ATHENS Course: Ontologies and the Semantic Web

Ontologies: Life Cycles and Methodologies

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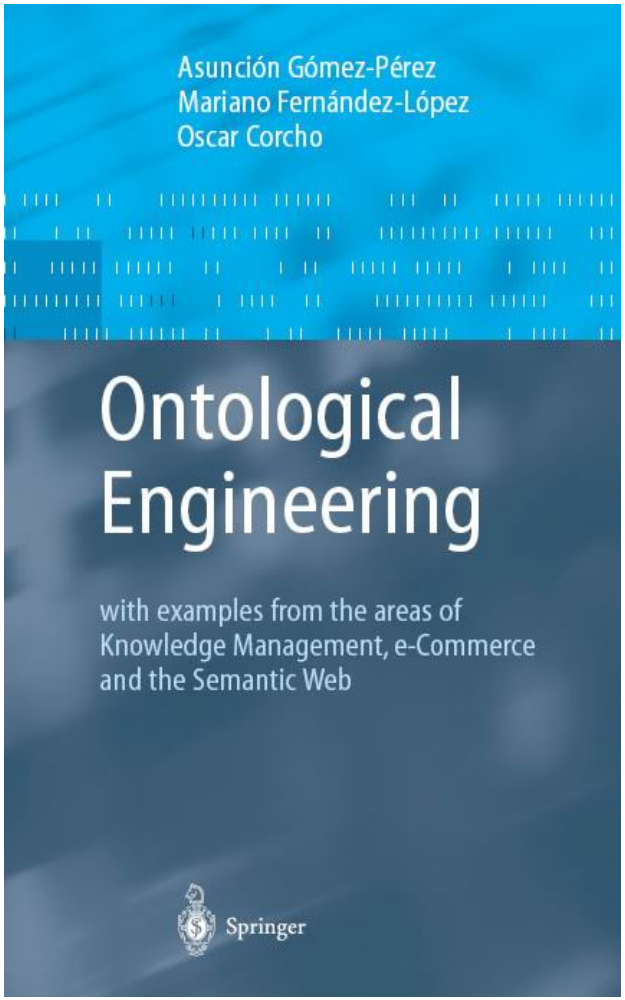
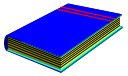
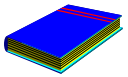
Main References



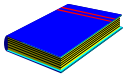
http://www.neon-project.org



D5.3.1, D5.3.2, D5.3.3 on NeOn Development Process and Ontology Life Cycle



D5.4.1, D5.4.2, D5.4.3 on NeOn Methodology for Building Contextualized Ontology Networks



PhD Thesis. “NeOn Methodology for Building Ontology Networks: Specification, Scheduling and Reuse”. 2010

Acknowledgements

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

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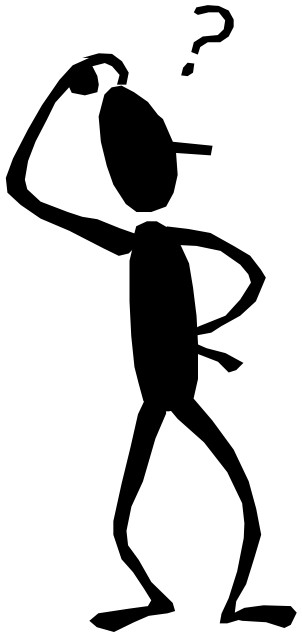
- **Introduction**
- Scenarios in Ontology Building
- Methodological Guidelines for Ontology Requirements Specification
- Quick Search of Existing Knowledge Resources
- Methodological Guidelines for Scheduling
- Methodological Guidelines for Reusing Knowledge Resources
- Conclusions

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.

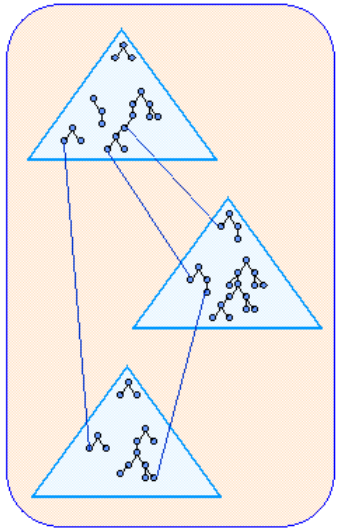
New Trends in Ontology Development

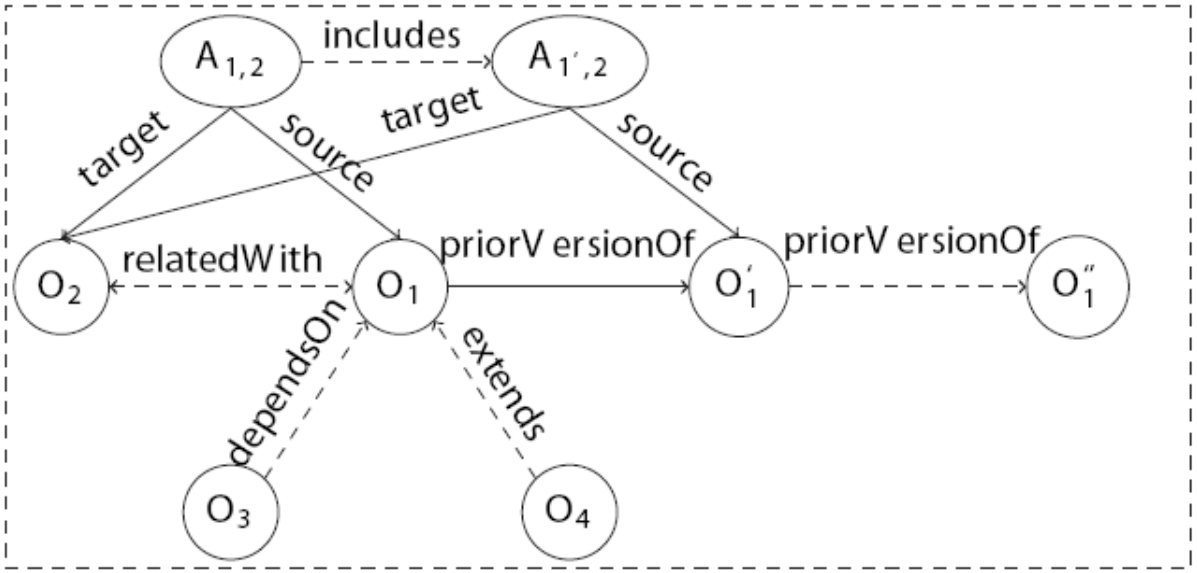
The development of ontologies in different international and national projects have revealed that **there are different alternative ways or possibilities to build ontologies**.

- 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

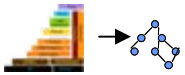
Conceptualize

Evaluate

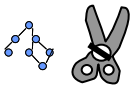
Requirements Specificaction

Extend

Import

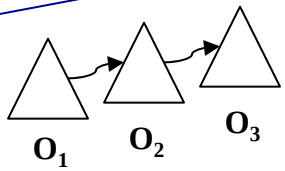


Prune

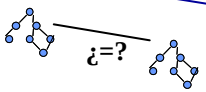


Specialize

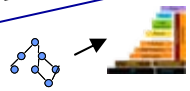
Evolution and Maintenance



Identify Differences

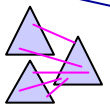


Export



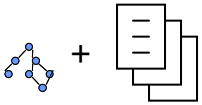
Integrate

Mappings

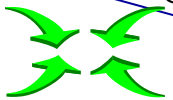


Reasoners

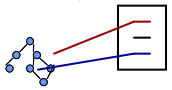
Document



Merge



Anotate



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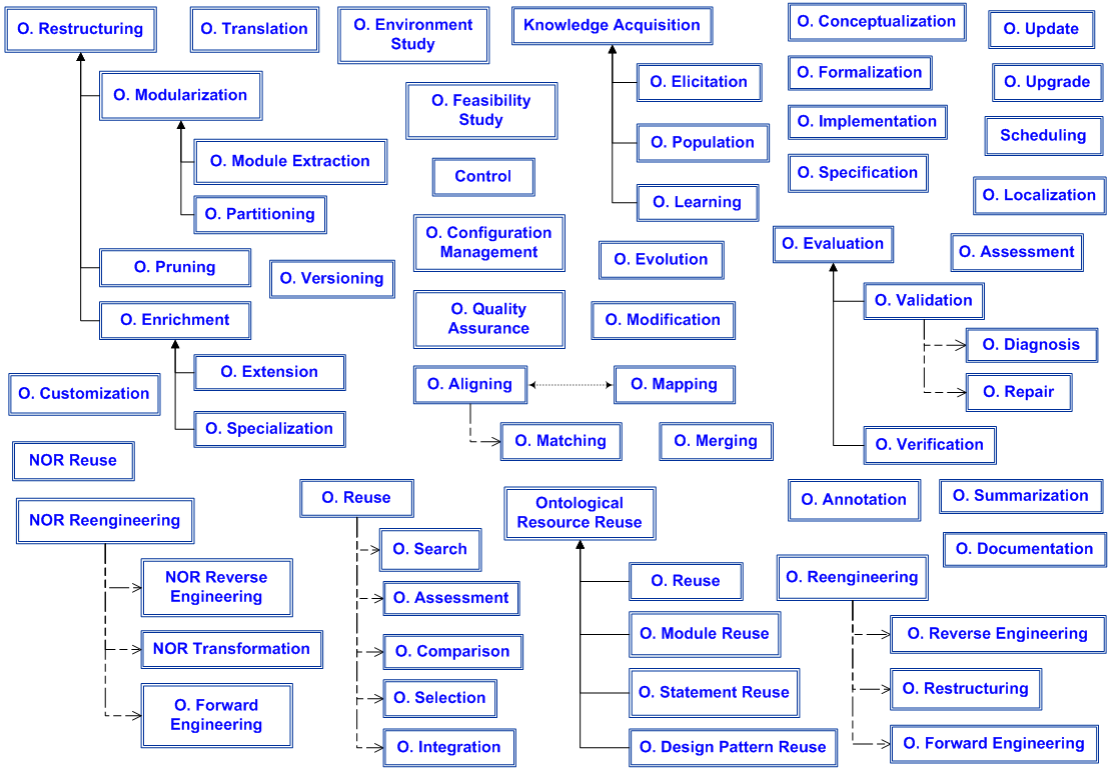
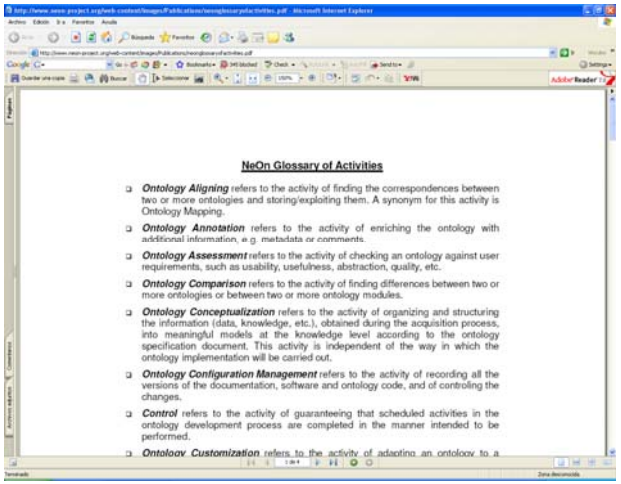
NeOn Glossary of Processes and Activities





http://www.neon-project.org

http://www.neon-project.org/web-content/media/book-chapters/Chapter-03-2.pdf

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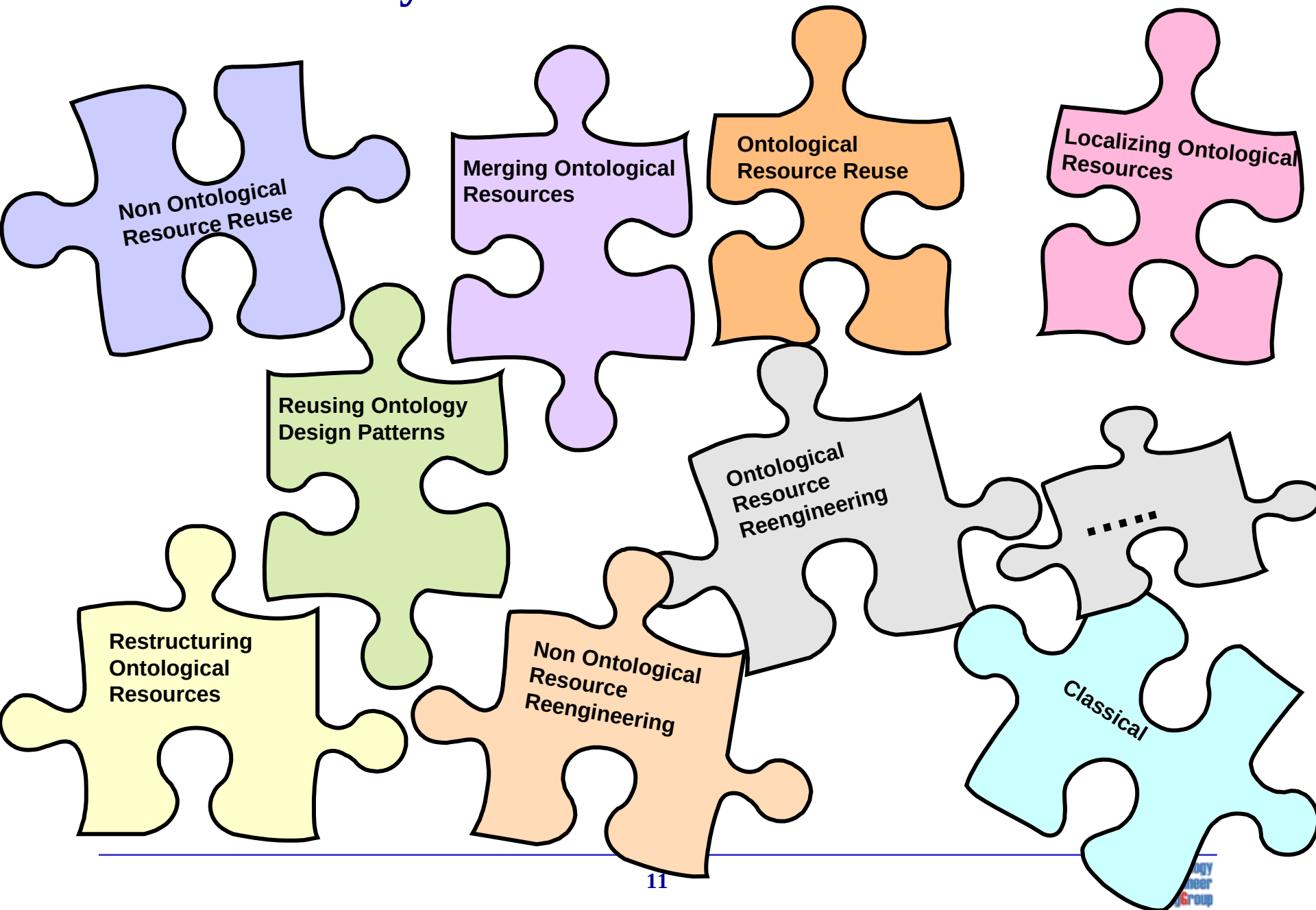
Key Processes and Activities



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.

