Ontology Engineering Methodologies

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Ontological Engineering

It refers to the set of activities that concern

the ontology development process,

the ontology life cycle,

the methods and methodologies for building ontologies,

and the tool suites

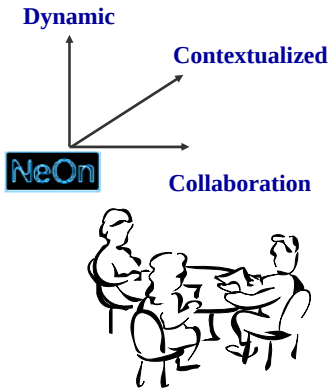
and languages that support them

Most relevant methodologies

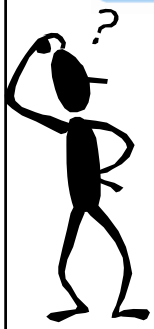
Methodologies for building single ontologies from scratch

- 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



I want to build my ontology



- Which one are the activities involved in the ontology development process?
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- How can I build the ontology for my application?
- Do I need a single ontology or an ontology network?

NeOn

The NeOn Glossary of Activities

- The *NeOn Glossary of Activities* identifies and defines the activities that are carried out when ontology networks are collaboratively built
- 55 activities
- Publication in the NeOn website

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

NeOn

The NeOn Glossary of Activities

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
- Ontology Merging
- Ontology Modification
- Ontology Modularization
- Ontology Module Extraction
- Ontology Partitioning
- Ontology Population
- Ontology Pruning
- Ontology Reconciliation
- Ontology Repair
- Ontology Reuse
- Ontology Selection (Marta)
- Ontology Specialization
- Ontology Specification
- Ontology Summarization
- Ontology Transforming
- Ontology Translating
- Ontology Update
- Ontology Upgrade
- Ontology Validation
- Ontology Verification
- Ontology Versioning
- To find candidate ontologies to be reused
- To find ontology differences
- To inspect the content and granularity of the

Some definitions

article | discussion | edit | history | protect | delete | move | watch | refresh

WP5WorkingArea: Knowledge Acquisition for Ontologies

- **Final Definition**: *Knowledge Acquisition for Ontologies* comprises activities for capturing knowledge (e.g., T-Box and A-Box) from a variety of sources. We distinguish between: **Ontology Elicitation**, **Ontology Learning** and **Ontology Population**.
- **Activity Group**: *Development*.

WP5WorkingArea: Ontology Elicitation

- **Final Definition**: *Ontology Elicitation* is a knowledge acquisition activity in which conceptual structures (e.g. T-Box) and their instances (e.g. A-Box) are acquired from domain experts.
- **Activity Group**: *Development*.

WP5WorkingArea: Ontology Learning

- **Final Definition**: *Ontology Learning* is a knowledge acquisition activity that relies on (semi-) automatic methods to transform unstructured (e.g. corpora), semi-structured (e.g. folksonomies, html pages, etc.) and structured data sources (e.g. data bases) into conceptual structures (e.g. T-Box).
- **Activity Group**: *Development*.

WP5WorkingArea: Ontology Population

(Redirected from WP5WorkingArea: Ontology Population/Grounding)

- **Final Definition**: *Ontology Population* is a knowledge acquisition activity that relies on (semi-) automatic methods to transform unstructured (e.g. corpora), semi-structured (e.g. folksonomies, html pages, etc.) and structured data sources (e.g. data bases) into instance data (e.g. A-Box).
- **Activity Group**: *Development*.

