





Ontological Engineering

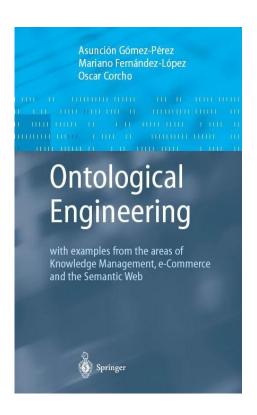
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Mari Carmen Suárez -Figueroa (mcsuarez@fi.upm.es)

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References





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

- Deliverable D5.3.1
- Deliverable D5.3.2
- Deliverable D5.4.1

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

I want to build my ontology



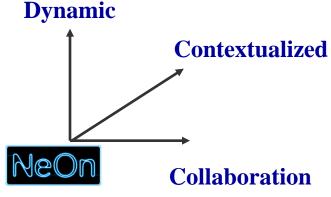
- Which are the key process and activities in ontology development?
- Which activities do I need in my development?
- When should I carry out each activity?
- Where is the relationship of one activity with the others?
- How do I collect the requirements of my ontology?
- Where can I find ontologies with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

Most relevant methodologies

Methodologies for building single ontologies

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

NeOn methodology for building ontology networks



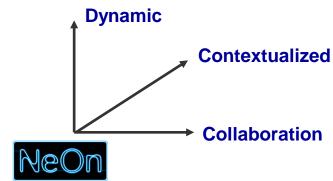


NeOn Ontology Development Paradigm

Whose emphasis is on

