alignments
O. Specification
Scheduling
O. Conceptualization
O. Formalization
O. Implementation
O. Localization
Ontology Restructuring
(Pruning, Extension, Specialization, Modularization)
RDF(S)
Flogic
OWL
Ontology Support Activities: Knowledge Acquisition (Elicitation); Documentation; Configuration Management; Evaluation (V&V); Assessment
1,2,3,4,5,6,7,8, 9

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
- 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

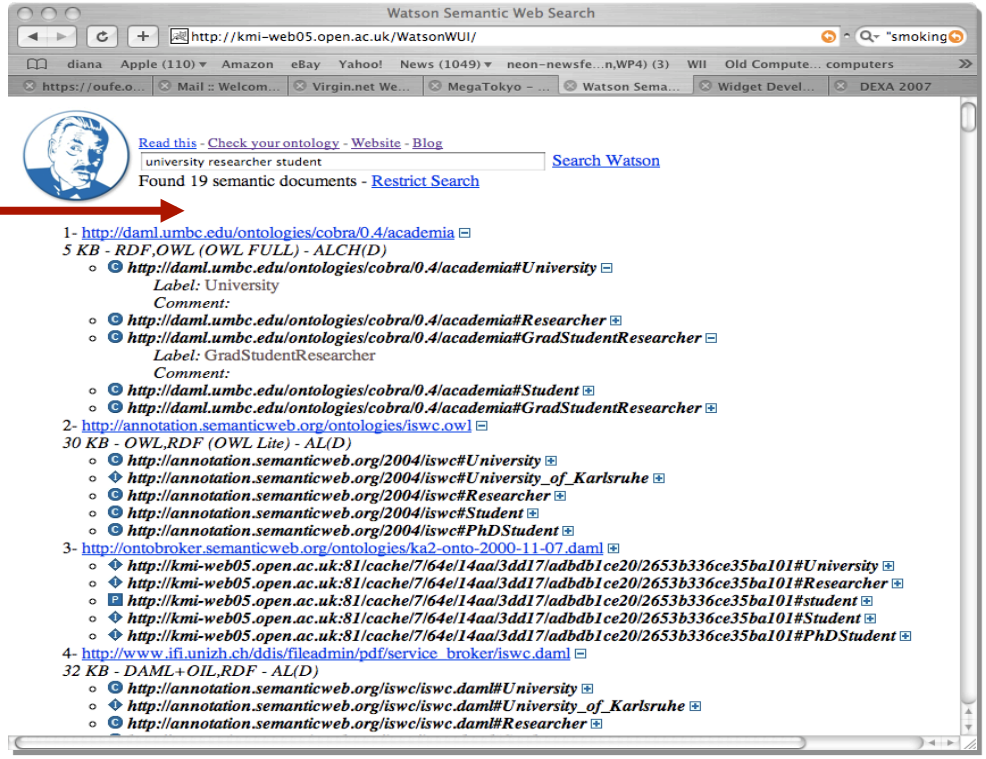
Activity Sector
- O21. Telecommunication
- O22. Justice and Judicial
- O23. Public Security and law
- O24. Manufacture of machine tools
- O25. Research and Development
- O26. Hardware Consultancy
- O27. Software Consultancy and Supply
- O28. Data processing

Education
- O29. Life Science
- O30. Mathematics
- O31. Computer Science
- O32. Computer Use
- O33. Statistics
- O34. Physics
- O35. Network Administration

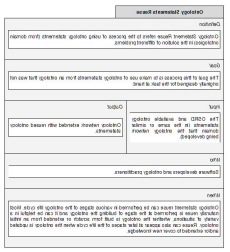
Languages
- O36. Swedish
- O37. Spanish
- O38. Slovenian
- O39. Portuguese
- O40. English
- O41. French
- O42. German

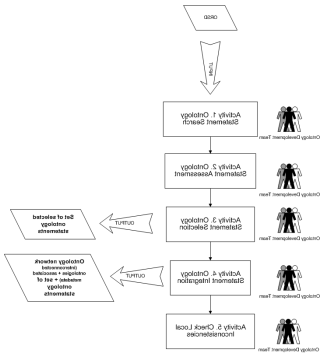
Currency
- O43. Euro
- O44. Krone
- O45. Great British Pound
- O46. Zlote
- O47. US Dollar
- O48. Franc

Location
- O49. Austria
- O50. Belgium
- O51. Danmark
- O52. Estonia
- O53. Finland
- O54. France
- O55. Germany
- O55. Greece