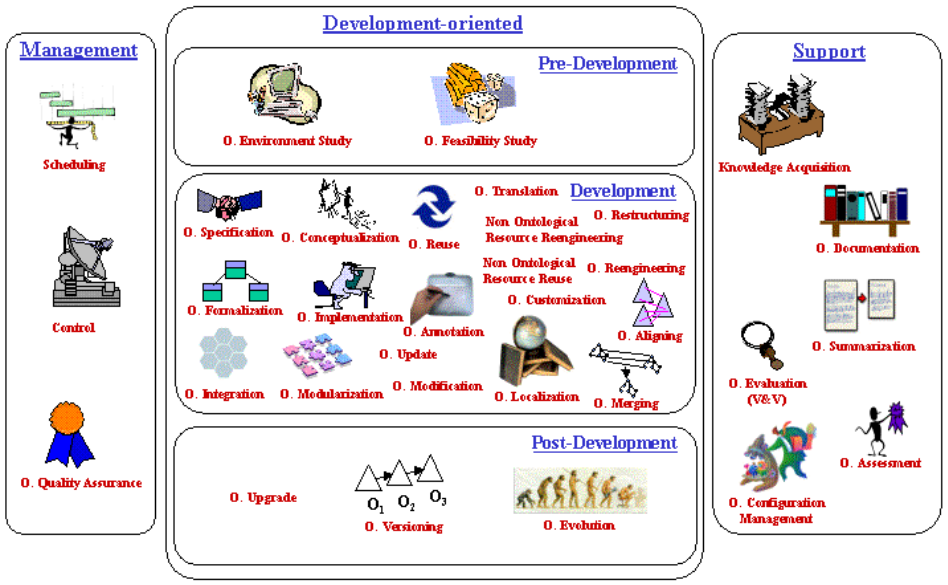
http://www.neon-project.org/wiki/index.php?title=WP5D5.3.1#NeOn_Glossary_of_Activities

Table of "Recommended and If-Applicable" Activities

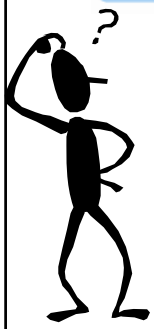
- For each activity included in the NeOn Glossary of Activities, the table identifies which activities are required and which activities are optional (can be carried out or not, depending on the case)during the ontology network building process.

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

Ontology Network Development Process



I want to build my ontology



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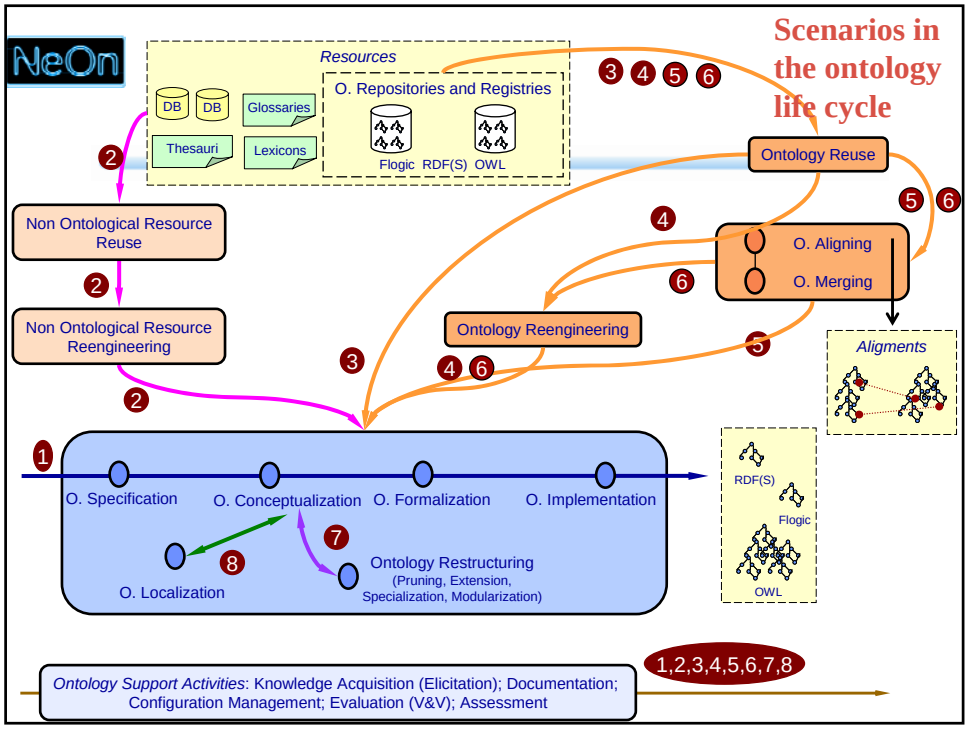
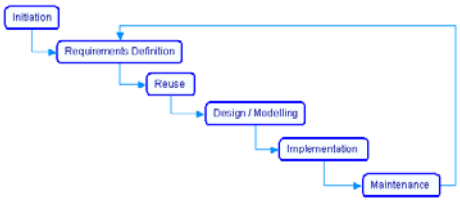
Scenarios