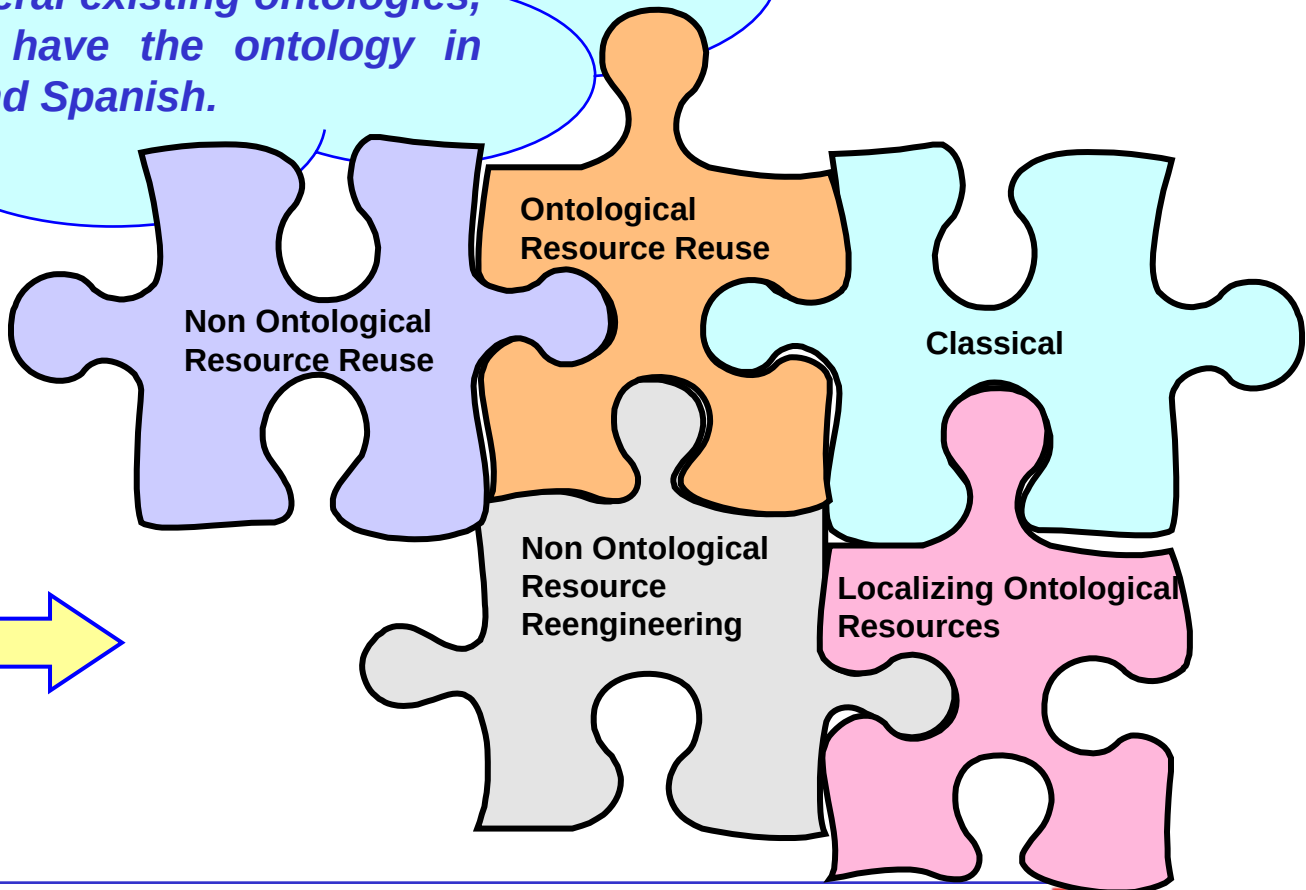
Non Ontological Resource Reuse

Classical

Non Ontological Resource Reengineering

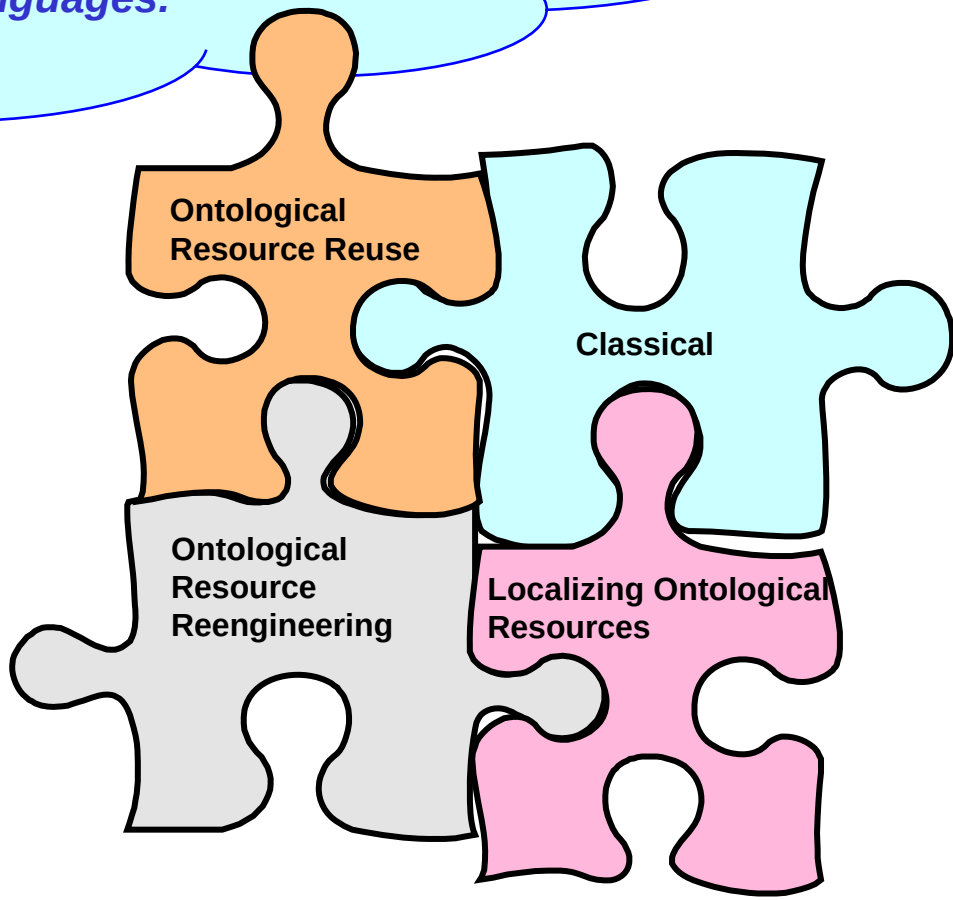
Building Ontology Networks: Use Case 2

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.

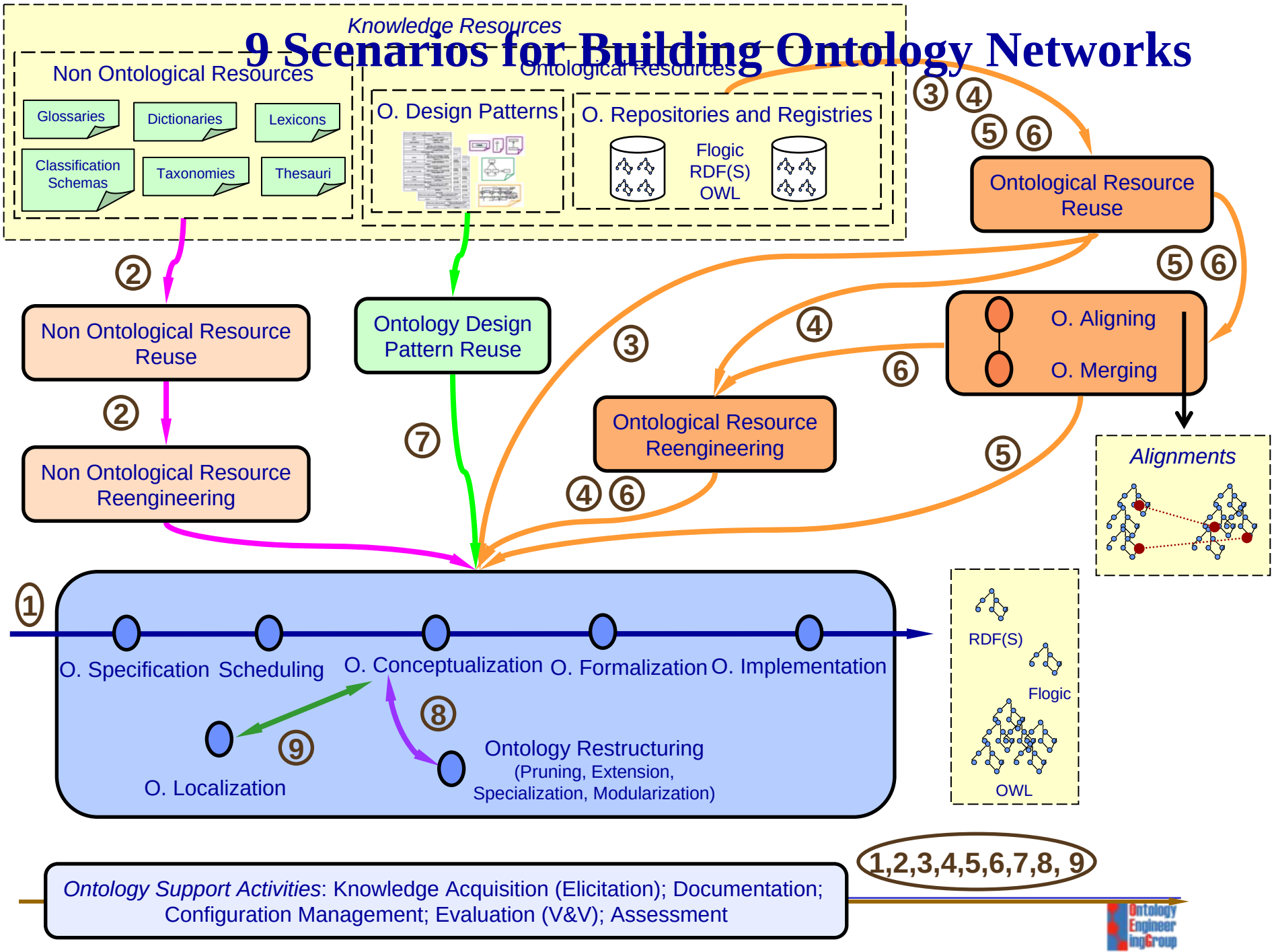


Building Ontology Networks: Use Case 3

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.



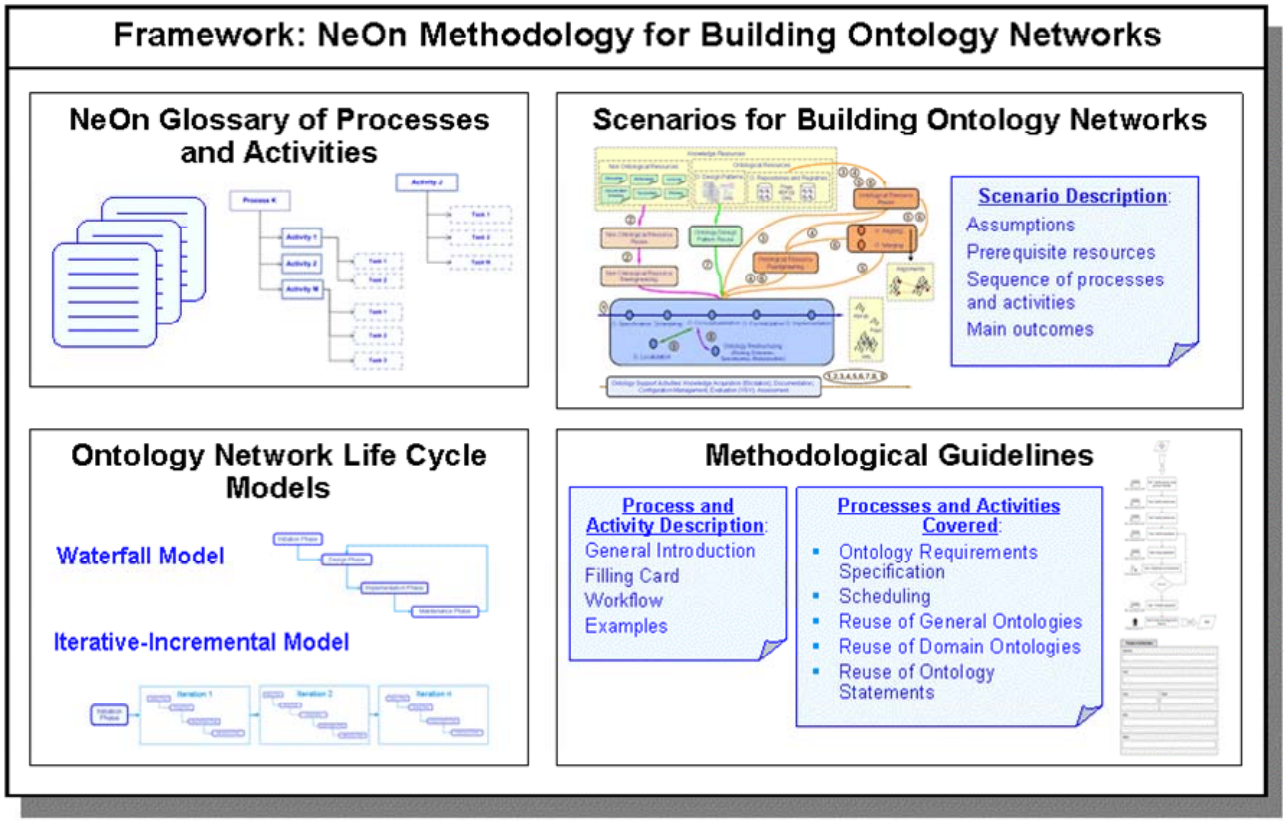
9 Scenarios for Building Ontology Networks



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 Framework



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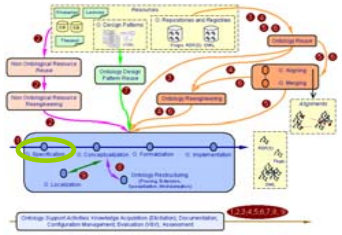
Ontology Requirements Specification



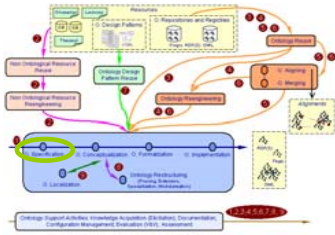
Ontology Requirements Specification is a collection of requirements that the ontology should fulfill, e.g. reasons to build the ontology, target group, intended uses.

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

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, possibly reached through a consensus process.

Goal

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.

Input

A set of ontological needs.

Output

Ontology Requirements Specification Document (ORSD).

