

ATHENS Course: Ontologies and the Semantic Web

Ontologies: Life Cycles and Methodologies



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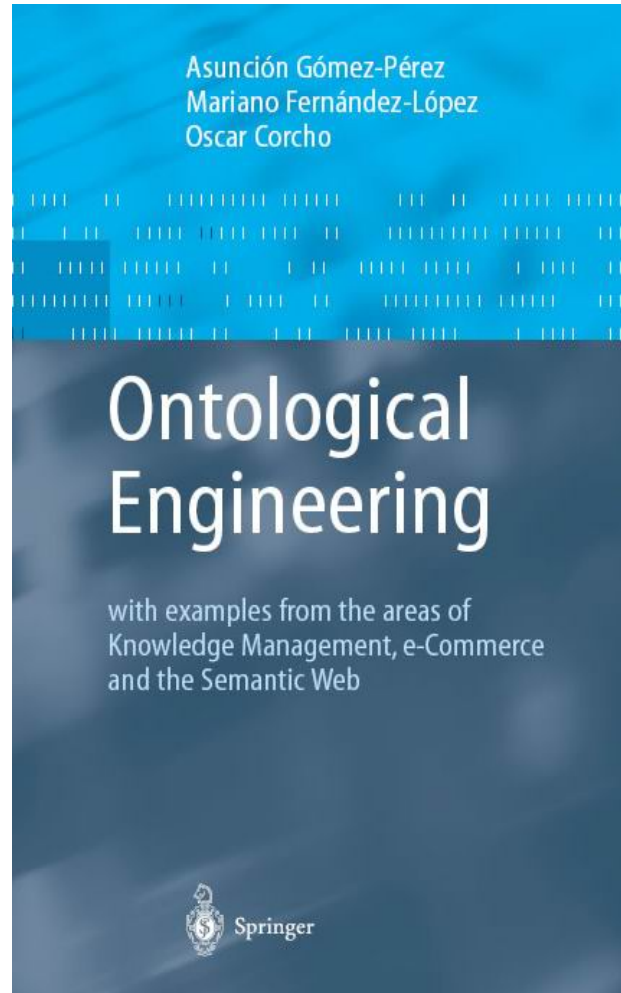
Ontology Engineering Group. Laboratorio de Inteligencia Artificial

Facultad de Informática

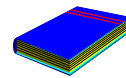
Universidad Politécnica de Madrid

Madrid. November 17th, 2009

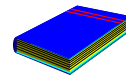
Main References



<http://www.neon-project.org>



D5.3.1 and D5.3.2 on NeOn Development Process and Ontology Life Cycle



D5.4.1 and D5.4.2 on NeOn Methodology for Building Contextualized Ontology Networks

Acknowledgements

- Asunción Gómez-Pérez, Mariano Fernández-López, and Boris Villazón
 - Most of the slides have been done jointly with them

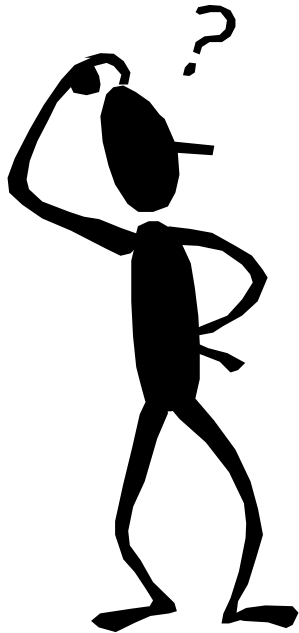
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- ☐ Methodological Guidelines for Ontology Requirements Specification
- ☐ Quick Search of Existing Knowledge Resources
- ☐ Methodological Guidelines for Scheduling
- ☐ Methodological Guidelines for Reusing Existing Knowledge Resources
- ☐ Conclusions

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I want to build my ontology



- Which ones are the activities involved in the ontology development process?
- Which one is the goal of each activity?
- Which activities do I need in my development?
- When should I carry out each activity?
- Where is the relationship of one activity with the others?
- Where can I find ontologies with the goal of reusing them?
- How can I build the ontology for my application?
- Do I need a single ontology or an ontology network?
- Etc.

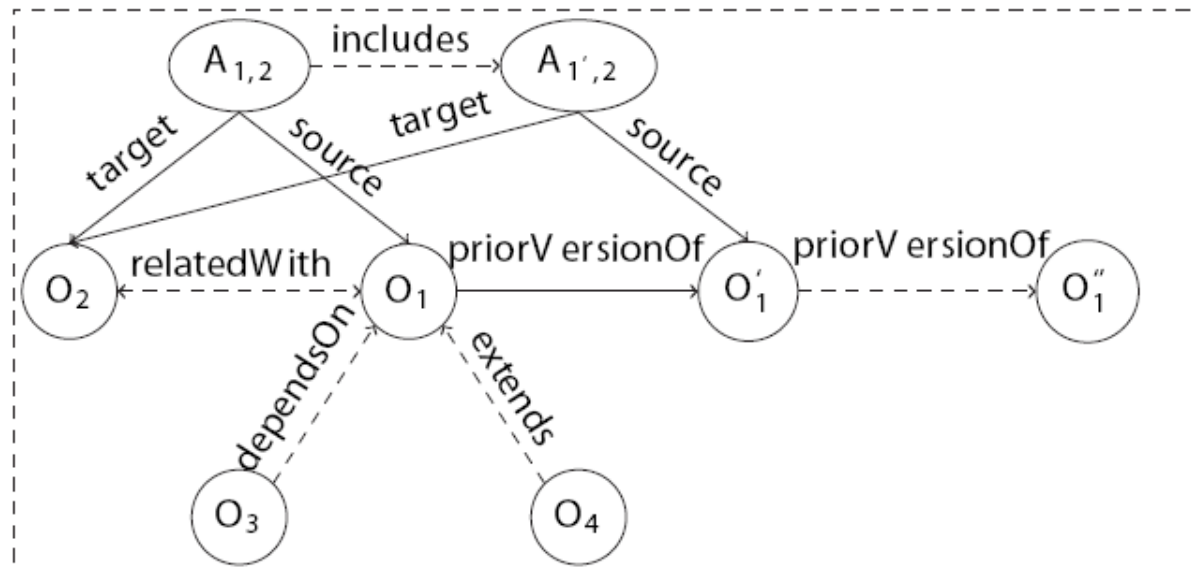
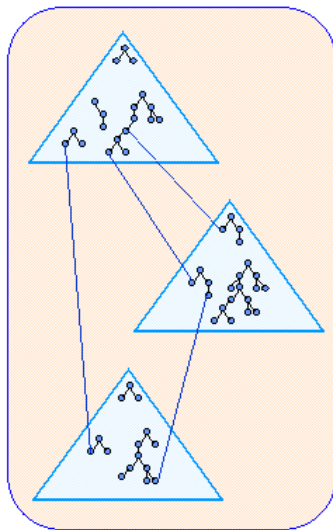
New Trends in Ontology Development

The development of ontologies in different international and national projects have revealed that **there are different alternative ways or possibilities to build ontologies.**

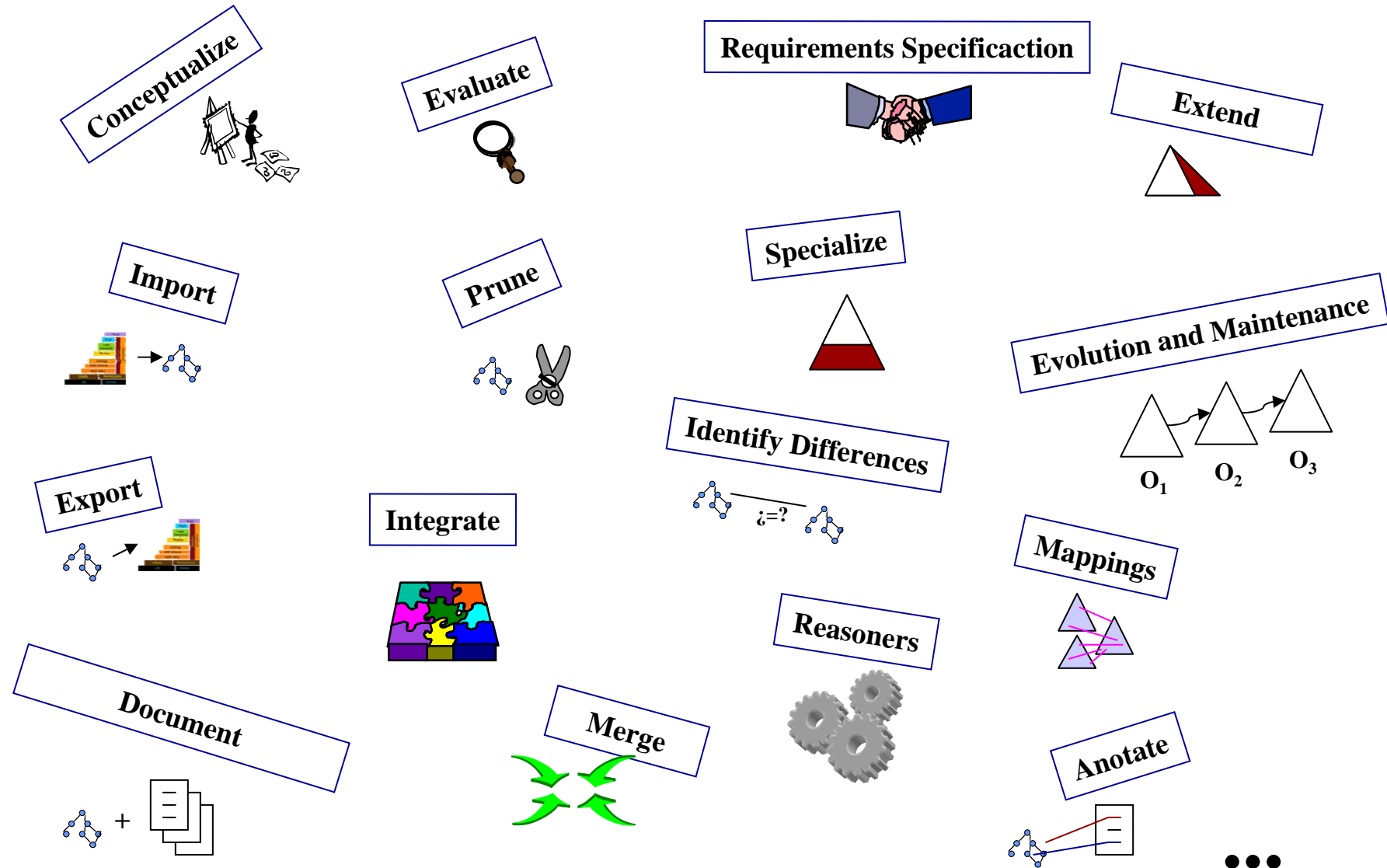
- ☐ In the Esperonto project ontologies were built **from scratch.**
- ☐ In Knowledge Web the **aligning and versioning of ontologies** was treated as well as the **use of best practices or patterns**, related to W3C activities.
- ☐ In the SEEMP project the development of ontologies is based on the **reuse of non ontological resources.**
- ☐ The SEKT project was focused on **argumentative development of ontologies** using the DILIGENT methodology.
- ☐ In the UMLS Project the experiences gained while transforming the **UMLS® Semantic Network into OWL ontology** are described.
- ☐ Within the UK PRODIGY and Drug Ontology Projects the **transformation of tangled hierarchies into formal ontologies** is described.
- ☐ Etc.

Ontology Networks

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



Activities for Developing Ontologies

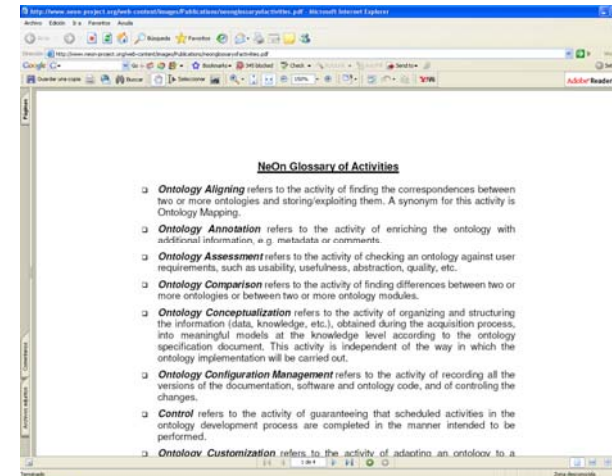


The NeOn Glossary of Activities

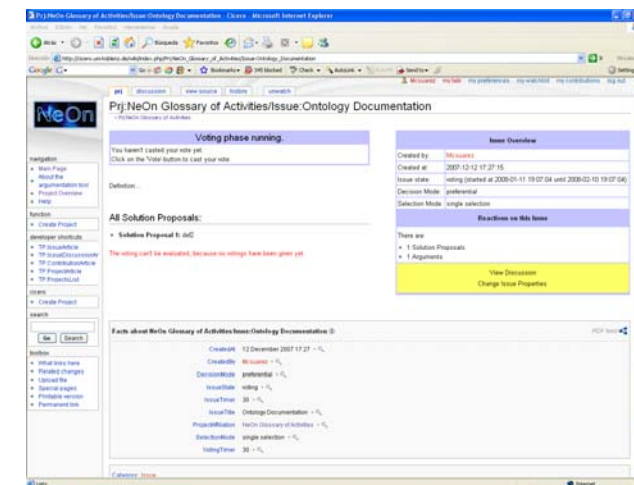


D5.3.1

- Publication in the NeOn website (<http://www.neon-project.org>)



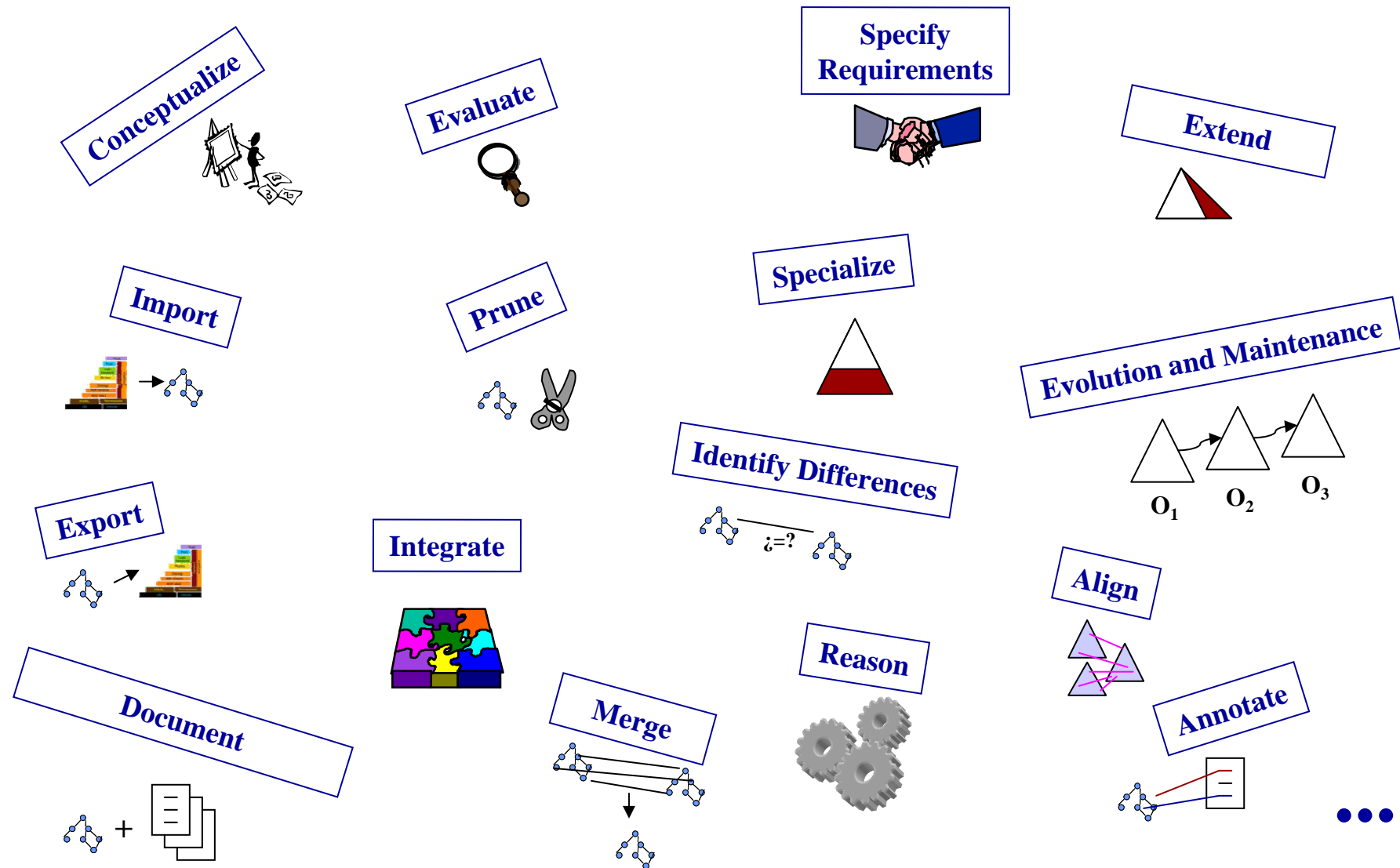
- On-going procedure for getting feed-back from the community using Cicero (<http://cicero.uni-koblenz.de>) developed in WP2