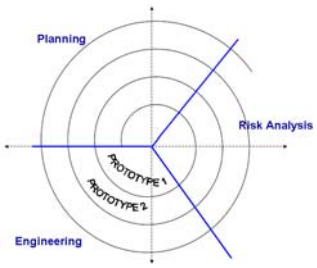
1. Building ontology networks from scratch without reusing existing resources.
2. Building ontology networks by reusing non ontological resources.
3. Building ontology networks by reusing ontologies or ontology modules.
4. Building ontology networks by reusing and reengineering ontologies or ontology 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 restructuring ontologies or ontology modules.
8. Building ontology networks by localizing ontologies or ontology modules.



Life Cycle Models and Life Cycles

- An **ontology life cycle model** is the framework (waterfall, evolving prototyping, spiral, etc.), selected by each using organization, on which to map the activities identified in the ontology development process.





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

How software developers and ontology practitioners select the *ontology life cycle model* and the *particular ontology life cycle* for developing his/her ontology?

Proposed steps:

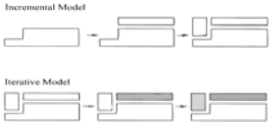
1. **Identify the user needs.**
2. **Select the *ontology life cycle model to be used.***
3. **Select activities from the "recommended and if-applicable" activity table.**
4. **Map the selected activities into the selected ontology life cycle model: the result is the *ontology life cycle for the user needs*.**

Ontology Life Cycle Models

- **Assumption: Ontology requirements are known at the begining of the ontology development project.**

Waterfall

'V' Model



- **Assumption: Ontology requirements can be not known at the begining of the ontology development project and can change during the project.**

Evolutionary Prototyping

Rapid Throwaway Prototyping

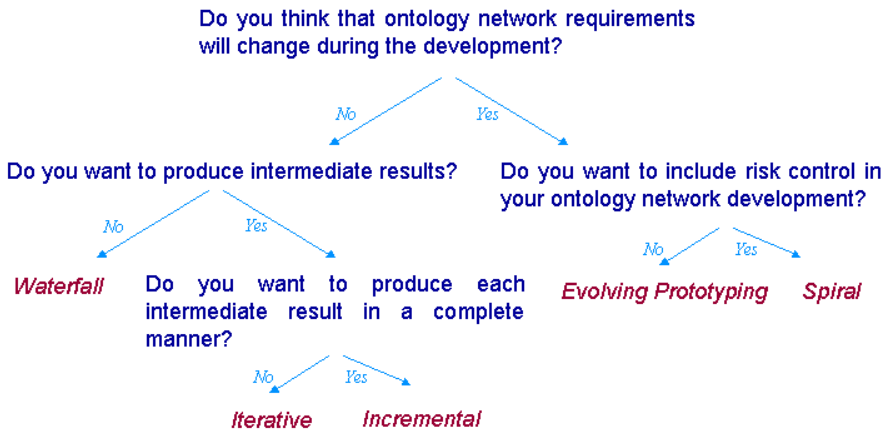
- **Assumption: Uncertainties in the ontology requirements can derive into risks in the project.**

Spiral

Risks can be:

- **Properties became classes**
- **Move from frames to DL**
- **Reuse new existing resources**

Decission tree for selecting your Ontology Life Cycle Model



Decission Tree for Selecting Activities

Have you developed more than 5 ontologies?

No

Set of "yes/no" natural language questions for identifying the 'if-applicable' activities to be carried out.

- Do you want to have your ontology network in different natural languages, as for example, in English, Spanish and French? YES → *O. Localization*.
- Do you want to take an existing and implemented ontology, in order to enhance it and implement it again? NO → *O. Reengineering is not selected*.