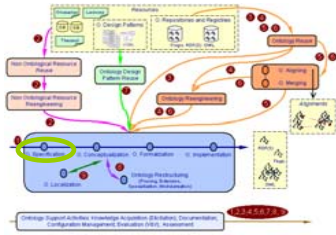
Who

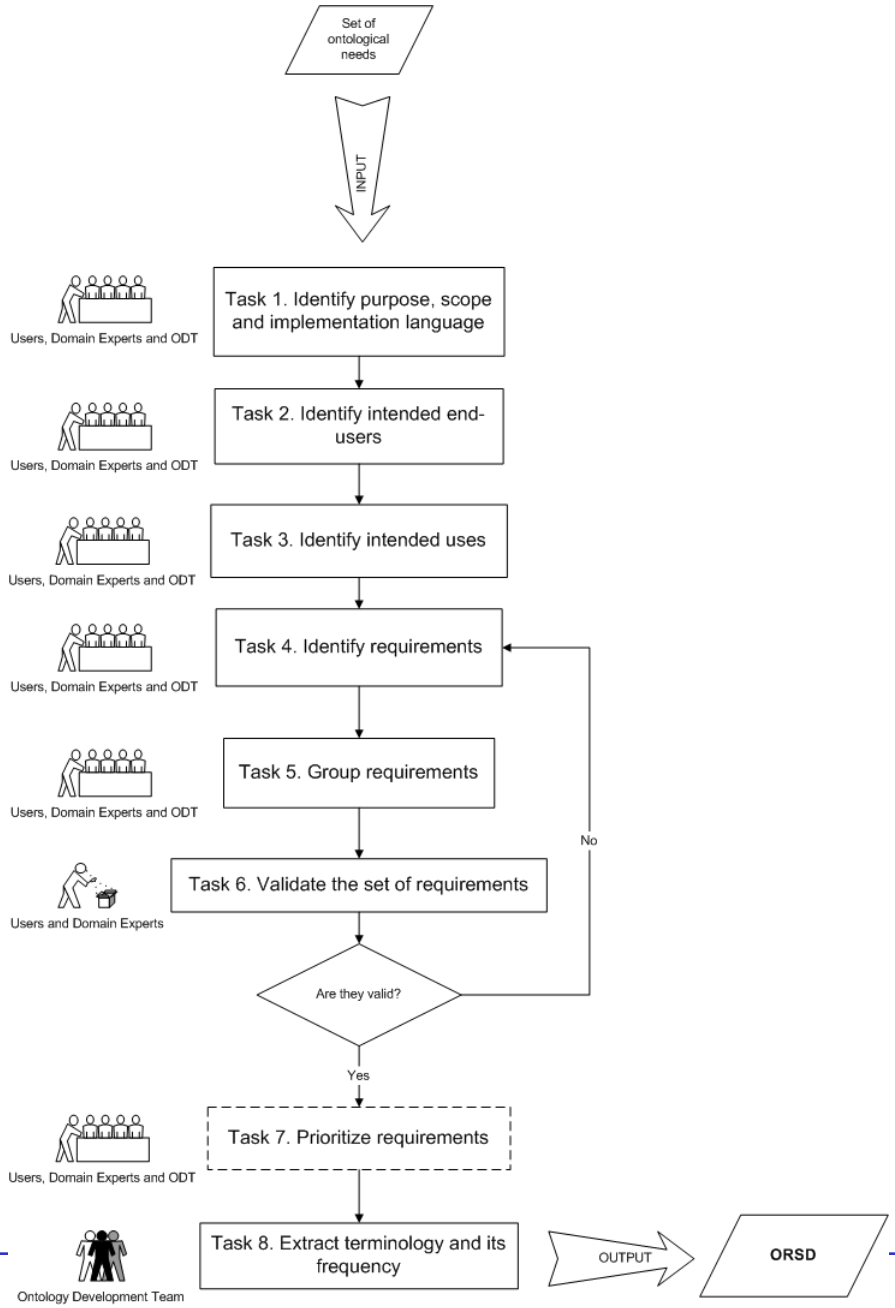
Software developers and ontology practitioners, who form the ontology development team (ODT), in collaboration with users and domain experts.

When

This activity must be carried out at the beginning of the ontology project and in parallel with the knowledge acquisition activity.

Ontology Requirements Specification. Tasks

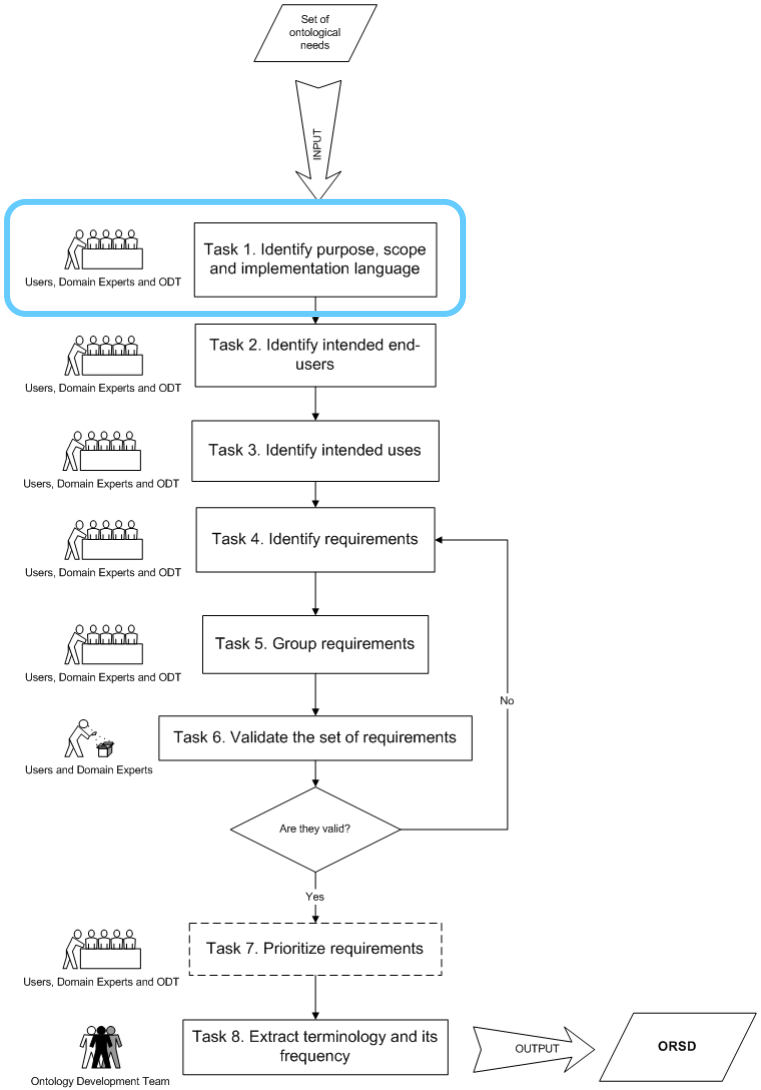




Ontology Requirements Specification Document. Template

Ontology Requirements Specification Document Template	
1	**Purpose**
	The main general goal of the ontology. In other words, the main function or role 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 have.
4	**Intended End-Users**
	The intended end-users expected for the ontology.
5	**Intended Uses**
	The intended uses expected for 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 optionally 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.

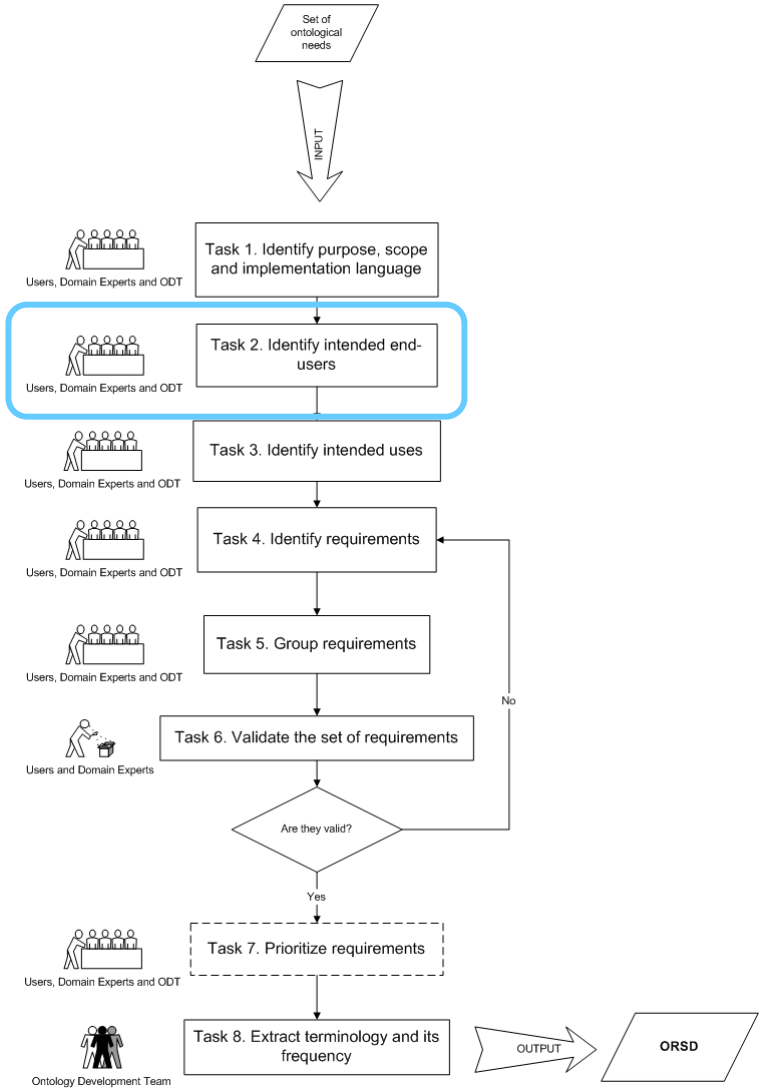
Ontology Requirements Specification. Task 1



- *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 OSRD 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.

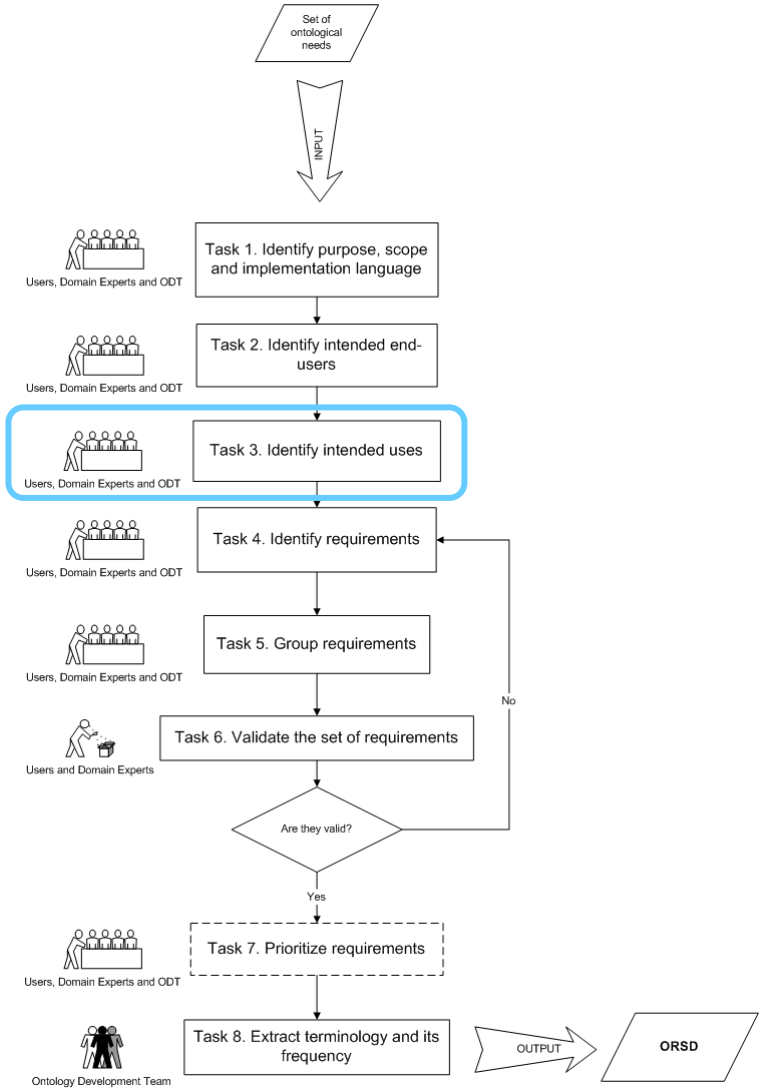
Ontology Requirements Specification. Task 2



- *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.

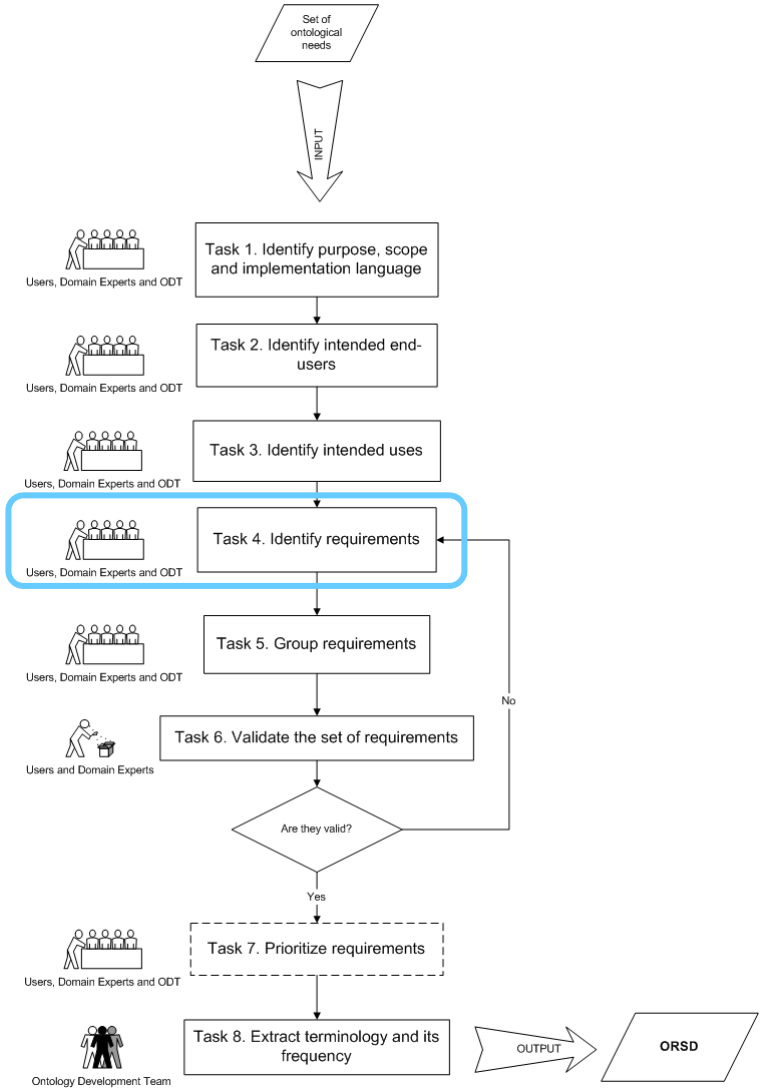
Ontology Requirements Specification. Task 3



- *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.