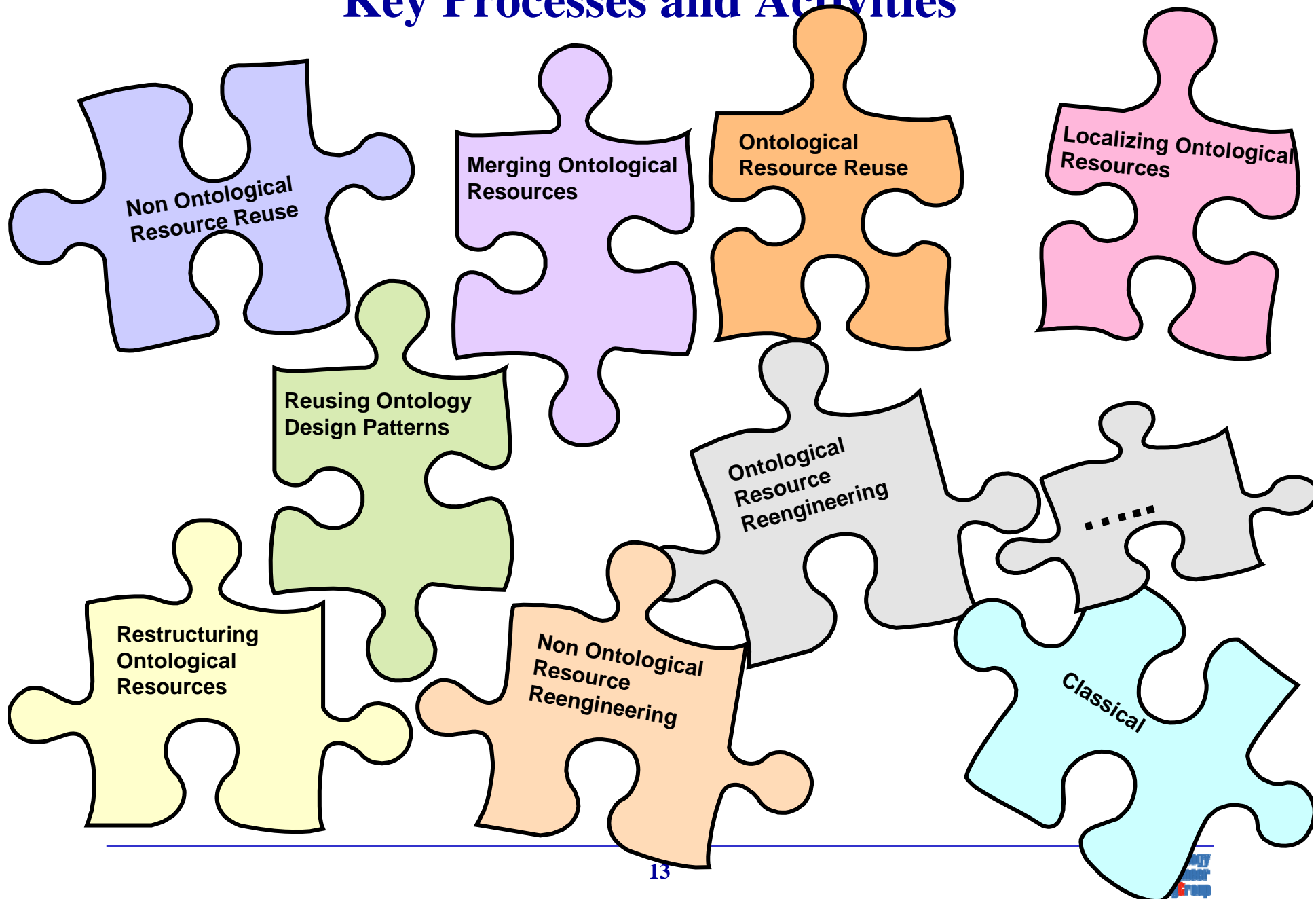
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Activities for Building Ontologies

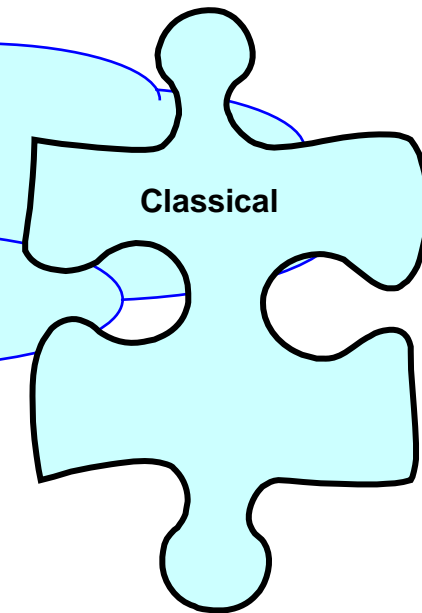


Key Processes and Activities



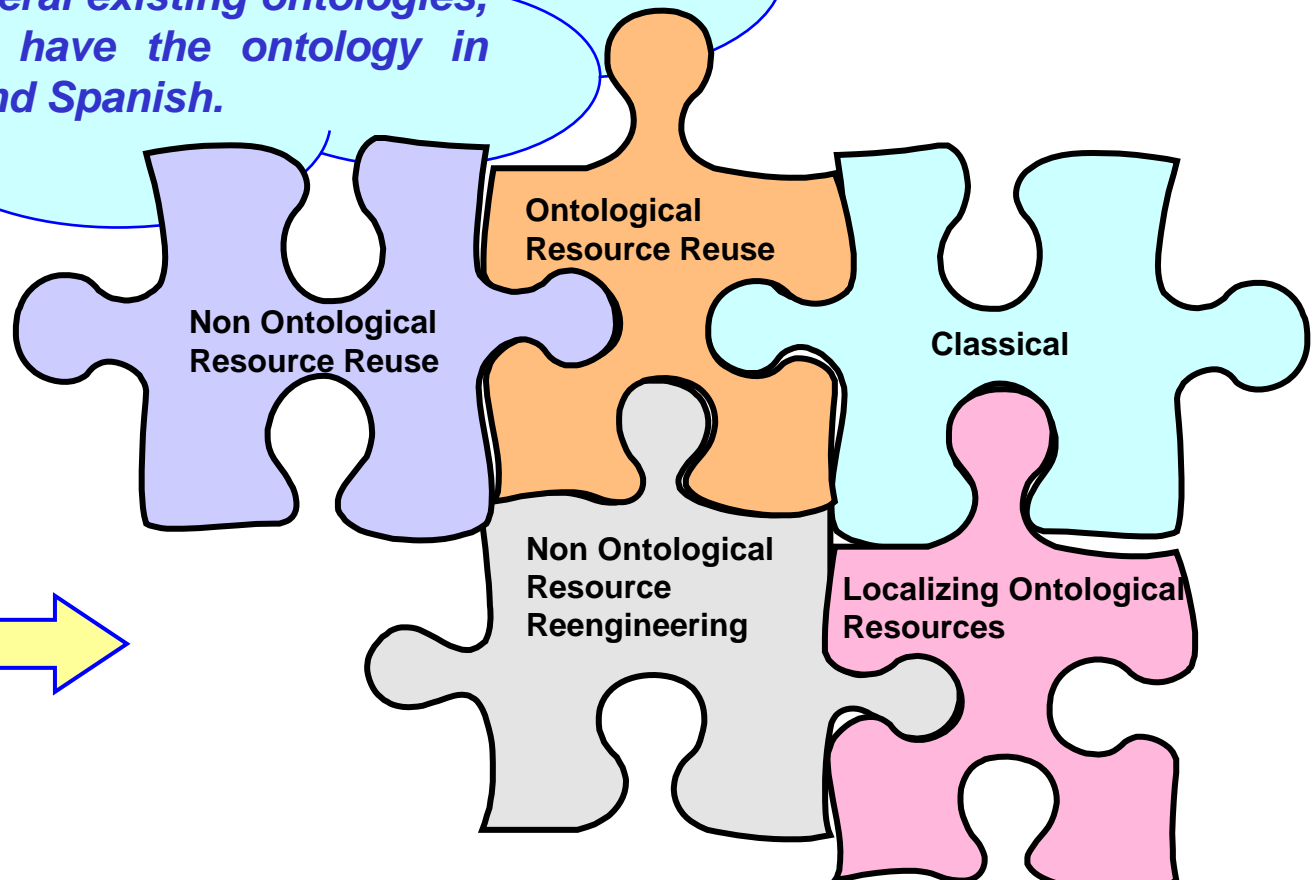
Building Ontology Networks: Use Case 1

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



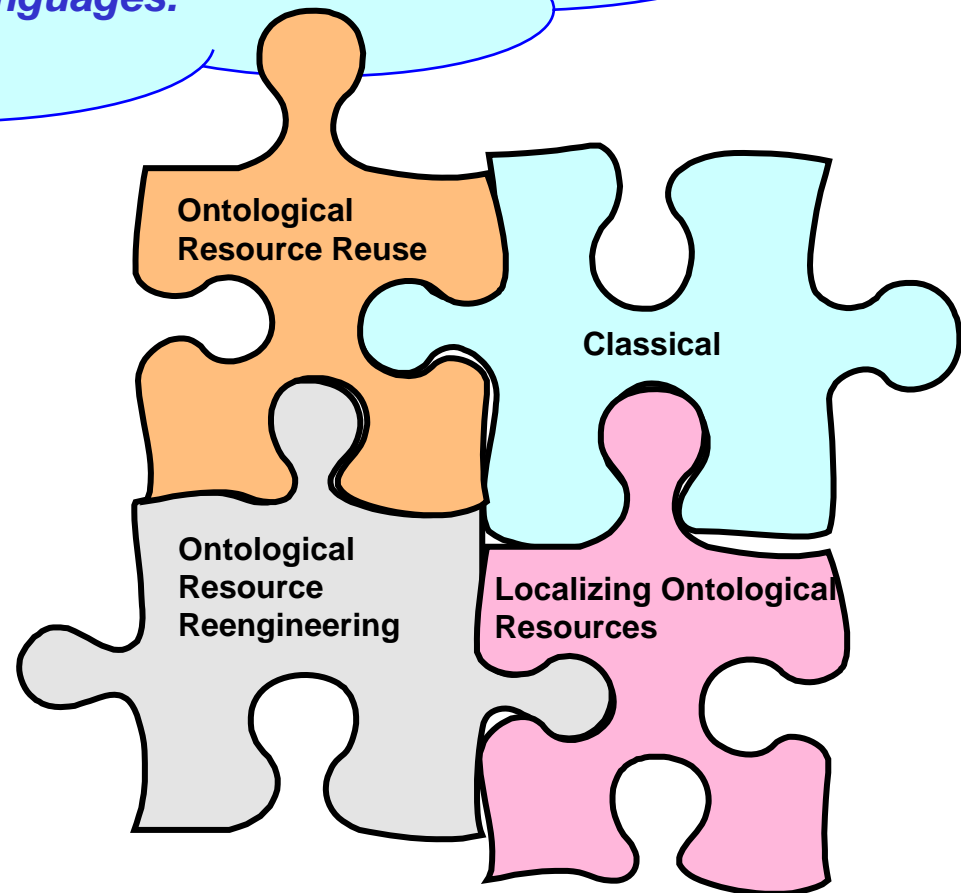
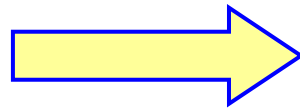
Building Ontology Networks: Use Case 2

In our team, we want to build an OWL ontology in the employment domain. We want to base on different human resource standards, on general existing ontologies, and we want to have the ontology in English, French and Spanish.

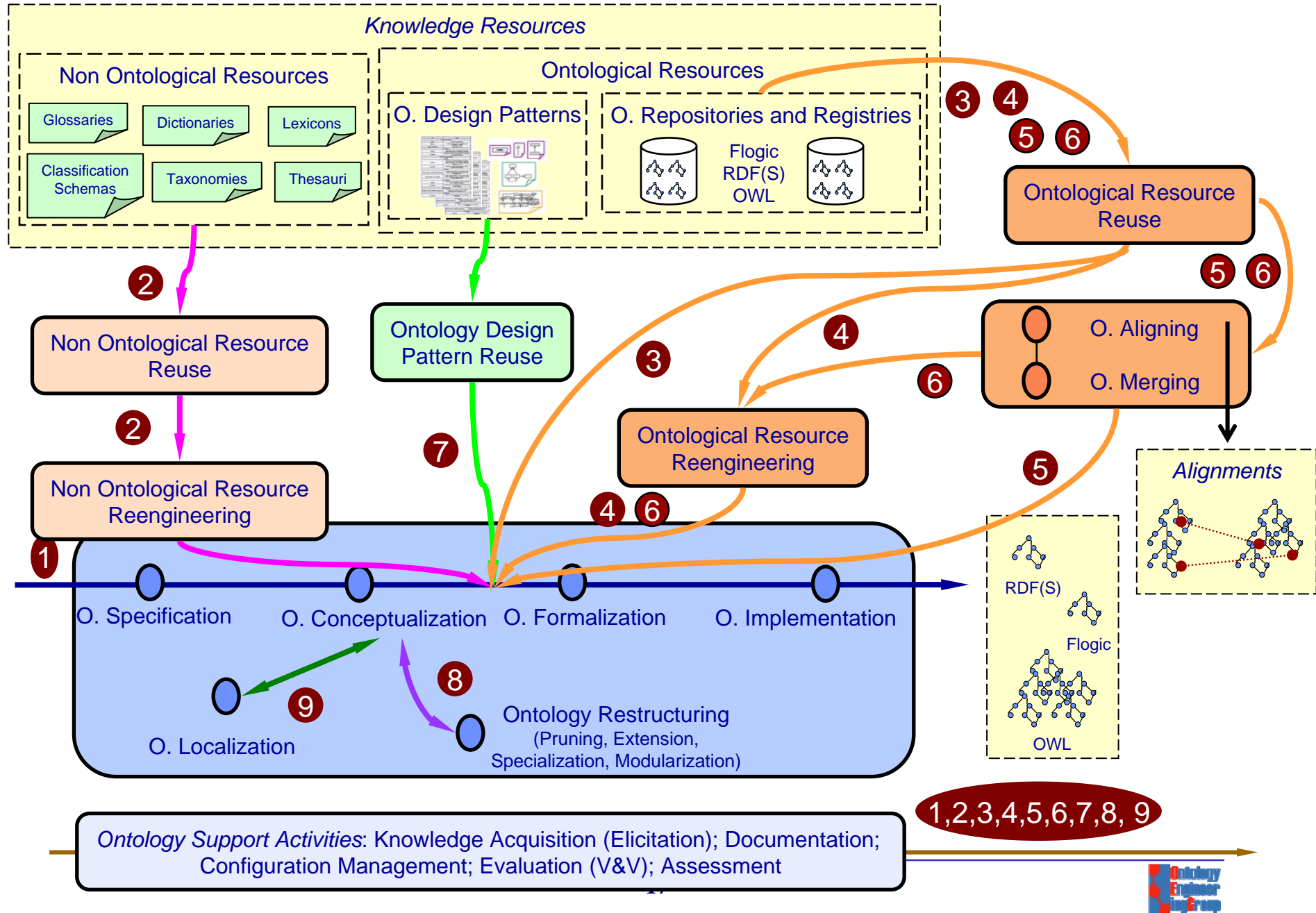


Building Ontology Networks: Use Case 3

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



9 NeOn Scenarios for Building Ontology Networks



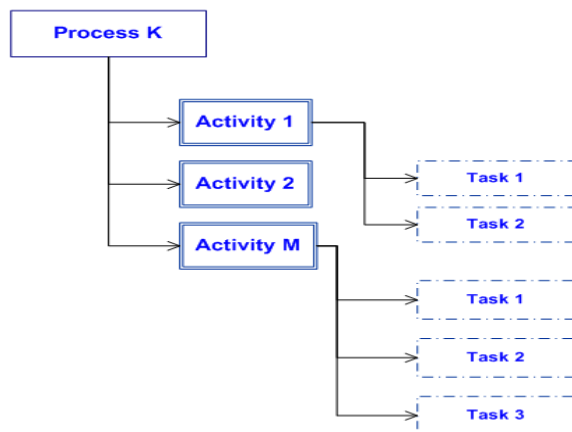
Scenarios for Building Ontology Networks

1. Building ontology networks **from specification to implementation**
2. Building ontology networks by **reusing and reengineering non ontological resources**
3. Building ontology networks by **reusing ontological resources**
4. Building ontology networks by **reusing and reengineering ontological resources**
5. Building ontology networks by **reusing and merging ontological resources**
6. Building ontology networks by **reusing, merging and reengineering ontological resources**
7. Building ontology networks by **reusing ontology design patterns**
8. Building ontology networks by **restructuring ontological resources**
9. Building ontology networks by **localizing ontological resources**

NeOn Methodology: Components

Process and activities covered:

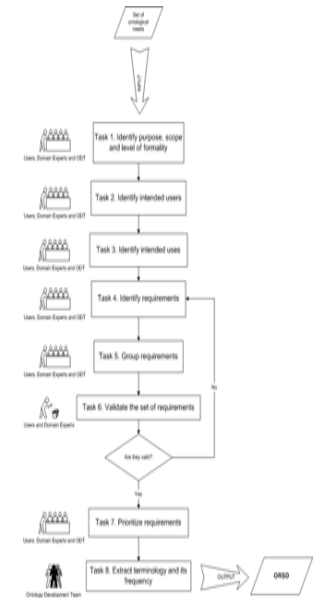
- ☐ Ontology Requirements Specification
- ☐ Scheduling
- ☐ Non Ontological Resource Reuse
- ☐ Non Ontological Resource Reengineering
- ☐ Reuse General Ontologies
- ☐ Reuse Domain Ontologies
- ☐ Reuse Ontology Statements
- ☐ Reuse Ontology Design Patterns



All processes and activities are described with:

- ☐ A filling card
- ☐ A workflow
- ☐ Examples

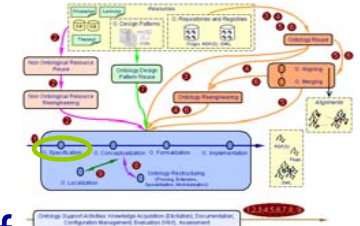
Process or Activity Name	
Definition	
<div></div>	
Goal	
<div></div>	
Input	Output
<div></div>	<div></div>
Who	
<div></div>	
When	
<div></div>	



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Ontology Requirements Specification



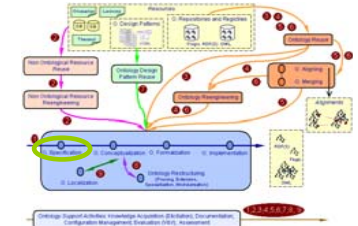
Ontology Requirements Specification is a collection of requirements that the ontology should fulfill, e.g. reasons to build the ontology, target group, intended uses.