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

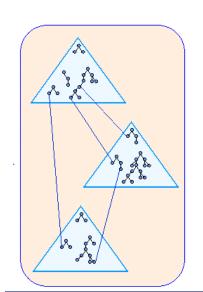


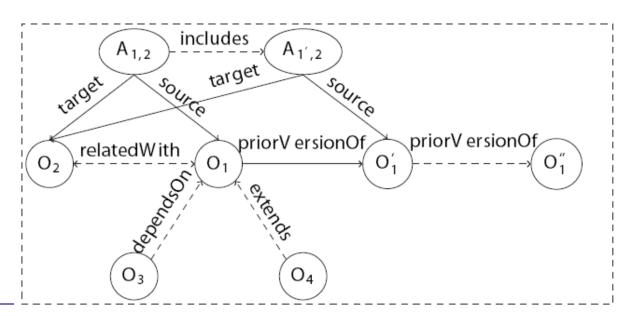




Ontology Networks

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



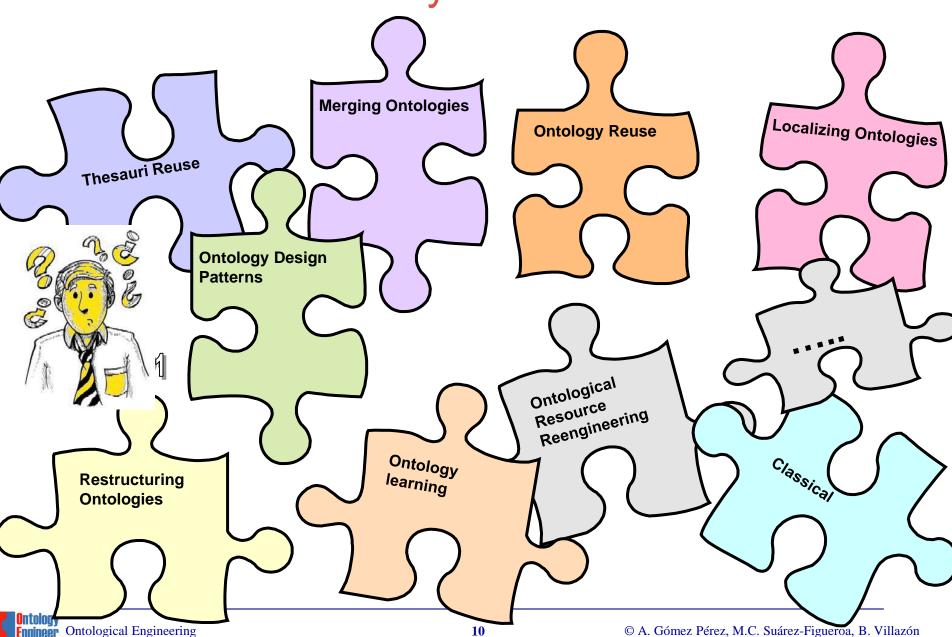


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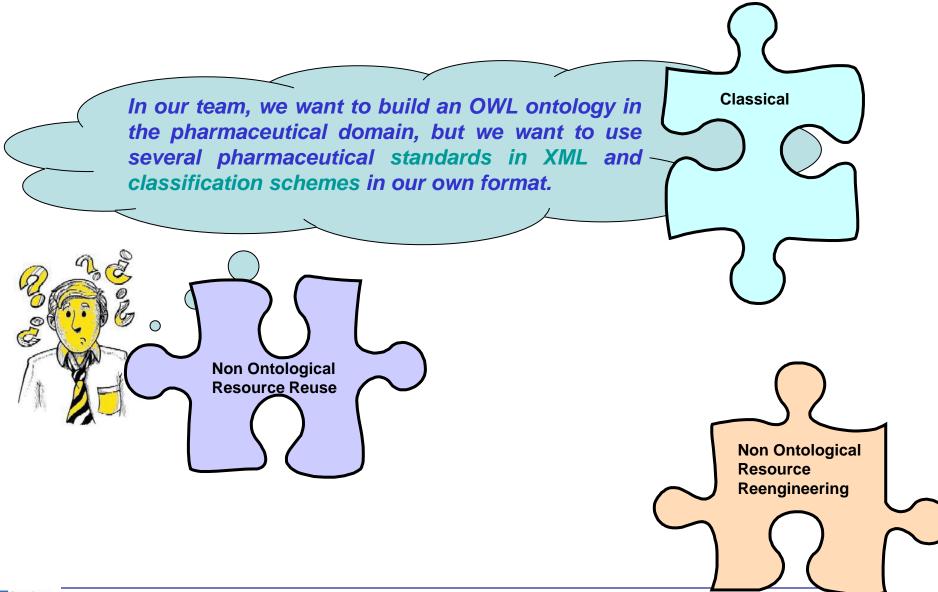
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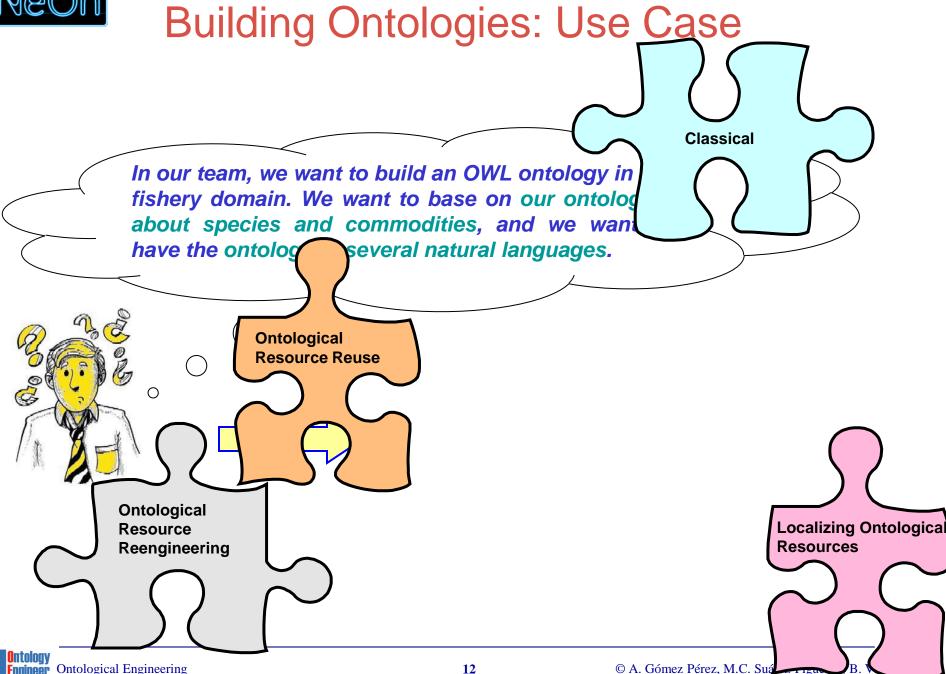
Too many activities...



Building Ontologies: Use Case





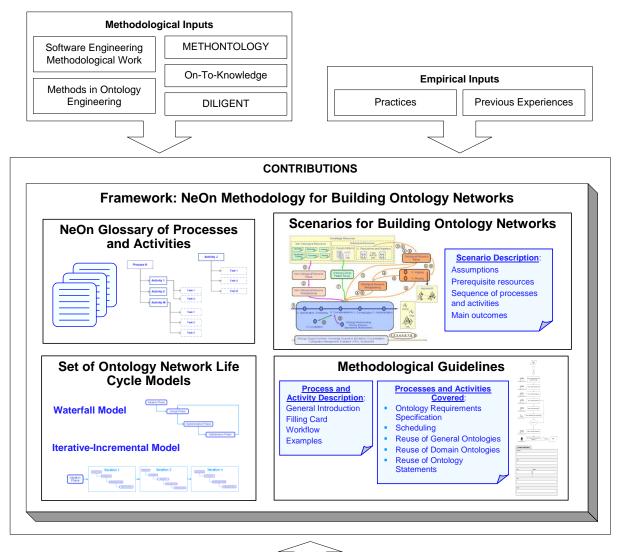


Key asssets in the NeOn methodology

- The NeOn Glossary of activities
- Table of Recommended and If-Applicable" Activities
- The NeOn scenarios
- All processes and activities are described with:
 - A filling card
 - A workflow
 - Examples



NeOn main assets







The NeOn Glossary of Activities



- The NeOn Glossary of Activities identifies and defines 55 activities that are carried out when ontology networks are collaboratively built
- Published in the NeOn website
- Consensuated by all NeOn partners
- On-going procedure for getting feed-back from the community