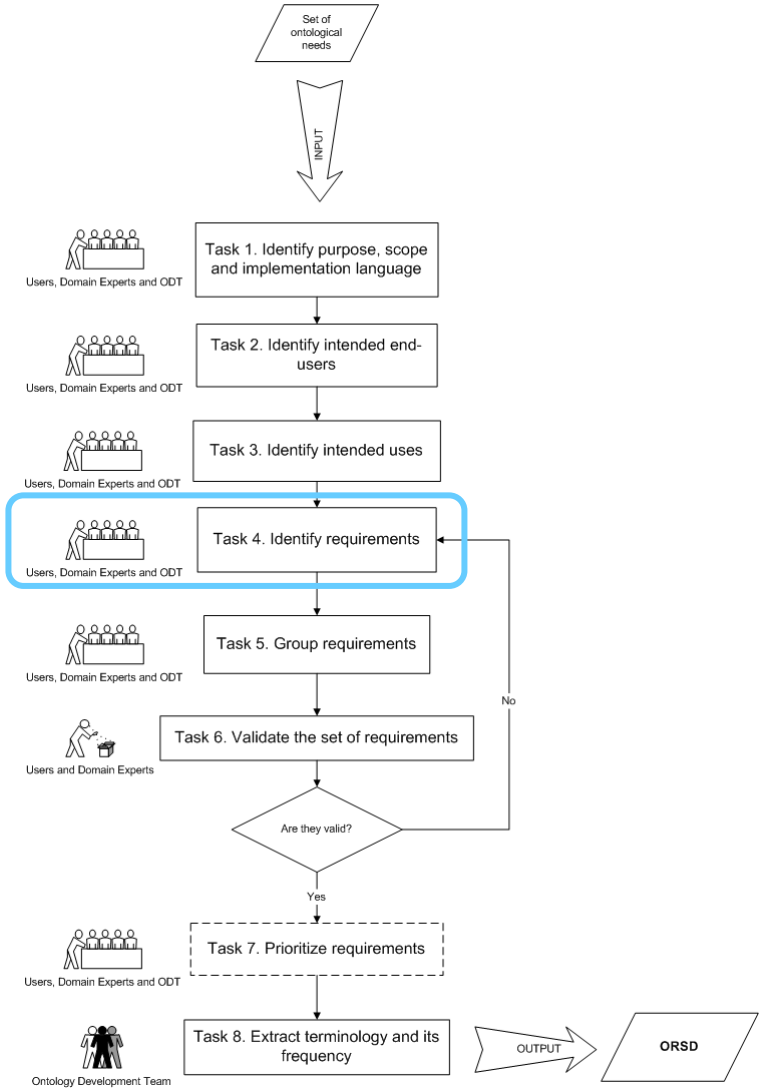
5	**Intended Uses**
Use 1.	Publish CV. Job seeker places his/her CV on the PES Portal.
Use 2.	Publish Job Offer. An Employer places a Job Offer on the PES Portal.
Use 3.	Search for Job Offers. The Employer looks for candidates for the Job Offer through PES Portal.
Use 4.	Search for Employment information. 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

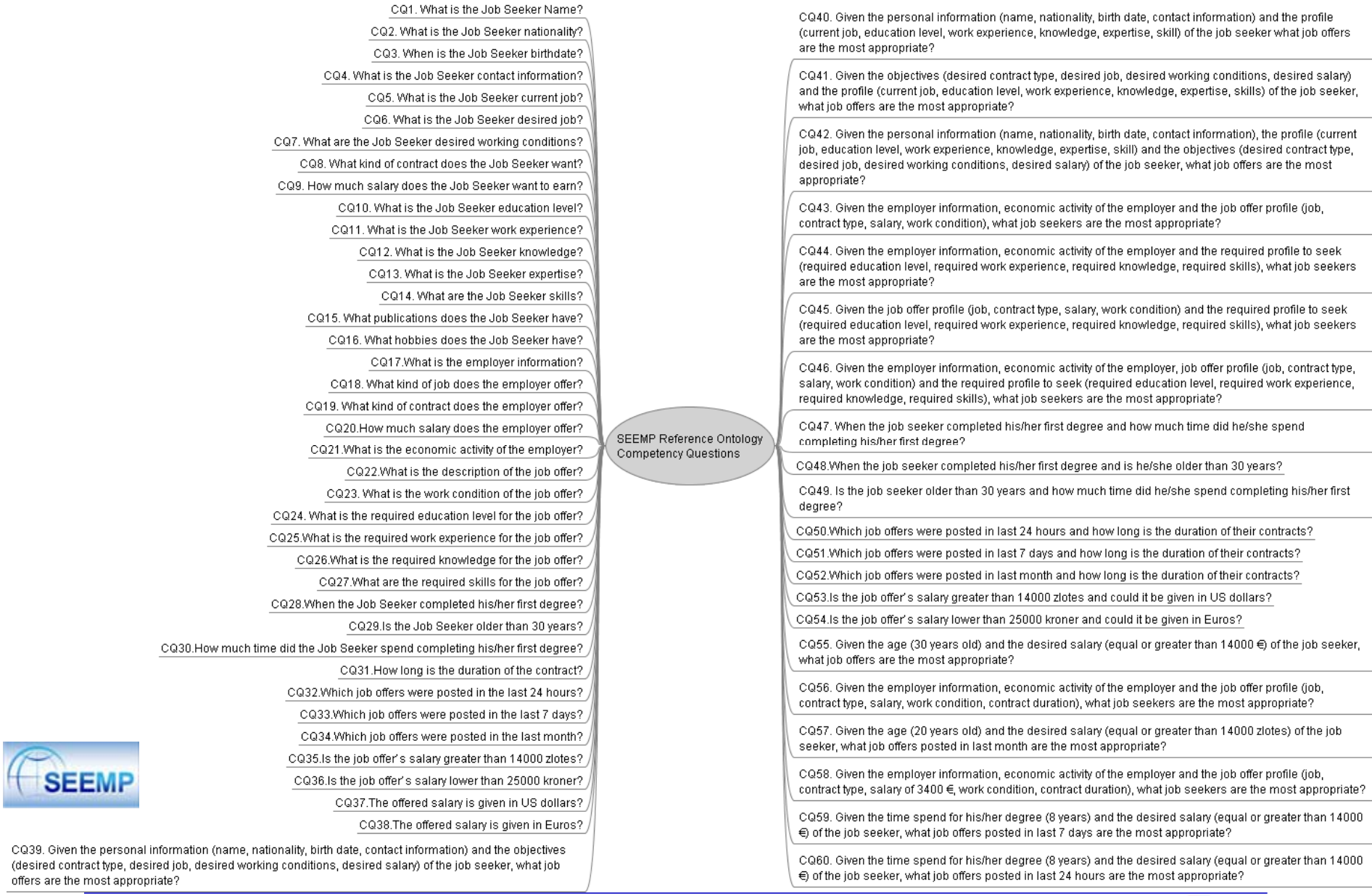
Ontology Requirements Specification. Task 4 (II)



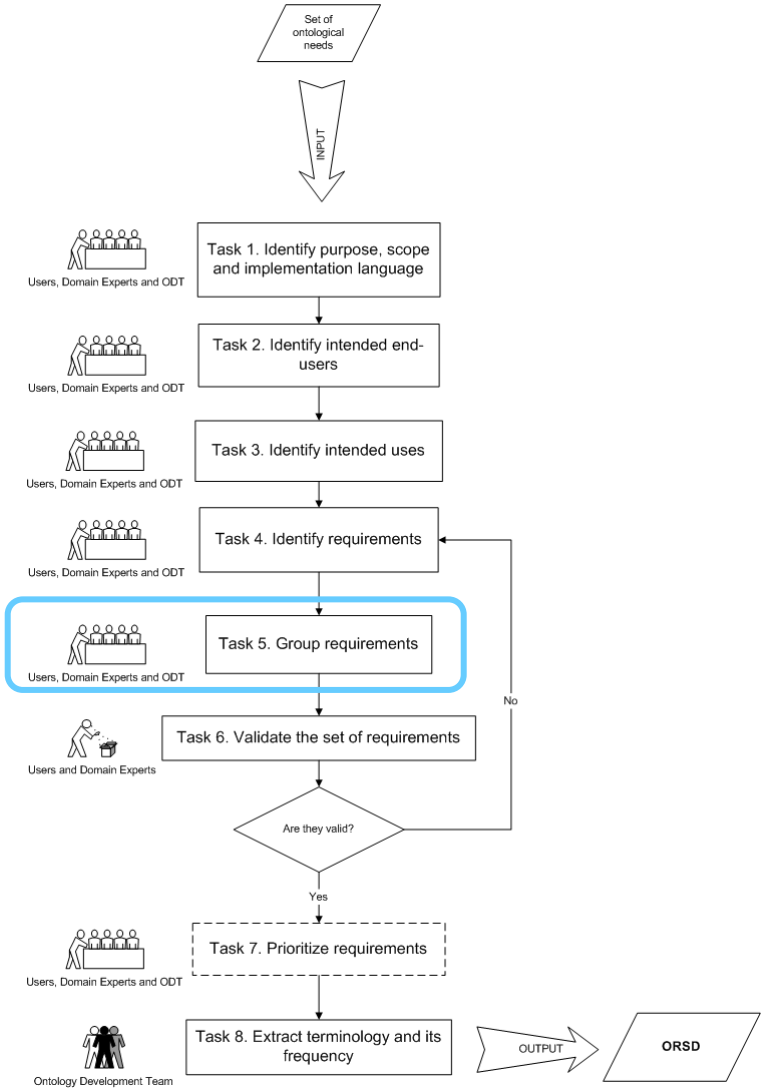
- *Approaches*:
  - Top-Down: Complex questions are decomposed in simple ones.
  - Bottom-Up: Simple questions that are organised to form complex ones.
  - Middle out: Mix approach between top-down and bottom-up.

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



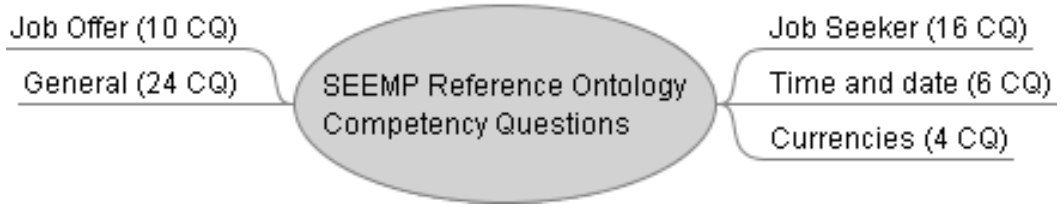
Ontology Requirements Specification. Task 5

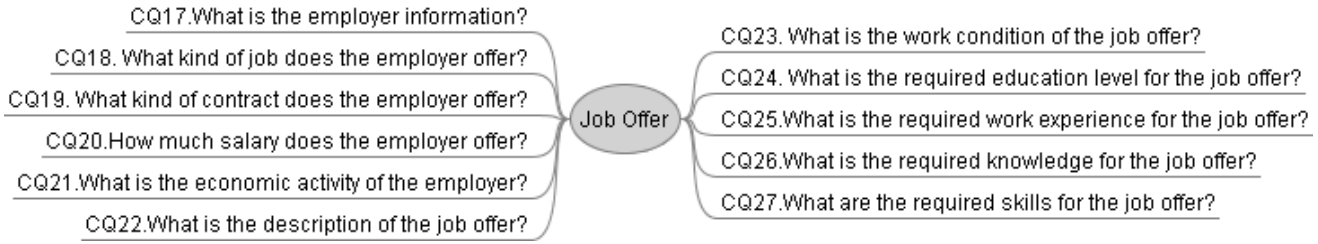


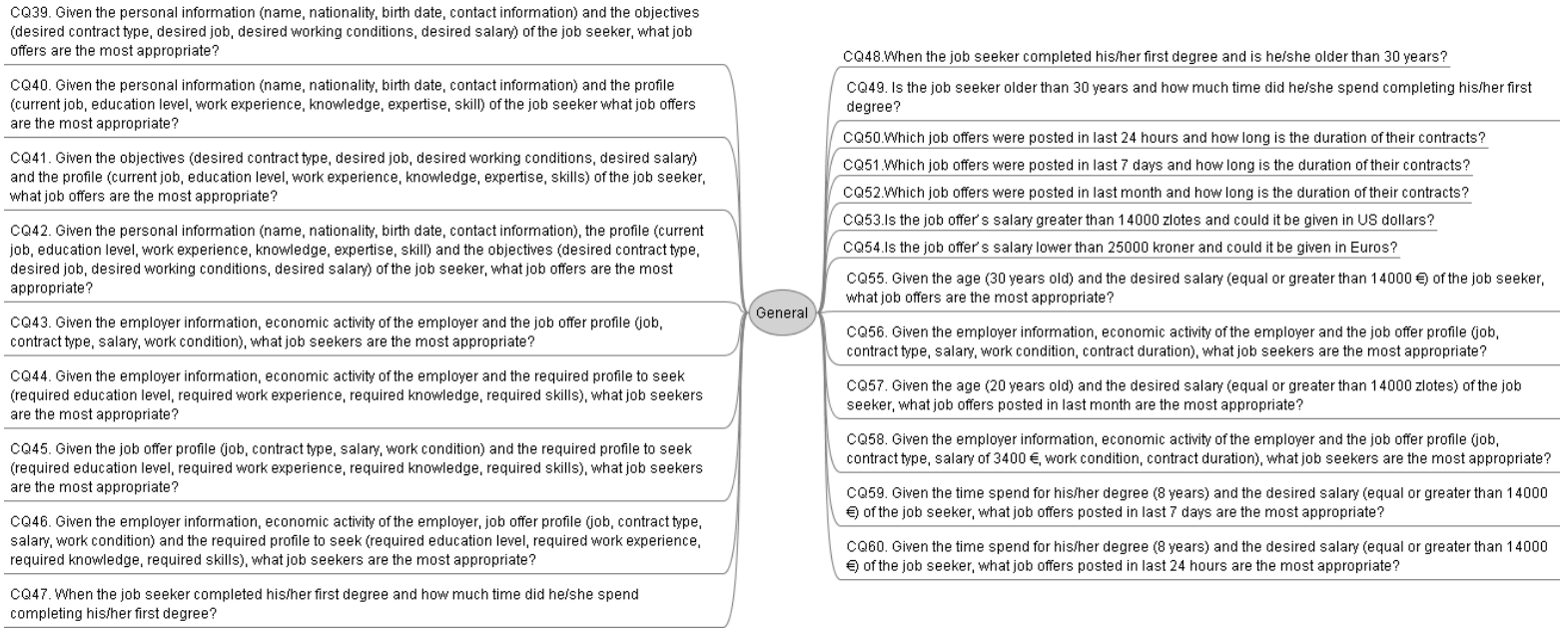
- *Input*: the list of CQs
- *Objective*: obtaining different **groups of CQs**
- *Techniques*: Card Sorting, when the grouping is done manually, and Clustering NL sentences or Information Extraction when the grouping is done automatically
- *Tools*: MindMap Tools or Cicero Tool (for distributed teams)
- *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.