Requirements are those needs that the ontology to be built should represent/cover.

Competency Questions (CQs) are questions that the ontology to be built should be able to answer.

- ☐ CQs are a way to represent requirements.
- ☐ CQs can be written in natural language (NL) and can be formalized in ontology query languages (e.g. SPARQL).

Ontology Requirements Specification



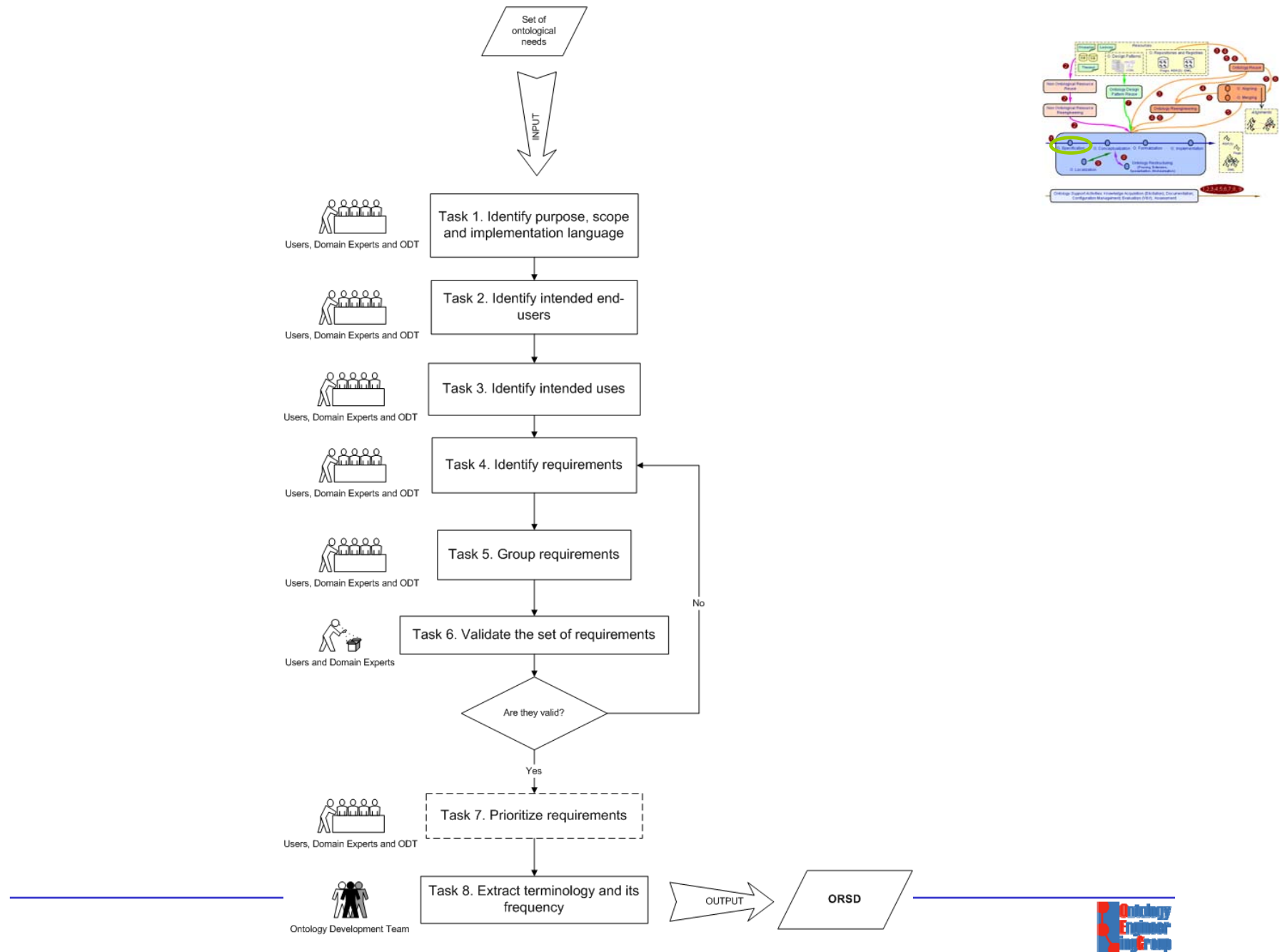
Ontology Requirements Specification	
<p><i>Definition</i></p> <p><i>Ontology Requirements Specification</i> refers to the activity of collecting the requirements that the ontology should fulfill, e.g. reasons to build the ontology, target group, intended uses, possibly reached through a consensus process.</p>	
<p><i>Goal</i></p> <p>The activity states why the ontology is being built, what its intended uses are, who the end-users are, and what the requirements the ontology should fulfill are.</p>	
<p><i>Input</i></p> <p>A set of ontological needs.</p>	<p><i>Output</i></p> <p>Ontology Requirements Specification Document (ORSD).</p>
<p><i>Who</i></p> <p>Software developers and ontology practitioners, who form the ontology development team (ODT), in collaboration with users and domain experts.</p>	
<p><i>When</i></p> <p>This activity must be carried out at the beginning of the ontology project and in parallel with the knowledge acquisition activity.</p>	



ODBASE 2009



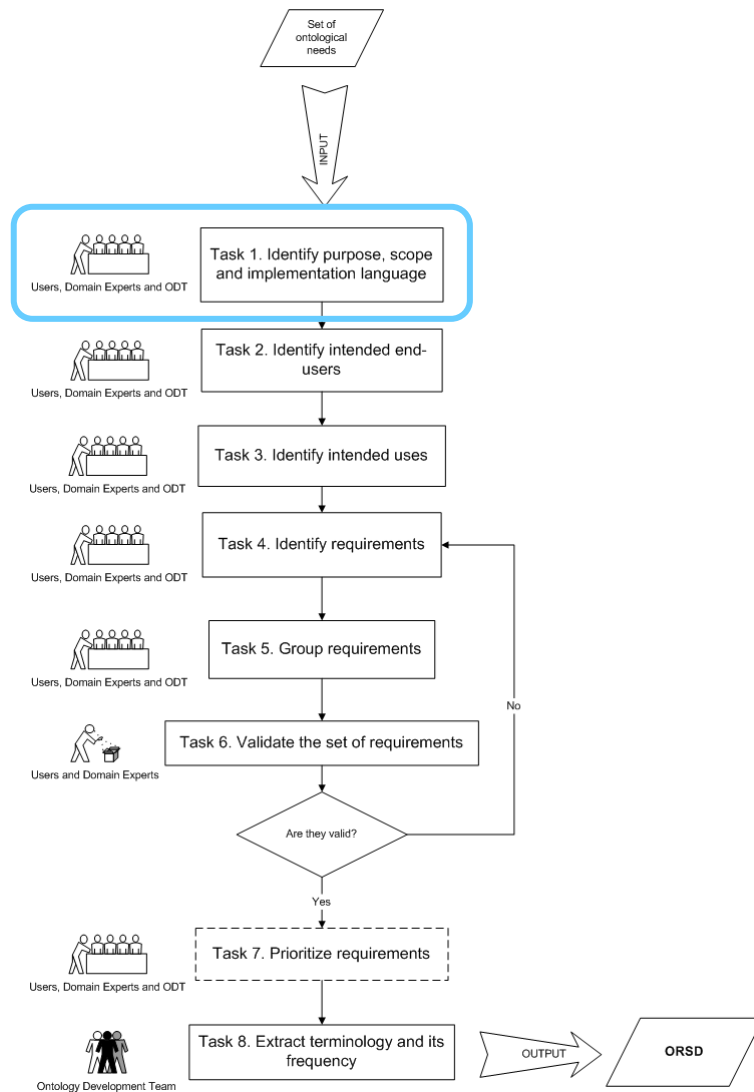
Ontology Requirements Specification. Tasks



Ontology Requirements Specification Document. Template

Ontology Requirements Specification Document Template	
1	Purpose
	<i>The main general goal of the ontology. In other words, the main function or role that the ontology should have.</i>
2	Scope
	<i>The general coverage and the degree of detail that the ontology should have.</i>
3	Implementation Language
	<i>The formal language that the ontology should have.</i>
4	Intended End-Users
	<i>The intended end-users expected for the ontology.</i>
5	Intended Uses
	<i>The intended uses expected for the ontology.</i>
6	Ontology Requirements
	a. Non-Functional Requirements
	<i>The general requirements or aspects that the ontology should fulfil, including optionally priorities for each requirement.</i>
	b. Functional Requirements: Groups of Competency Questions
	<i>The content specific requirements that the ontology should fulfil, in the form of groups of competency questions and their answers, including optionally priorities for each group and for each competency question.</i>
7	Pre-Glossary of Terms
	a. Terms from Competency Questions
	<i>The list of terms included in the competency questions and their frequencies.</i>
	b. Terms from Answers
	<i>The list of terms included in the answers and their frequencies.</i>
	c. Objects
	<i>The list of objects included in the competency questions and in their answers.</i>

Ontology Requirements Specification. Task 1

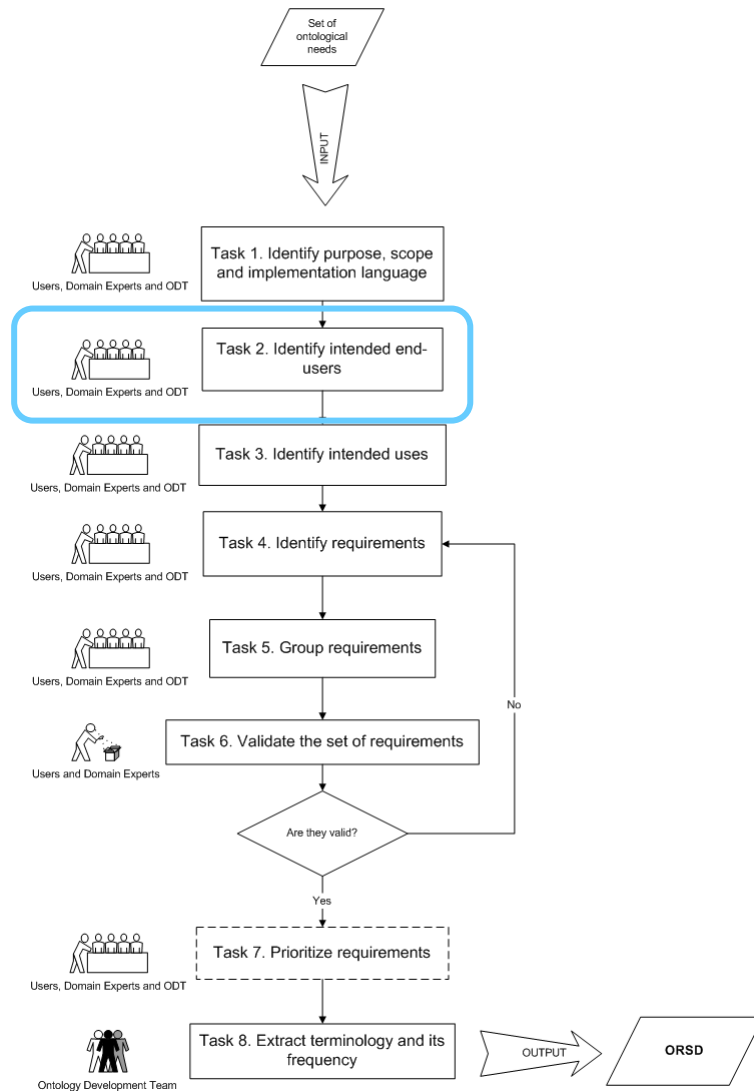


- ❑ *Input:* a set of ontological needs
- ❑ *Objective:* obtaining the **purpose, scope and formality level of the ontology**
- ❑ *Techniques:* physical or virtual interviewers
- ❑ *Output:* purpose, scope and level of formality of the ontology, which will be included in the corresponding slots of the ORSD template

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 that can 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.



Ontology Requirements Specification. Task 2

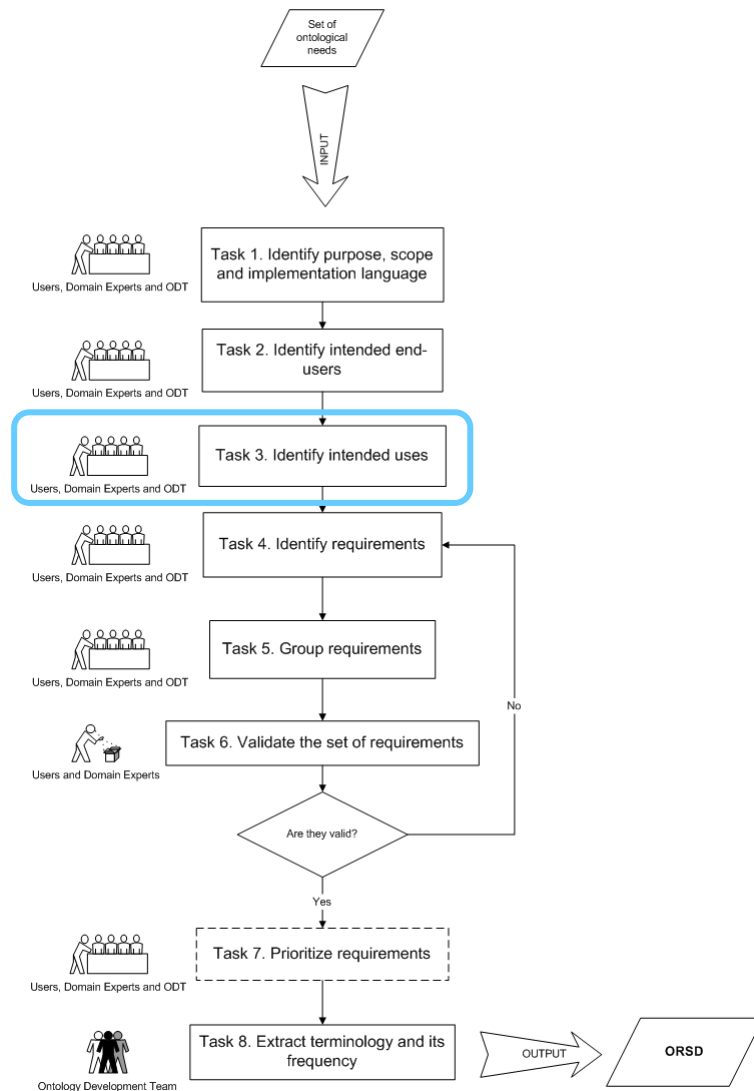


- ❑ *Input*: a set of ontological needs
- ❑ *Objective*: identifying the **intended end-users**
- ❑ *Techniques*: physical or virtual interviewers
- ❑ *Output*: a list with the intended users, which will be included in the corresponding slot of the OSRD template

4	Intended End-Users
User 1.	Candidate who is unemployed and searching for a job or searching another occupation for immediate or future purposes
User 2.	Employer who needs more human resources.
User 3.	Public or private employment search service which offers services to gather CVs or job postings and to prepare some data and statistics.
User 4.	National and Local Governments which want to analyze the situation on the employment market in their countries and prepare documents on employment, social and educational policy.
User 5.	European Commission and the governments of EU countries which want to analyze the statistics and prepare international agreements and documents on the employment, social and educational policy.