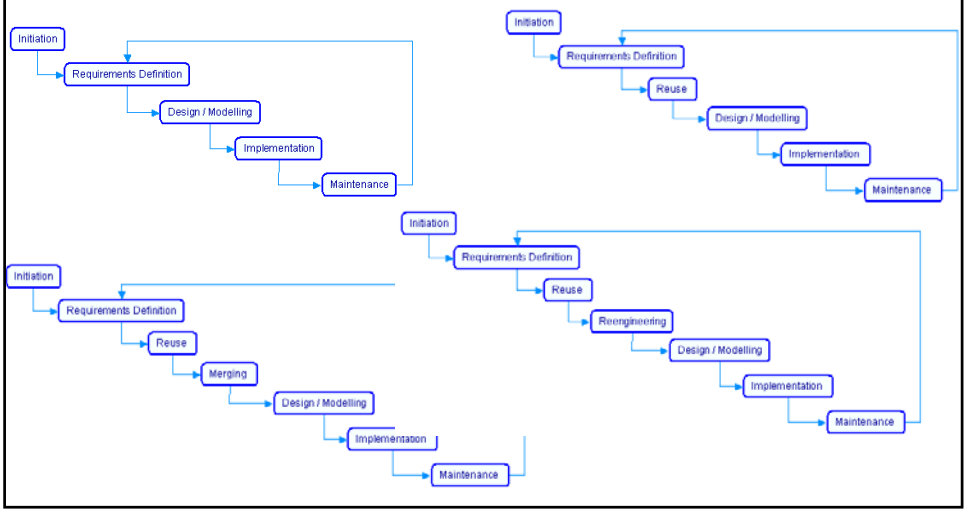
Yes

Software developers and ontology practicioners select the activities to be carried out from the "Required-If Applicable" table

	If Applicable	*Selected*
Ontology Aligning	X	X
Ontology Customization	X	
Ontology Learning	X	
Ontology Localization	X	X
Ontology Matching	X	X
Ontology Modification	X	
Ontology Reengineering	X	
Ontology Restructuring	X	X

Automatically

Several ontology life cycles for the same model



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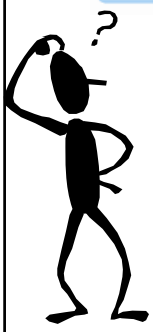

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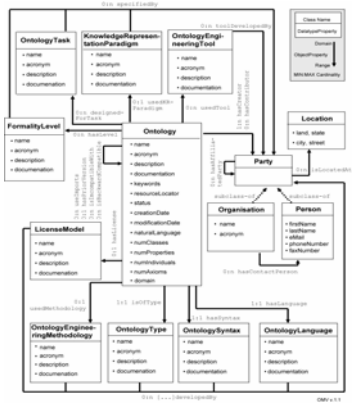
Searching Ontologies