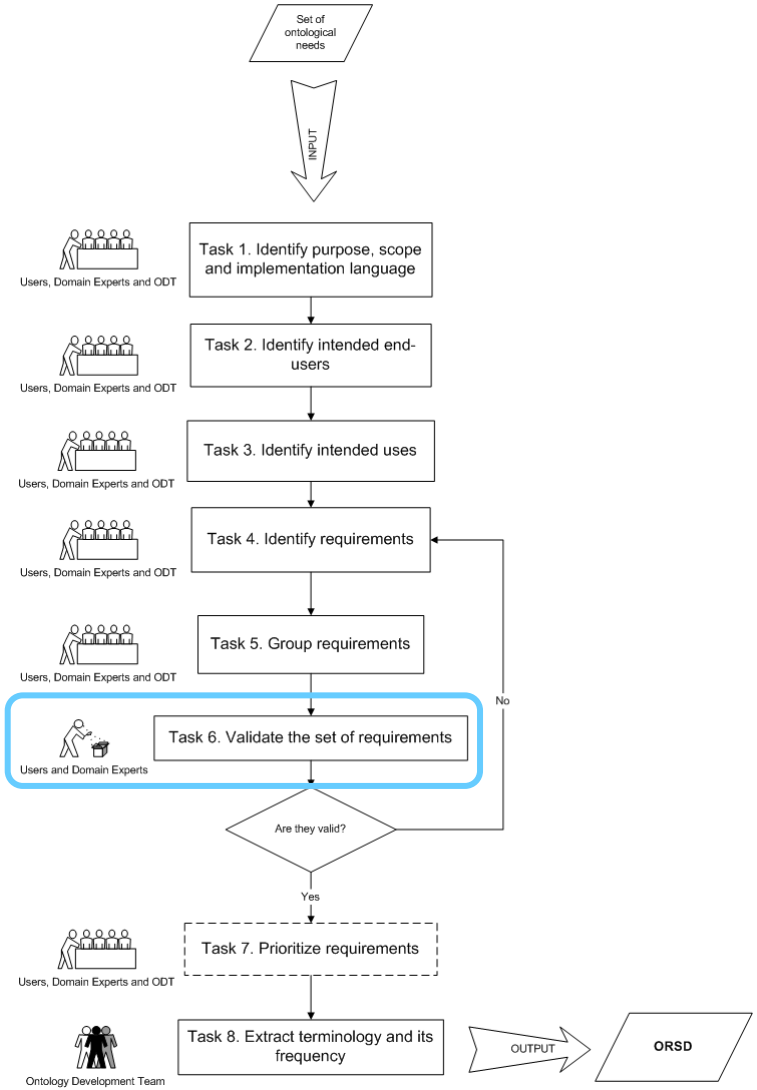
Task 5. Group requirements (CQs)







Ontology Requirements Specification. Task 6



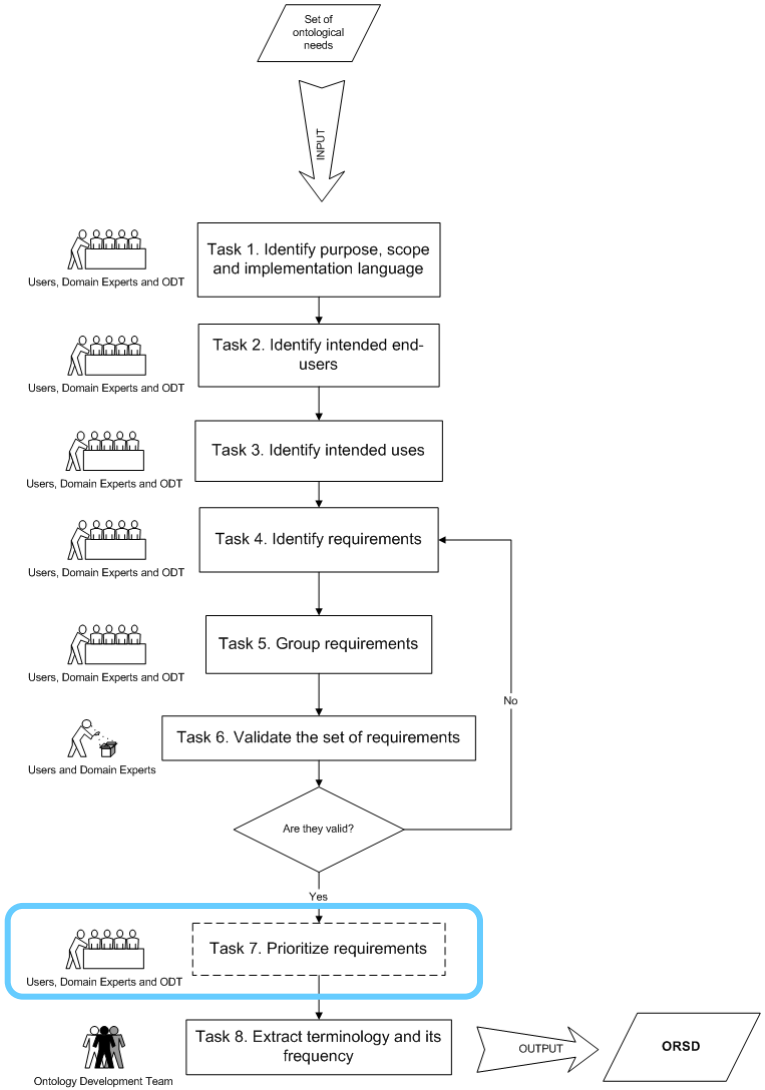
- *Input*: the set of grouped CQs
- *Objective*: to identify possible conflicts between CQs, missing CQs, and contradictions in CQs. To decide **if such CQs are valid or not**
- *Output*: a confirmation about the validity of the set of CQs
- *Criteria*:

Correctness.	*Completeness.*
Consistent.	*Verificable.*
Understandable.	*No Ambiguity.*
Conciseness.	*Realism.*
Modifiable.	
Traceable.	

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.

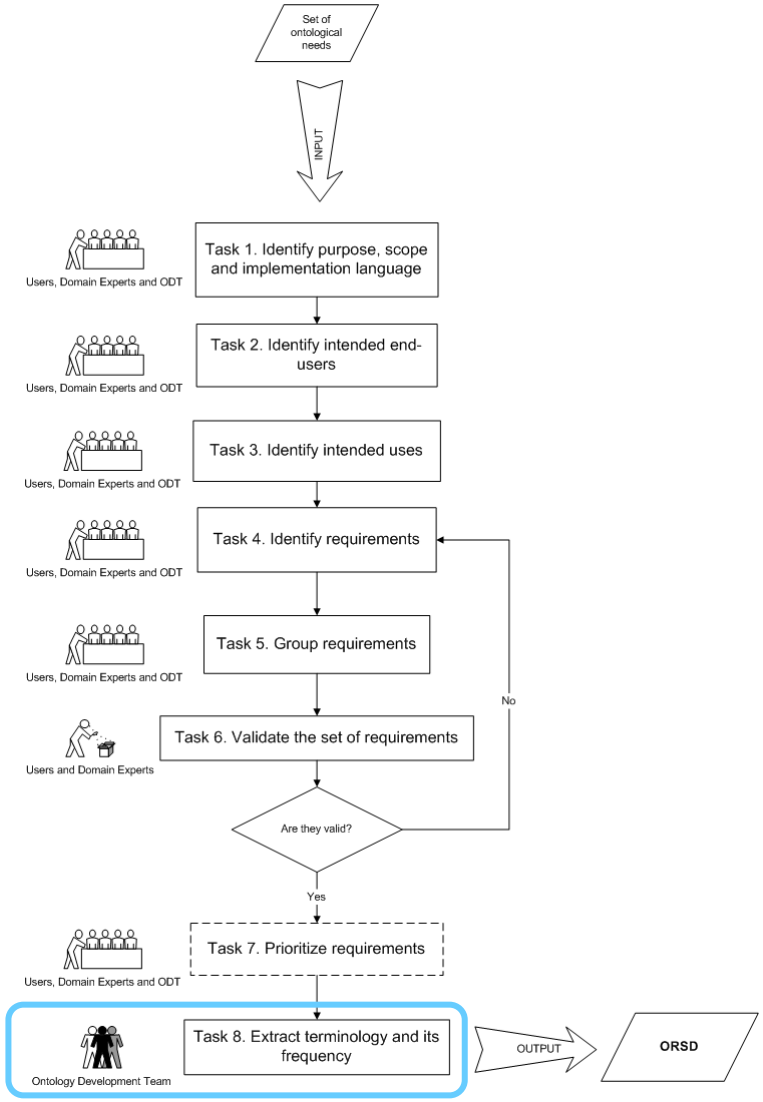
Ontology Requirements Specification. Task 7



- *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**
	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.

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.

6	**Ontology Requirements**
	b. Functional Requirements: Groups of Competency Questions
	CQG1. Job Seeker (14 CQ)
	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' skills? SQL programming, network administration
	CQG2. Job Offer (11 CQ)
	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; warehouse, Hardware programming

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.

Hands-on Activities

Working in Pairs

We propose the following **domain problem** for the hands-on sessions

"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:

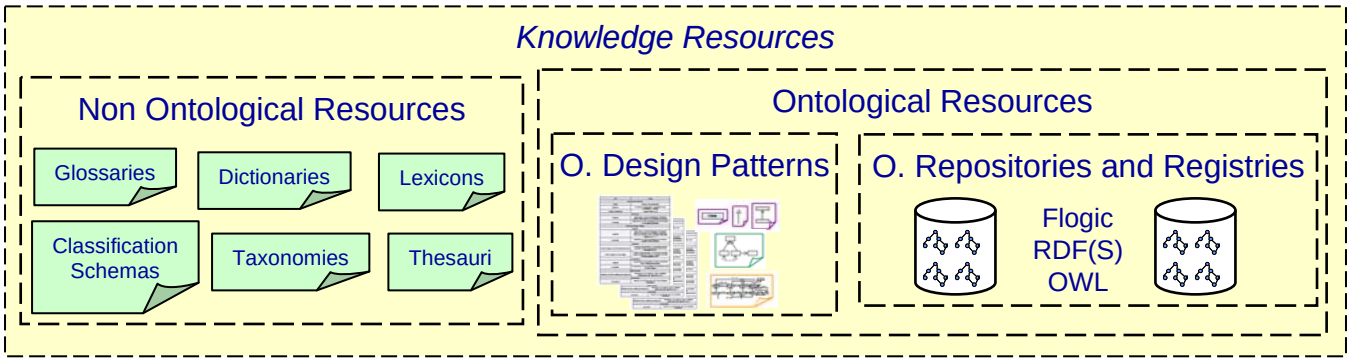
- The ***purpose*** of the ontology to be built
- The ***scope*** of the ontology to be built
- The ***competency questions the ontology should fulfil***, classified into different groups.

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 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: • 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

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)

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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  <ISO_3166-1_Entry>
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Non-ontological resources - ISCO-88 (COM)

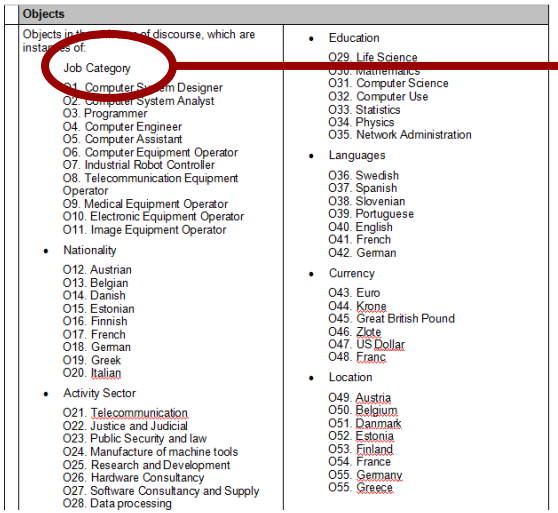
level	description EN	description FR	description DE	texte auto EN	
3	Religious professionals	Membres du clergé	Geistliche, Seelsorger		
3	Public service administrative professionals	Cadres administratifs des services publics	Wissenschaftliche Verwaltungsfachkräfte des öffentlichen Dienstes	This is a new 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 Ha
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 Geburtsh
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



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

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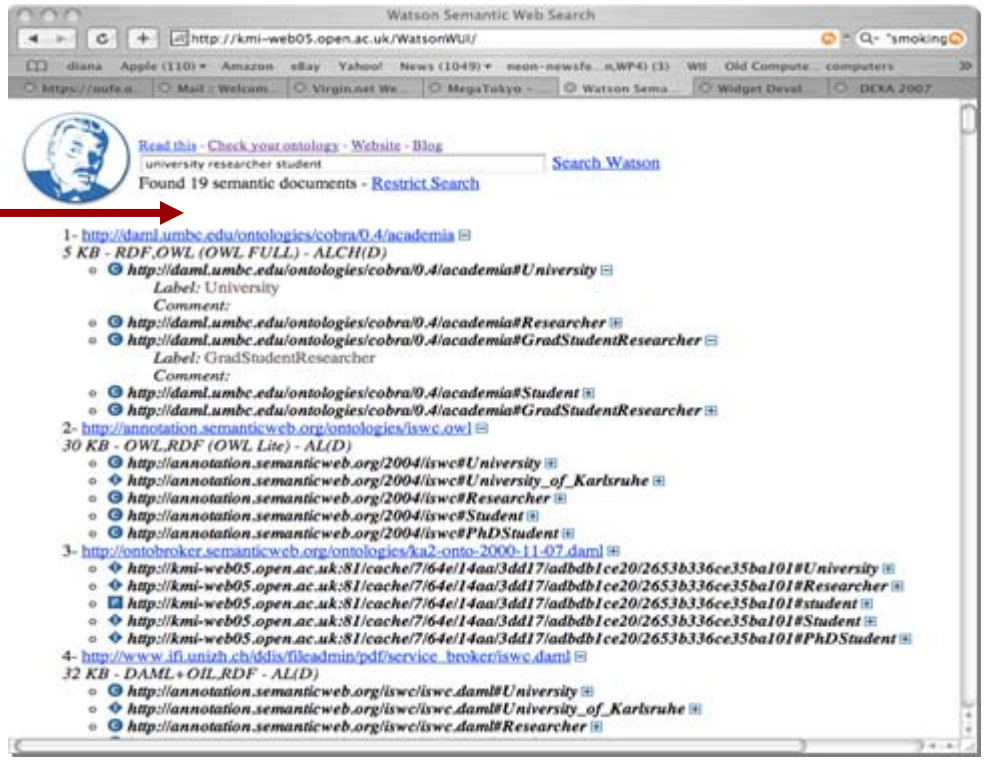
  - O8. Telecommunication Equipment Operator
  - O9. Medical Equipment Operator
  - O10. Electronic Equipment Operator
  - O11. Image Equipment Operator
- Nationality
  - O12. Austrian
  - O13. Belgian
  - O14. Danish
  - O15. Estonian
  - O16. Finnish
  - O17. French
  - O18. German
  - O19. Greek
  - 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 guidelines for reusing statements

Index

- Introduction
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- Quick Search of Existing Knowledge Resources
- **Methodological Guidelines for Scheduling**
  - **Ontology Network Life Cycle Models and Ontology Life Cycle**
- Methodological Guidelines for Reusing 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.

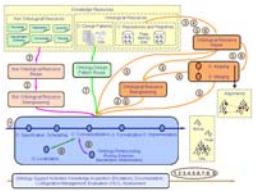
The **ontology life cycle** is the specific sequence of activities that the ontology practitioners carry out for developing an ontology.