Ontology Requirements Specification. Task 3

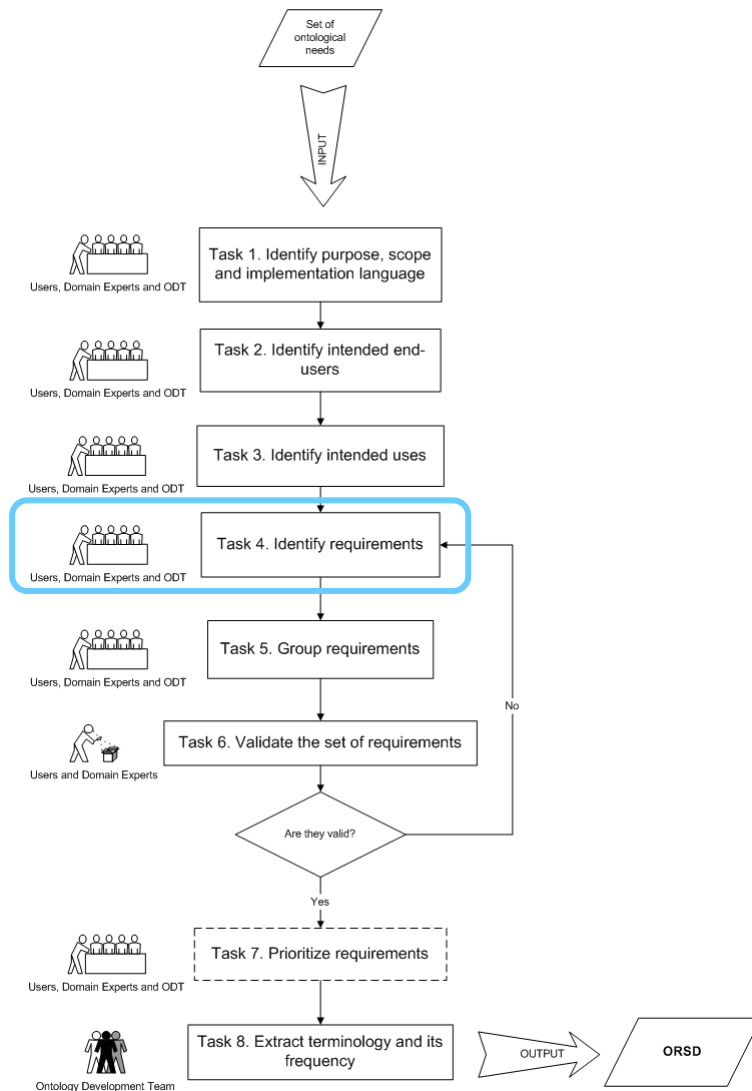


- ❑ *Input*: a set of ontological needs
- ❑ *Objective*: identifying the **intended uses**
- ❑ *Techniques*: physical or virtual interviewers between them
- ❑ *Output*: a list of intended uses in the form of scenarios. The scenarios can be described in natural language or expressed in UML as use cases. The list of scenarios will be included in the corresponding slot of the OSRD template.

5	Intended Uses
	Use 1. Publish CV. Job seeker places his/her CV on the PES Portal.
	Use 2. Publish Job Offer. An Employer places a Job Offer on the PES Portal.
	Use 3. Search for Job Offers. The Employer looks for candidates for the Job Offer through PES Portal.
	Use 4. Search for Employment information. Job Seeker looks for of general information about employment in a given location at the PES Portal.
	Use 5. Provide Job Statistics. The PES Portal provides employment statistics to the Job Seeker and Employer.



Ontology Requirements Specification. Task 4 (I)



❑ *Input*: a set of ontological needs

❑ *Objective*: identifying the set of **ontology requirements that the ontology should satisfy**

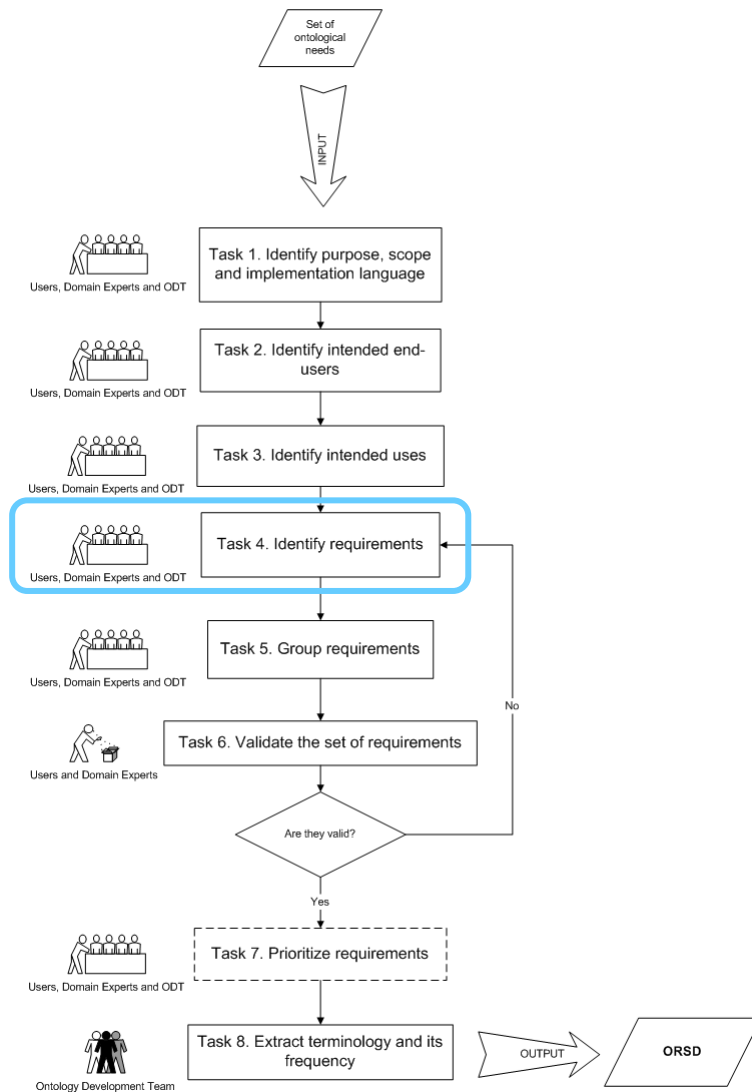
- *Non-functional ontology requirements* refer to the characteristics, qualities, or general aspects not related to the ontology content that the ontology should satisfy
- *Functional ontology requirements*, which can be also seen as content specific requirements, refer to the particular knowledge to be represented by the ontology

❑ *Techniques*: interview users and domain experts. For functional ontology requirements → writing the requirements in Natural Language in the form of the so-called **competency questions (CQs)**

❑ *Tools*: mind map tools, excel, and collaborative tools (e.g., Cicero)

❑ *Output*: (1) a list of non-functional ontology requirements written in natural language; and (2) a list functional ontology requirements in the form of CQs and their associated answers

Ontology Requirements Specification. Task 4 (II)



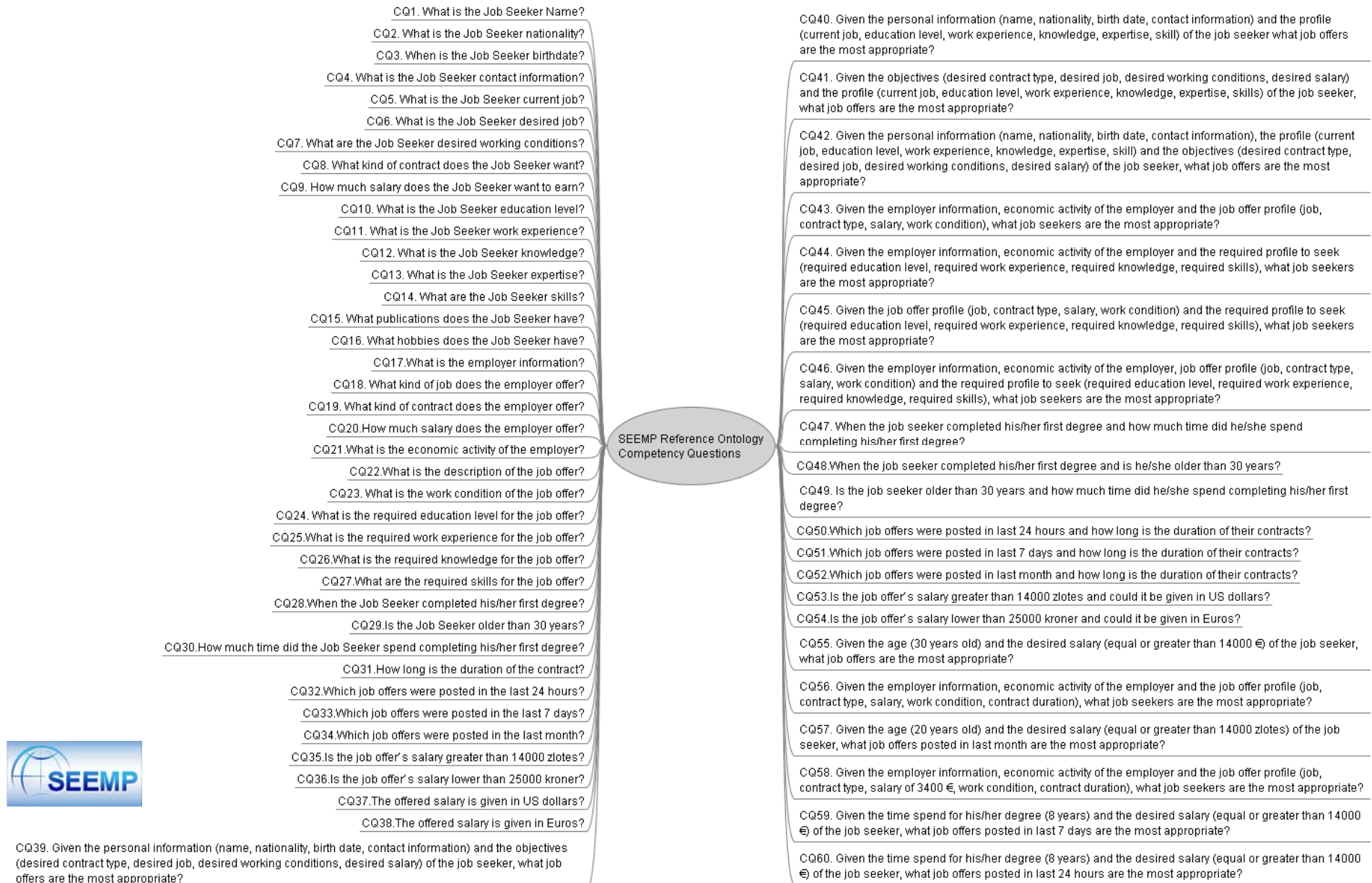
Approaches:

- Top-Down: Complex questions are decomposed in simple ones.
- Bottom-Up: Simple questions that are organised to form complex ones.
- Middle out: Mix approach between top-down and bottom-up.

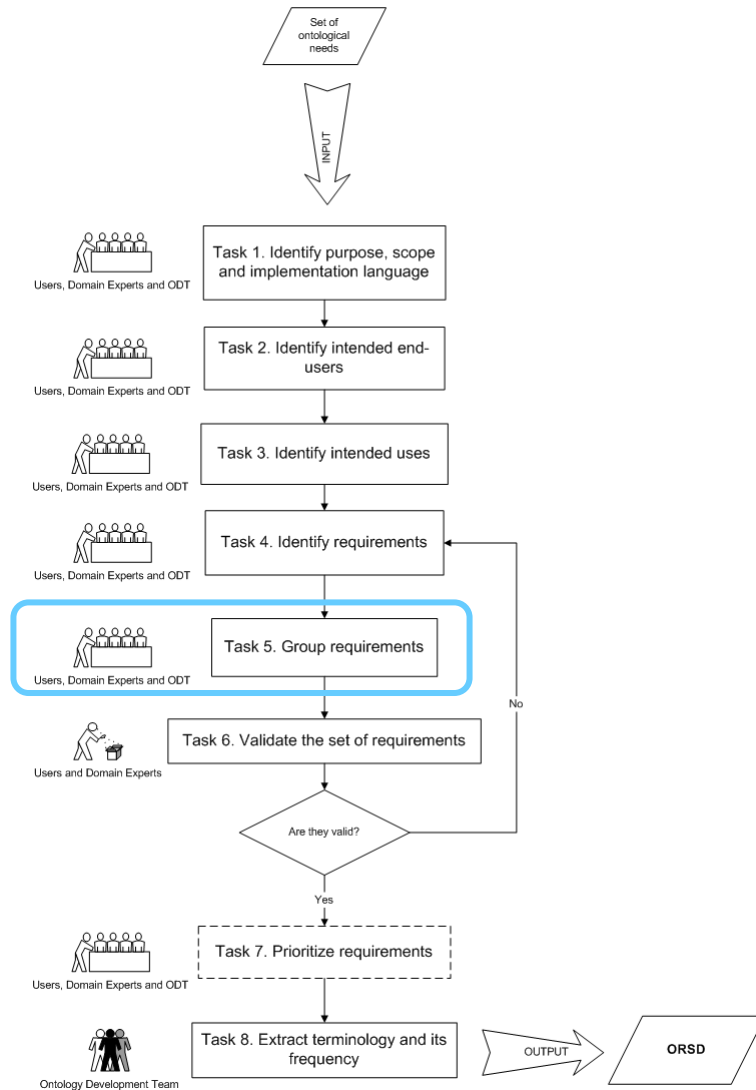
6	Ontology Requirements
	a. Non-Functional Requirements
	NFR1. The ontology must support a multilingual scenario in the following languages: English, Spanish, Italian, and French.
	NFR2. The ontology must be based on the international, European or de-facto standards in existence or under development.



Task 4. Identify requirements: Functional requirements

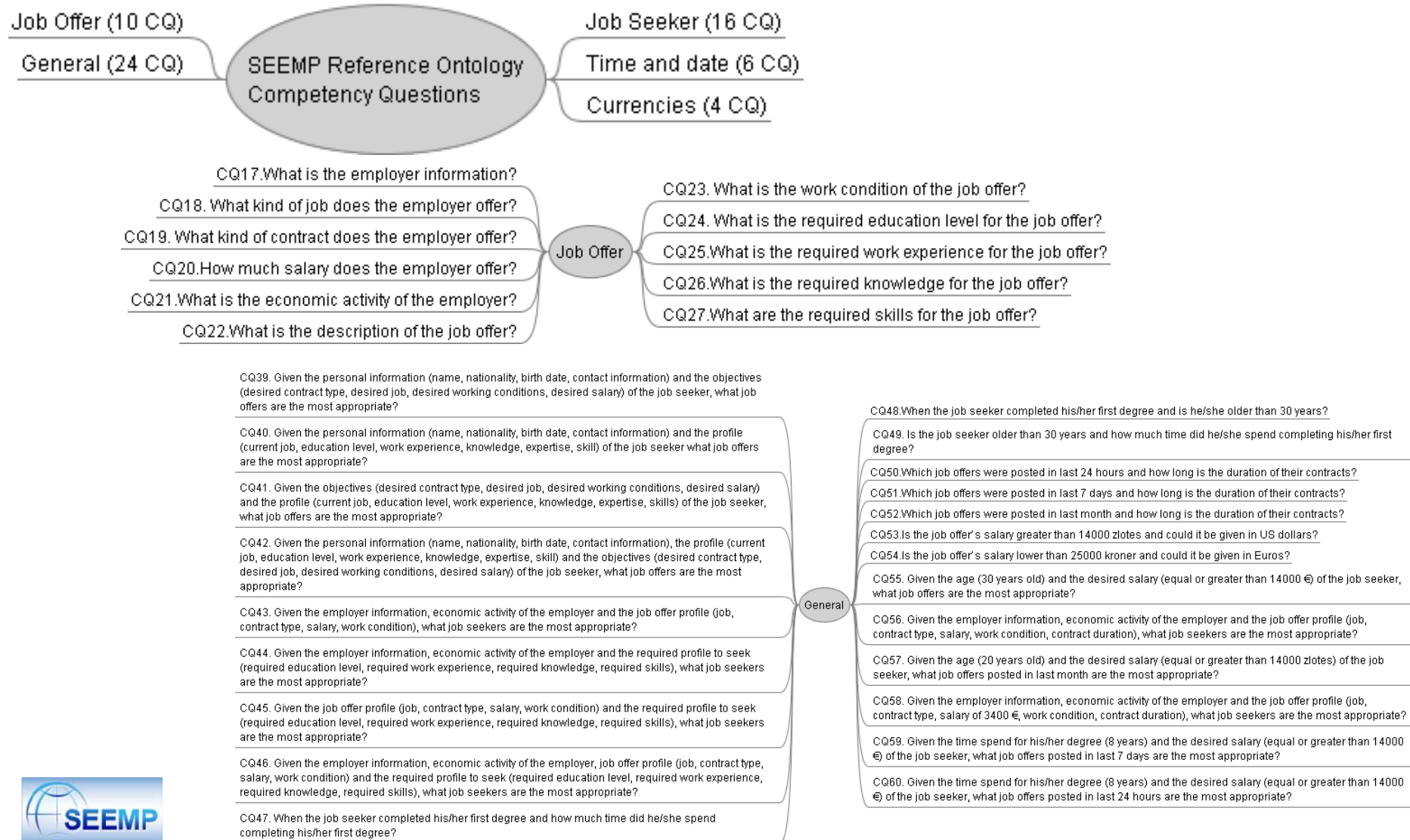


Ontology Requirements Specification. Task 5

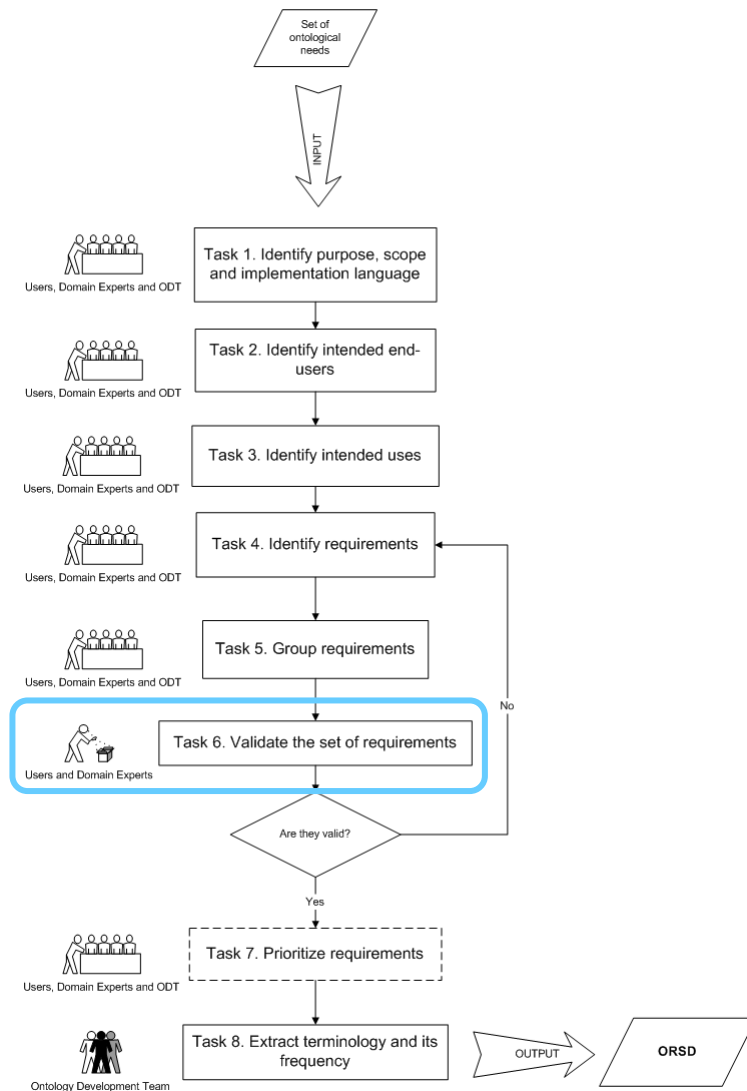


- ❑ *Input:* the list of CQs
- ❑ *Objective:* obtaining different **groups of CQs**
- ❑ *Techniques:* Card Sorting, when the grouping is done manually, and Clustering NL sentences or Information Extraction when the grouping is done automatically
- ❑ *Tools:* MindMap Tools or Cicero Tool (for distributed teams)
- ❑ *Output:* a set of groups including CQs
- ❑ *Hybrid approach:*
 - The analysis of the frequency of terms and the grouping of CQs based on those terms that have a higher frequency.
 - The use of pre-established categories, such as time and date, units of measure, currencies, location, languages, etc.