NeOn Glossary of Activities

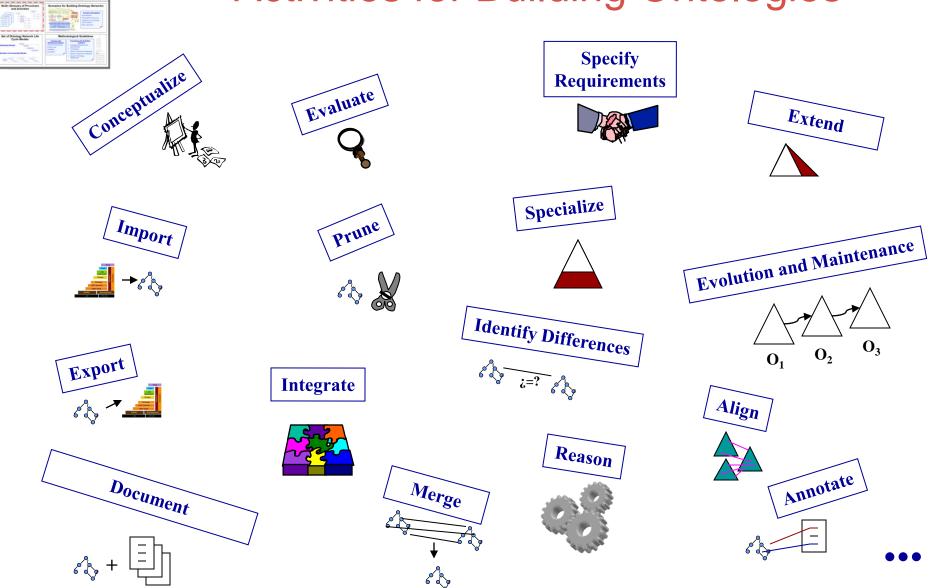
- Ontology Alignment / Aligning
- Ontology Articulation
- Ontology Assessment
- Ontology Combining
- Ontology Conceptualization
- Ontology Configuration Management
- Ontology Coordination
- Ontology Diagnosis
- Ontology Documentation
- Ontology Elicitation
- Ontology Enrichment
- Ontology Evaluation
- Ontology Evolution
- Ontology Extension
- Ontology Formalization
- Ontology Implementation
- Ontology Integration
- Knowledge Acquisition for Ontologies
- Ontology Learning
- Ontology Localization
- Ontology Mapping
- Ontology Matching
- Ontology Mediation



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

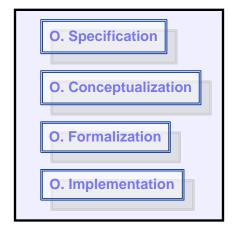


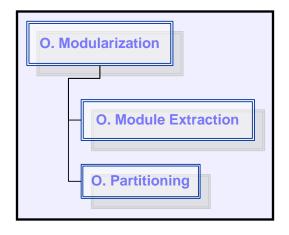
Activities for Building Ontologies

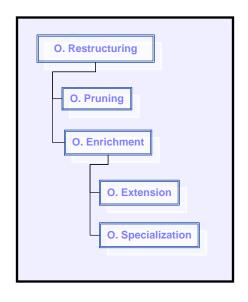


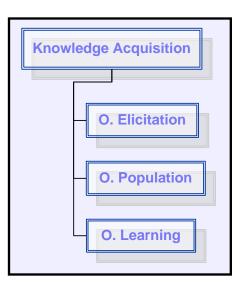


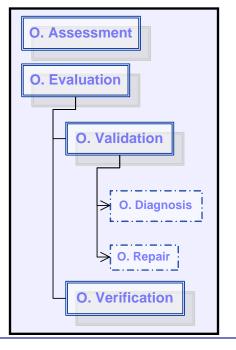
Relating Activities

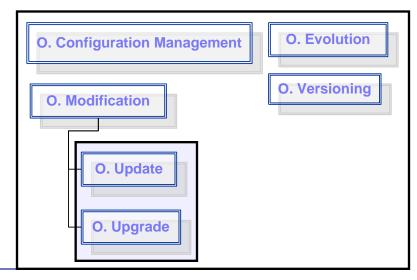










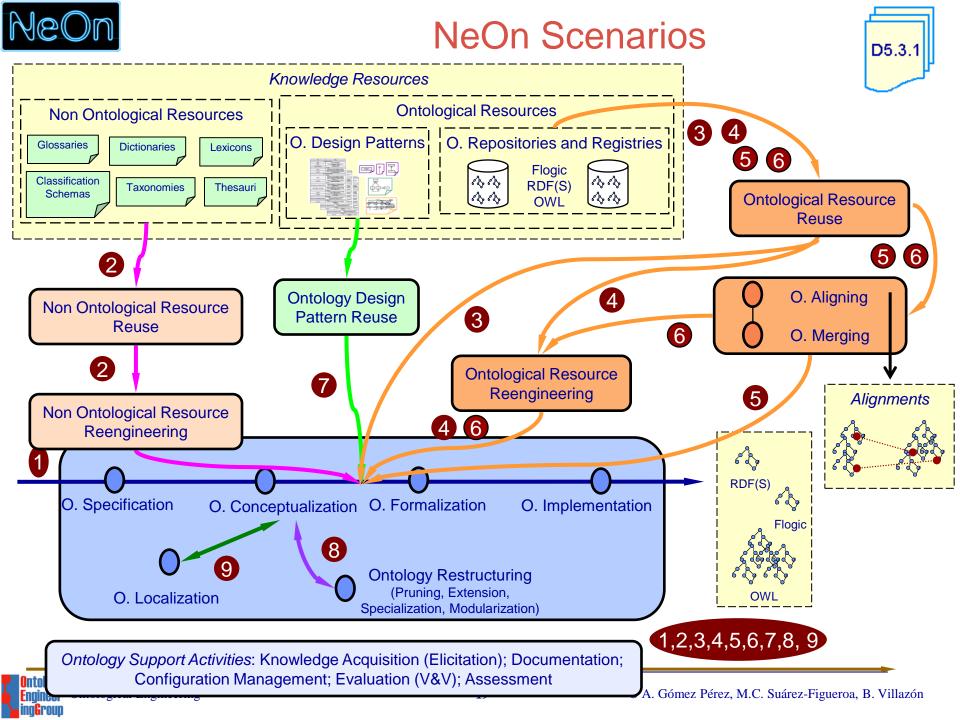




"Recommended and If-Applicable" Activities

For each activity included in the NeOn Glossary of Activities, the table identifies which activities are required and which activities are optional (can be carried out or not, depending on the case)during the ontology network building process.