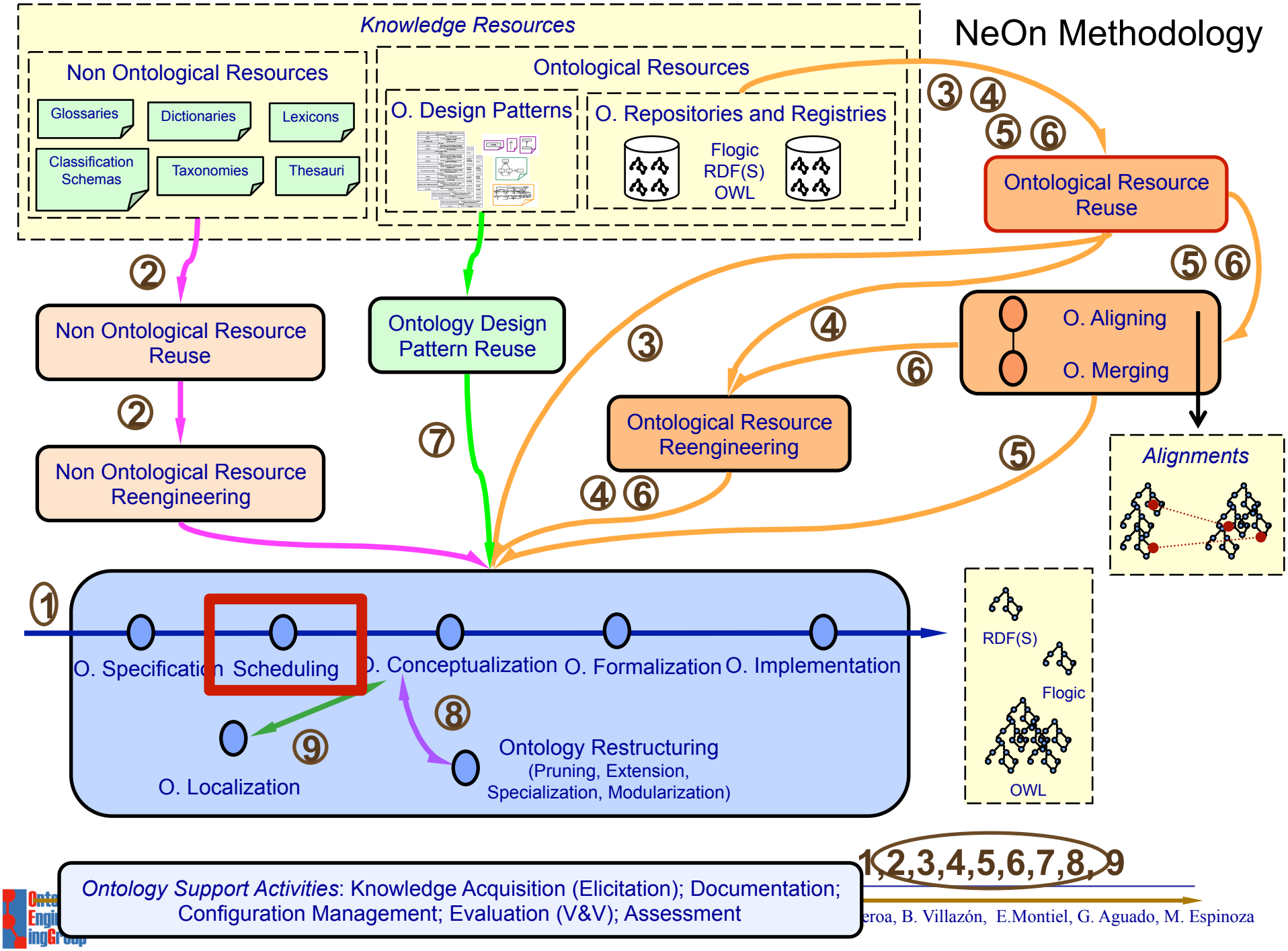


The NeOn methodology includes guideliness for reusing statements

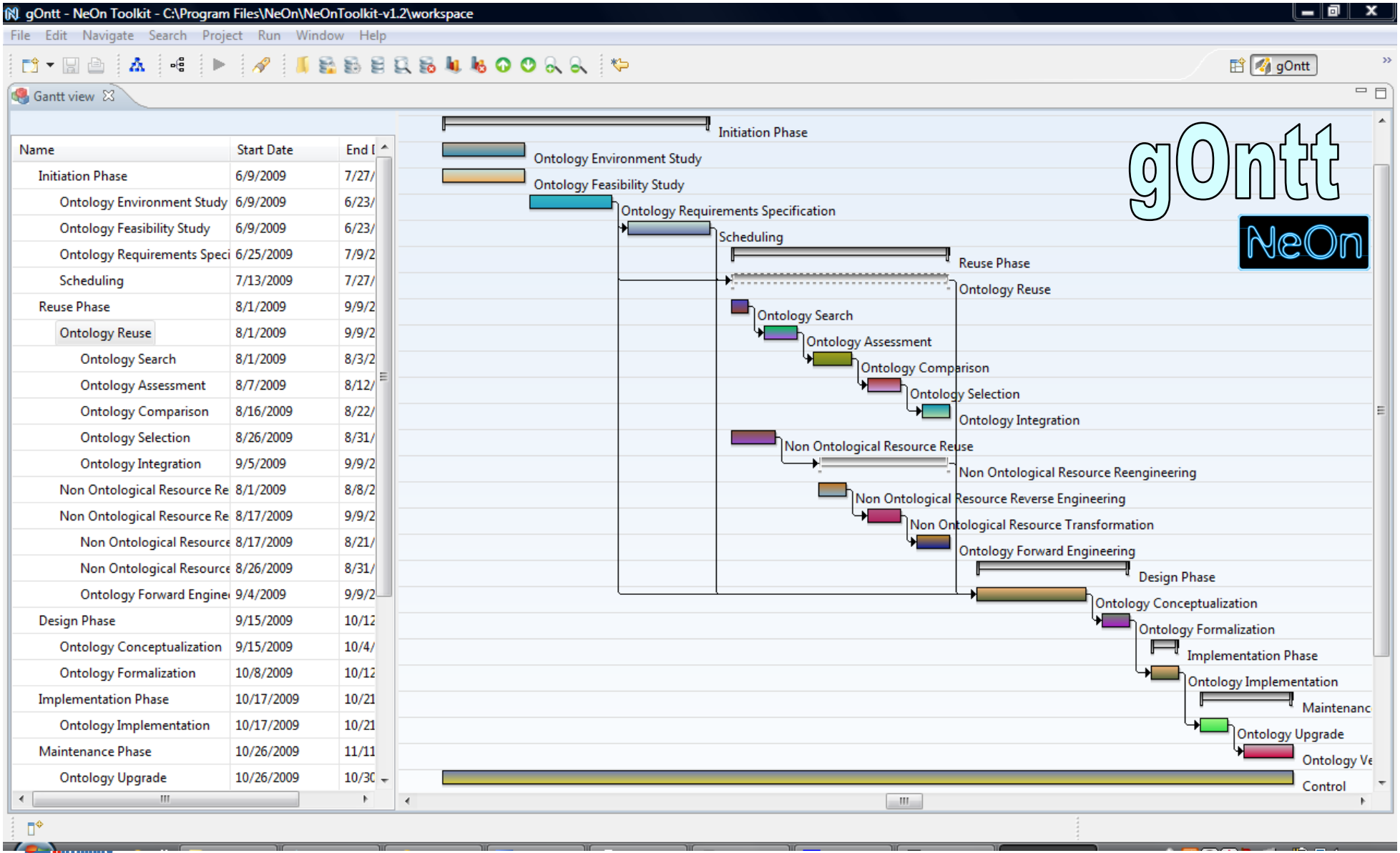




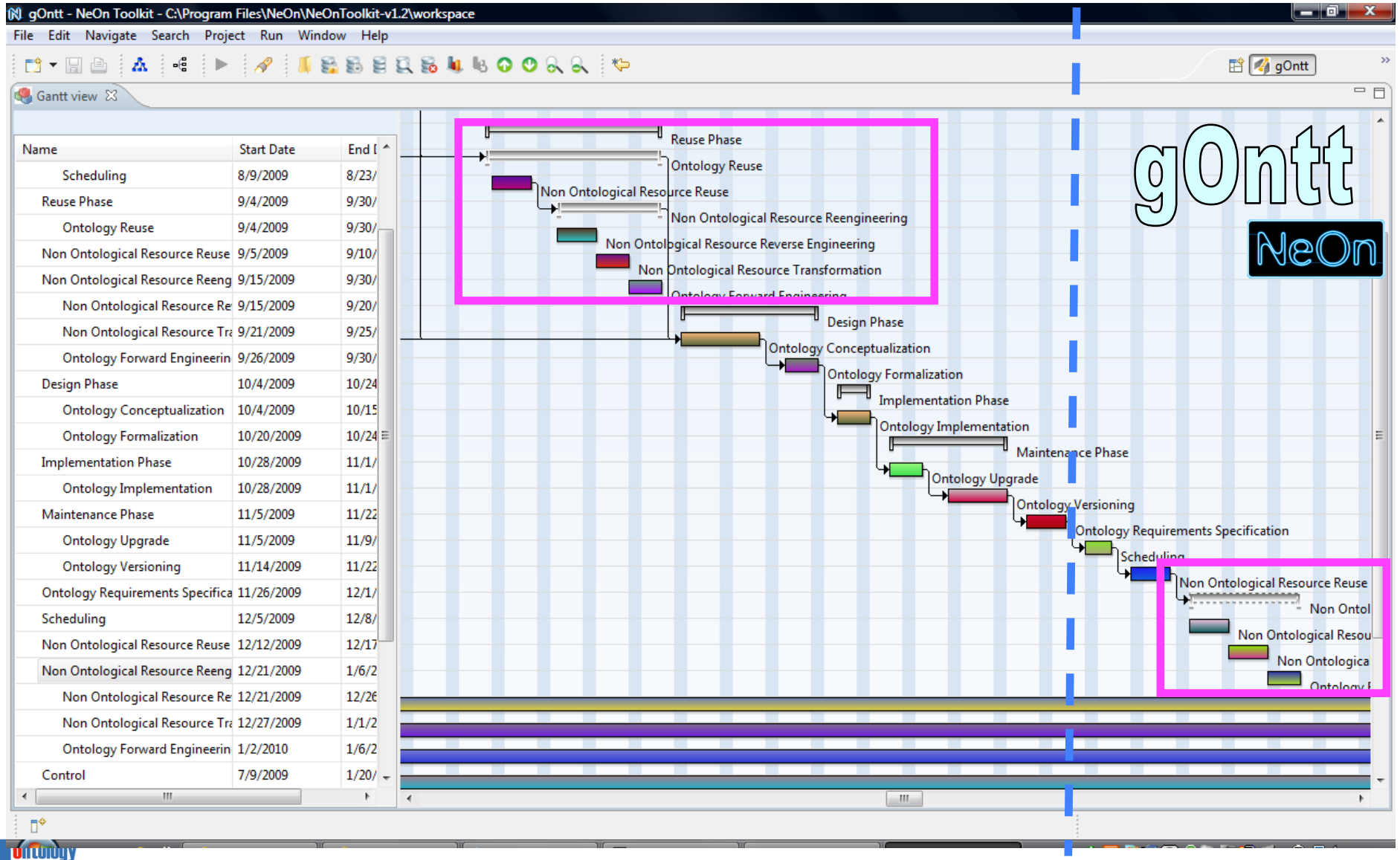
NeOn Methodology



Gantt chart for your project. Waterfall model



Reuse and Re-engineering + Incremental

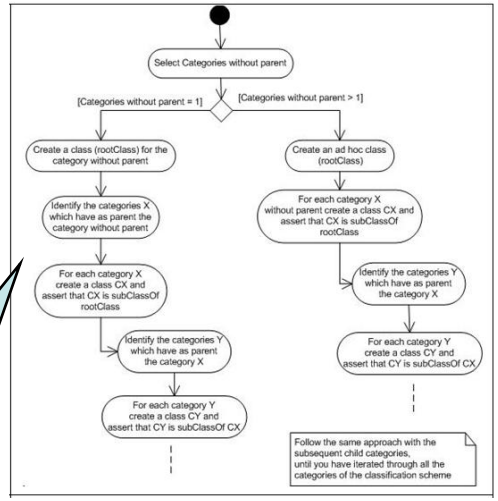


Motivation

resource

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

Algorithm

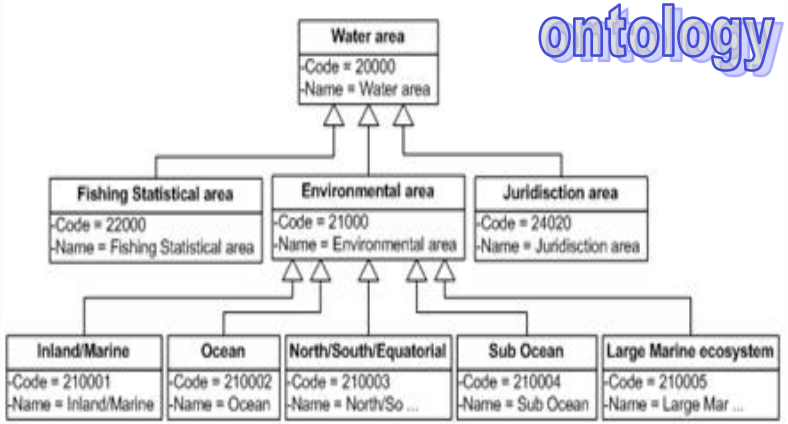


I want to transform my adjacency list-based classification into an ontology

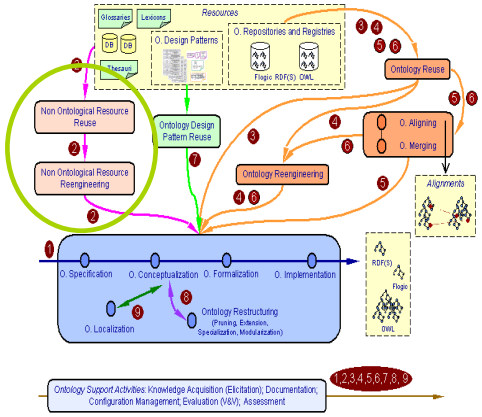
(UML)

Example Solution Ontology

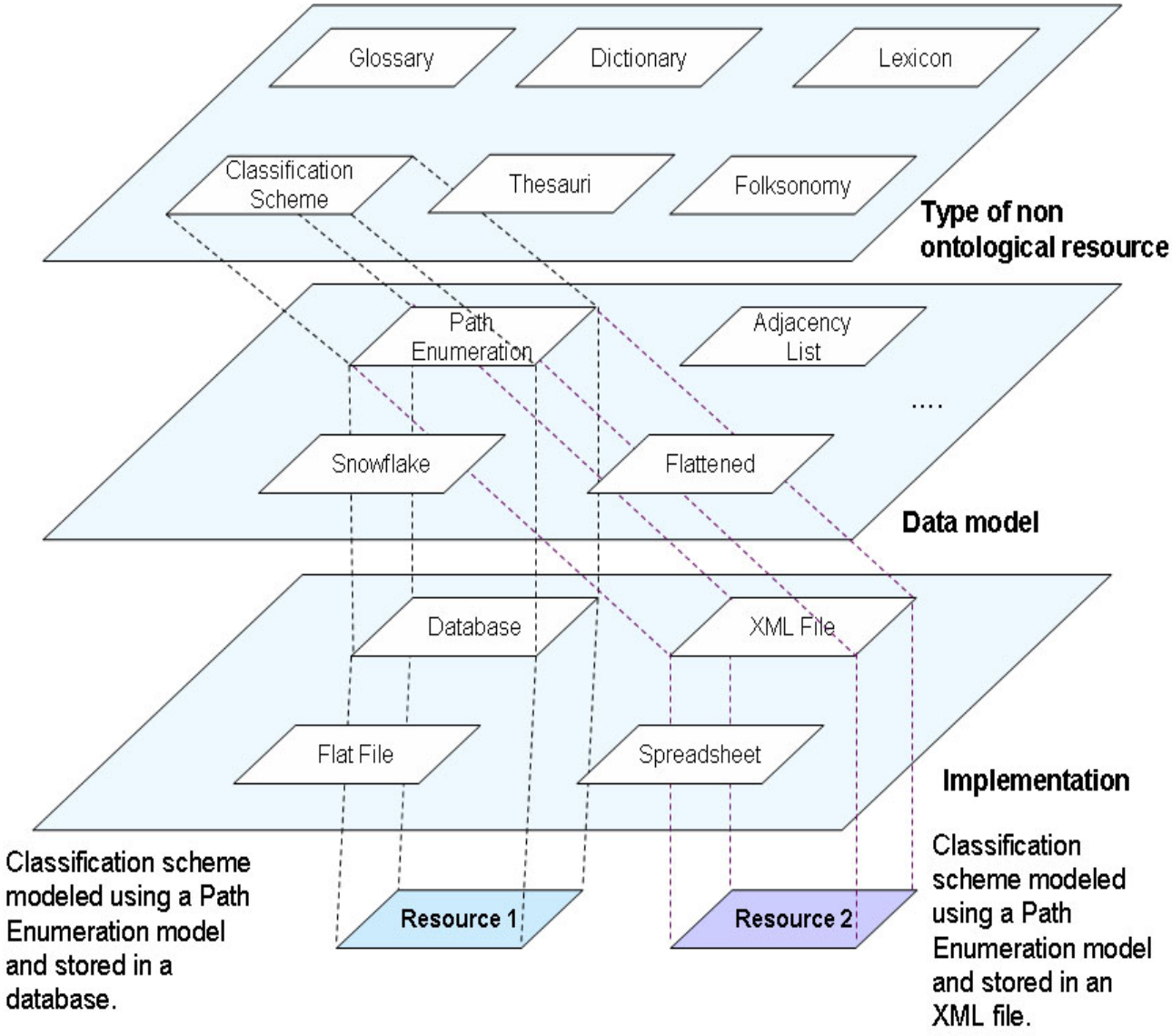
ontology



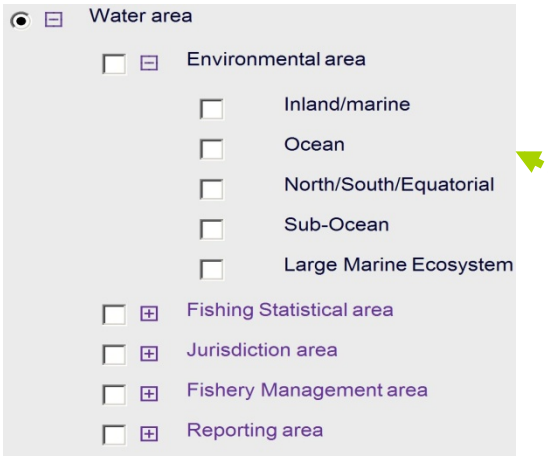
Types of non-ontological resources



Non-Ontological Resources *are knowledge-aware resources whose semantics have not been formalized yet by means of an ontology*