- OMV: Ontology Metadata Vocabulary



- Ontology registries

OYSTER

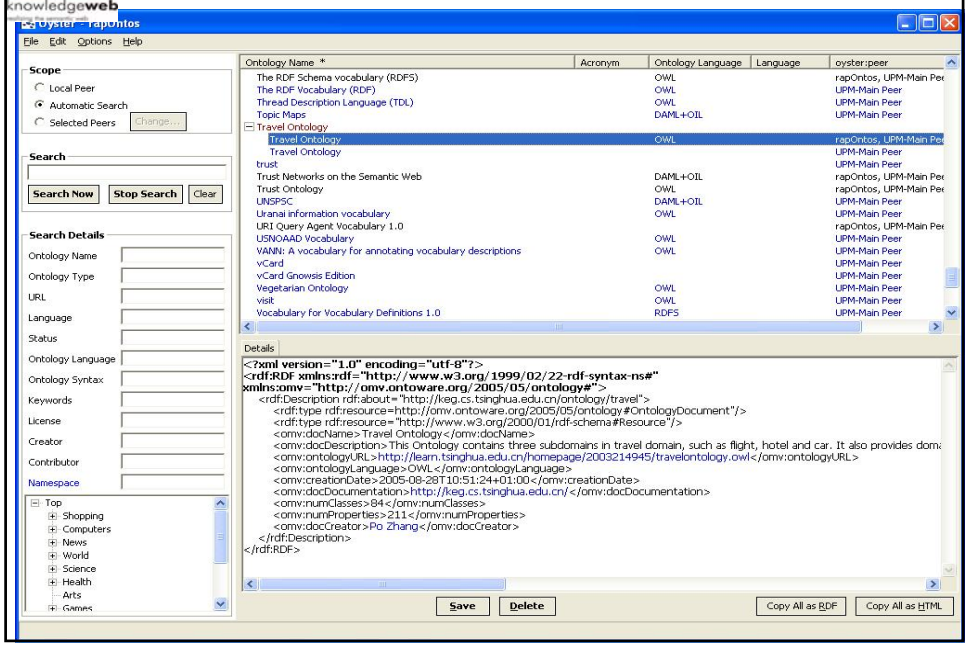
Onthology.org

knowledge zone one stop shop for ontologies

Swoogle semantic web search 2006

watson exploring the semantic web

Searching ontologies using Oyster



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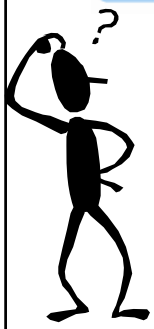

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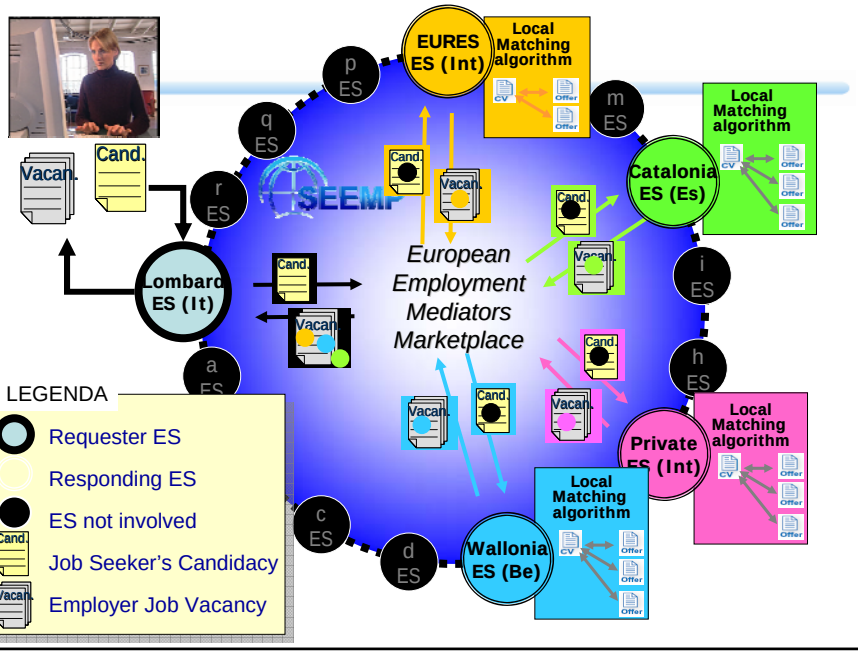
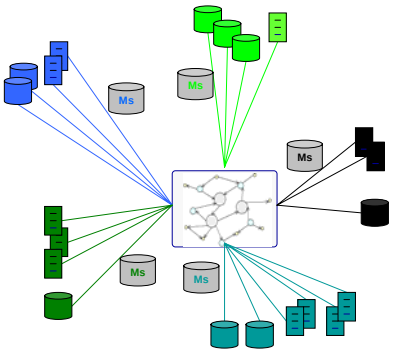
Helping Job Seekers on their way