	Required	If Applicable
Ontology Conceptualization	Х	
Ontology Evaluation	Х	
Ontology Integration	Х	
Knowledge Acquisition for Ontologies	Х	
Ontology Learning		Х
Ontology Localization		Х
Ontology Matching		Х
Ontology Search	Х	
Ontology Specification	X	





Scenarios

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

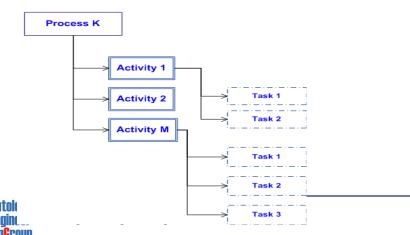
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NeOn Methodology

Process and activities covered:

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

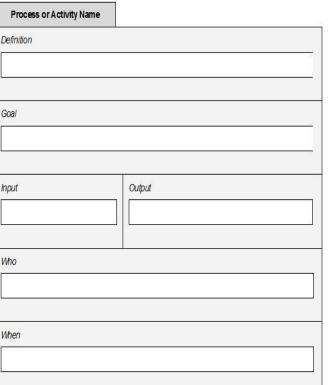


All processes and activities are described with:

☐ A filling card

■ A workflow

□ Examples





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On Ontology Requirement Specification

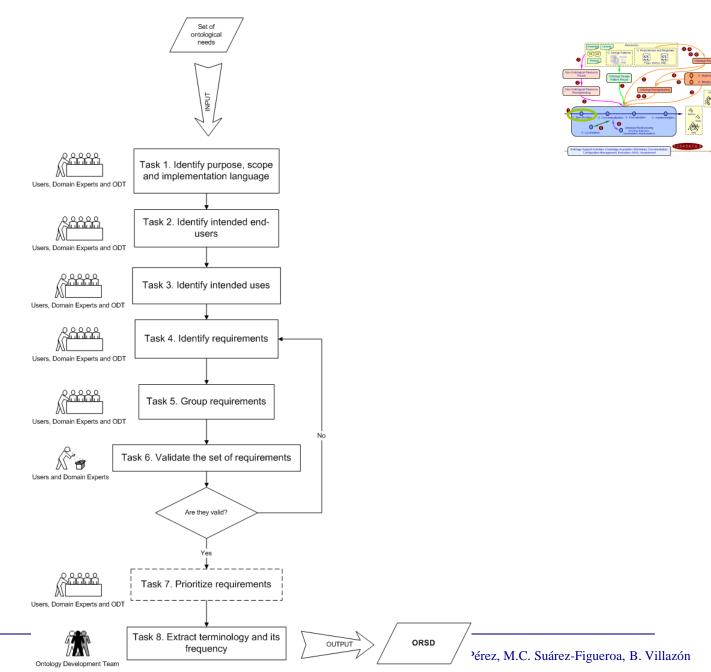


Ontology Specification

Ontology Specification	
Definition	
	the activity of collecting the requirements that the ns to build the ontology, target group, intended uses, usus process.
Goal	
	by the ontology is being built, what its intended uses are, ne requirements the ontology should fulfill are.
Input	Output
A set of ontological needs.	Ontology Requirements Specification Document (ORSD).
Who	
Software developers and ontology (ODT), in collaboration with users a	practitioners, who form the ontology development team and domain experts.
When	
This activity must be carried out in	parallel with the knowledge acquisition activity.

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

- CQs natural in language
- CQs in SPARQL

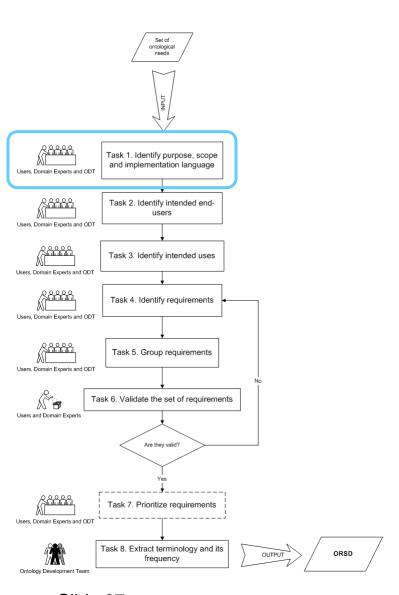


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Ontological Engineering

Ontology Requirements Specification Document. Template

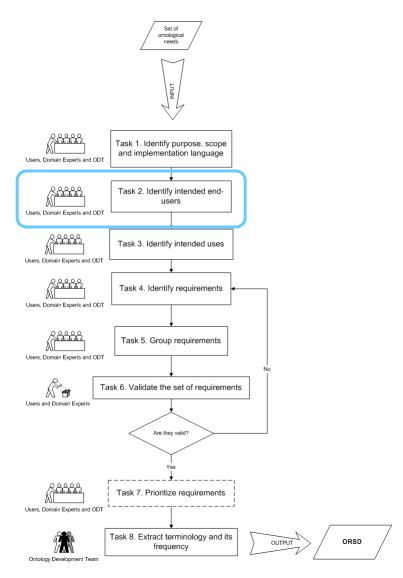
-	Ontology Requirements Specification Document Template
1	Purpose
	The main general goal of the ontology. In other words, the main function or role that the ontology should have.
2	Scope
	The general coverage and the degree of detail that the ontology should have.
3	Implementation Language
	The formal 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.