- NeOn Deliverable D5.3.1 (2007)
- I-SEMANTICS 2008
- PhD Thesis (2010)

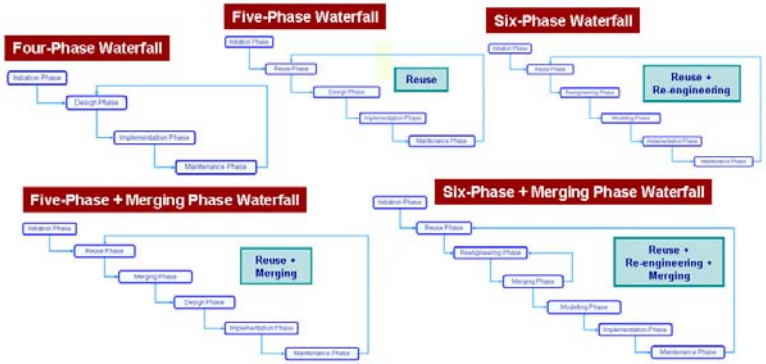
Waterfall and Iterative-Incremental Models

Waterfall Model

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

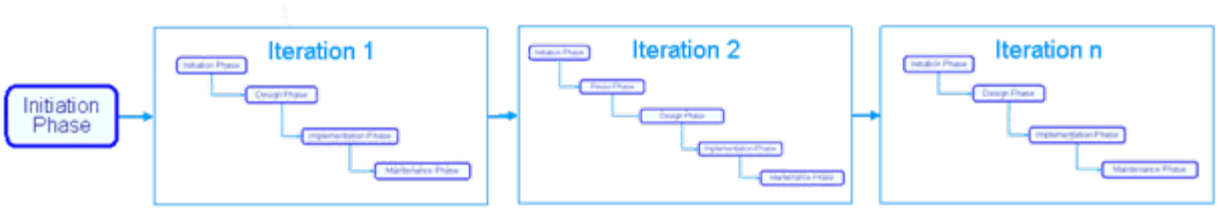


Scenarios identified caused the creation of different versions



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.



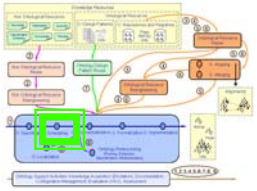
❑ PhD Thesis (2010)

Scheduling. Filling Card

Scheduling

Definition

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.



Goal

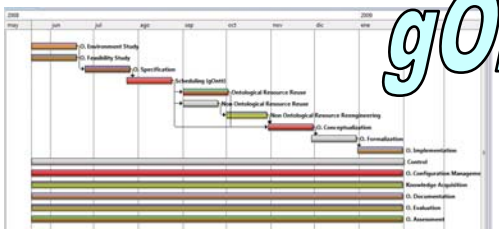
The scheduling activity states a concrete programming or scheduling to guide the ontology network development, including processes and activities, their order, and time and human resources restrictions and assignments.

Input

Ontology Requirements Specification Document (ORSD).

Output

Schedule for the ontology network development.



Who

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

When

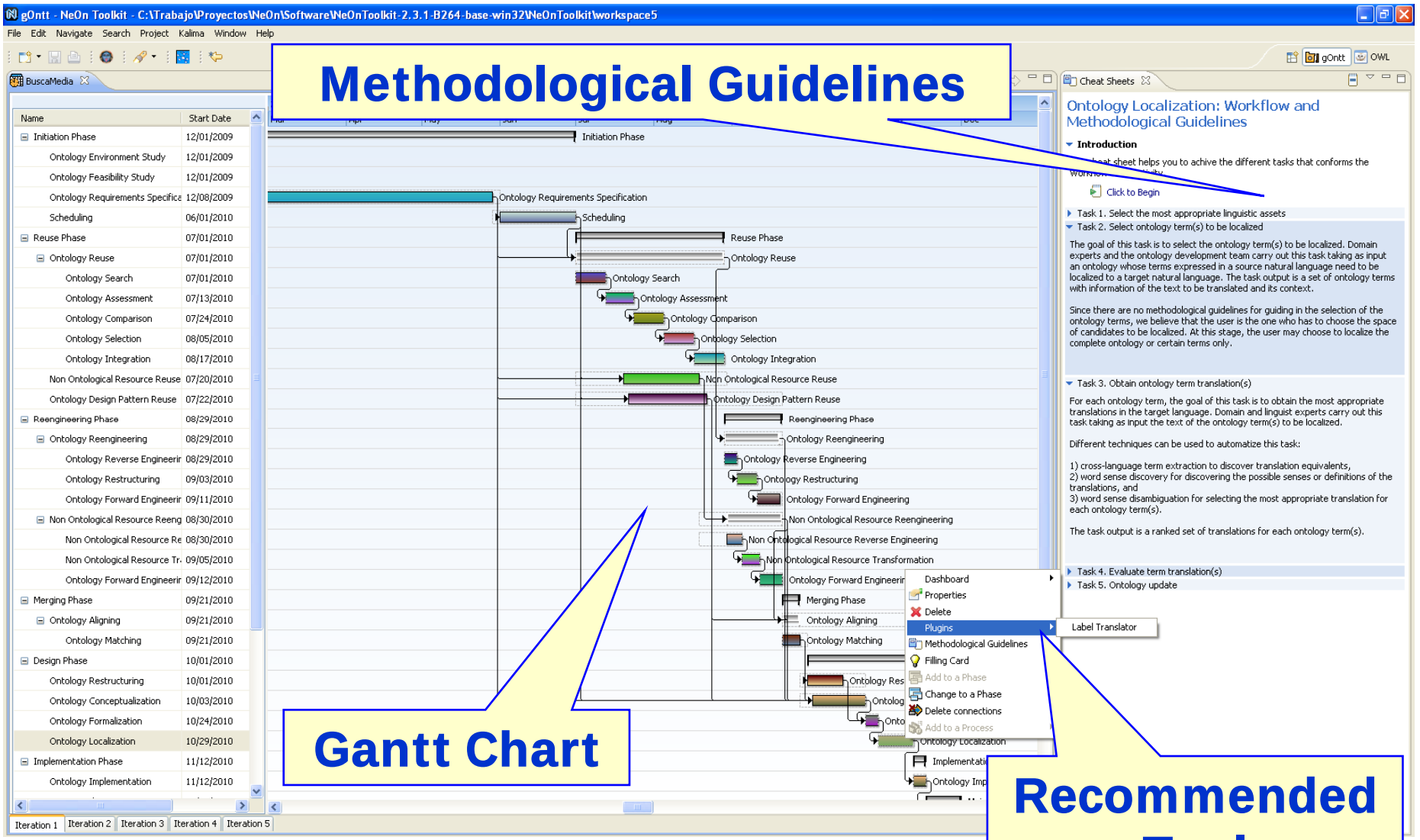
This activity must be carried out after the ontology requirements specification activity.

- PhD Thesis (2010)

Scheduling: Technological Support. gOntt (I)

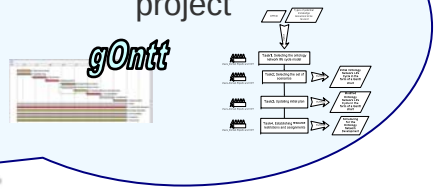
- **gOntt** helps in **scheduling an ontology network development project**
  - To create particular schedules from scratch
  - To create particular schedules in a guided way
    - gOntt provides wizard menus to select the ontology life cycle model and to select processes and activities
    - gOntt uses templates to automatically generate the initial plan for the ontology project in the form of a Gantt chart
- **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

Scheduling: Technological Support. gOntt (II)

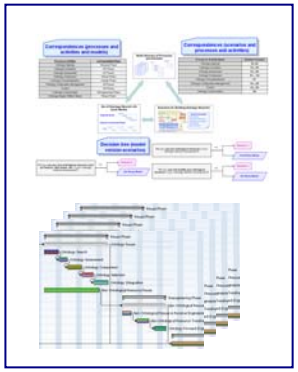


Scheduling: gOntt and Guidelines

I need to schedule my ontology development project



Methodological Basis



ORSD

Types of potential knowledge resources to be reused

INPUT

Users, Domain Experts and ODT

Task 1. Selecting the ontology network life cycle model

OUTPUT

Initial Ontology Network Life Cycle in the form of a Gantt chart

Users, Domain Experts and ODT

Task 2. Selecting the set of scenarios

OUTPUT

Modified Ontology Network Life Cycle in the form of a Gantt chart

Users, Domain Experts and ODT

Task 3. Updating initial plan

OUTPUT

Scheduling for the Ontology Network Development

Users, Domain Experts and ODT

Task 4. Establishing resource restrictions and assignments

Life cycle model selection

Are the ontology requirements assumed to be fully known at the begining of the ontology network development? ○ Yes ◉ No

How many cycles do you want to perform in your ontology network development? 3

Scenarios selection

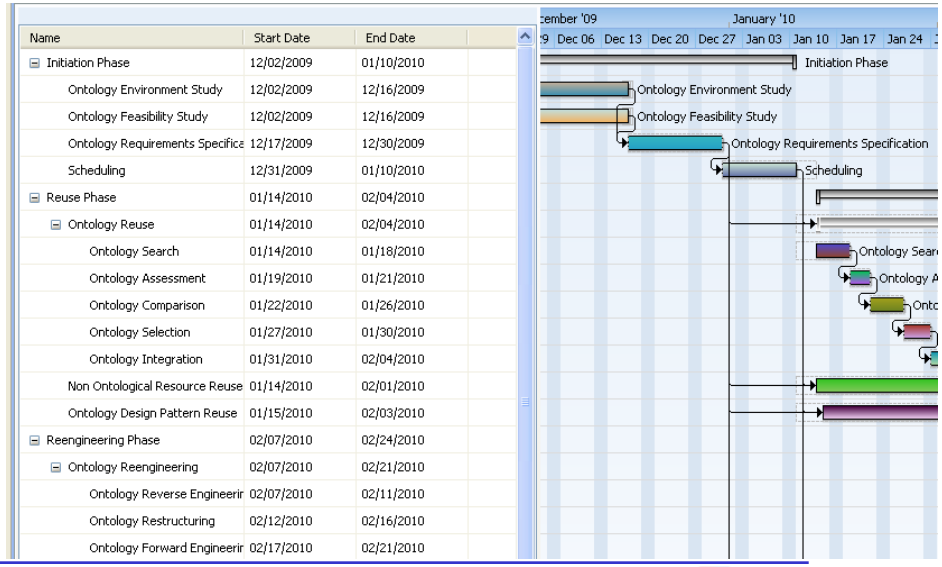
Scenario 1: From specification to implementation. ◉ Yes ○ No

Scenario 2: Have you planned to use any non-ontological resource such as thesauri, data bases, etc. in your ontology network development? ◉ Yes ○ No

Scenario 3: Have you planned to use any existing ontological resource in your ontology network development? ◉ Yes ○ No

Scenario 4: Have you planned to use and modify any existing ontological resource in your ontology network development? ◉ Yes ○ No

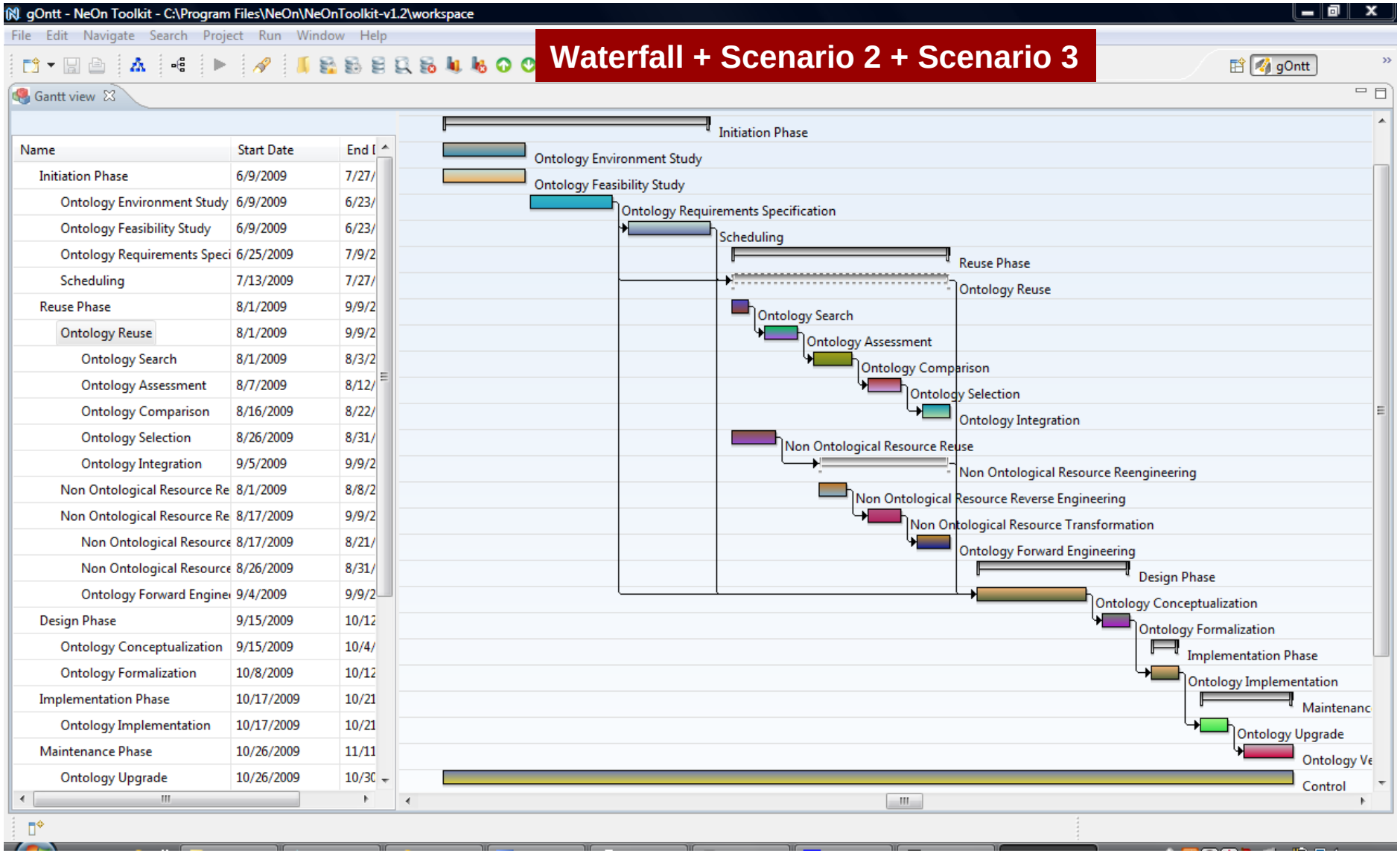
Scenario 5: Have you planned to use and merge a set of existing ontological resources in your ontology network development? ○ Yes ◉ No



Name	Start Date	End Date
Initiation Phase	12/02/2009	01/10/2010
Ontology Environment Study	12/02/2009	12/16/2009
Ontology Feasibility Study	12/02/2009	12/16/2009
Ontology Requirements Specifica	12/17/2009	12/30/2009
Scheduling	12/31/2009	01/10/2010
Reuse Phase	01/14/2010	02/04/2010
Ontology Reuse	01/14/2010	02/04/2010
Ontology Search	01/14/2010	01/18/2010
Ontology Assessment	01/19/2010	01/21/2010
Ontology Comparison	01/22/2010	01/26/2010
Ontology Selection	01/27/2010	01/30/2010
Ontology Integration	01/31/2010	02/04/2010
Non Ontological Resource Reuse	01/14/2010	02/01/2010
Ontology Design Pattern Reuse	01/15/2010	02/03/2010
Reengineering Phase	02/07/2010	02/24/2010
Ontology Reengineering	02/07/2010	02/21/2010
Ontology Reverse Engineerir	02/07/2010	02/11/2010
Ontology Restructuring	02/12/2010	02/16/2010
Ontology Forward Engineerir	02/17/2010	02/21/2010