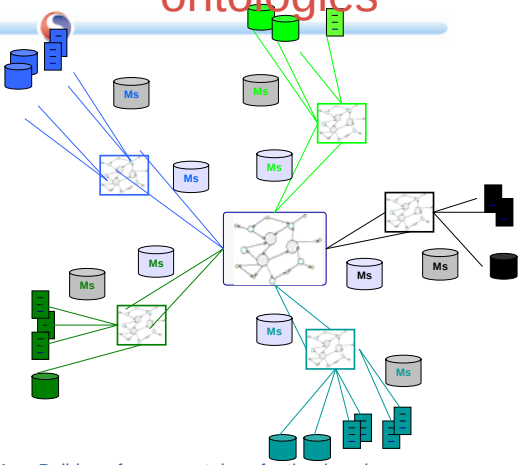


Centralized network of ontologies

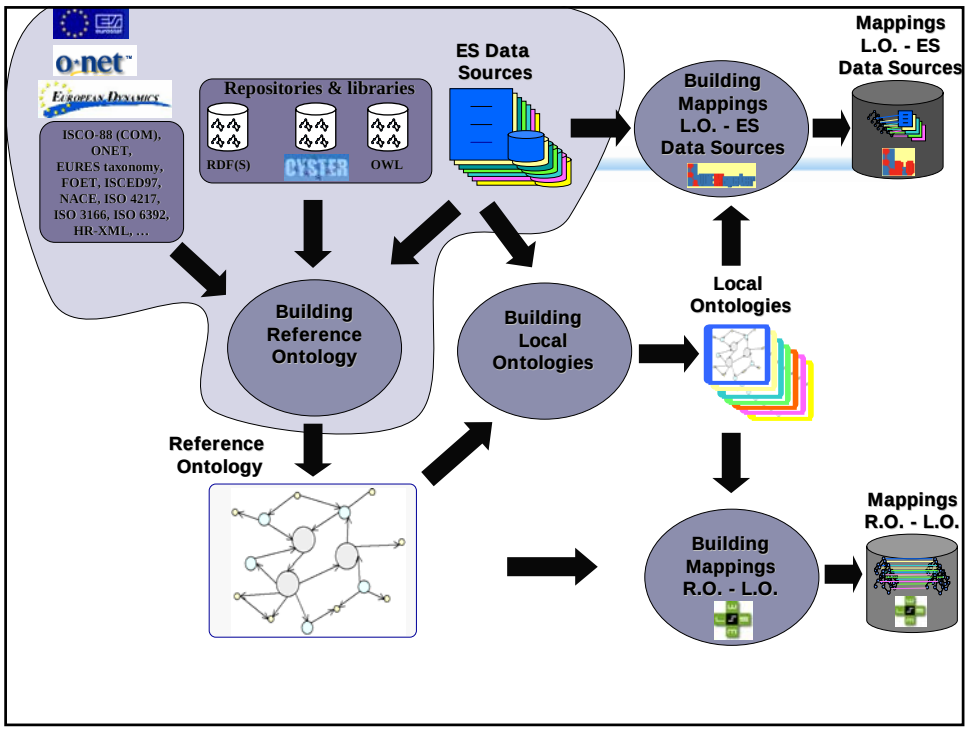


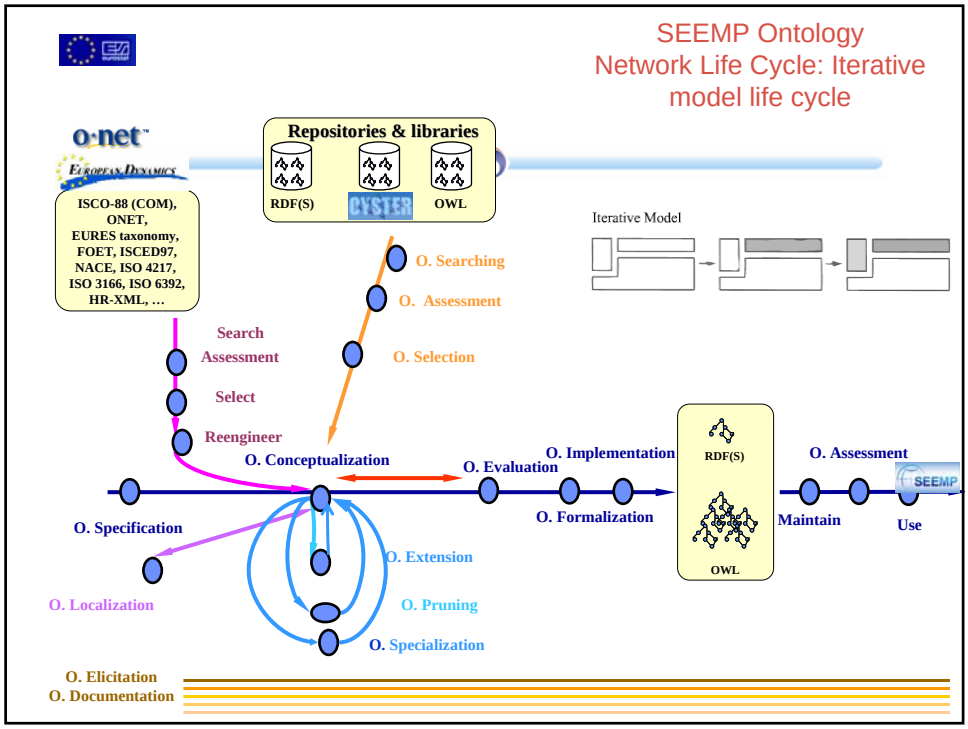
1. Build a reference ontology
2. Build mappings between the reference ontology and the data sources