Task 5. Group requirements (CQs)



Ontology Requirements Specification. Task 6



❑ *Input:* the set of grouped CQs

❑ *Objective:* to identify possible conflicts between CQs, missing CQs, and contradictions in CQs. To decide **if such CQs are valid or not**

❑ *Output:* a confirmation about the validity of the set of CQs

❑ *Criteria:*

Correctness.

Consistent.

Understandable.

Conciseness.

Modifiable.

Traceable.

Completeness.

Verifiable.

No Ambiguity.

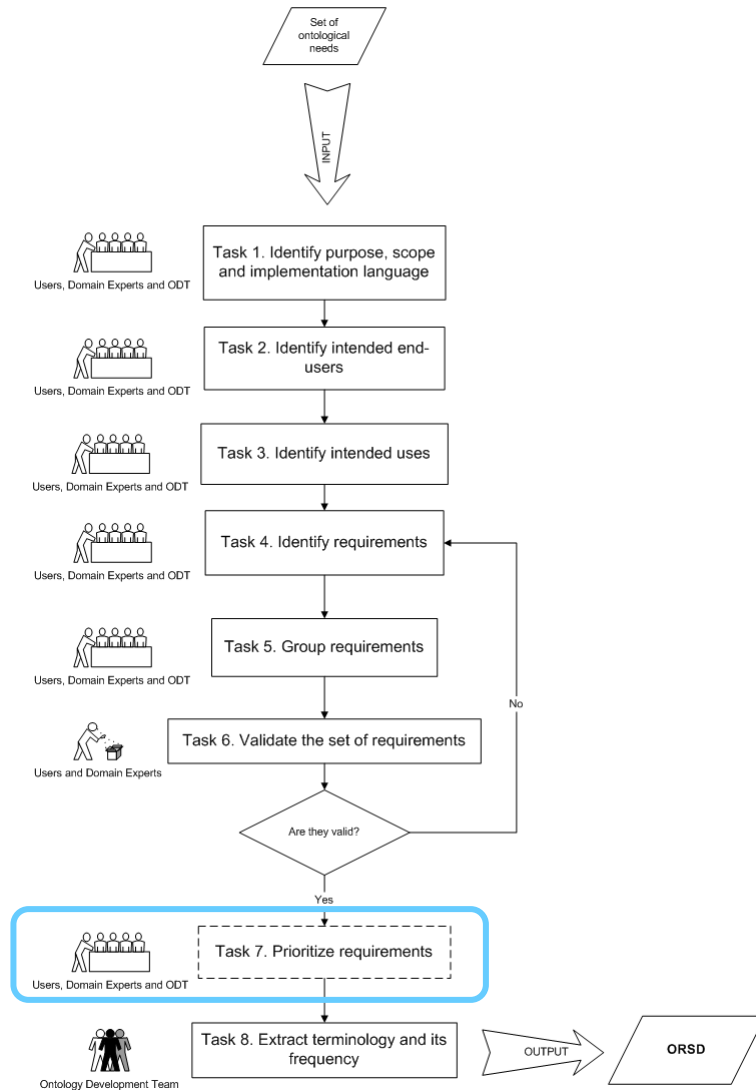
Realism.

Correctness. Domain experts checked the correctness of each competency question, verifying that its formulation and answers were correct.

Consistent. Domain experts also verified that the competency questions did not have any possible inconsistency.



Ontology Requirements Specification. Task 7



❑ *Input:* the groups of CQs written in natural language (obtained in task 5)

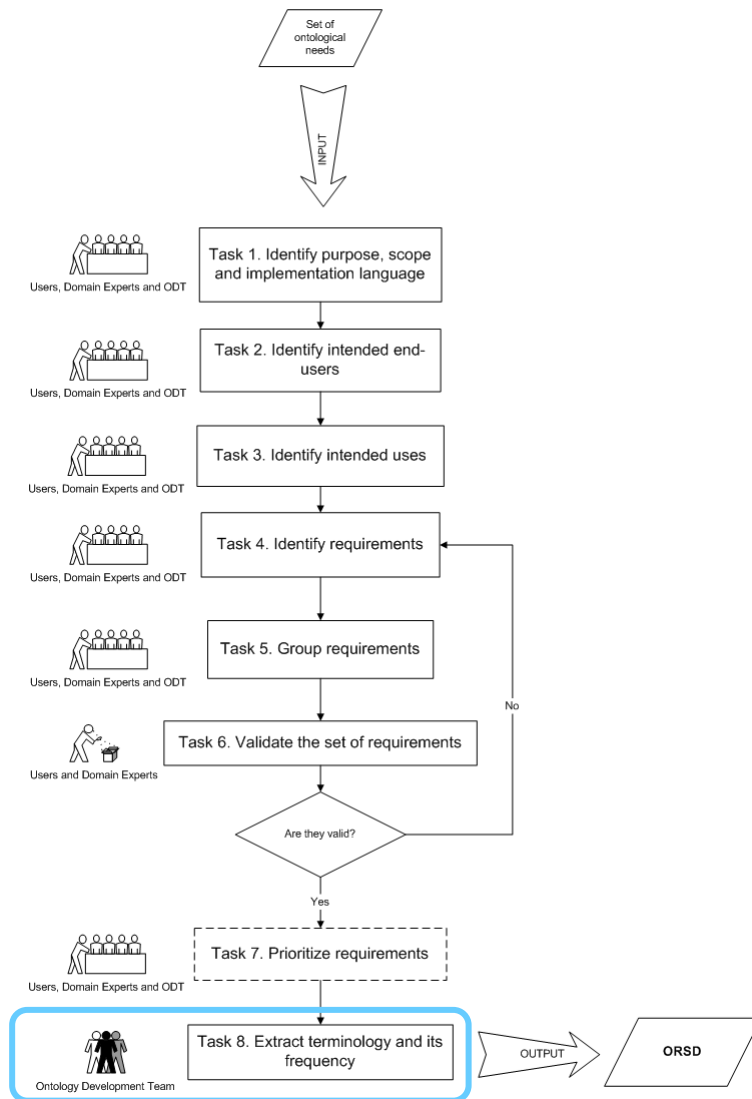
❑ *Objective:* to give **different levels of priority** to the different groups of CQs, and within each group to the identified requirements (in the form of CQs)

❑ *Output:* a set of priorities attached to each group of CQs and to each CQ in a group

Within the SEEMP Reference Ontology specification we did not carry out this step. This means the first version of the ontology must be able to represent the knowledge contained in all the competency questions.



Ontology Requirements Specification. Task 8



- ❑ *Input*: the list of identified CQs and their answers
- ❑ *Objective*: to extract from the list of CQs a pre-glossary to be used in the conceptualization activity. Obtaining a list of the **most used terms**
- ❑ *Techniques*: terminology extraction techniques and tools supporting such techniques

From the requirements in form of competency questions, we extract the terminology (names, adjectives and verbs) that will be formally represented in the ontology by means of concepts, attributes and relations.

From the answers to the CQs we extract the objects in the universe of discourse that will be represented as instances.

Task 8. Extract terminology and its frequency

7	Pre-Glossary of Terms			
	a. Terms from Competency Questions + Frequency			
	Job Seeker	27	Address	1
	CV	2	Nationality	1
	Personal Information	3	Contact (phone, fax, mail)	3
	Name	4	Objective	3
	Gender	1	Job Category	3
	Birth date	1	...	
	b. Terms from Answers + Frequency			
	SW engineer, programmer	5	Research, Financial, Education	4
	British, Spanish, Italian, French	1	1 year, 2 years, 3 years	1
	Autonomous, Seasonal Job,	2	3000 Euros per month	1
	Basic education, Higher education	1	CEFRIEL Research Company	1
	c. Objects			
	Andorra, Angola, Argentina, Australia, Bolivia, France, Italy, Malta, Spain, etc. Euro, Zloty, Great British Pound, US Dollar, Peso, etc. CEFRIEL, ATOS, etc.			

SEEMP Ontology Requirement Specification Document



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 that can 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	<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. Employer who needs more human resources.</p> <p>User 3. Public or private employment search service which offers services to gather CVs or job postings and to prepare some data and statistics.</p> <p>User 4. National and Local Governments which want to analyze the situation on the employment market in their countries and prepare documents on employment, social and educational policy.</p> <p>User 5. European Commission and the governments of EU countries which want to analyze the statistics and prepare international agreements and documents on the employment, social and educational policy.</p>
5 Intended Uses	<p>Use 1. Publish CV. Job seeker places his/her CV on the PES Portal.</p> <p>Use 2. Publish Job Offer. An Employer places a Job Offer on the PES Portal.</p> <p>Use 3. Search for Job Offers. The Employer looks for candidates for the Job Offer through PES Portal.</p> <p>Use 4. Search for Employment information. Job Seeker looks for of general information about employment in a given location at the PES Portal.</p> <p>Use 5. Provide Job Statistics. The PES Portal provides employment statistics to the Job Seeker and Employer.</p>

6 Ontology Requirements	
b. Functional Requirements: Groups of Competency Questions	
	<i>CQG1. Job Seeker (14 CQ)</i>
	CQ1. What is the Job Seeker's name? Lewis Hamilton
	CQ2. What is the Job Seeker's nationality? British; Spanish; Italian; French;
	CQ3. What is the Job Seeker's birth date? '13/09/1984; 30/03/1970; 15/04/1978
	CQ4. What is the Job Seeker's contact information? Tel: 34600654231. Email: jsanz@fi2.upm2.es
	CQ5. What is the Job Seeker's current job? Programmer; Computer Engineer; Computer Assistant
	CQ6. What is the Job Seeker's desired job? Radio Engineer; Hardware designer; Software Engineer
	CQ7. What are the Job Seeker's desired working conditions? Autonomous; Seasonal Job; Traineeship; Consultant
	CQ8. What kind of contract does the Job Seeker want? Full time; Partial time; Autonomous; Seasonal Job
	CQ9. How much salary does the Job Seeker want to earn? 3000 Euros per month, 40000 Euros per year
	CQ10. What is the Job Seeker's education level? Basic education; Higher education/University
	CQ11. What is the Job Seeker's work experience? 6 months, 1 year, 2 years
	CQ12. What is the Job Seeker's knowledge? Java Programming; C Programming; Database Administration
	CQ13. What is the Job Seeker's expertise? Software Engineering
	CQ14. What are the Job Seeker's skills? SQL programming, network administration
	<i>CQG2. Job Offer (11 CQ)</i>
	CQ15. What is the employer's information? CEFRIEL Research Company, Milano, Italy; ATOS, Madrid, Spain
	CQ16. What kind of job does the employer's offer? Java Programmer; C Programmer; Database administration
	CQ17. What kind of contract does the employer's offer? Seasonal Job; Autonomous
	CQ18. How much salary does the employer's offer? 3500 Euros, 3000 USD
	CQ19. What is the economic activity of the employer? Research; Financial;
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.

warehouse, Hardware programming

Hands-on Activities



Working in Pairs

We propose the following **domain problem** for the hands-on sessions in this tutorial.

“The International Olympic Committee decides to rely on semantic technologies to manage information related to the Olympic Games. For this purpose, such a committee needs an ontology network able to model information about the sports (summer and winter), about countries and teams involved, about venues and dates, and about medals and winners”.

Note: each group should focus on winter or summer sports; and should select one particular sport to define it in more detail.

Hands-on Activity: Ontology Requirements Specification



Based on the summary of the domain we presented before, identify:

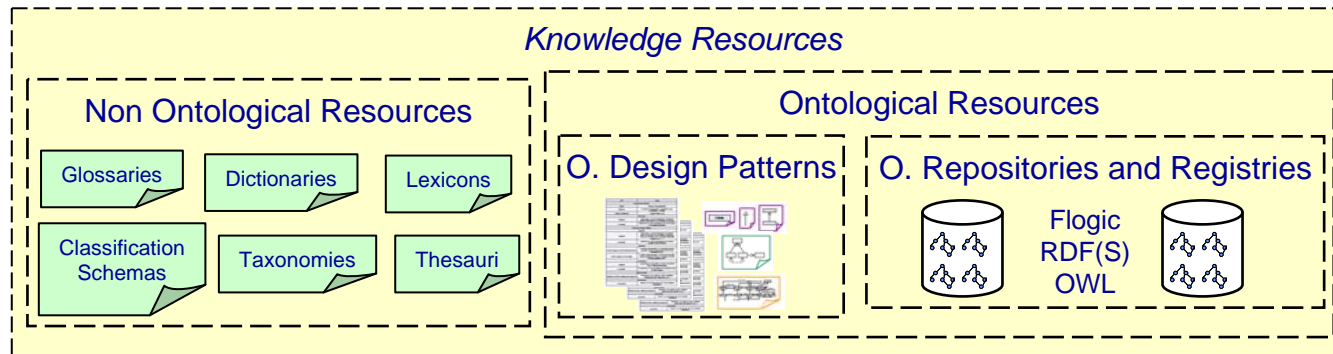
- ☐ The ***purpose*** of the ontology
- ☐ The ***scope*** of the ontology
- ☐ The ***competency questions the ontology should fulfil***, classified into different groups.