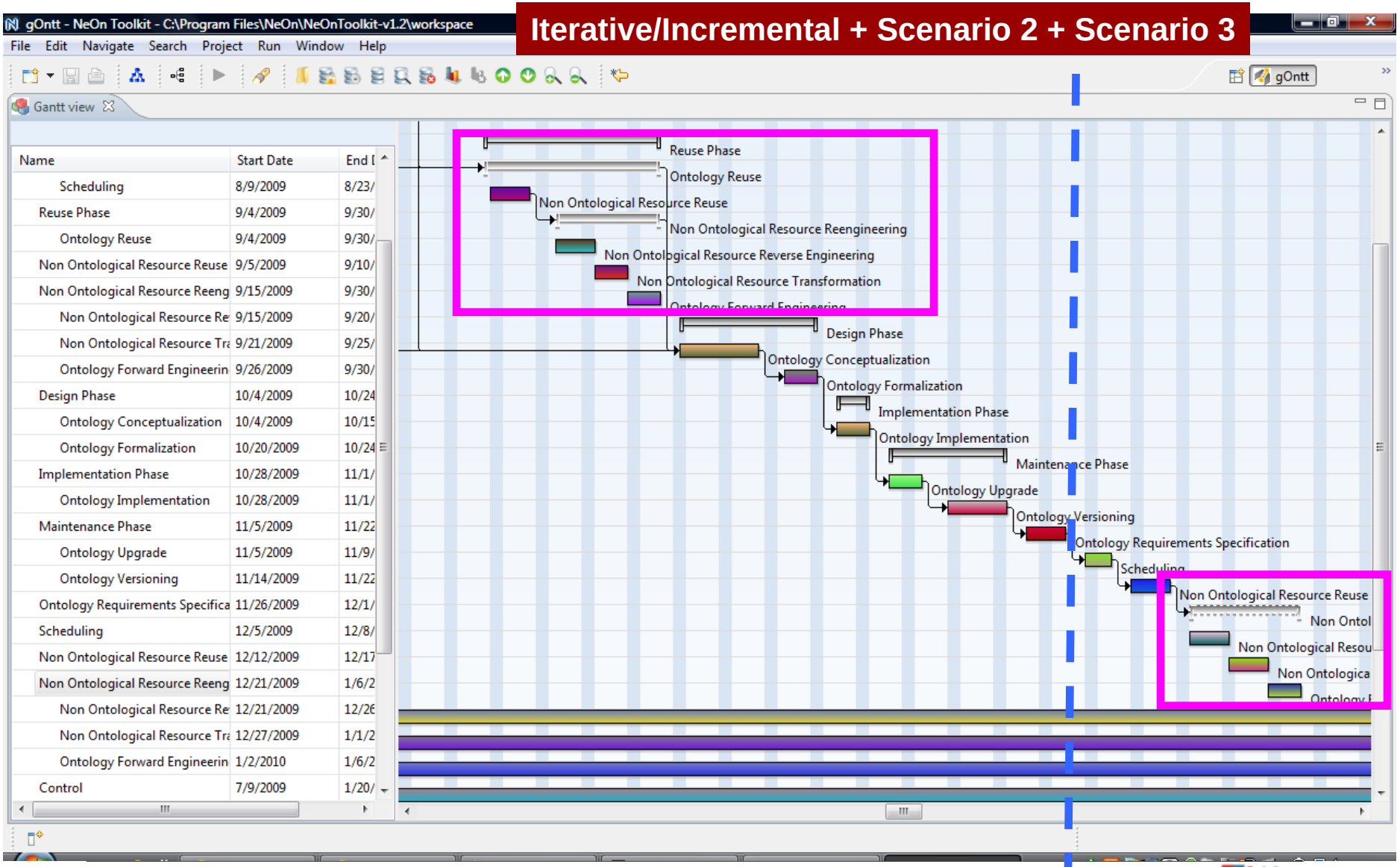
Ontology Engineering Group

Gantt chart for your project (I)



Gantt chart for your project (II)

Iterative/Incremental + Scenario 2 + Scenario 3



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- Quick Search of Existing Knowledge Resources
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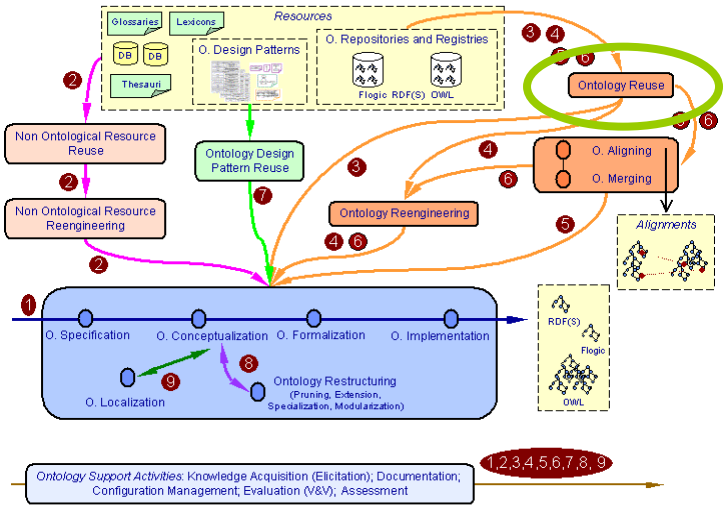
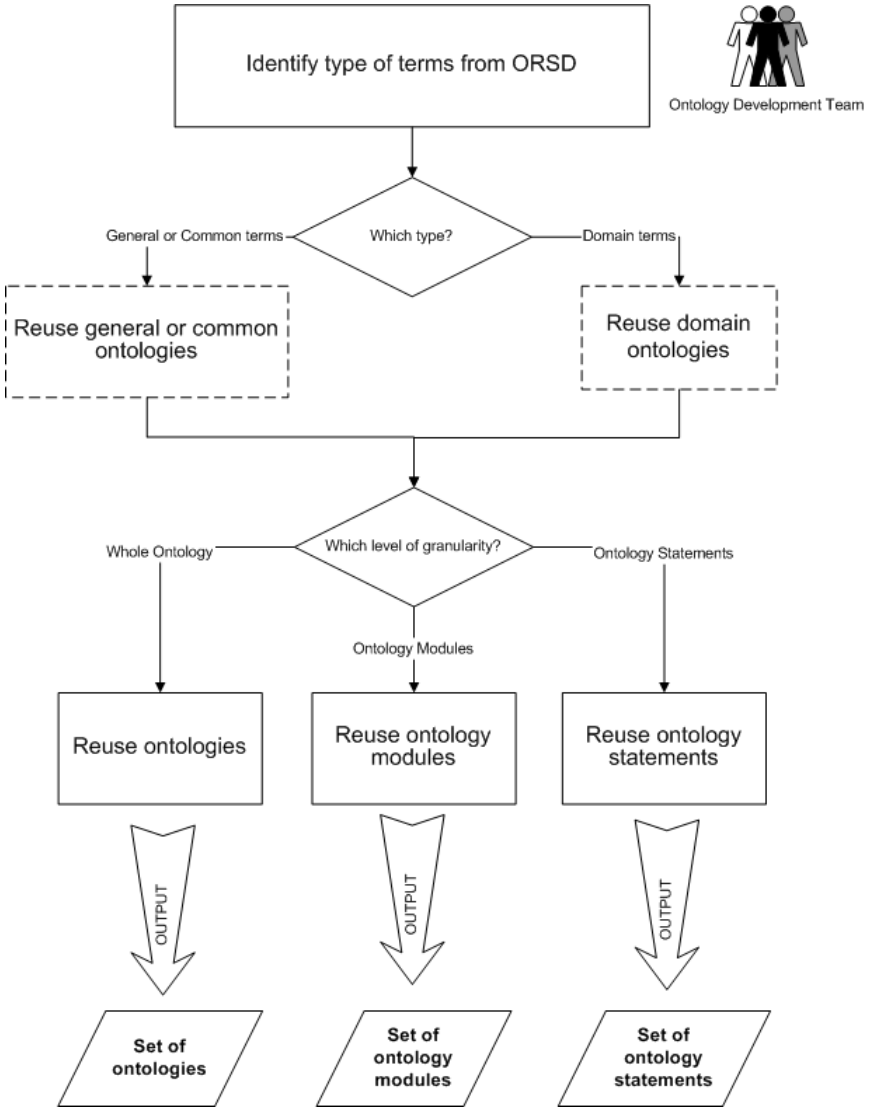
- **Methodological Guidelines for Reusing Knowledge Resources**
- Conclusions

Ontological Resource Reuse Process

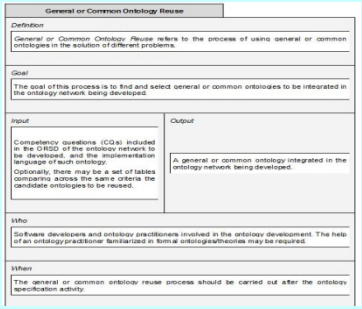


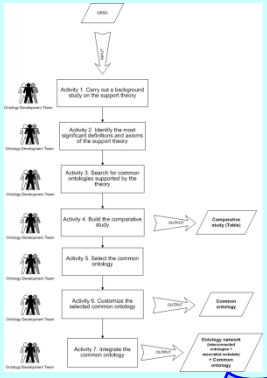


- **Ontological Resource Reuse** is defined as the process of using available ontological resources (ontologies, modules, statements) in the solution of different problems.

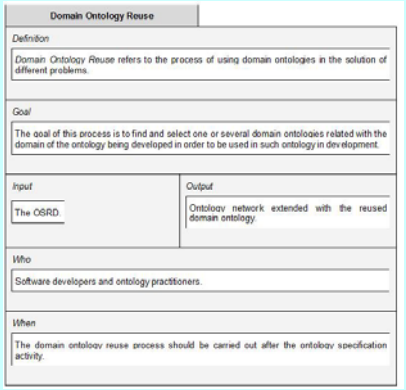
Guidelines for Reusing Ontological Resources

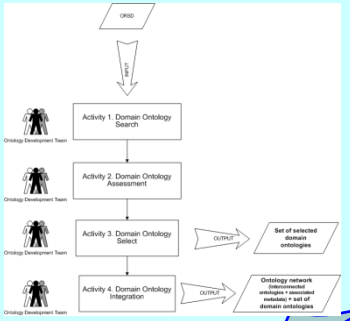
Reuse Common Ontologies



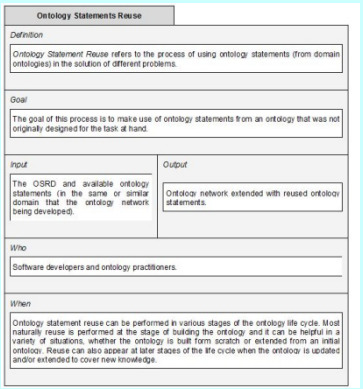


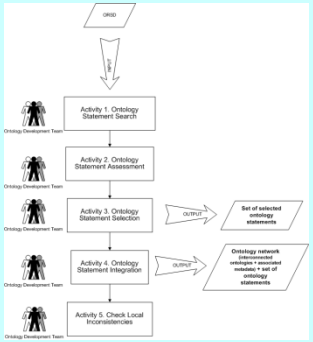
Reuse Domain Ontologies





Reuse Ontology Statements





Watson plug-in

- PhD Thesis (2010)

Ontology Engineering Group

Patterns

Pattern is something proposed for imitation.

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

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

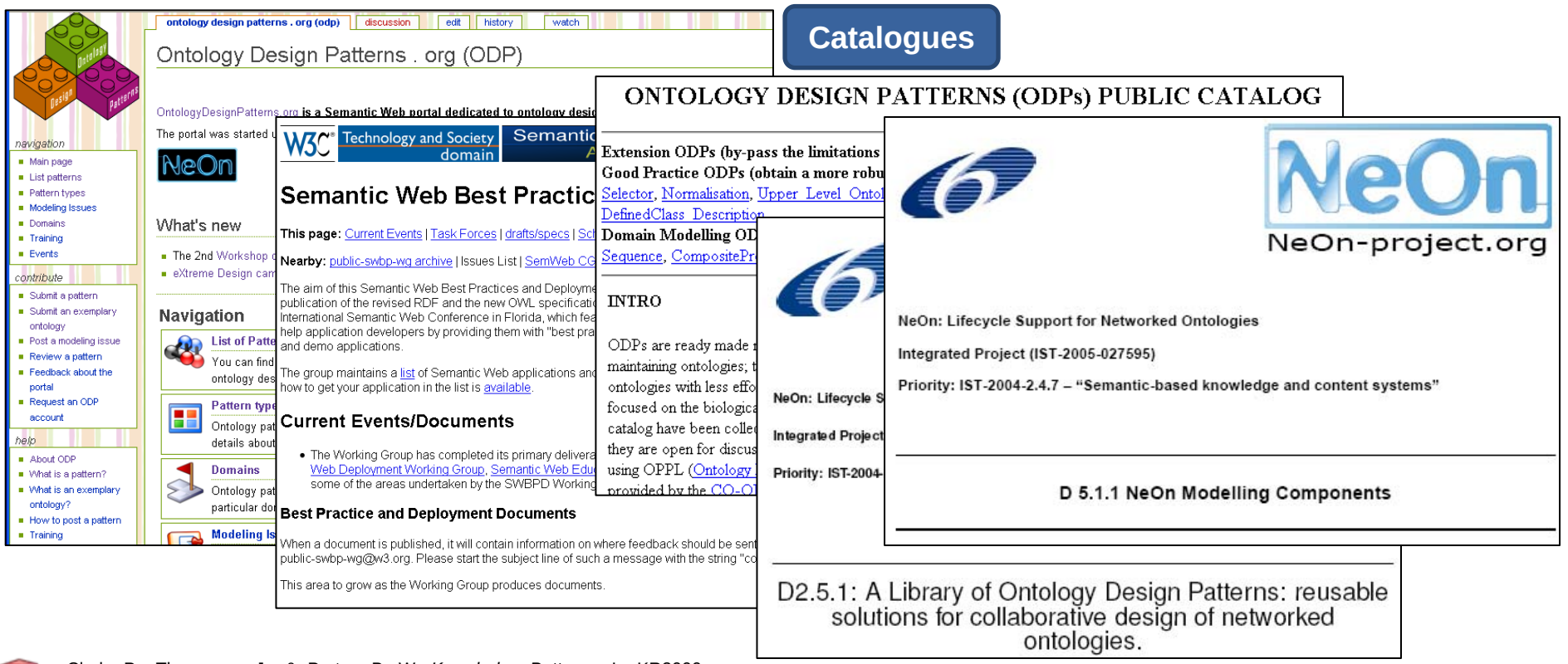
- Pattern is associable with the wider "**good/best practice**" of software engineering. It includes a wider range of solution types. For example: naming conventions in software engineering are considered good practices, they are not design patterns.
- ODPs can be classified into **six families**
  - Each family addresses different kinds of problems, and can be represented with different levels of formality.