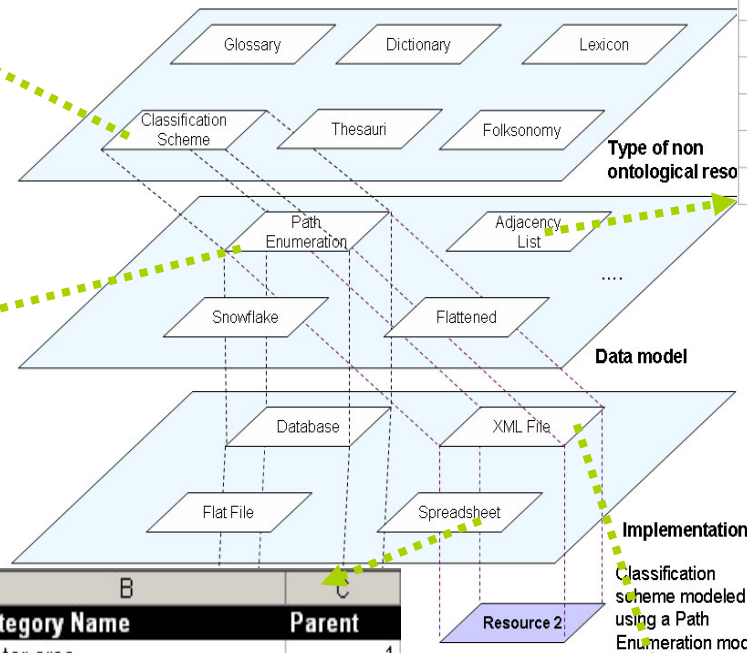


Types of non-ontological resources



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/Equato
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

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  </Category>
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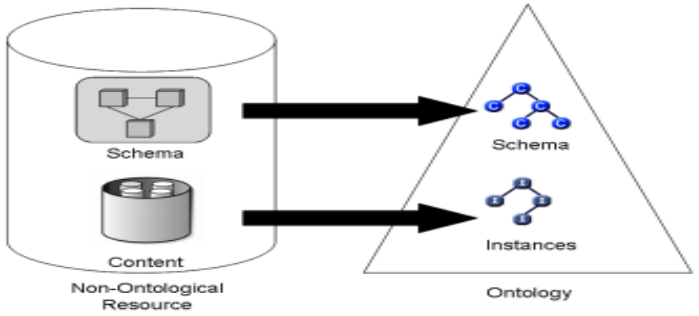
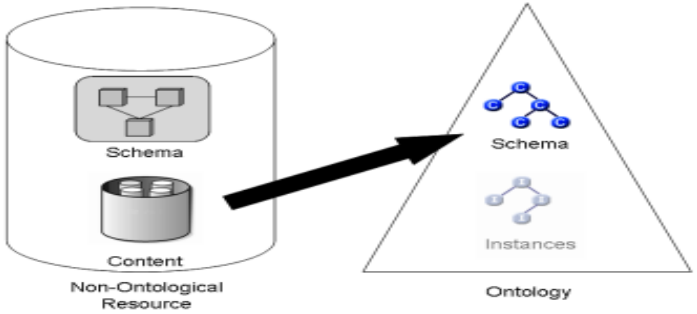
Approaches to transform resources into ontologies

ABox



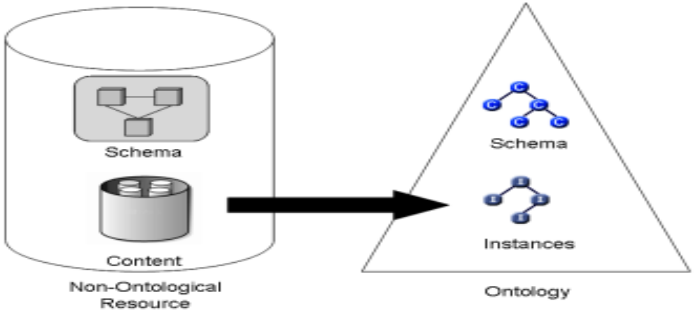
Transforming resource schema into an ontology schema, and resource content into ontology instances

TBox



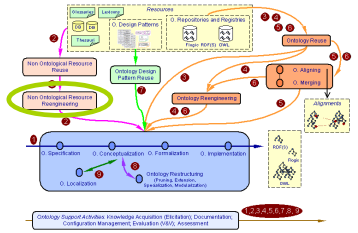
Transforming resource content into an ontology schema