Index

- ❑ Introduction
- ❑ Scenarios in Ontology Building
- ❑ Methodological Guidelines for Ontology Requirements Specification
- ❑ **Quick Search of Existing Knowledge Resources**
- ❑ Methodological Guidelines for Scheduling
- ❑ Methodological Guidelines for Reusing Existing Knowledge Resources
- ❑ Conclusions

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



Search and Select non-ontological resources



We select the most appropriate standards and taxonomies for:

- **Occupation Classification**
ISCO-88 (COM), SOC, ISCO-88, ONET, Eures Taxonomy.
- **Classification of Economic Activities**
ISIC Rev. 3.1, NACE Rev. 1.1, NAICS
- **Apprenticeship classifications**
ISCED 97, FOET
- **Currency Classification**
ISO 4217
- **Geography Classification**
ISO 3166, Eures Taxonomy
- Language Classification**
ISO 6392, CEF
- Driving License Classification**
European Legislation
- Skill Classification**
Eures Taxonomy
- Contract Types Classification**
LE FOREM, Eures and BLL Classification
- Work Condition Classification**
LE FOREM, Eures and BLL Classification

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

Examples of non-ontological resources

ISO 4217 (currencies)

Entity	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	Azerbaijani Manat	AZN	944
BAHAMAS	Bahamian Dollar	BSD	044
BAHRAIN	Bahraini Dinar	BHD	048
BANGLADESH	Taka	BDT	050
BARBADOS	Barbados Dollar	BBD	052
BELARUS	Belarusian Ruble	BYR	974

ISO 3166 (countries)

```
<?xml version="1.0" encoding="ISO-8859-1" standalone="yes"?>
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  </ISO_3166-1_Entry>
  <ISO_3166-1_Entry>
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    <ISO_3166-1_Alpha-2_Code_element>AX</ISO_3166-1_Alpha-2_Code_element>
  </ISO_3166-1_Entry>
  <ISO_3166-1_Entry>
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    <ISO_3166-1_Alpha-2_Code_element>AL</ISO_3166-1_Alpha-2_Code_element>
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  <ISO_3166-1_Entry>
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    <ISO_3166-1_Alpha-2_Code_element>DZ</ISO_3166-1_Alpha-2_Code_element>
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  </ISO_3166-1_Entry>
```

Non-ontological resources - ISCO-88 (COM)

level	description EN	description FR	description DE	texte auto EN	
	3 Religious professionals	Membres du clergé	Geistliche, Seelsorger		
	3 Public service administrative professionals	Cadres administratifs des services publics	Wissenschaftliche Verwaltungsfachkräfte des öffentlichen Dienstes	This is a new minor group, designed explicitly for the classification of occupations in which the primary tasks consist of general administrative functions within the public	Hier han ausdrück deren H
	3 Physical and engineering science technicians	Techniciens des sciences physiques et techniques	Material- und ingenieurtechnische Fachkräfte		
	3 Computer associate professionals	Pupitreurs et autres opérateurs de matériels informatiques	Datenverarbeitungsfachkräfte	If the job title and associated information on activities does not permit a clear distinction, additional information on a level of relevant qualifications or description of tasks may	Wenn di Informati erlauben
	3 Optical and electronic equipment operators	Techniciens d'appareils optiques et électroniques	Bediener optischer und elektronischer Anlagen		
	3 Ship and aircraft controllers and technicians	Techniciens des moyens de transport maritime et aérien	Schiffs-, Flugzeugführer und verwandte Berufe		
	3 Safety and quality inspectors	Inspecteurs d'immeubles, de sécurité, d'hygiène et de qualité	Sicherheits- und Qualitätskontrolleure		
	3 Life science technicians and related associate professional	Techniciens et travailleurs assimilés des sciences de la vie et de la santé	Biotechniker und verwandte Berufe		
	3 Health associate professionals (except nursing)	Professions intermédiaires de la médecine moderne (à l'exception du personnel infirmier)	Medizinische Fachberufe (ohne Krankenpflege)		
	3 Nursing and midwifery associate professionals	Personnel infirmier et sages-femmes (niveau intermédiaire)	Nicht-wissenschaftliche Krankenpflege- und Geburtshilfefachkräfte	Concerning "Nursing and midwifery professionals", see notes to sub-major group 22.	Für "Wis Geburtsl
	3 Primary education teaching associate professionals	Professions intermédiaires de l'enseignement primaire	Nicht-wissenschaftliche Lehrkräfte des Primarbereiches		
►	3 Pre-primary education teaching associate professionals	Professions intermédiaires de l'enseignement préprimaire	Nicht-wissenschaftliche Lehrkräfte des Vorschulbereiches		
	3 Special education teaching associate professionals	Professions intermédiaires de l'éducation des handicapés	Nicht-wissenschaftliche Sonderschullehrkräfte		

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 Requirements Specification Document

Objects	
Objects in the domain of discourse, which are instances of:	
Job Category	• Education
01. Computer System Designer	029. Life Science
02. Computer System Analyst	030. Mathematics
03. Programmer	031. Computer Science
04. Computer Engineer	032. Computer Use
05. Computer Assistant	033. Statistics
06. Computer Equipment Operator	034. Physics
07. Industrial Robot Controller	035. Network Administration
08. Telecommunication Equipment Operator	• Languages
09. Medical Equipment Operator	036. Swedish
10. Electronic Equipment Operator	037. Spanish
11. Image Equipment Operator	038. Slovenian
	039. Portuguese
	040. English
	041. French
	042. German
• Nationality	• Currency
012. Austrian	043. Euro
013. Belgian	044. Krone
014. Danish	045. Great British Pound
015. Estonian	046. Zloty
016. Finnish	047. US Dollar
017. French	048. Franc
018. German	• Location
019. Greek	049. Austria
020. Italian	050. Belgium
• Activity Sector	051. Denmark
021. Telecommunication	052. Estonia
022. Justice and Judicial	053. Finland
023. Public Security and law	054. France
024. Manufacture of machine tools	055. Germany
025. Research and Development	056. Greece
026. Hardware Consultancy	
027. Software Consultancy and Supply	
028. Data processing	

Watson Semantic Web Search

Read this - Check your ontology - Website - Blog

university researcher student

Found 19 semantic documents - Restrict Search

1- <http://daml.umbc.edu/ontologies/cobra/0.4/academia>

5 KB - RDF, OWL (OWL FULL) - ALCH(D)

• <http://daml.umbc.edu/ontologies/cobra/0.4/academia#University>

Label: University

Comment:

• <http://daml.umbc.edu/ontologies/cobra/0.4/academia#Researcher>

• <http://daml.umbc.edu/ontologies/cobra/0.4/academia#GradStudentResearcher>

Label: GradStudentResearcher

Comment:

• <http://daml.umbc.edu/ontologies/cobra/0.4/academia#Student>

• <http://daml.umbc.edu/ontologies/cobra/0.4/academia#GradStudentResearcher>

2- <http://annotation.semanticweb.org/ontologies/iswc.owl>

30 KB - OWL, RDF (OWL Lite) - AL(D)

• <http://annotation.semanticweb.org/2004/iswc#University>

• http://annotation.semanticweb.org/2004/iswc#University_of_Karlsruhe

• <http://annotation.semanticweb.org/2004/iswc#Researcher>

• <http://annotation.semanticweb.org/2004/iswc#Student>

• <http://annotation.semanticweb.org/2004/iswc#PhDStudent>

3- <http://ontobroker.semanticweb.org/ontologies/ka2-onto-2000-11-07.dam>

• <http://kmi-web05.open.ac.uk:81/cache/7/64e/14aa/3dd17/adbb1ce20/2653b336ce35ba101#University>

• <http://kmi-web05.open.ac.uk:81/cache/7/64e/14aa/3dd17/adbb1ce20/2653b336ce35ba101#Researcher>

• <http://kmi-web05.open.ac.uk:81/cache/7/64e/14aa/3dd17/adbb1ce20/2653b336ce35ba101#Student>

• <http://kmi-web05.open.ac.uk:81/cache/7/64e/14aa/3dd17/adbb1ce20/2653b336ce35ba101#PhDStudent>

4- http://www.jfi.unizh.ch/ddis/fileadmin/pdf/service_broker/iswc.dam

32 KB - DAML+OIL, RDF - AL(D)

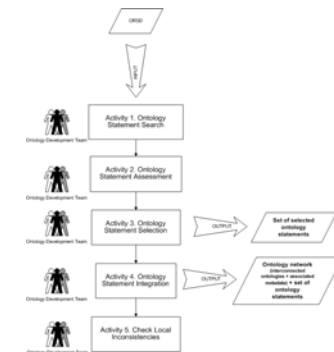
• <http://annotation.semanticweb.org/iswc/iswc.dam#University>

• http://annotation.semanticweb.org/iswc/iswc.dam#University_of_Karlsruhe

• <http://annotation.semanticweb.org/iswc/iswc.dam#Researcher>

The NeOn Methodology includes guidelines for reusing statements

Ontology Statement Reuse	
Answer	
Ontology Statement Reuse refers to the process of using existing statements from domain ontologies in the solution of a new problem.	
Goal	
The goal of this process is to reuse existing ontology statements from an ontology that was not explicitly designed for the current problem.	
Input	Output
Free (input) and available ontology statements that can be used in the current problem.	Existing ontology statements with related ontology statements.
Software designers and ontology practitioners	
Other	
Ontology statement reuse can be performed in various stages of the ontology life cycle. It should be performed in the early stages of the ontology life cycle, such as in the requirements phase, to ensure that the ontology is designed to be reusable. It can also be performed in later stages of the life cycle, such as in the implementation phase, to ensure that the ontology is designed to be reusable.	



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- ❑ **Methodological Guidelines for Scheduling**
 - ❑ **Ontology Network Life Cycle Models and Ontology Life Cycle**
- ❑ Methodological Guidelines for Reusing Existing Knowledge Resources
- ❑ Conclusions

Ontology Network Life Cycle Model

An **ontology network life cycle model** is defined as the framework, selected by each organization, on which to map the activities identified and defined in the NeOn Glossary of Activities in order to produce the *ontology network life cycle*.

- As in Software Engineering, in the *Ontology Engineering field*, there is not a unique model valid for all ontology development projects, since each life cycle model is appropriate for a concrete development, depending on several features.

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

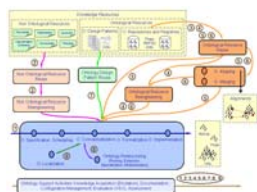


NeOn Deliverable D5.3.1 (2007)
I-SEMANTICS 2008

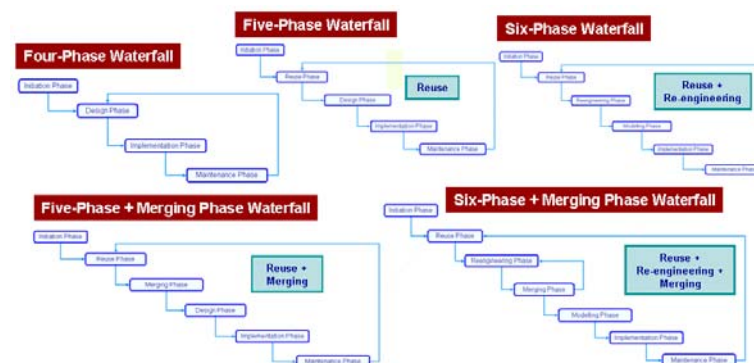
Waterfall and Iterative-Incremental Models

Waterfall Model

- To be used when: **the requirements are completely known, without ambiguities and unchangeable at the beginning of the ontology network development.**

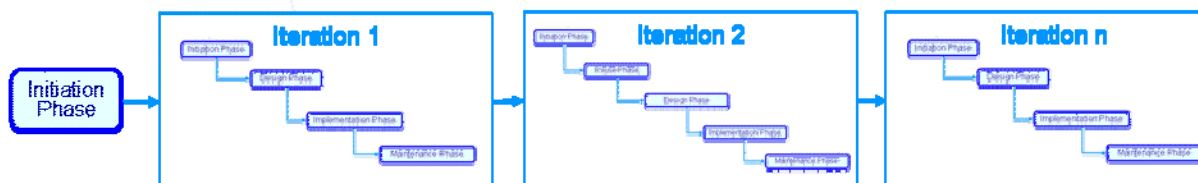


Scenarios identified caused the creation of different versions



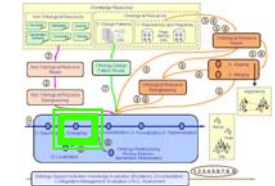
Iterative-Incremental Model

- The **development of ontology networks organized in a set of iterations.**
- The **result of any iteration is a functional and partial ontology network** that meets a subset of the ontology network requirements.



Scheduling. Filling Card

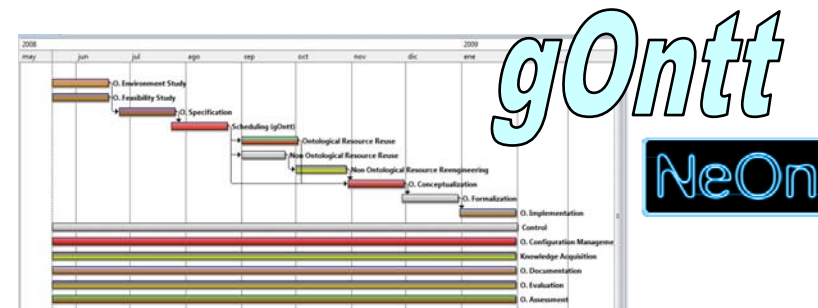
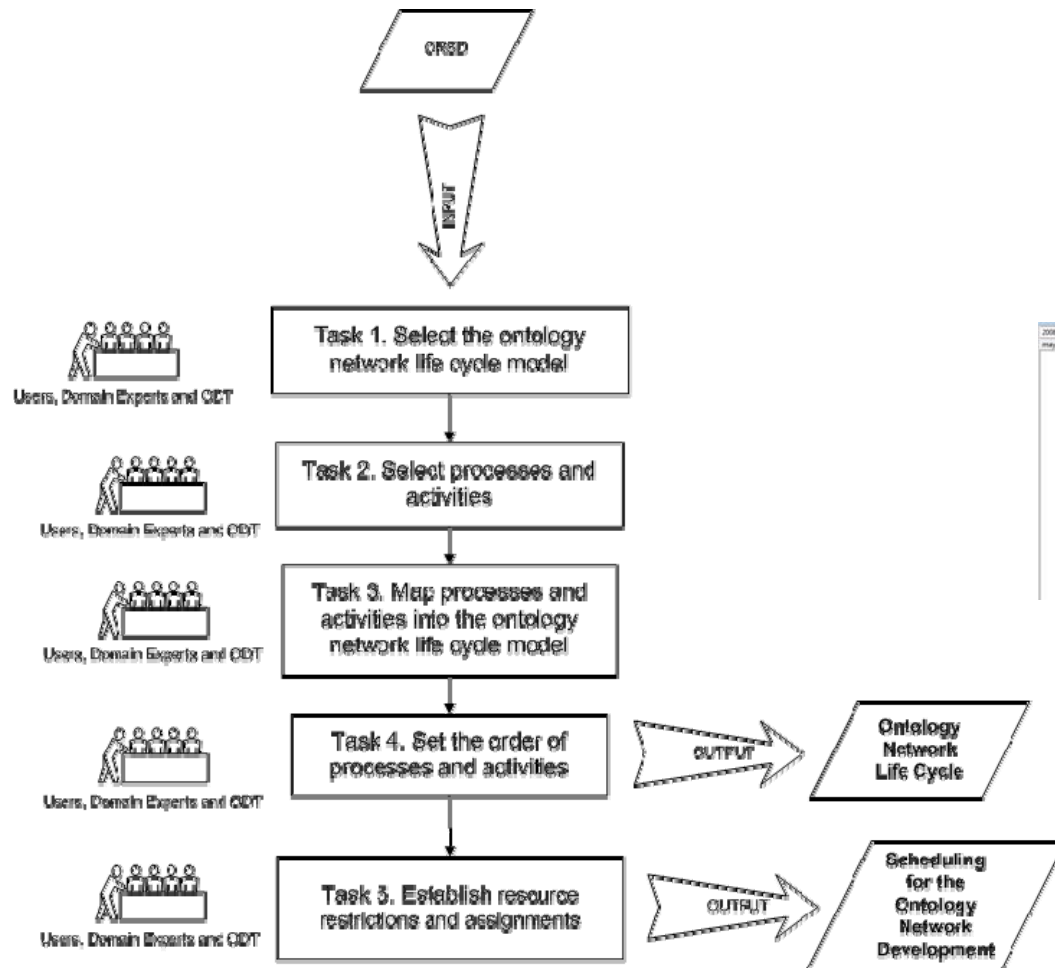
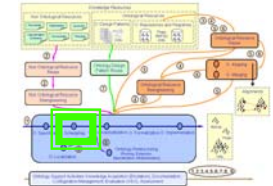
D5.3.2



Scheduling	
<p><i>Definition</i></p> <p>Scheduling refers to the activity of identifying the different activities and processes to be performed during the ontology development, their arrangement, and the time and resources needed for their completion.</p>	
<p><i>Goal</i></p> <p>The scheduling activity states a concrete programming or scheduling to guide the ontology network development, including processes and activities, their order, and time and human resources restrictions and assignments.</p>	
<p><i>Input</i></p> <p>Ontology Requirements Specification Document (ORS D).</p>	<p><i>Output</i></p> <p>Schedule for the ontology network development.</p>
<p><i>Who</i></p> <p>Software developers and ontology practitioners, who form the ontology development team (ODT), in collaboration with users and domain experts.</p>	
<p><i>When</i></p> <p>This activity must be carried out after the ontology requirements specification activity.</p>	

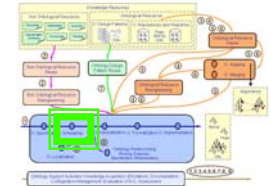
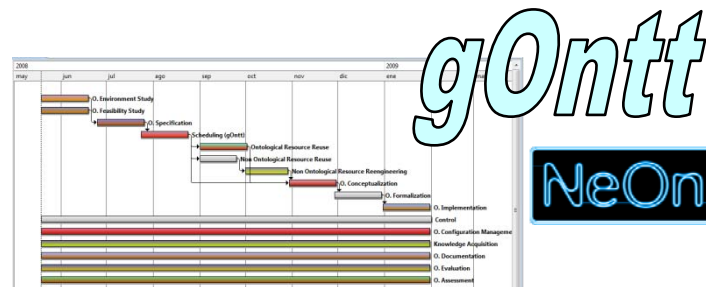
Scheduling. Methodological Guidelines