Ontology Design Patterns

The idea of **applying patterns for modelling** ontologies was proposed by [Clark et al., 2000]

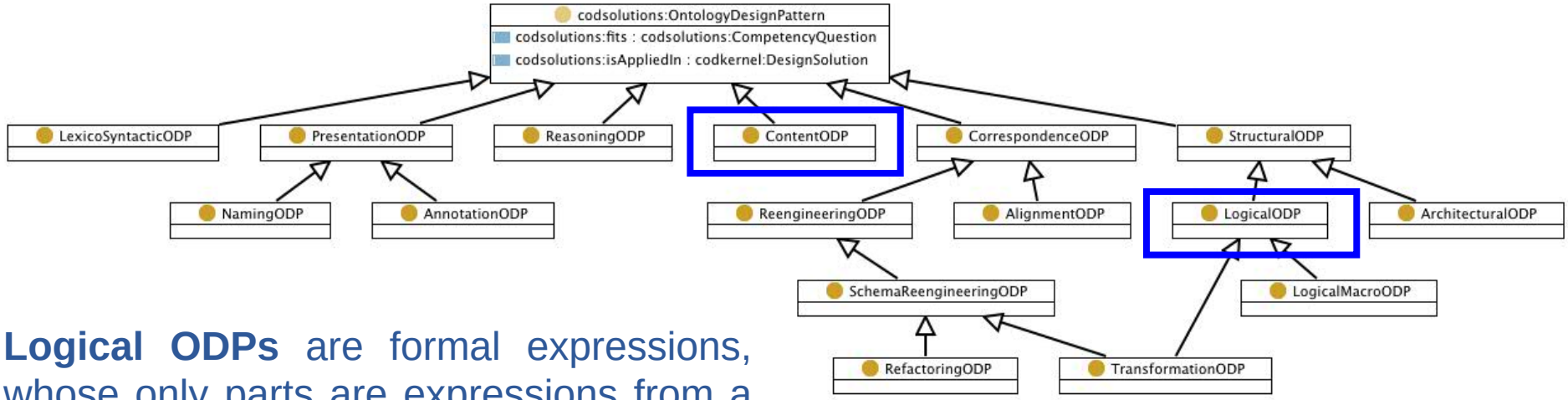
The **goal of the ODPs reuse** is

- to facilitate the solution of modelling issues
- to improve interoperability through using well-proven solutions and best practices, in the form of patterns



Clark, P., Thompson, J., & Porter, B. W. *Knowledge Patterns*. In KR2000: Principles of Knowledge Representation and Reasoning. pp. 591-600. 2000

Types of Ontology Design Patterns



Logical ODPs are formal expressions, whose only parts are expressions from a logical vocabulary e.g., OWL DL, that solve a problem of expressivity

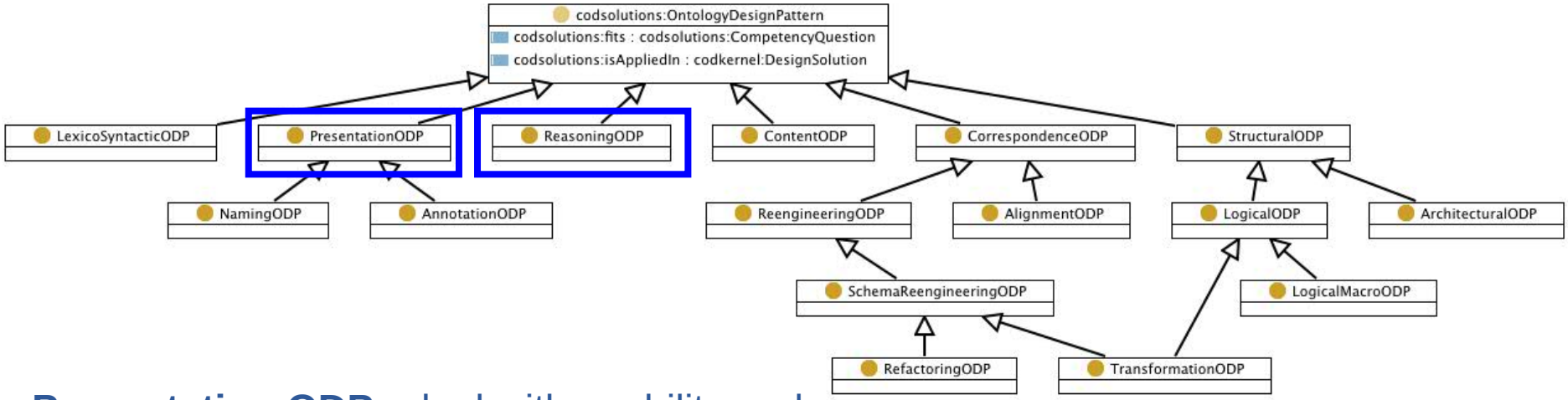
- Logical ODPs are independent from a specific domain of interest, i.e. they are content-independent
- Logical ODPs solve design problems where the primitives of the representation language do not directly support certain logical constructs

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

- Logical OPs solve design problems independently of a particular conceptualization.
- CPs propose patterns for solving design problems for the domain classes and properties that populate an ontology. They address content problems.

http://ontologydesignpatterns.org/wiki/OPTypes

Types of Ontology Design Patterns



Presentation ODPs deal with usability and readability of ontologies from a user perspective

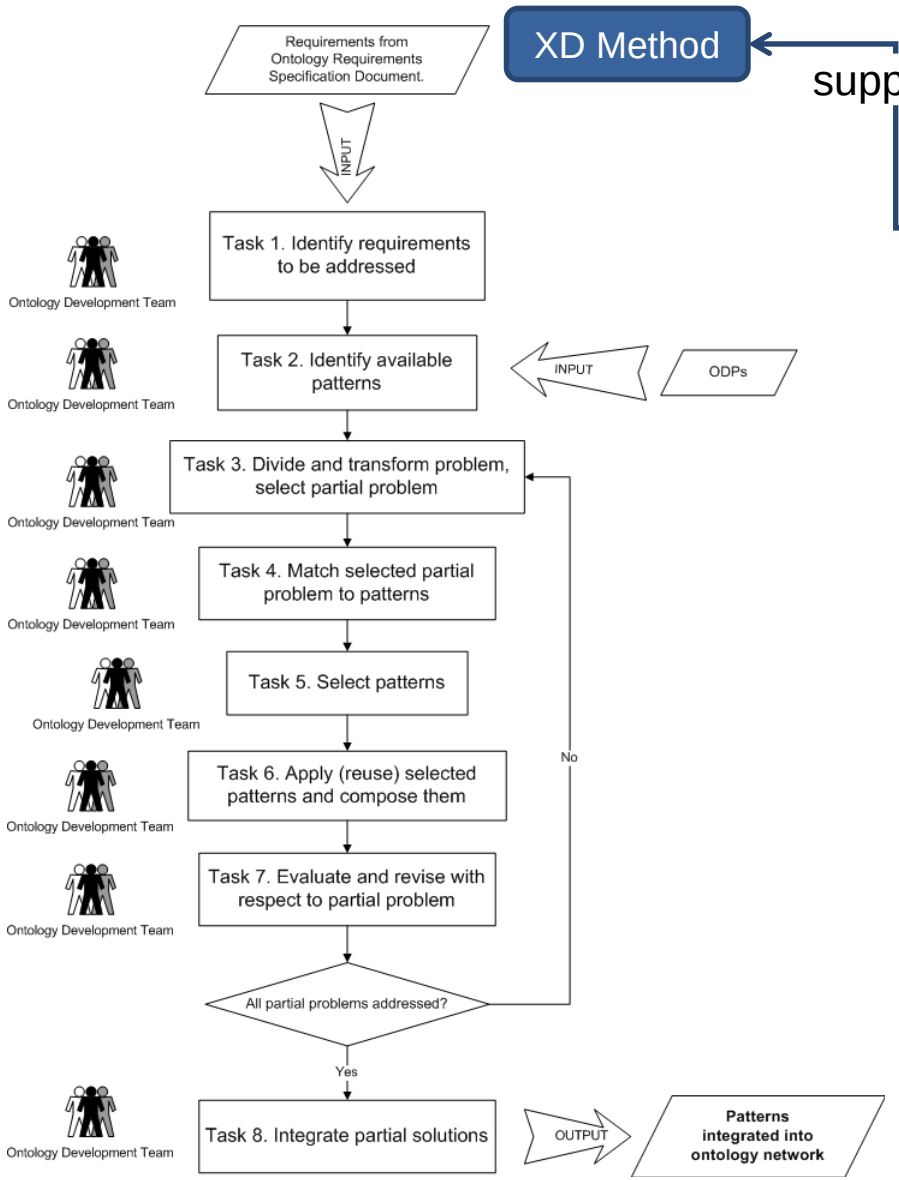
Reasoning ODPs are applications of Logical ODPs oriented to obtain certain reasoning results, based on the behavior implemented in a reasoning engine

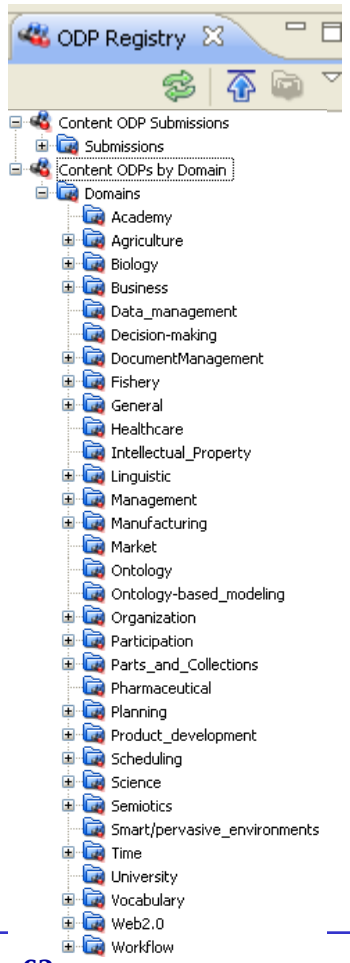
http://ontologydesignpatterns.org/wiki/OPTypes

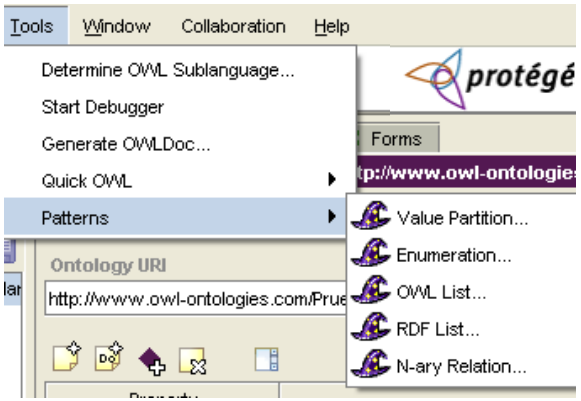
Inventory of Patterns

http://ontologydesignpatterns.org

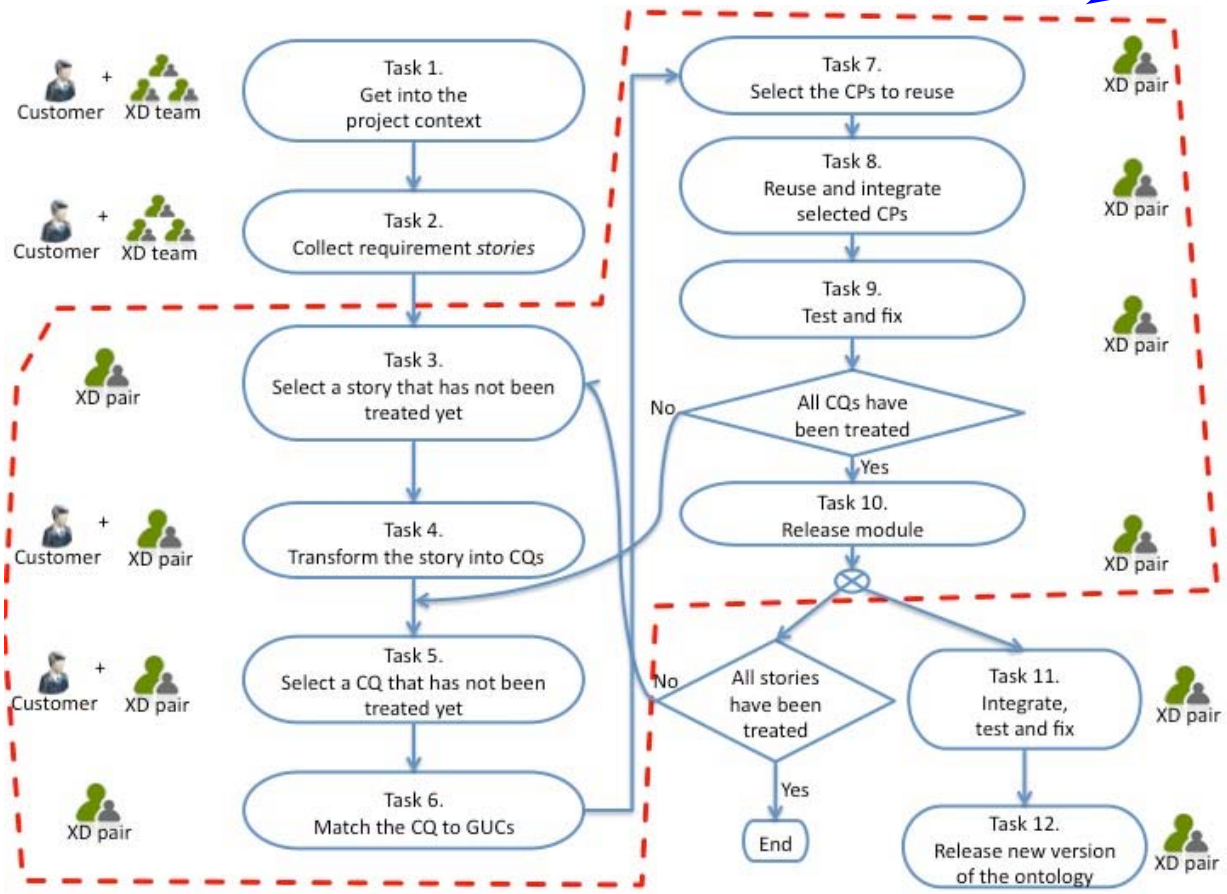
Ontology Design Patterns: how to reuse them







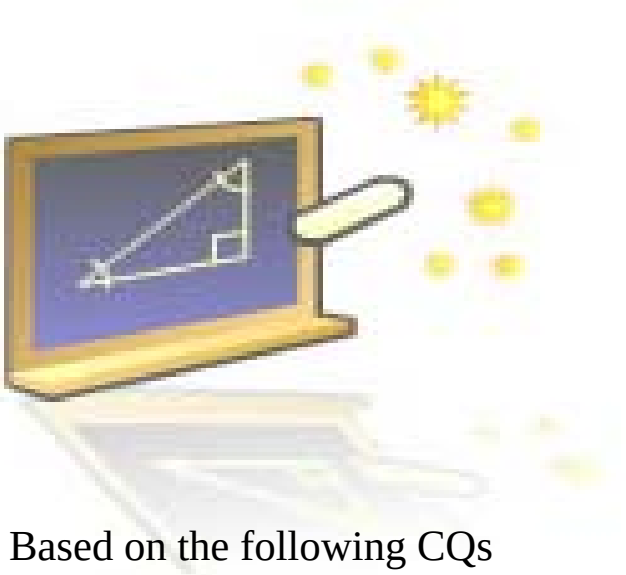
Content Pattern Reuse: XD Method



Tool Support

XD Tools

Hands-on Activity: Ontology Modelling



Based on the following CQs

- Which are the types of Olympic Games? Summer Olympic Games and Winter Olympic Games
- Who are the people that form part of the jury?
- Who are the members of a team?
- Who are the winners in a discipline?
- Who are the participants in a discipline?
- Where are Olympic Games organized?
- Which are the events that the Olympic Games consist of?

to ***create an ontology (in paper) that model the domain identified***

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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, D5.3.3**
- 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**

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