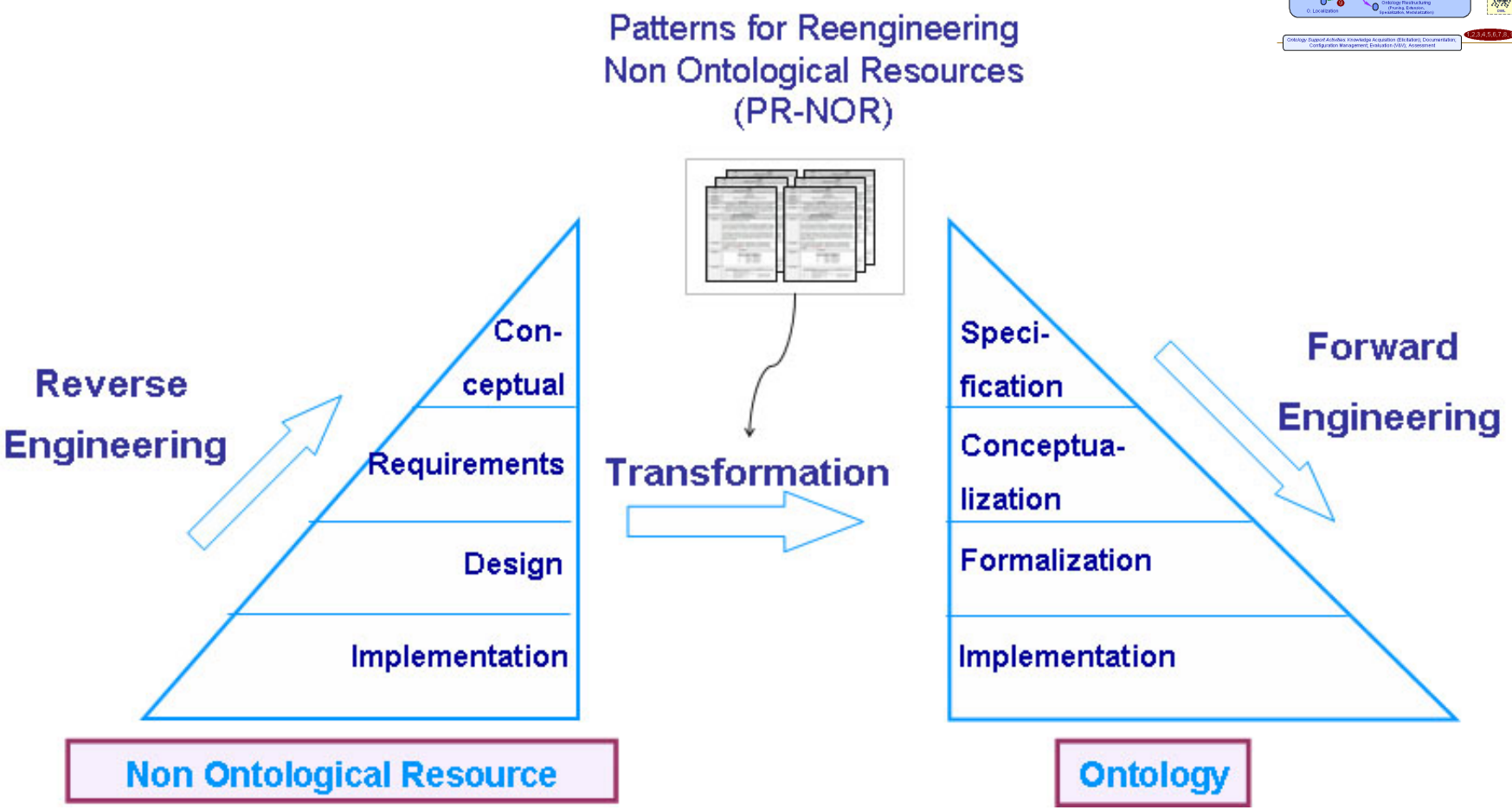
Population



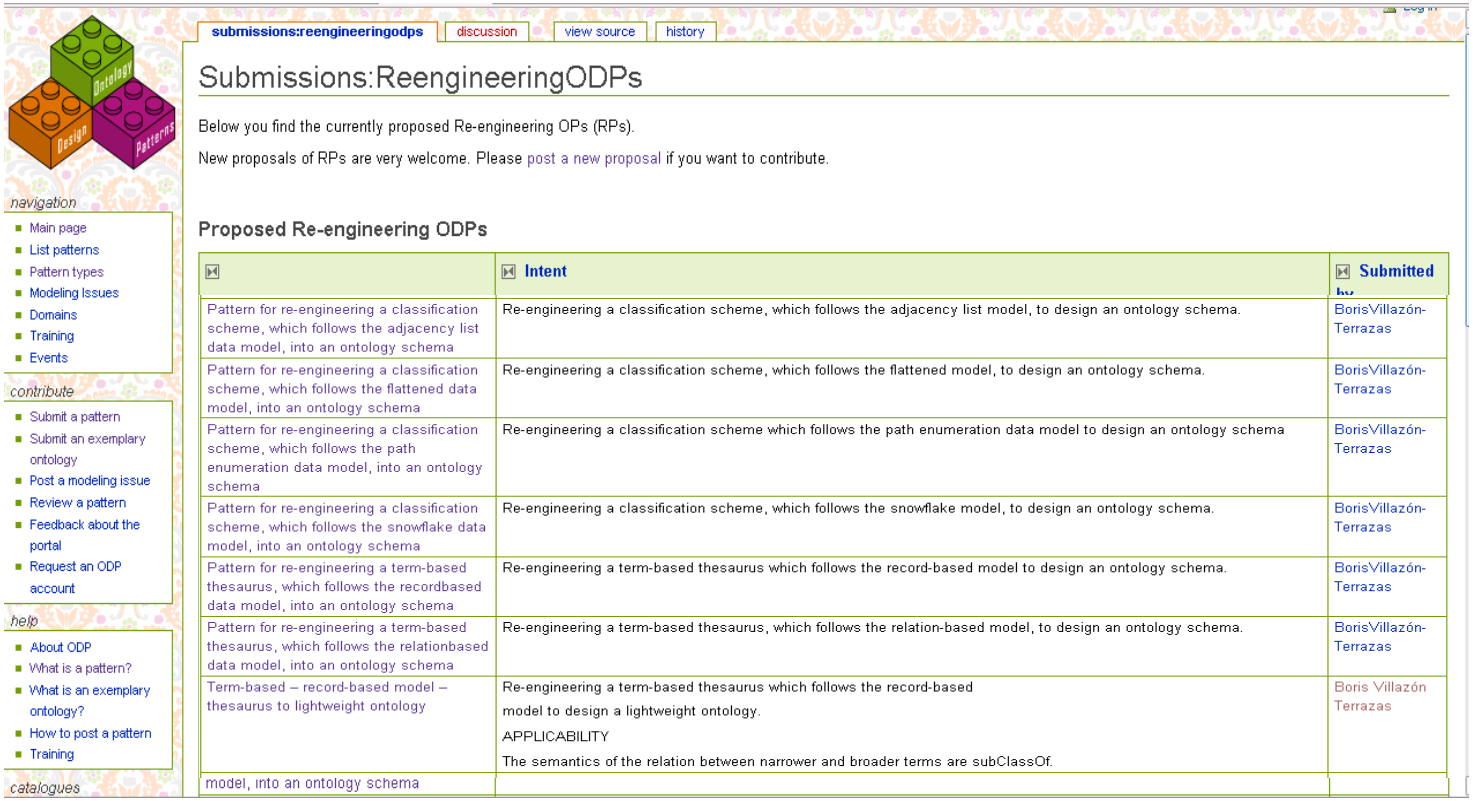
Transforming resource content into instances of an existing ontology

Approach for Re-engineering Non-Ontological Resources





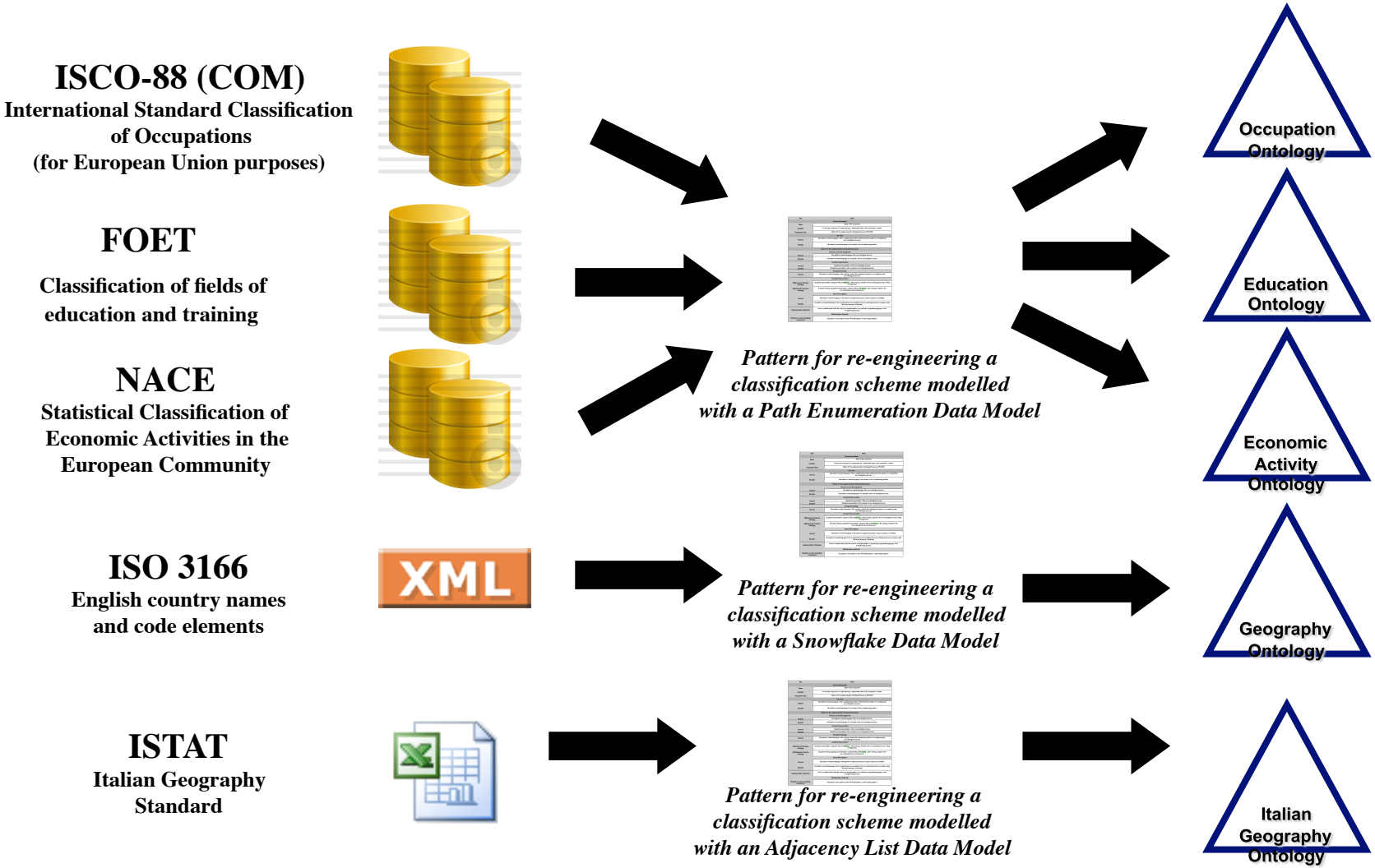
PR-NOR library at the ODP Portal



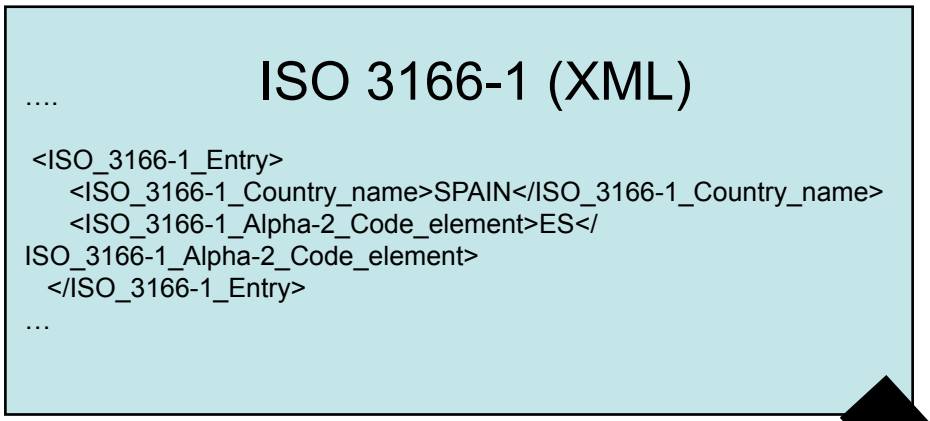
NOR2O: a Library for Transforming Non-Ontological Resources to Ontologies