D5.3.2



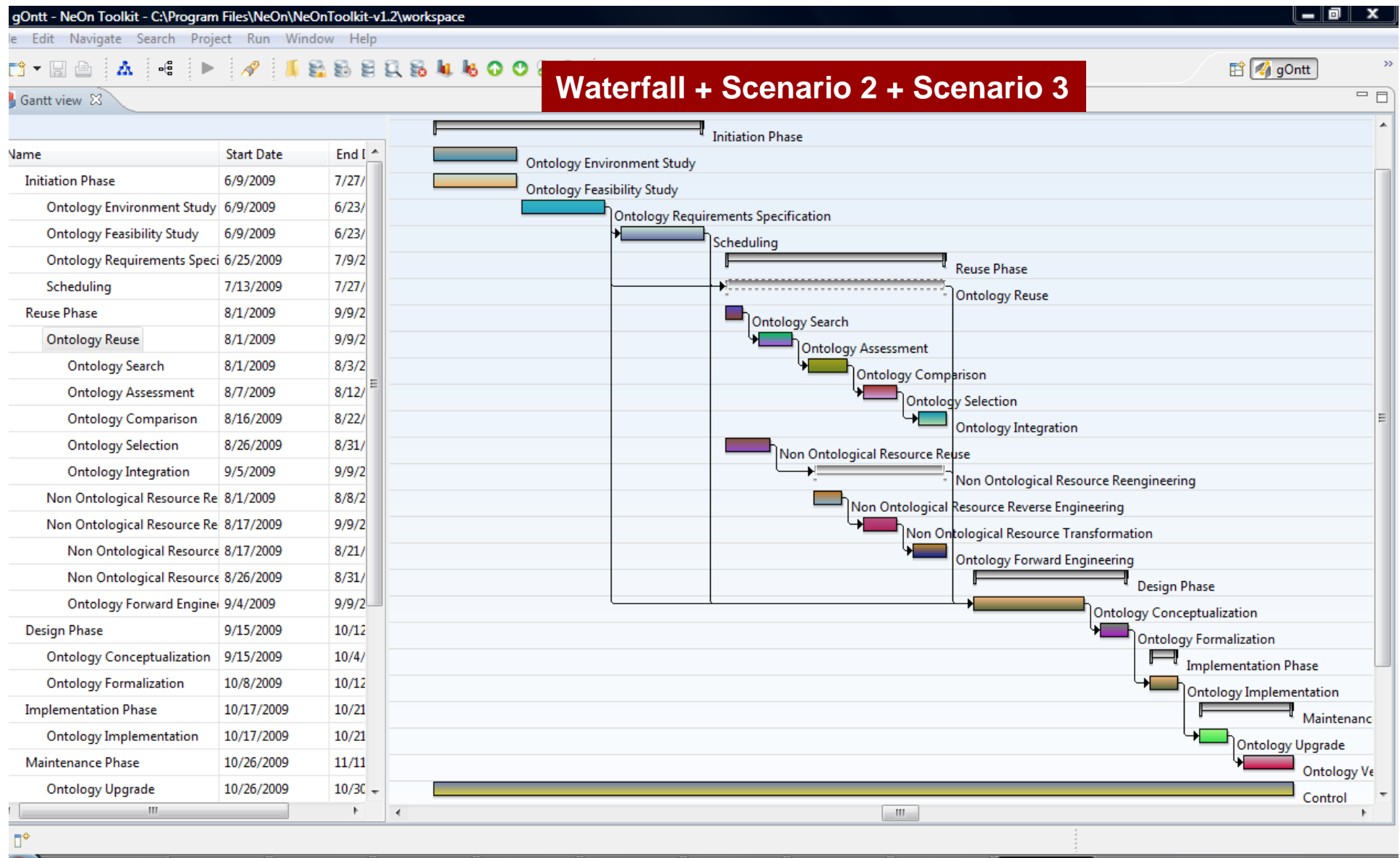
Scheduling. gOntt Plug-in

D5.3.2

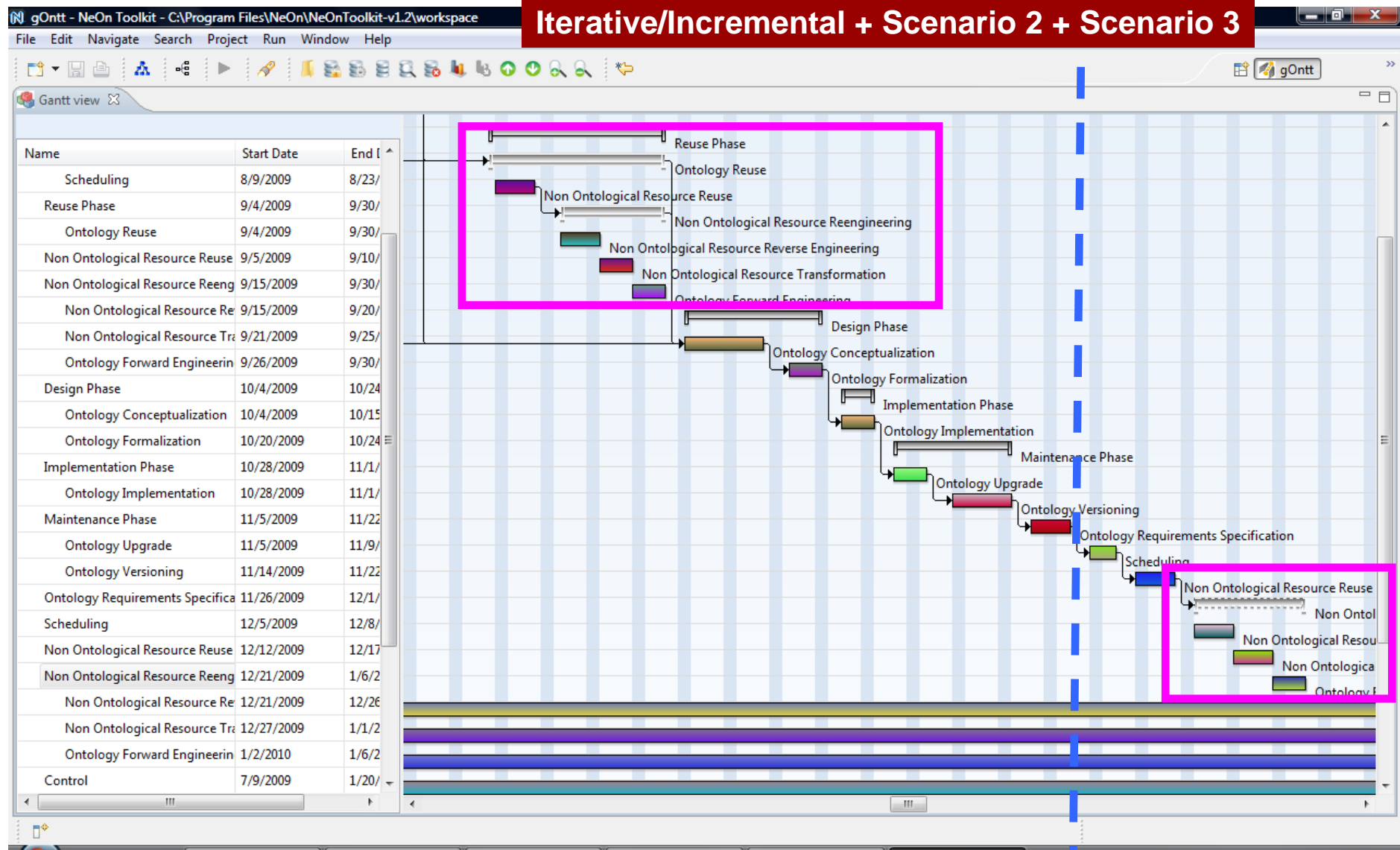


- **gOntt** helps in scheduling an ontology network development.
- **gOntt** is a **NeOn** plug-in for integrating the **NeOn Methodology** and the **NeOn Toolkit**.
 - *gOntt* provides filling cards, workflows, and methodological guidelines.
 - *gOntt* triggers the *NeOn* plug-ins associated to each process and activity planned.

Gantt chart for your project (I)



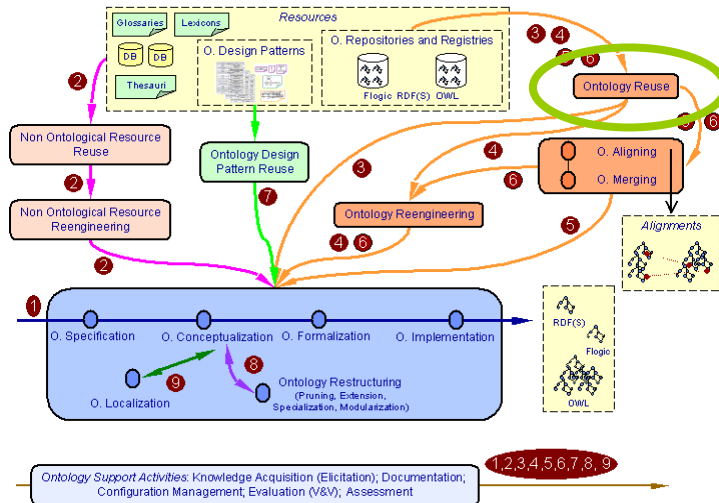
Gantt chart for your project (II)



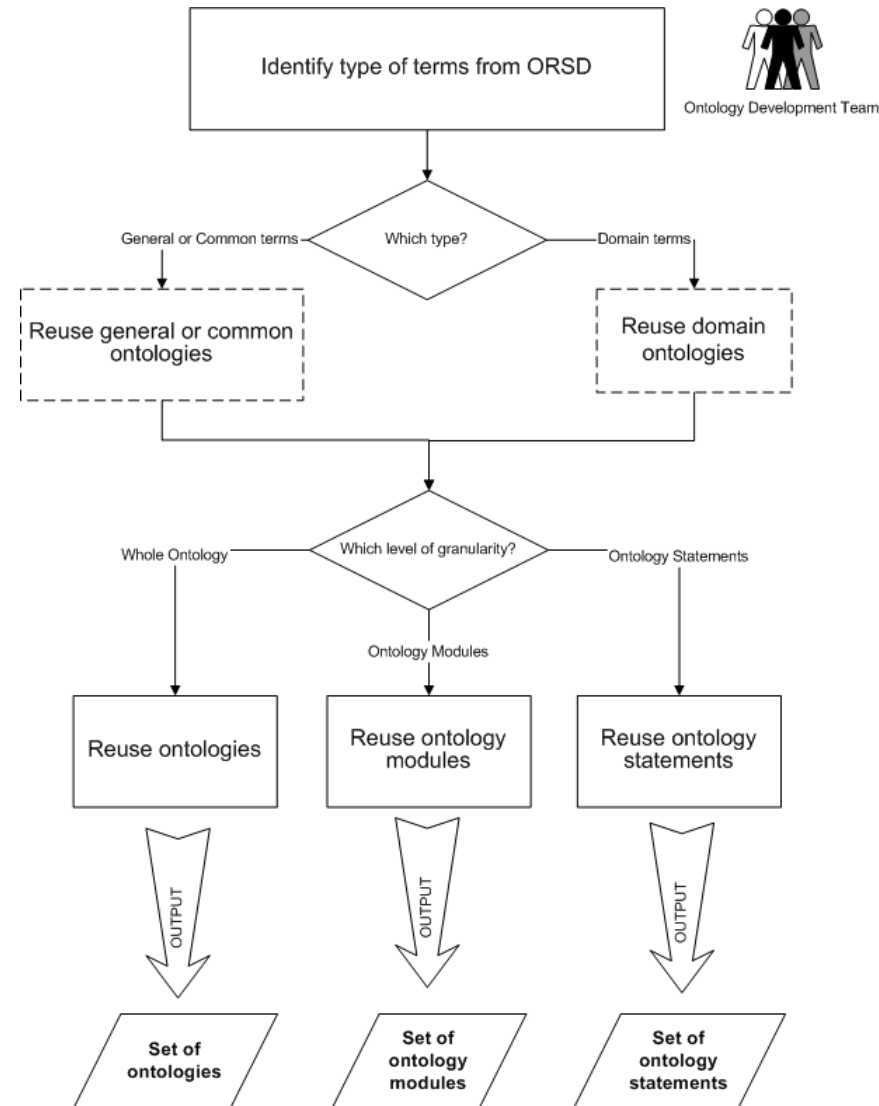
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- ❑ **Methodological Guidelines for Reusing Existing Knowledge Resources**
- ❑ Conclusions

Ontological Resource Reuse Process

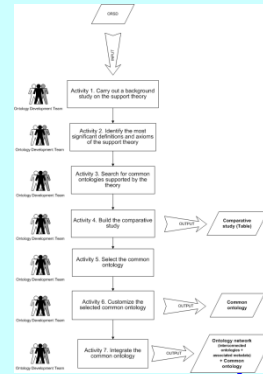
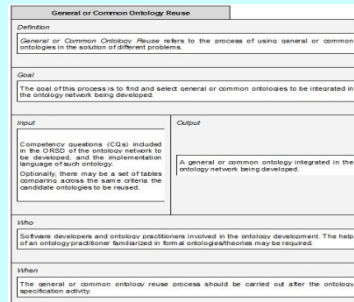


- **Ontological Resource Reuse** is defined as the process of using available ontological resources (ontologies, modules, statements) in the solution of different problems.

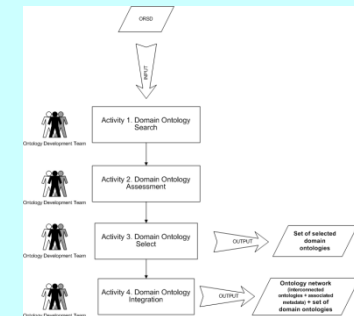
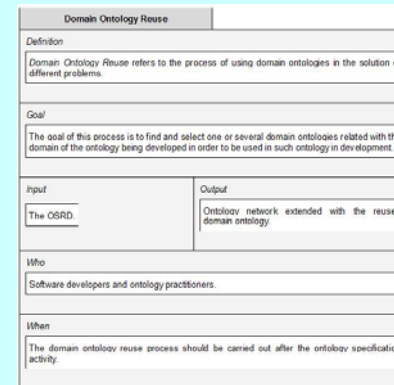


Detailed descriptions in D5.4.1

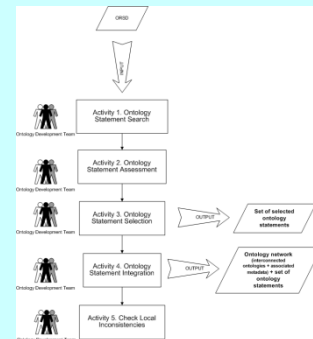
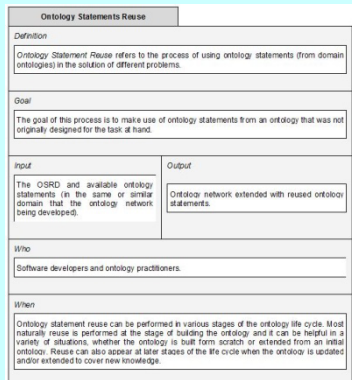
Reuse Common Ontologies



Reuse Domain Ontologies



Reuse Ontology Statements



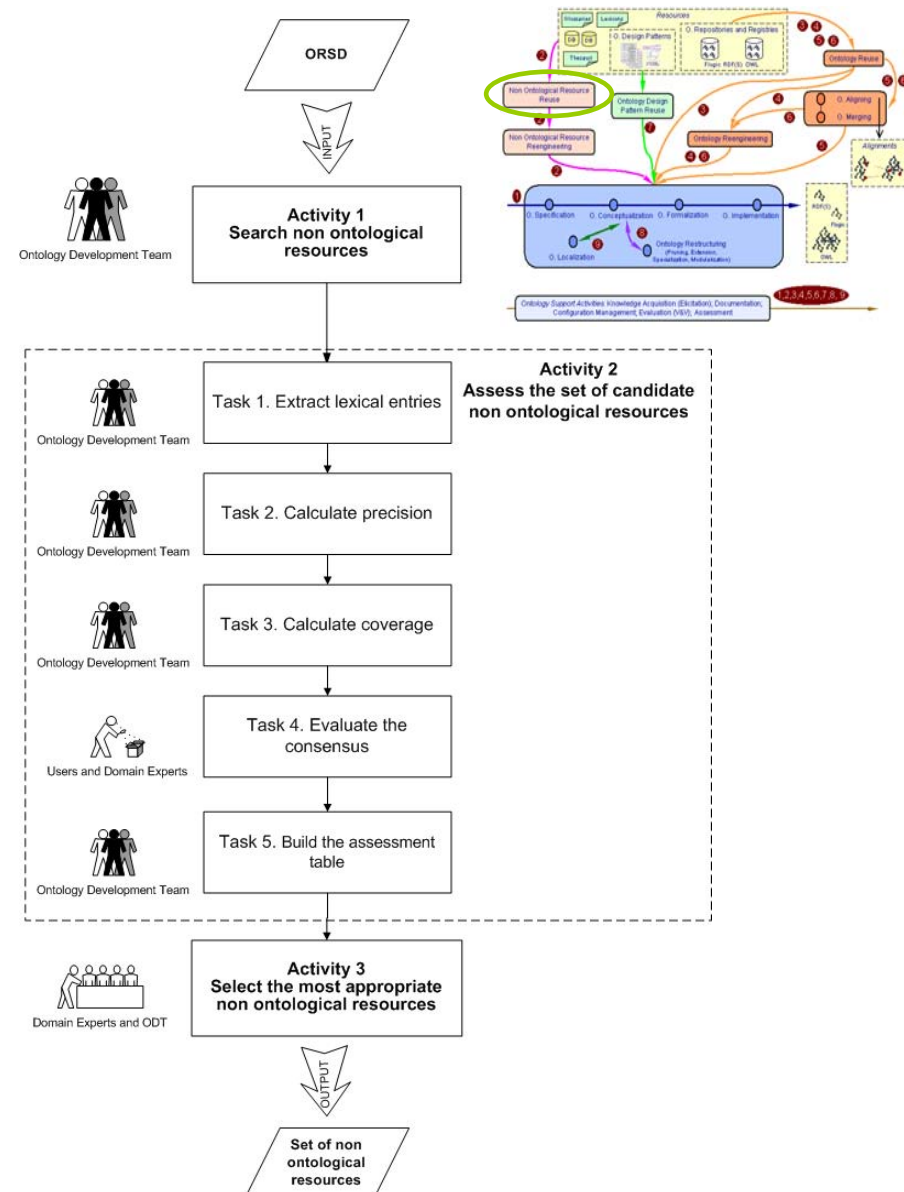
Watson plug-in

Non Ontological Resource Reuse Process

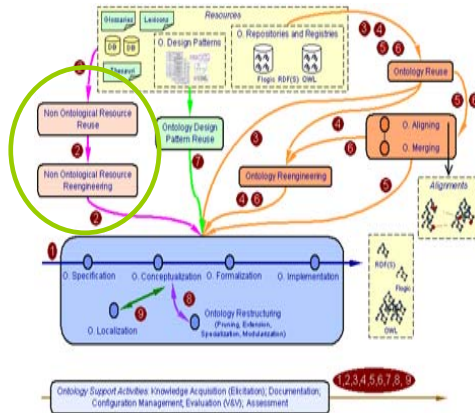
Non Ontological Resource Reuse	
<i>Definition</i>	
Non Ontological Resource Reuse refers to the process of choosing the most suitable non ontological resources for the development of ontologies ³¹ .	
<i>Goal</i>	
To choose the most suitable non ontological resources for building ontologies.	
<i>Input</i>	<i>Output</i>
The ontology requirements specification document (ORSD).	A set of non ontological resources that to some extent covers the expected domain.
<i>Who</i>	
Domain experts, software developers and ontology practitioners.	
<i>When</i>	
After the ontology specification activity and before the non ontological resource reengineering process.	