- 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.

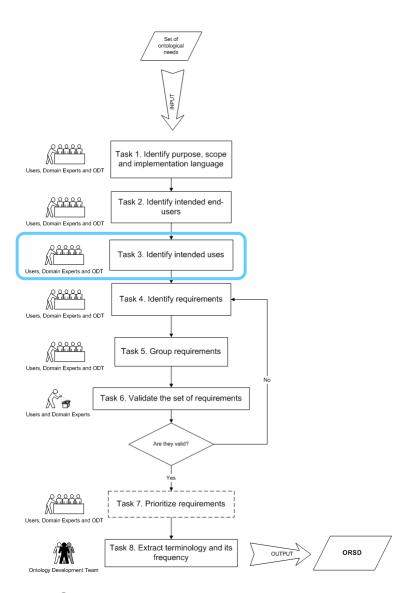
2



- 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

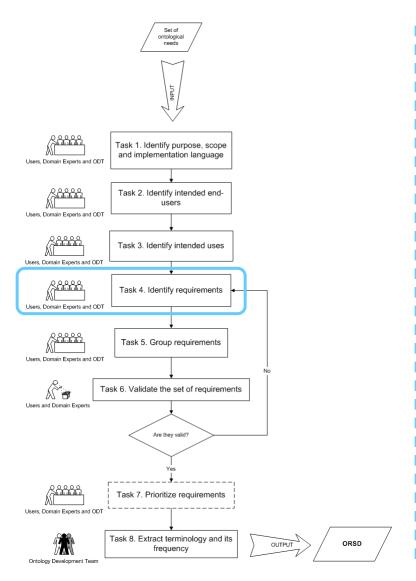
4	Inter	ided End-Users
	User 1.	Candidate who is unemployed and searching for a job or searching another occupation for immediate or future purposes
	User 2.	Employer who needs more human resources.
	User 3.	Public or private employment search service which offers services to gather CVs or job postings 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.

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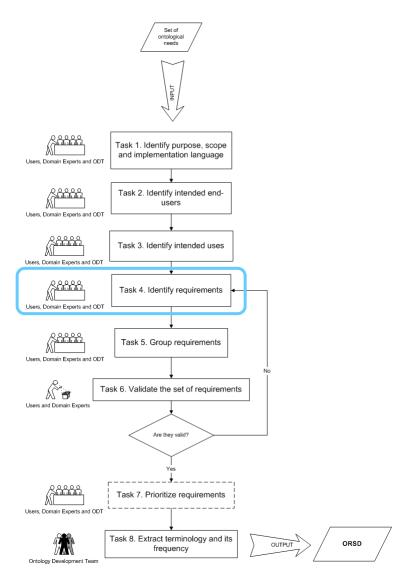


Input: a set of ontological needs
 Objective: identifying the intended uses
 Techniques: physical or virtual interviewers between them
 Output: a list of intended uses in the form of scenarios. The scenarios can be described in natural language or expressed in UML as use cases. The list of scenarios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

5	Inten	ded 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.



- 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



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.

ó	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

CQ1. What is the Job Seeker Name?

CQ2. What is the Job Seeker nationality?

CQ3. When is the Job Seeker birthdate?

CQ4. What is the Job Seeker contact information?

CQ5. What is the Job Seeker current job?

CQ6. What is the Job Seeker desired job?

CQ7. What are the Job Seeker desired working conditions?

CQ8. What kind of contract does the Job Seeker want?

CQ9. How much salary does the Job Seeker want to earn?

CQ10. What is the Job Seeker education level?

CQ11. What is the Job Seeker work experience?

CQ12. What is the Job Seeker knowledge?

CQ13. What is the Job Seeker expertise?

CQ14. What are the Job Seeker skills?

CQ15. What publications does the Job Seeker have?

CQ16. What hobbies does the Job Seeker have?

CQ17.What is the employer information?

CQ18. What kind of job does the employer offer?

Oct of virial land of job does the employer oner:

CQ19. What kind of contract does the employer offer?

CQ20.How much salary does the employer offer?
CQ21.What is the economic activity of the employer?

CQ22.What is the description of the job offer?

CQ23. What is the work condition of the job offer?

CQ24. What is the required education level for the job offer?

CQ25.What is the required work experience for the job offer?

CQ26.What is the required knowledge for the job offer?

CQ27.What are the required skills for the job offer?

CQ28.When the Job Seeker completed his/her first degree?

CQ29.Is the Job Seeker older than 30 years?

CQ30. How much time did the Job Seeker spend completing his/her first degree?

CQ31.How long is the duration of the contract?

CQ32.Which job offers were posted in the last 24 hours?

CQ33.Which job offers were posted in the last 7 days?

CQ34.Which job offers were posted in the last month?

CQ35.Is the job offer's salary greater than 14000 zlotes?