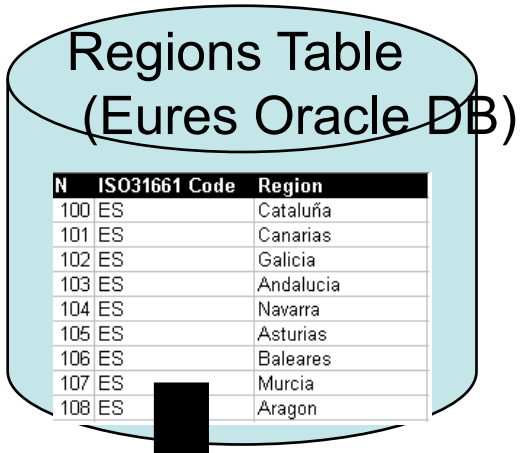
http://mccarthy.dia.fi.upm.es/nor2o/

Pattern based approach for re-engineering non ontological resources



Knowledge Resource Re-engineering and Aggregation





Excerpt of the Geography Ontology

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  <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"/>
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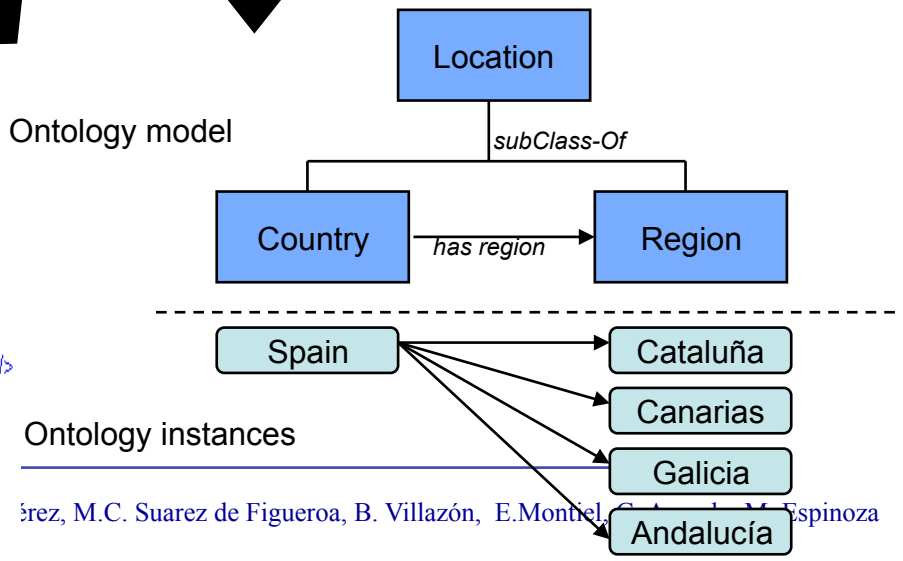
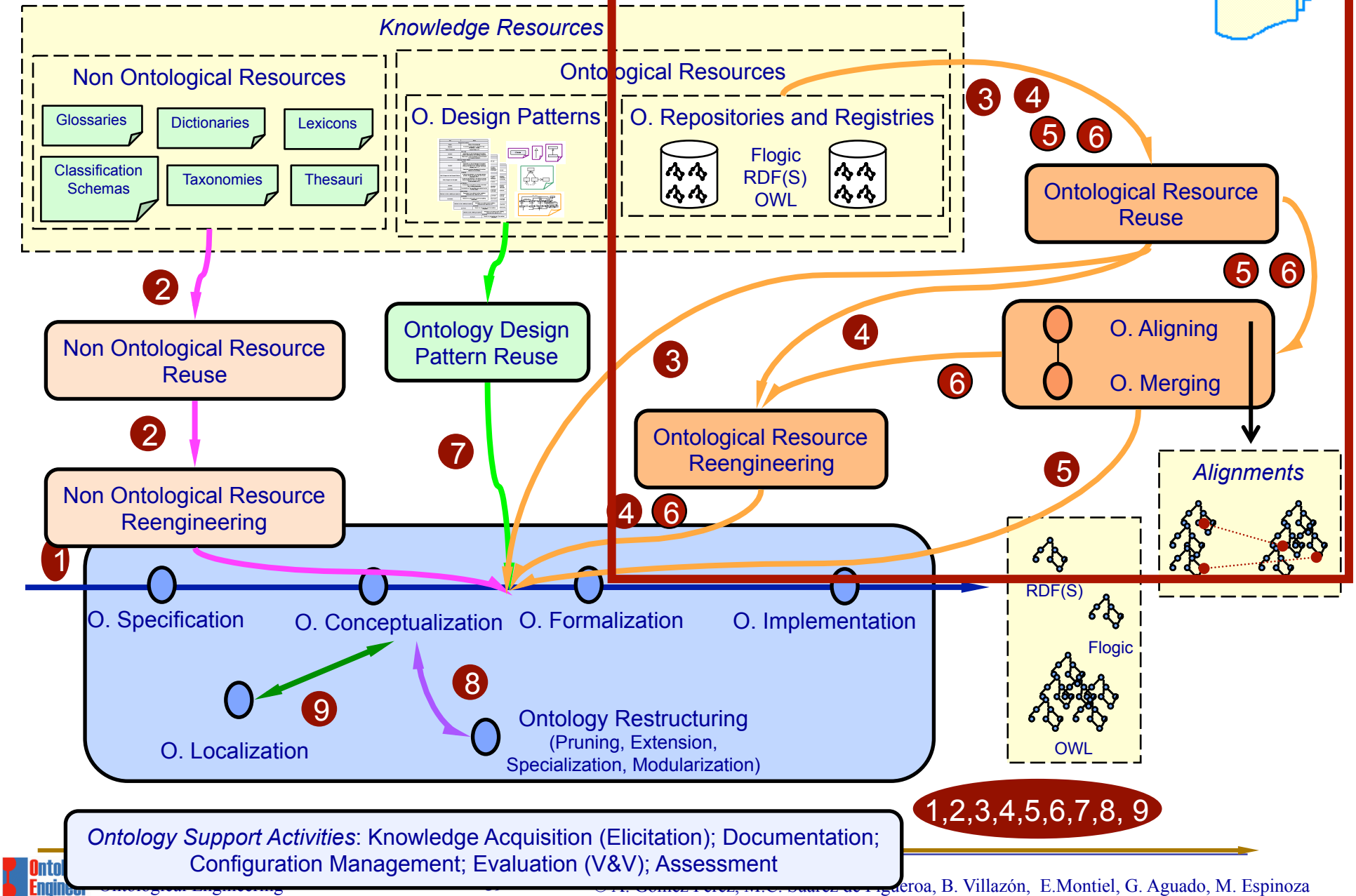
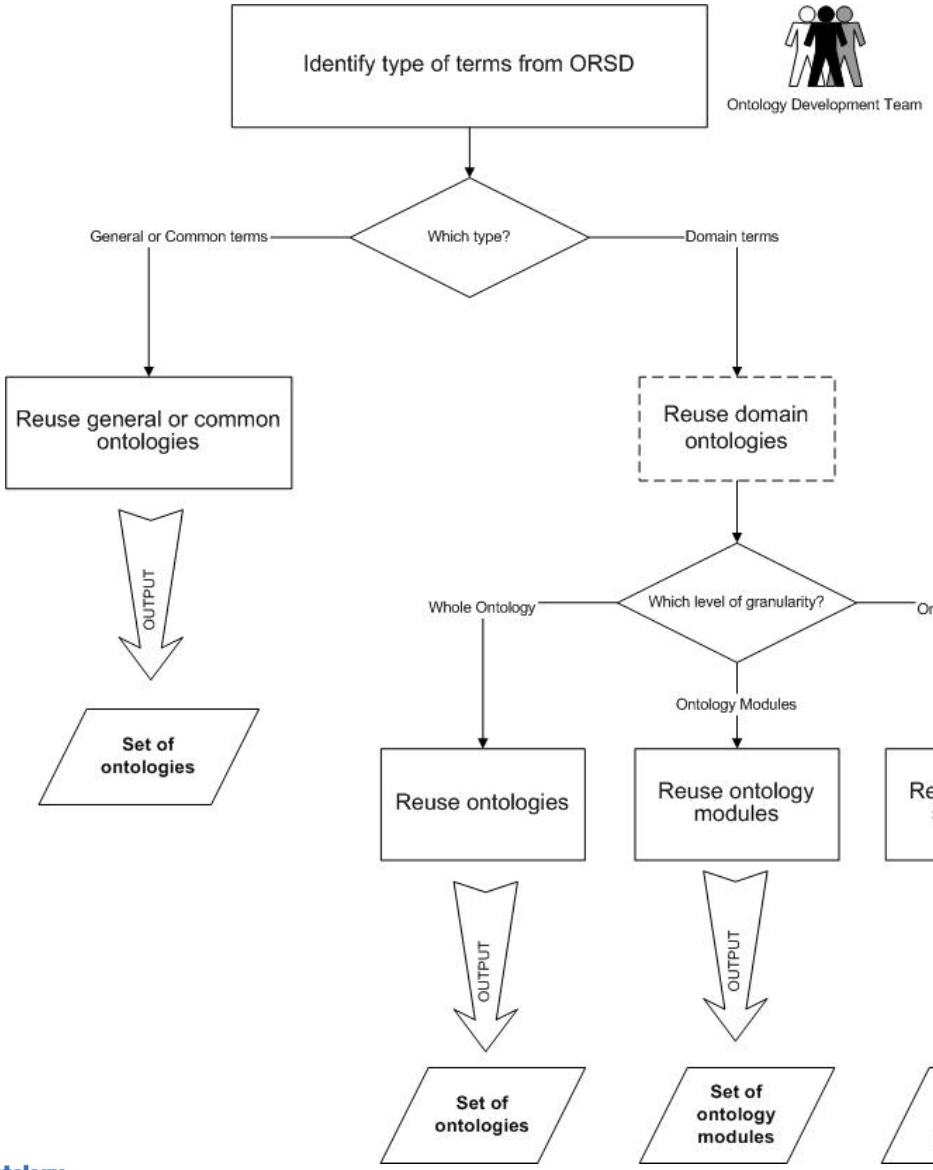
```

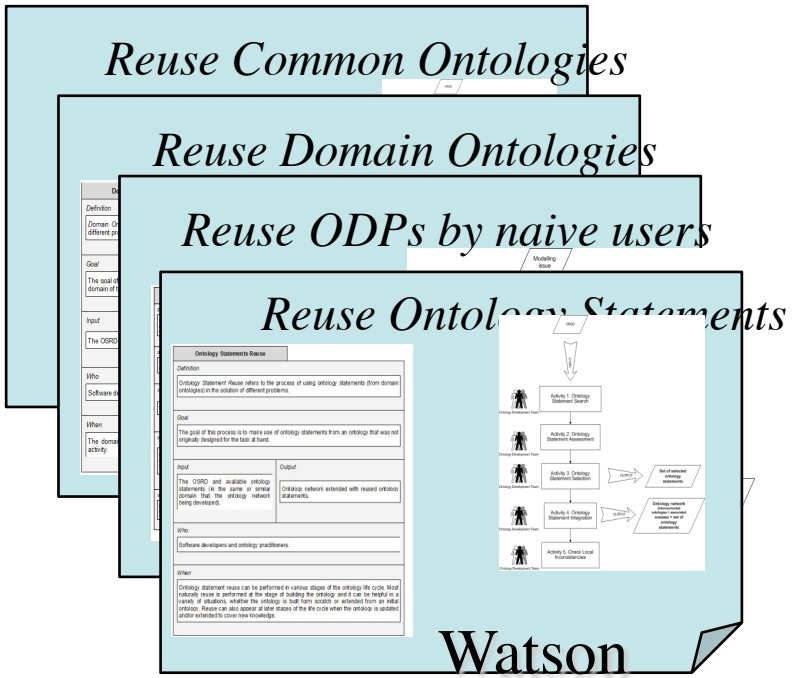


NeOn Scenarios

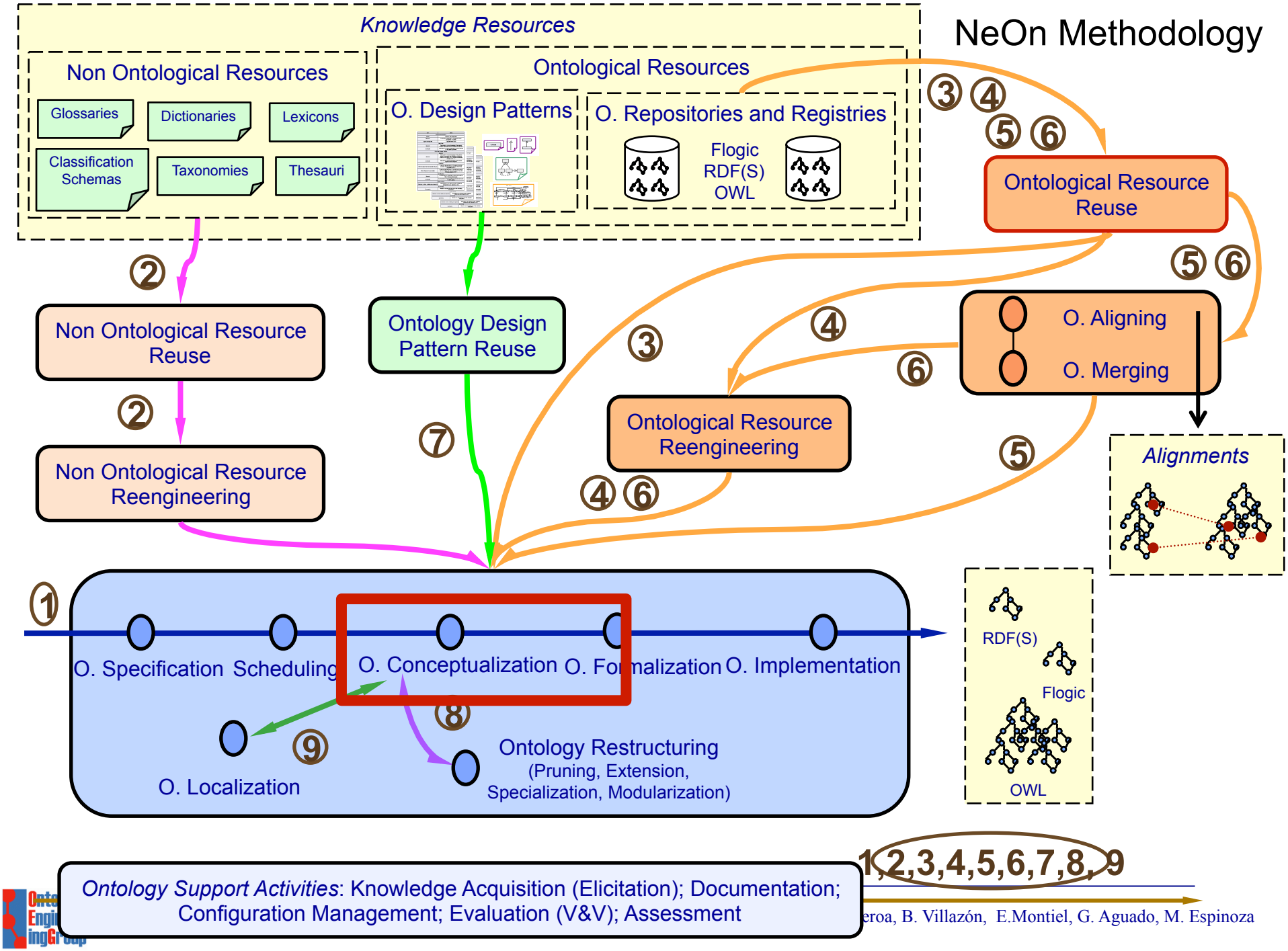


Ontological Resource Reuse Process

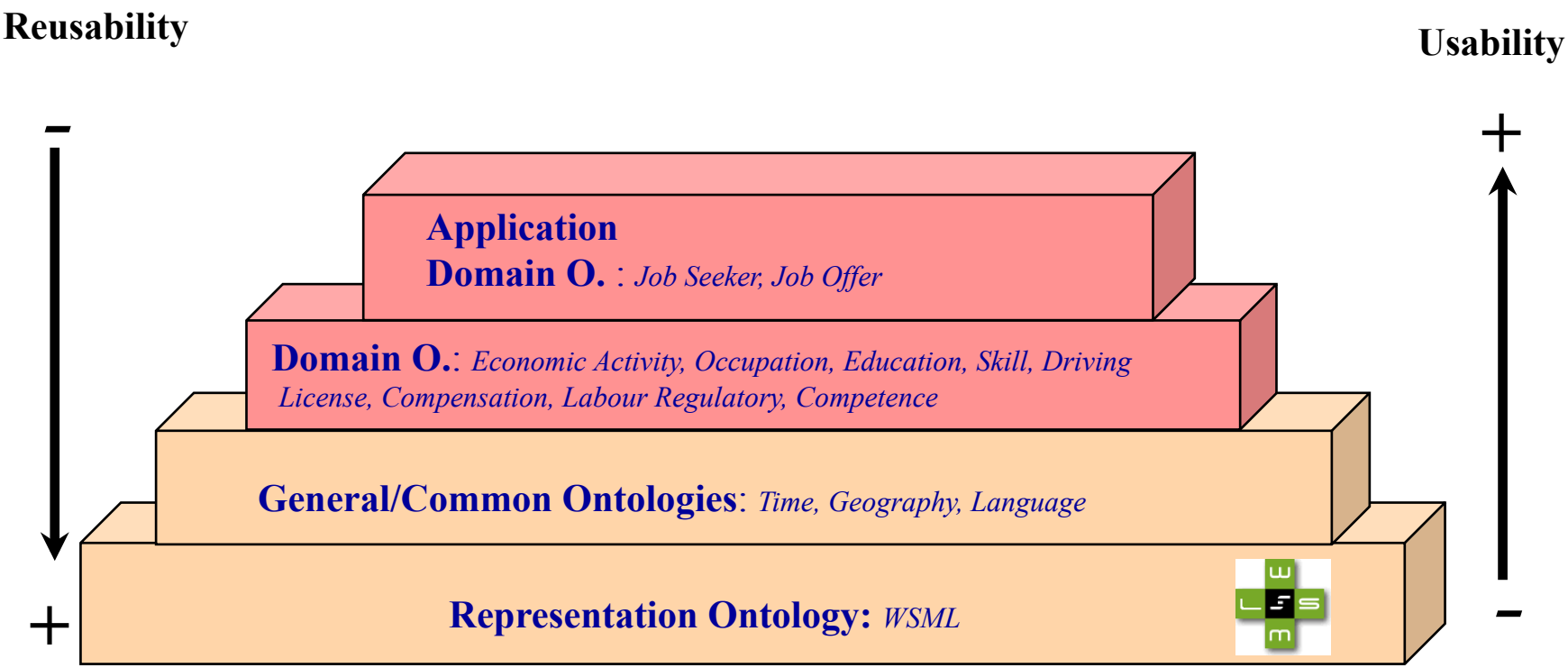




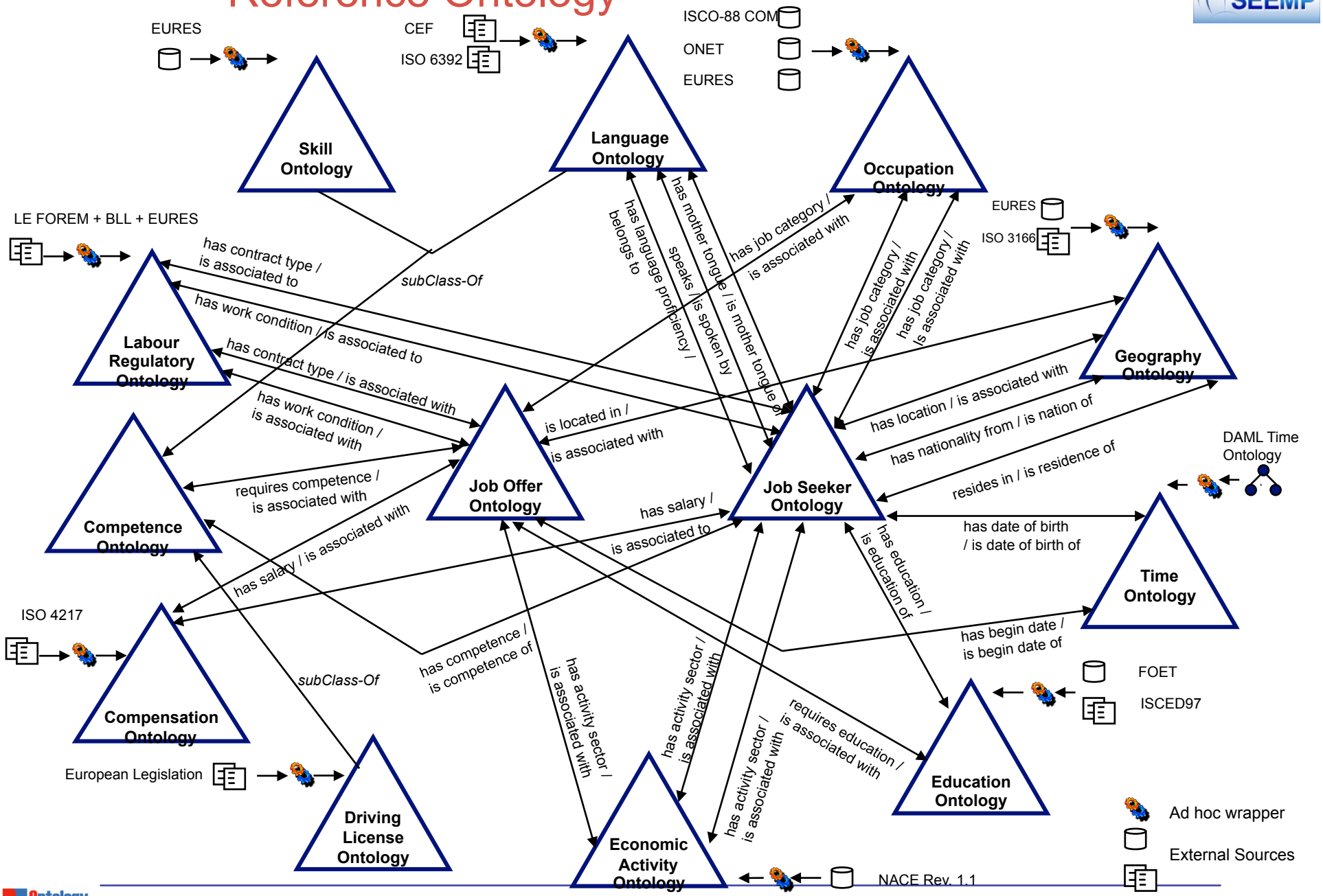
NeOn Methodology



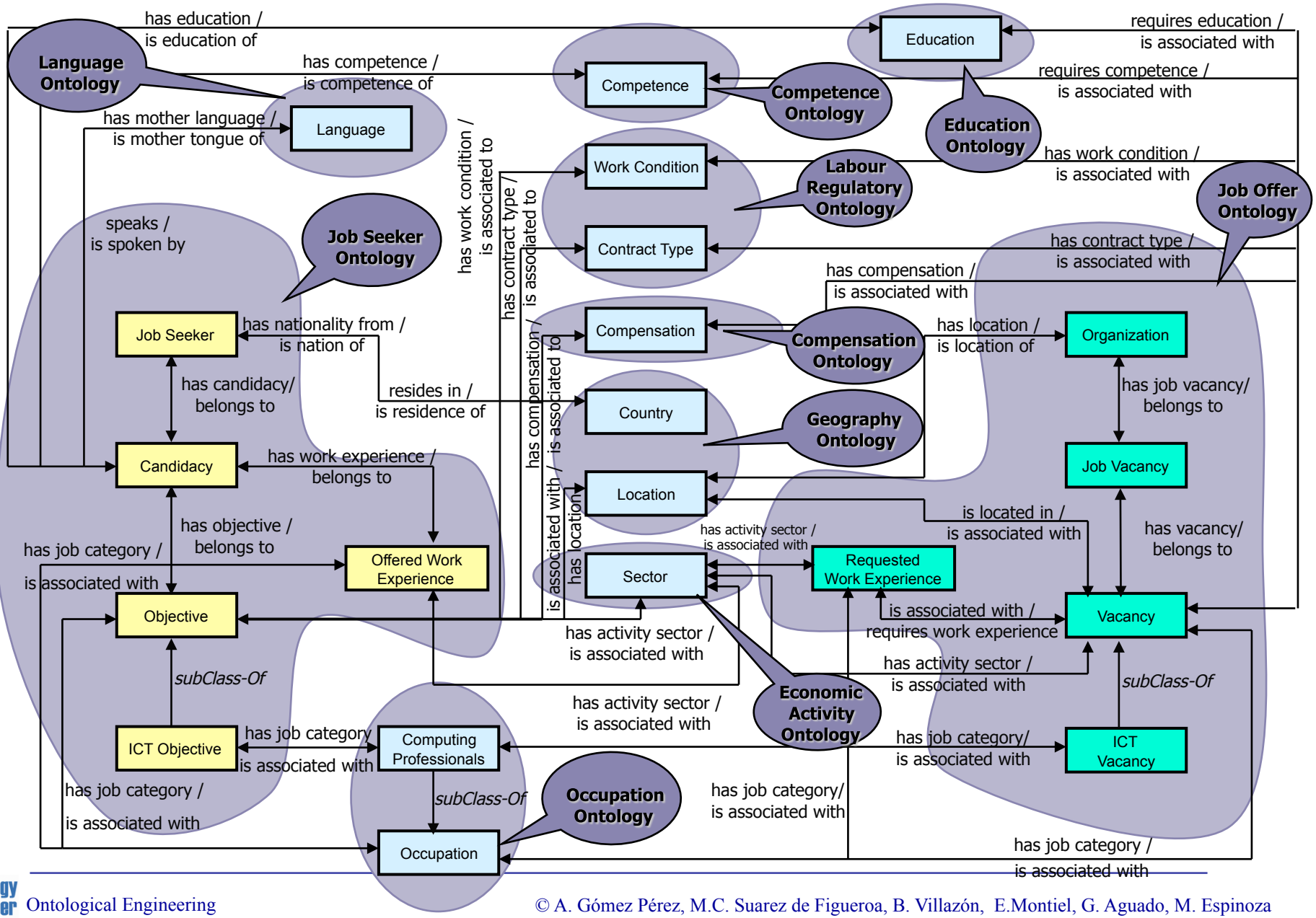
Conceptualization:
Modular approach for ontology construction



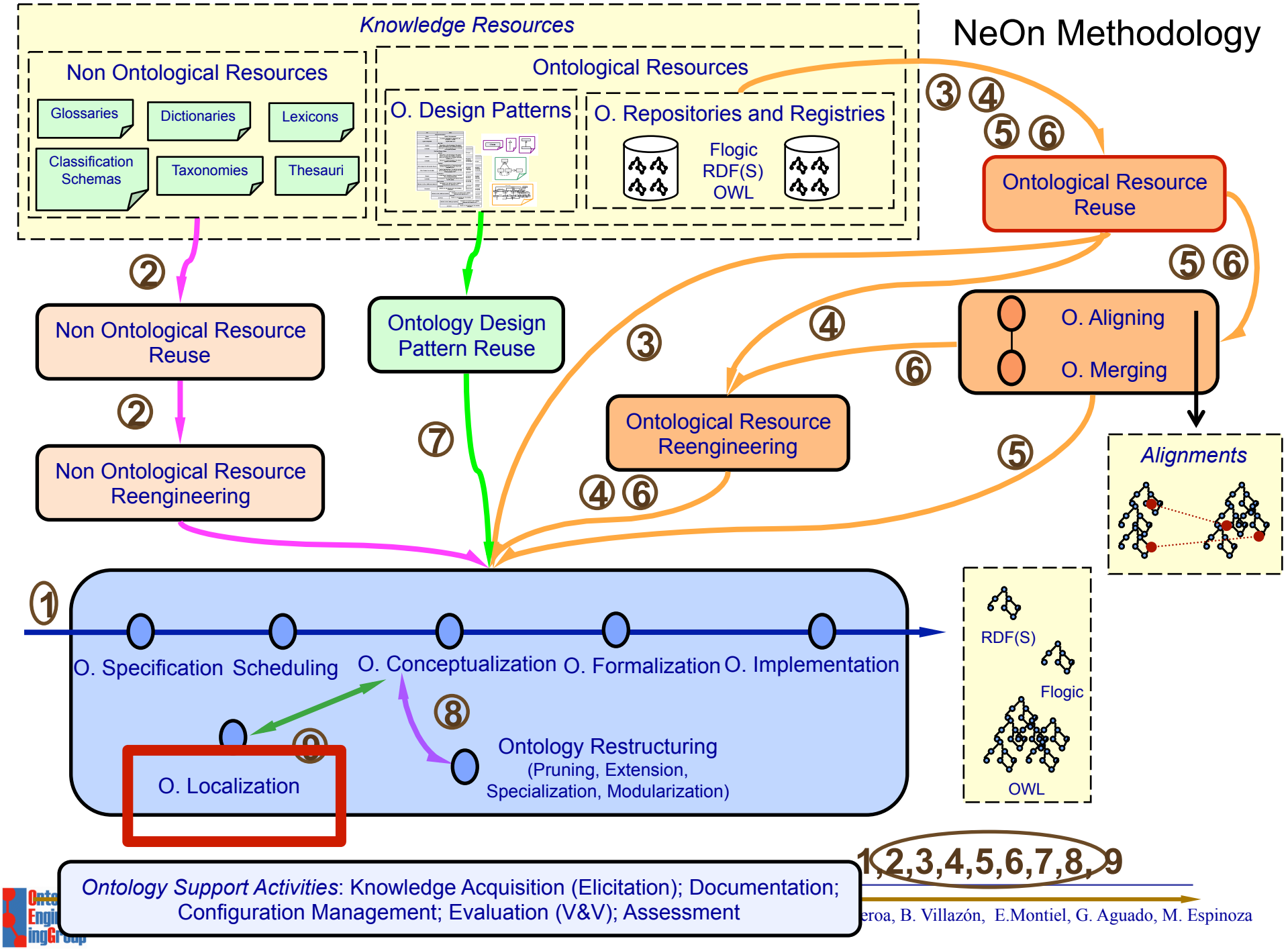
Reference Ontology



Details of the ontology



NeOn Methodology



Ontology Localization

Ontology Localization

Definition

Ontology localization refers to the adaptation of an ontology to particular language and culture

Goal

To translate an ontology expressed in a source natural language into a target natural language.

Input

An ontology whose ontology terms are expressed in one or several natural languages, from which one is selected as source natural language.

Output

An ontology whose ontology terms have been translated to the target natural language.

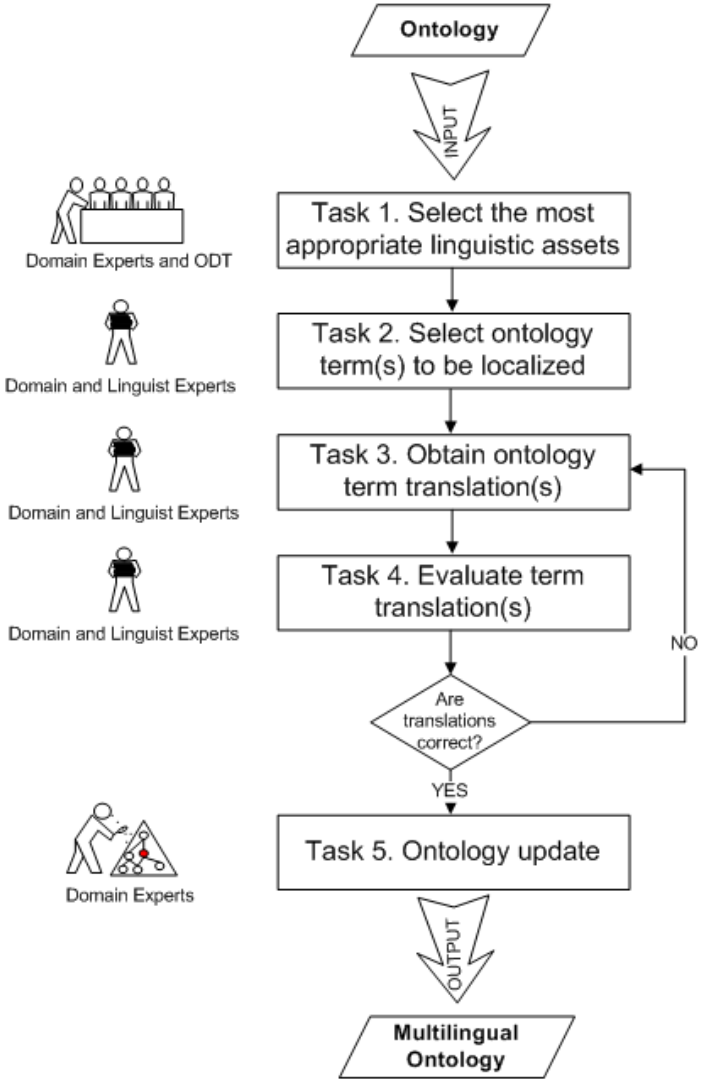
The resulting translations are added to available labels of the original ontology already in one or several languages.

Who

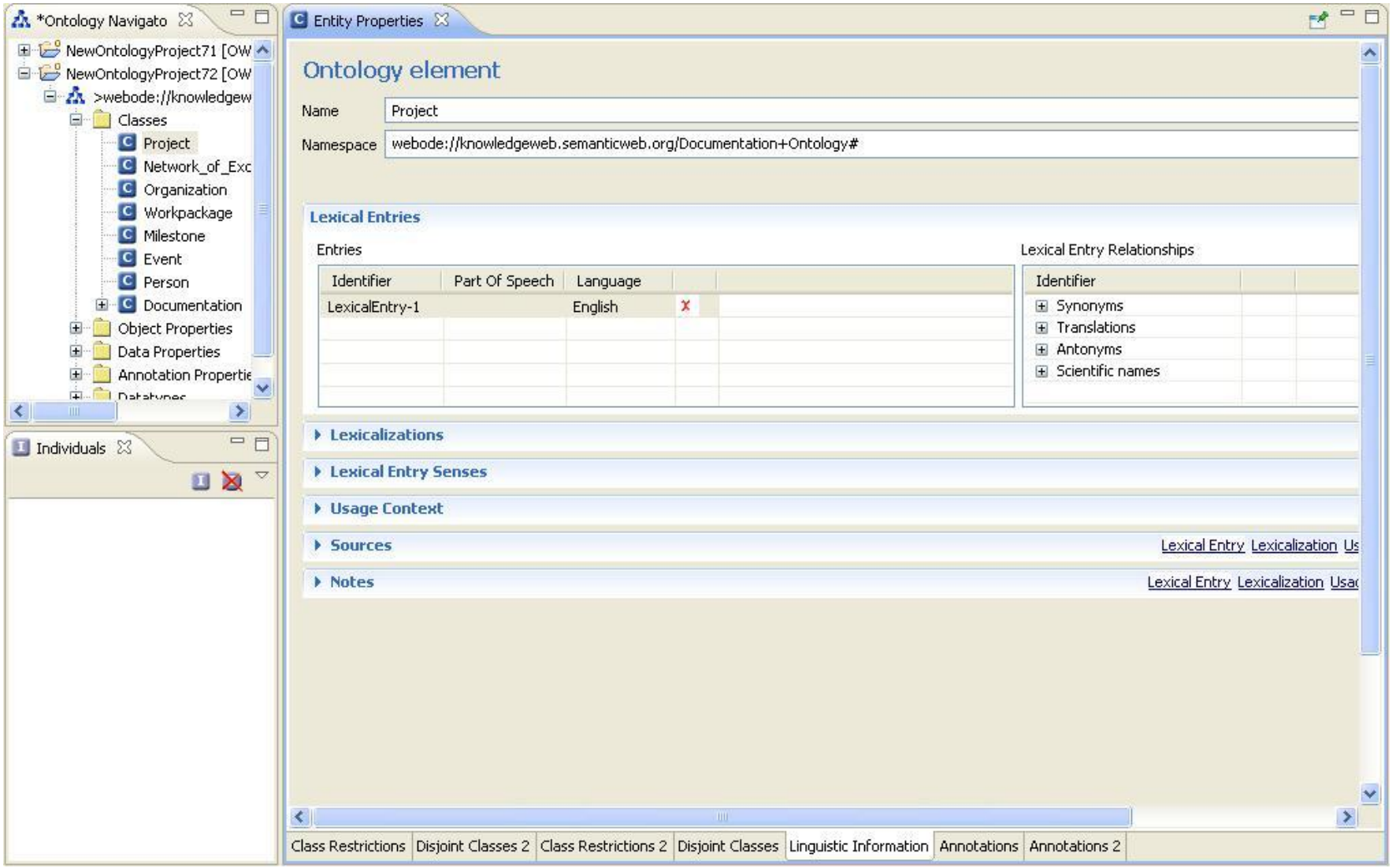
Software developers and ontology practitioners, who form part of the ontology development team, in collaboration with domain and linguistic experts.

When

Once the conceptual model of the ontology is stable, with the aim of avoiding spending time and resources in a model that is not definitive.



LabelTranslator NeOn plugin



Conclusions

1. **The NeOn methodology gives**
   1. **detailed guidelines for building ontologies**
   2. **facilitates the reuse and reengineering of non ontological resources into ontologies**

2. **The reuse of non-ontological resources that have been reached some degree of consensus in a community allows the development of ontologies easier and quicker**

Handbook on the NeOn Methodology

NeOn Book

NeOn Methodology in a Nutshell

Title	Author(s)
Introduction	Asunción Gómez-Pérez, Enrico Motta, Mari Carmen Suárez-Figueroa
Definition of Ontology Networks	Mathieu d'Aquin, Aldo Gangemi, Peter Haase
NeOn Methodology Framework:	
Scenarios for Building Ontology Networks and Glossary of Processes and Activities	Mari Carmen Suárez-Figueroa, Asunción Gómez-Pérez
Collection of Ontology Life Cycle Models	Asunción Gómez-Pérez, Mari Carmen Suárez-Figueroa, Mariano Fernández-López