Example

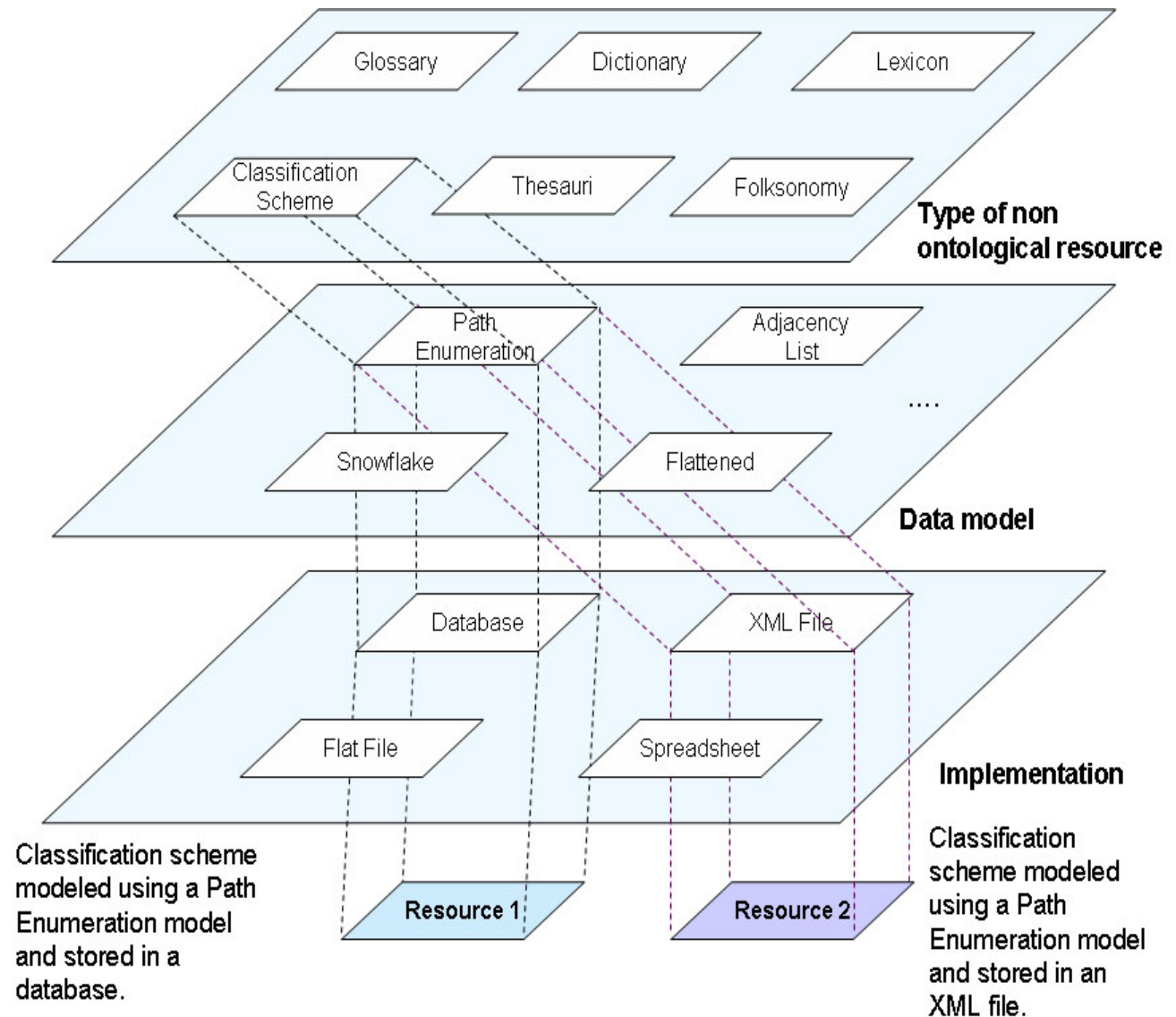
- SEEMP: Non Ontological Resource Reuse in the Occupation Domain
- The process: D54.1 in NeOn



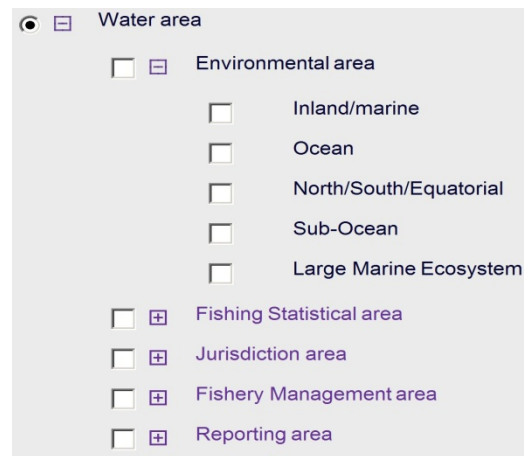
Types of non-ontological resources



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

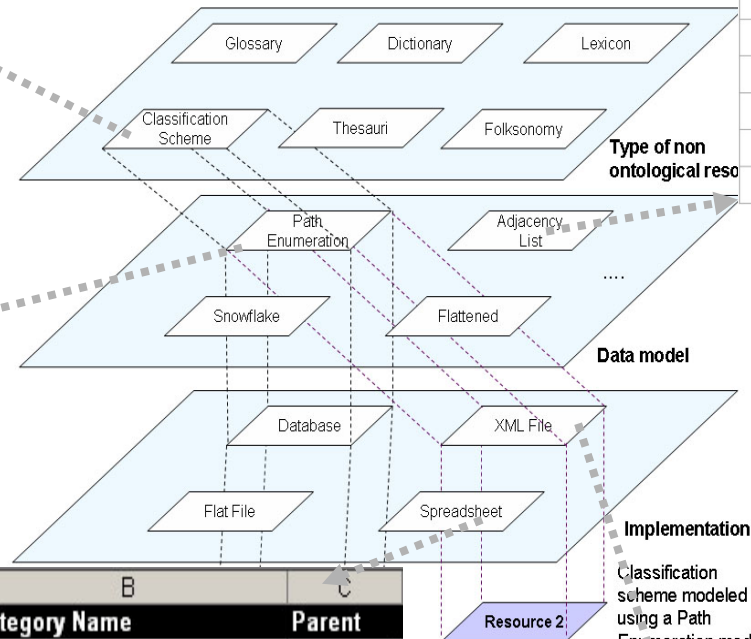


Types of non ontological resources



Id	Category Name
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
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	Inland/marine	21000
7	21002	Ocean	21000
8	21003	North/South/Equatorial	21000
9	21004	Sub Ocean	21000
10	21005	Large Marine ecosystem	21000



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

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  </Category>
  <Category>
    <NodeId>21000</NodeId>
  
```

Data Models for Classification Schema

- **Path Enumeration Data Model** is a recursive structure for hierarchy representations defined as a model which stores for each node the path (as a string) from the root to the node. This string is the concatenation of the nodes code in the path from the root to the node.
- **Adjacency List** is a recursive structure for hierarchy representations comprising a list of nodes with a linking column to their parent nodes

ID	CSI_Name
20000	Water area
20000.21000	Environmental area
20000.24020	Jurisdiction area
20000.22000	Fishing Statistical area
20000.21000.21001	Inland/marine
20000.21000.21002	Ocean
20000.21000.21003	North/South/Equatorial
20000.22000.22001	FAO statistical area
20000.22000.22002	Areal grid system

ID	CSI_Name	Parent
20000	Water area	
21000	Environmental area	20000
24020	Jurisdiction area	20000
22000	Fishing Statistical area	20000
21001	Inland/marine	21000
21002	Ocean	21000
21003	North/South/Equatorial	21000
22001	FAO statistical area	22000
22002	Areal grid system	22000

Data Models for Classification Schema

- **Snowflake Data Model** is a normalized structure for hierarchy representations. For each hierarchy level a entity is created. In this model each hierarchy node has a linked column to its parent node.

First Level		
ID	CSI_Name	
20000	Water area	

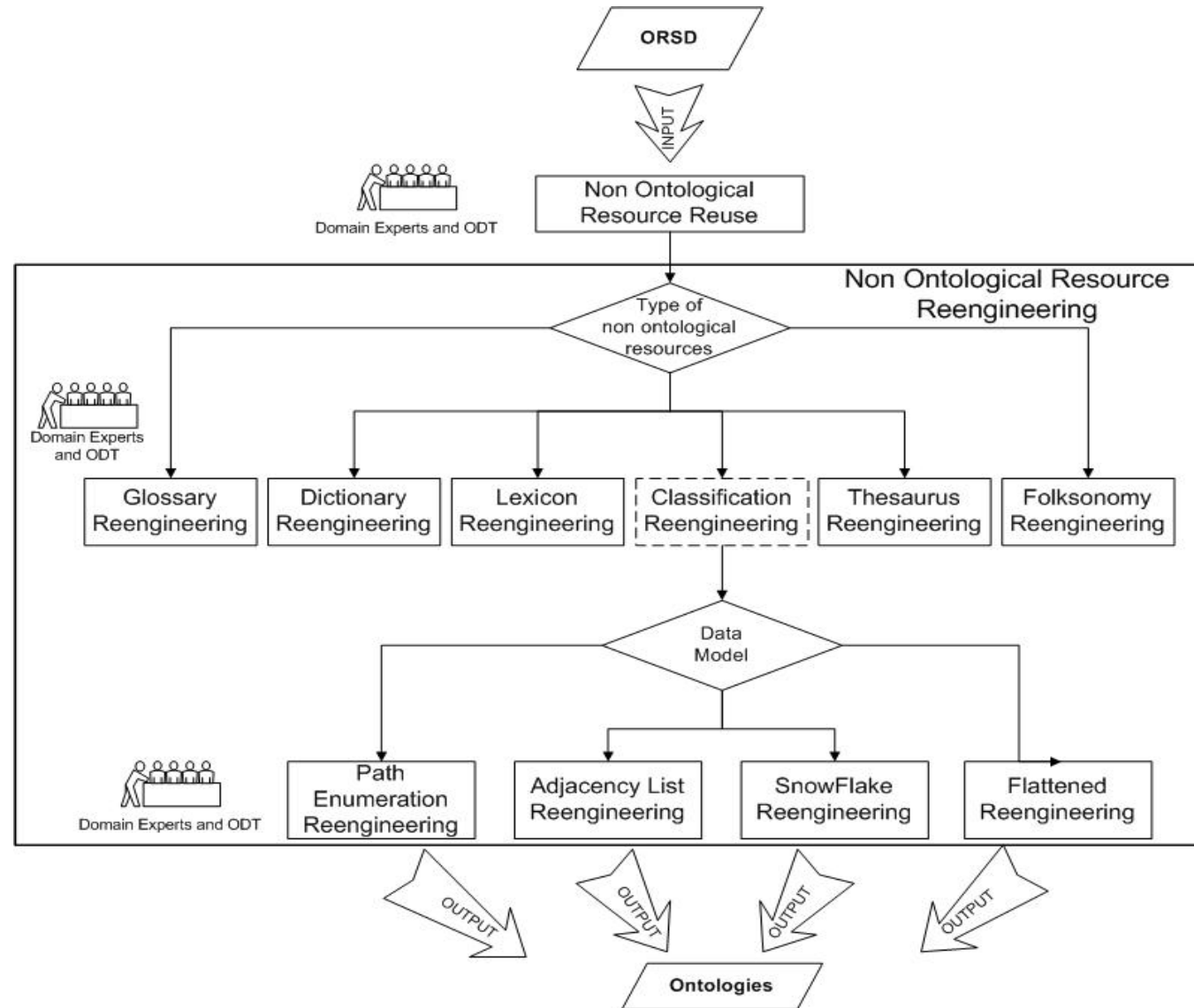
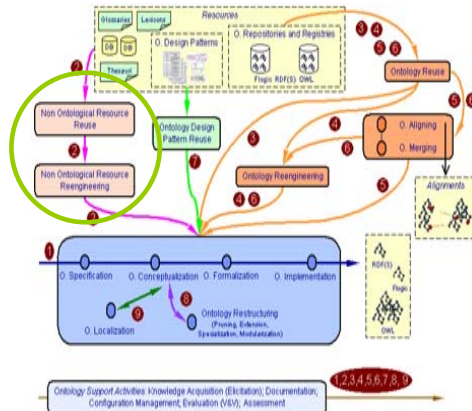
Second Level		
ID	First Level ID	CSI_Name
21000	20000	Environmental area
24020	20000	Jurisdiction area
22000	20000	Fishing Statistical area

Third Level		
ID	Second Level ID	CSI_Name
21001	21000	Inland/marine
21002	21000	Ocean
21003	21000	North/South/Equatorial
22001	22000	FAO statistical area
22002	22000	Areal grid system

- **Flattened Data Model**, is a denormalized structure for hierarchy representations. The hierarchy is represented using one table where each hierarchy level is stored on a different column. This model is similar to path enumeration because each row has the complete path from the root to the node.

First Level		Second Level		Third Level	
ID	CSI_Name	ID	CSI_Name	ID	CSI_Name
20000	Water area	21000	Environmental area	21001	Inland/marine
20000	Water area	21000	Environmental area	21002	Ocean
20000	Water area	21000	Environmental area	21003	North/South/Equatorial
20000	Water area	22000	Fishing Statistical area	22001	FAO statistical area
20000	Water area	22000	Fishing Statistical area	22002	Areal grid system
20000	Water area	24020	Jurisdiction area		

The resource type and its data model influence the reengineering process



Exercise to be done in the Hands-on Session



Based on the CQs identified and on the possible knowledge resources to be reused you already found in previous hands-on activities, to *create an ontology (in paper) that model the domain identified*.

Index

- ❑ Introduction
- ❑ Scenarios in Ontology Building
- ❑ Methodological Guidelines for Ontology Requirements Specification
- ❑ Quick Search of Existing Knowledge Resources
- ❑ Methodological Guidelines for Scheduling
- ❑ Methodological Guidelines for Reusing Existing Knowledge Resources
- ❑ **Conclusions**

Conclusions

Which are the key process and activities in ontology development?

- ☐ NeOn Scenarios for Building Ontology Networks

How do I collect the requirements of my ontology?

- ☐ Ontology Requirements Specification

Which specific sequence of activities should carry out for building my ontology?

When should I carry out each activity?

Where is the relationship of one activity with the others?

- ☐ Ontology Network Life Cycle models
- ☐ Ontology Network Life Cycles
- ☐ Scheduling and gOntt

How do I reuse existing non-ontological resources to build my ontology?

- ☐ Non Ontological Resource Reuse and Reengineering

Where can I find ontologies with the goal of reusing them?

- ☐ OMV and Watson

How do I reuse existing ontological resources to build my ontology?

- ☐ Ontological Resource Reuse

NeOn Methodology Pointers

- ❑ Scenarios for Building Ontology Networks → **D5.3.1 and D5.4.2**
- ❑ NeOn Glossary of Processes and Activities → **D5.3.1 and D5.3.2**
- ❑ Set of Ontology Network Life Cycle Models → **D5.3.2**
- ❑ Methodological Guidelines for Ontology Requirements Specification → **D5.4.1**
- ❑ Methodological Guidelines for Scheduling and gOntt plug-in → **D5.3.2**
- ❑ Methodological Guidelines for Non-Ontological Resource Reuse and Reengineering → **D5.4.1 and D2.2.2**
- ❑ Methodological Guidelines for Ontological Resource Reuse → **D5.4.1**
- ❑ Methodological Guidelines for ODP Reuse → **D5.4.1 and D5.4.2**
- ❑ Methodological Guidelines for Ontology Modularization → **D5.4.2**
- ❑ Methodological Guidelines for Ontology Evaluation → **D5.4.2**
- ❑ Methodological Guidelines for Ontology Evolution → **D5.4.2**
- ❑ Methodological Guidelines for Ontology Localization → **D5.4.2**



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