CQ36.Is the job offer's salary lower than 25000 kroner?

.

CQ37.The offered salary is given in US dollars?

CQ38.The offered salary is given in Euros?

CQ39. Given the personal information (name, nationality, birth date, contact information) and the objectives (desired contract type, desired job, desired working conditions, desired salary) of the job seeker, what job offers are the most appropriate?

SEEMP Reference Ontology

Competency Questions

CQ40. Given the personal information (name, nationality, birth date, contact information) and the profile (current job, education level, work experience, knowledge, expertise, skill) of the job seeker what job offers are the most appropriate?

CQ41. Given the objectives (desired contract type, desired job, desired working conditions, desired salary) and the profile (current job, education level, work experience, knowledge, expertise, skills) of the job seeker, what job offers are the most appropriate?

CQ42. Given the personal information (name, nationality, birth date, contact information), the profile (current job, education level, work experience, knowledge, expertise, skill) and the objectives (desired contract type, desired job, desired working conditions, desired salary) of the job seeker, what job offers are the most appropriate?

CQ43. Given the employer information, economic activity of the employer and the job offer profile (job, contract type, salary, work condition), what job seekers are the most appropriate?

CQ44. Given the employer information, economic activity of the employer and the required profile to seek (required education level, required work experience, required knowledge, required skills), what job seekers are the most appropriate?

CQ45. Given the job offer profile (job, contract type, salary, work condition) and the required profile to seek (required education level, required work experience, required knowledge, required skills), what job seekers are the most appropriate?

CQ46. Given the employer information, economic activity of the employer, job offer profile (job, contract type, salary, work condition) and the required profile to seek (required education level, required work experience, required knowledge, required skills), what job seekers are the most appropriate?

CQ47. When the job seeker completed his/her first degree and how much time did he/she spend completing his/her first degree?

CQ48.When the job seeker completed his/her first degree and is he/she older than 30 years?

CQ49. Is the job seeker older than 30 years and how much time did he/she spend completing his/her first degree?

CQ50.Which job offers were posted in last 24 hours and how long is the duration of their contracts?

CQ51.Which job offers were posted in last 7 days and how long is the duration of their contracts?

CQ52.Which job offers were posted in last month and how long is the duration of their contracts?

CQ53.Is the job offer's salary greater than 14000 zlotes and could it be given in US dollars?

CQ54.Is the job offer's salary lower than 25000 kroner and could it be given in Euros?

CQ55. Given the age (30 years old) and the desired salary (equal or greater than 14000 €) of the job seeker, what job offers are the most appropriate?

CQ56. Given the employer information, economic activity of the employer and the job offer profile (job, contract type, salary, work condition, contract duration), what job seekers are the most appropriate?

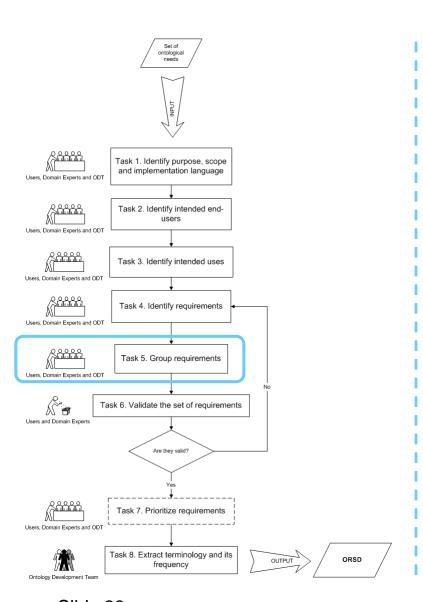
CQ57. Given the age (20 years old) and the desired salary (equal or greater than 14000 zlotes) of the job seeker, what job offers posted in last month are the most appropriate?

CQ58. Given the employer information, economic activity of the employer and the job offer profile (job, contract type, salary of 3400 €, work condition, contract duration), what job seekers are the most appropriate?

CQ59. Given the time spend for his/her degree (8 years) and the desired salary (equal or greater than 1 4000 €) of the job seeker, what job offers posted in last 7 days are the most appropriate?

CQ60. Given the time spend for his/her degree (8 years) and the desired salary (equal or greater than 14000 €) of the job seeker, what job offers posted in last 24 hours are the most appropriate?





- 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)

Job Offer (10 CQ)

General (24 CQ)

SEEMP Reference Ontology Competency Questions Job Seeker (16 CQ)

Time and date (6 CQ)

Currencies (4 CQ)

Job Offer

CQ17.What is the employer information?

CQ18. What kind of job does the employer offer?

CQ19. What kind of contract does the employer offer?

CQ20. How much salary does the employer offer?

CQ21.What is the economic activity of the employer?

CQ22.What is the description of the job offer?

CQ23. What is the work condition of the job offer?

CQ24. What is the required education level for the job offer?

CQ25.What is the required work experience for the job offer?

CQ26.What is the required knowledge for the job offer?

CQ27.What are the required skills for the job offer?

General

CQ39. Given the personal information (name, nationality, birth date, contact information) and the objectives (desired contract type, desired job, desired working conditions, desired salary) of the job seeker, what job offers are the most appropriate?

CQ40. Given the personal information (name, nationality, birth date, contact information) and the profile (current job, education level, work experience, knowledge, expertise, skill) of the job seeker what job offers are the most appropriate?