Methodology guidelines	
Ontology Requirements Specification	Asunción Gómez-Pérez, Mari Carmen Suárez-Figueroa
Searching Ontologies	Mathieu d'Aquin, Holger Lewen
Scheduling using gOntt	Mari Carmen Suárez-Figueroa, Asunción Gómez-Pérez
Reusing and Re-engineering Non-Ontological Resources	Asunción Gómez-Pérez, Boris Villazón-Terrazas
Reusing General Ontologies	Mariano Fernández-López, Asunción Gómez-Pérez, Mari Carmen Suárez-Figueroa
Reusing Domain Ontologies	Mari Carmen Suárez-Figueroa, Asunción Gómez-Pérez
Reusing Statements	Mari Carmen Suárez-Figueroa, Mathieu d'Aquin
Conceptualizing using ODPs	Eva Blomqvist, Enrico Daga, Aldo Gangemi, Valentina Presutti,
Ontology Localization	Elena Montiel-Ponsoda, Mauricio Espinoza
Ontology Evaluation	Marta Sabou
Modularizing Ontologies	Mathieu d'Aquin
Ontology Evolution | Exploiting Tools	Raúl Palma, Peter Haase | Fouad Zablith
Ontology Alignment	Jérôme Euzenat, Chan Le Duc
Technology Support	
NeOn Toolkit Description	Michael Erdmann, Walter Waterfeld
NeOn Plugins	Andreas Harth, Walter Waterfeld, Holger Lewen
Large Scale Development of Ontology Networks	
Fisheries	Caterina Caracciolo, Margherita Sini, Aldo Gangemi
Invoices	Jose Manuel Gómez-Pérez
Nomenclature	Germán Herrrero, Tomas Pariente-Lobo

http://www.neon-project.org/nw/NeOn_Book

▪ 22 Executive Chapter Summaries are available at the NeOn Web Site

Ontology Requirements Specification

Authors: Asunción Gómez-Pérez, Mari Carmen Suárez-Figueroa

What is an Ontology Requirements Specification?

Ontology Requirements Specification

Definition

Ontology Requirements 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) and possibly reach through a consensus process

Goal

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

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 at the beginning of the ontology project and in parallel with the knowledge acquisition activity

What is the output?

Ontology Requirements Specification Document Template

1 **Purpose**
The main goal of the ontology. In other words, the main function or role that that the ontology should have.

2 **Scope**
The general coverage and the degree of detail that the ontology should have.

3 **Implementation Language**
The formal language that the ontology should use.

4 **Intended End-Users**
The intended end-users of the ontology.

5 **Intended Uses**
The intended uses of the ontology.

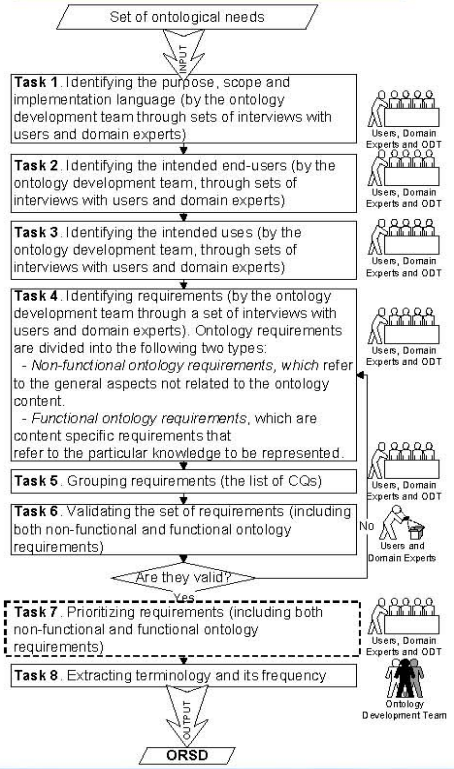
6 **Ontology Requirements**
- **a. Non-Functional Requirements**
  The general requirements or aspects that the ontology should fulfil, including optionally priorities for each requirement.
- **b. Functional Requirements: Groups of Competency Questions**
  The content specific requirements that the ontology should fulfil in the form of groups of competency questions and their answers, including optional priorities for each group and for each competency question.

7 **Pre-Glossary of Terms**
- **a. Terms from Competency Questions**
  The list of terms included in the competency questions and their frequencies.
- **b. Terms from Answers**
  The list of terms included in the answers and their frequencies.
- **c. Objects**
  The list of objects included in the competency questions and in their answers.

Motivation

One of the critical activities when developing ontologies is to identify their requirements. Requirements included in the ORSD facilitates the ontology development in different ways: (1) allowing the identification of which particular knowledge should be represented in the ontology; (2) facilitating the reuse of knowledge resources by means of focusing the resource search towards the particular knowledge to be represented in the ontology; and (3) permitting the verification of the ontology with respect to the requirements that the ontology should fulfill.

What is the process?



Ontology Requirements Specification

Experiments and examples

SEEMP Reference Ontology Requirements Specification Document

1 **Purpose**
The purpose of building the Reference Ontology is to provide a consensual knowledge model of the employment domain to be used by public e-Employment services.

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 **Implementation Language**
The ontology has to be implemented in WSML language.

4 **Intended End-Users**
User 1. Unemployed candidate searching for a job or another occupation for immediate or future purposes
User 2. Employer who needs more human resources.
User 3. Public or private employment search service that provides assistance to gather CVs or job postings and to prepare some data and statistics.
User 4. National and Local Governments that want to analyze the situation on the employment market in their countries and to prepare documents on employment, social and educational policy.

5 **Intended Uses**
Use 1. Publishing CV. Job seeker places his/her CV on the PES Portal.
Use 2. Publishing Job Offer. An Employer places a Job Offer on the PES Portal.
Use 3. Searching for Job Offers. The Employer looks for candidates for the Job Offer through the PES Portal.
Use 4. Searching for Employment information. Job Seeker looks for general information about employment in a given location at the PES Portal.

6 **Ontology Requirements**

a. Non-Functional Requirements
NFR1. The ontology must support a multilingual scenario in the following languages: English, Spanish, Italian, and French.
NFR2. The ontology must be based on the international, European or de-facto standards in existence or under development.

b. Functional Requirements: Groups of Competency Questions

CQG1. Job Seeker (14 CQ)	CQG2. Job Offer (11 CQ)
CQ1. What is the Job Seeker's name? Lewis Hamilton	CQ12. What is the employer's information? CEFRIEL Research