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CQ51.Which job offers were posted in last 7 days and how long is the duration of their contracts?

CQ52.Which job offers were posted in last month and how long is the duration of their contracts?

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CQ54.Is the job offer's salary lower than 25000 kroner and could it be given in Euros?

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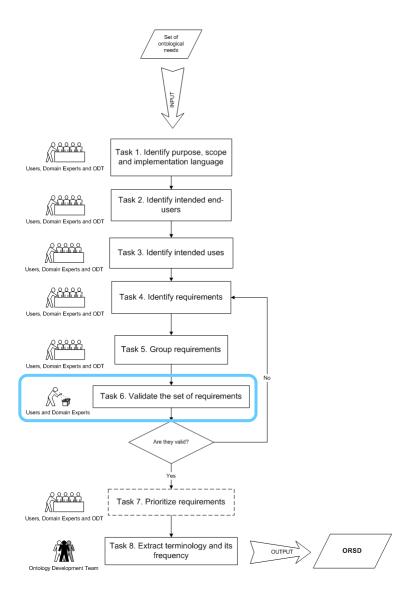
CQ58. Given the employer information, economic activity of the employer and the job offer profile (job, contract type, salary of 3400 €, work condition, contract duration), what job seekers are the most appropriate?

CQ59. Given the time spend for his/her degree (8 years) and the desired salary (equal or greater than 14000 e) of the job seeker, what job offers posted in last 7 days are the most appropriate?

CQ60. Given the time spend for his/her degree (8 years) and the desired salary (equal or greater than 14000 €) of the job seeker, what job offers posted in last 24 hours are the most appropriate?



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- ☐ *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.

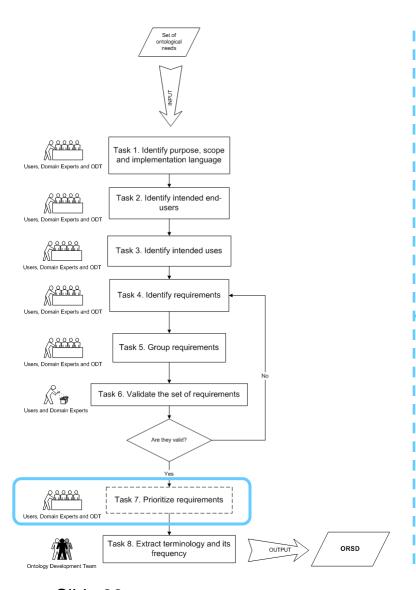
Modifiable.

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.

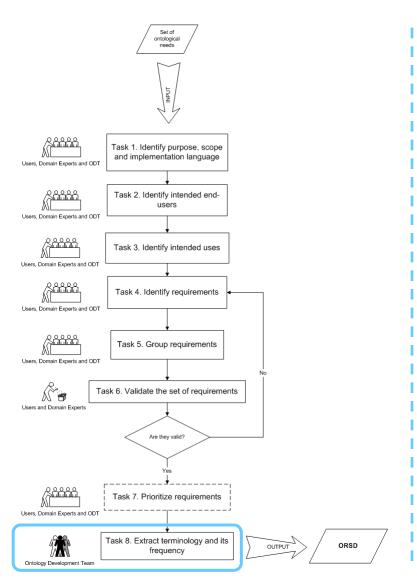
SEEMP



- ☐ *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.





- ☐ 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 Qu	estions	+ Frequency	
	Job Seeker 27 Address 1			
	CA	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 Autonomous, Seasonal Job, 2 3000 Euros per month		1 year, 2 years, 3 years	1
			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

б	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.

б	Ontology Requirements			
	b. Functional Requirements: Groups of Competency Questions			
	CQG1. Job Seeker (14 CQ)			

L	The	ontology has to be implemented in WSML language.	ľ
4	Intended End-Users		
	User 1.	Candidate who is unemployed and searching for a jet occupation for immediate or future purposes	
	User 2.	Employer who needs more human resources.	l
	User 3.	Public or private employment search service which c CVs or job postings and to prepare some data and statis	
	User 4.	National and Local Governments which want to anal employment market in their countries and prepare doc	
		social and educational policy.	l
	User 5.	European Commission and the governments of EU c analyze the statistics and prepare international agreen the employment, social and educational policy.	
5	Intended Uses		

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

<u> </u>		II dos maria talenaria	T				
7 Pre-Glossary of Terms							
a. Terms from Competency Qu	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, Austral	Andorra, Angola, Argentina, Australia, Bolivia, France, Italy, Malta, Spain, etc.						
Euro, Zloty, Great British Pound, US	5 Dollar	r, Peso, etc.					
CEFRIEL, ATOS, etc.							

ish; Italian; French;
003/1970; 15/04/1978
Tel: 34600654231. Email:
mer; Computer Engineer;
gineer; Hardware designer;
conditions? Autonomous;
t? Full time; Partial time;
m? 3000 Euros per month,
Basic education; Higher
hs, 1 year, 2 years
amming; C Programming,
teering
p, network administration

esearch Company, Milano,

r? Java Programmer, C

easonal Job; Autonomous Euros, 3000 USD yer? Research; Financial;

ied Java Programmer r? Full time; Partial time;

b offer? Basic education;

SEEMP

Higher education/University

- CQ23. What is the required work experience for the job offer? 1 year, 2 years, 3 years, 4 years, 5 or more years
- CQ24. What is the required knowledge for the job offer? Java, Haskell, Windows

CQ25. What are the required skills for the job offer? ASP Programmer. Data warehouse, Hardware programming

Slide 39

Ontological Engineering

Index

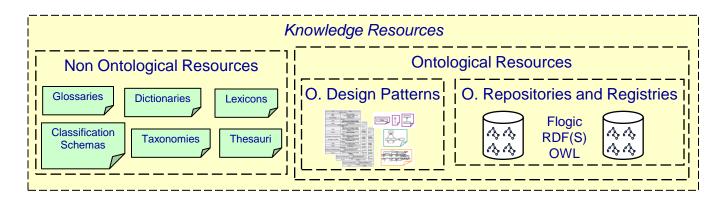
- Introduction
- Scenarios in Ontology Building
- Methodological Guidelines for Ontology Specification
- Quick Search and Selection of Existing Knowledge Resources
- Guidelines for Ontology development project Planning
- Methodological Guidelines for Non Ontological Resource Reuse and Reengineering
-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





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







ISO 4217 (currencies)

Entitiy	Currency	Code	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	
ARMENTA	Armenian Dram	AMD	051	
ARUBA	Aruban Guilder	AWG	533	
AUSTRALIA	Australian Dollar	AUD	036	
AUSTRIA	Euro	EUR	978	
AZERB AIJAN	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	
BELARUS	Belarussian Ruble	BYR	974	

ISO 3166 (countries)

```
<?xml version="1.0" encoding="ISO-8859-1" standalone="yes"?>
<ISO 3166-1 List en xml:lang="en">
<ISO_3166-1_Entry>
    <ISO 3166-1 Country name>AFGHANISTAN</ISO 3166-1 Country name>
    <ISO 3166-1 Alpha-2 Code element>AF</ISO 3166-1 Alpha-2 Code element>
   </ISO 3166-1 Entry>
   <ISO 3166-1 Entry>
    <ISO 3166-1 Country name>ALAND ISLANDS</ISO 3166-1 Country name>
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   </ISO 3166-1 Entry>
  <ISO 3166-1 Entry>
    <ISO 3166-1 Country name>ALBANIA</ISO 3166-1 Country name>
    <ISO 3166-1 Alpha-2 Code element>AL</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>DZ</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>AS</ISO 3166-1 Alpha-2 Code element>
   </ISO 3166-1 Entry>
  <ISO 3166-1 Entry>
    <ISO 3166-1 Country name>ANDORRA</ISO 3166-1 Country name>
    <ISO 3166-1 Alpha-2 Code element>AD</ISO 3166-1 Alpha-2 Code element>
   </ISO 3166-1 Entry>
  <ISO_3166-1_Entry>
    <ISO_3166-1_Country_name>ANGOLA</ISO_3166-1_Country_name>
    <ISO 3166-1 Alpha-2 Code_element>AO</ISO_3166-1_Alpha-2_Code_element>
   </ISO 3166-1 Entry>
   <ISO 3166-1 Entry>
    <ISO 3166-1 Country_name>ANGUILLA</ISO_3166-1_Country_name>
    <ISO 3166-1 Alpha-2 Code element>Al</ISO 3166-1 Alpha-2 Code element>
   </ISO 3166-1 Entry>
```

Non-ontological resources - ISCO-88 (COM)

lev	el 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 Geburtst
	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	l	
	3 Special education teaching associate professionals	Professions intermédiaires de l'éducation des handicapés	Nicht-wissenschaftliche Sonderschullehrkräfte		



Searching non ontological resources

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

Language Classification ISO 6392, CEF

Driving License Classification European Legislation

Skill Classification

Eures Taxonomy

Contract Types Classification

LE FOREM, Eures and BLL Classification

Work Condition Classification

LE FOREM, Eures and BLL Classification

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



Ontological Engir



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



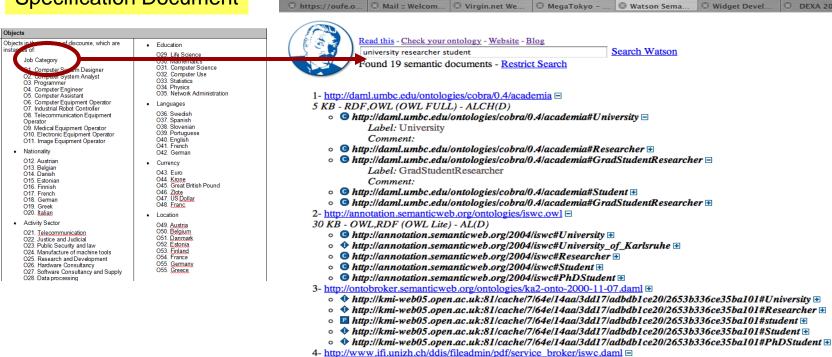
Searching Ontologies in Watson

| http://kmi-web05.open.ac.uk/WatsonWUI/

Watson Semantic Web Search

diana Apple (110) ▼ Amazon eBay Yahoo! News (1049) ▼ neon-newsfe...n,WP4) (3) WII Old Compute... computers

Ontology Requirement Specification Document



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

¢

○ http://annotation.semanticweb.org/iswc/iswc.daml#University :

http://annotation.semanticweb.org/iswc/iswc.daml#Researcher •

⋄ ♦ http://annotation.semanticweb.org/iswc/iswc.daml#University_of_Karlsruhe •

Watson NeOn Toolkit plugin

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