CQ2. What is the Job Seeker's nationality? British; Spanish; Italian; French;	Company, Milano, Italy; ATOS, Madrid, Spain
CQ3. What is the Job Seeker's contact information? Tel: 34600654231. Email: jsanz@fi2.upm2.es	CQ13. What kind of job does the employer's offer? Java Programmer; C Programmer, Database administration
CQ4. What is the Job Seeker's current job? Programmer; Computer Engineer; Computer Assistant	CQ14. What kind of contract does the employer's offer? Seasonal Job; Autonomous
CQ5. Which is the Job Seeker's desired job? Radio Engineer; Hardware designer; Software Engineer	CQ15. How much salary does the employer's offer? 3500 Euros, 3000 USD
CQ6. Which are the Job Seeker's desired working conditions? Autonomous; Seasonal Job; Traineeship; Consultant	CQ16. What kind of economical activity does the employer have? Research; Financial; Education; Industrial
CQ7. What kind of contract does the Job Seeker want? Full time; Partial time; Autonomous; Seasonal Job	CQ17. What is the description of the job offer? Sun Certified Java Programmer
CQ8. What is the Job Seeker's work experience? 6 months, 1 year, 2 years	CQ18. What are the working conditions of the job offer? Full time; Partial time; Autonomous; Seasonal Job
CQ9. What is the Job Seeker's area of knowledge? Java Programming; C Programming, Database Administration	CQ19. What is the required education level for the job offer? Basic education; Higher education/University
CQ10. What is the Job Seeker's expertise? Software Engineering	CQ20. What is the required work experience for the job offer? 1 year, 2 years, 3 years, 4 years, 5 or more years
CQ11. Which are the Job Seeker's skills? SQL programming, network administration	CQ21. What is the required knowledge for the job offer? Java, Haskell, Windows
	CQ22. What are the required skills for the job offer? ASP Programmer, Data warehouse, Hardware programming

7 **Pre-Glossary of Terms**

a. Terms from Competency Questions + Frequency

Job Seeker	27	Name	4	Address	1	Objective	3
CV	2	Gender	1	Nationality	1	Job Category	3
Personal Information	3	Birth date	1	Contact (phone, fax, mail)	3	...	

b. Terms from Answers + Frequency

SW engineer, programmer	5	Autonomous, Seasonal Job,	2	Research, Financial, Education	4	3000 Euros per month	1
British, Spanish, Italian, French	1	Basic education, Higher education	1	1 year, 2 years, 3 years	1	CEFRIEL Research Company	1

c. Objects
Andorra, Argentina, Australia, Bolivia, France, Italy, Spain, etc.; Euro, Zloty, Great British Pound, US Dollar, Peso, etc.; CEFRIEL, ATOS, etc.

Additional information:

- NeOn Deliverable D5.4.1 (http://www.neon-project.org/web-content/images/Publications/neon_2008_d5.4.1.pdf)
- ODBASE'09 Paper: "How to write and use the Ontology Requirements Specification Document". Mari Carmen Suárez-Figueroa, Asunción Gómez-Pérez, and Boris Villazón-Terrazas

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