Federated network of ontologies



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


o-net
European Dynamics
ISCO-88 (COM), ONET, EURES taxonomy, FOET, ISCED97, NACE, ISO 4217, ISO 3166, ISO 6392, HR-XML, …
Repositories & libraries
RDF(S)
OWL
ES Data Sources
Building Mappings L.O. - ES Data Sources
Mappings L.O. - ES Data Sources
Building Reference Ontology
Building Local Ontologies
Local Ontologies
Reference Ontology
Building Mappings R.O. - L.O.
Mappings R.O. - L.O.


SEEMP Ontology Network Life Cycle: Iterative model life cycle
o-net
European Dynamics
ISCO-88 (COM), ONET, EURES taxonomy, FOET, ISCED97, NACE, ISO 4217, ISO 3166, ISO 6392, HR-XML, …
Repositories & libraries
RDF(S)
OWL
Iterative Model
O. Searching
O. Assessment
O. Selection
Search
Assessment
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Reengineer
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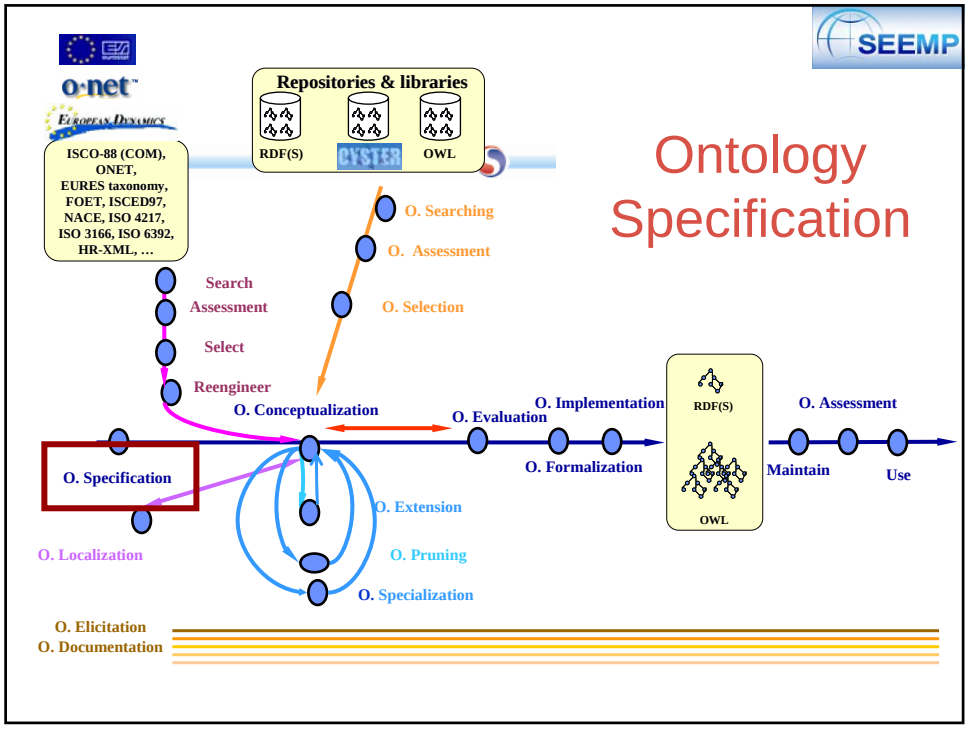
O. Evaluation
O. Implementation
O. Formalization
RDF(S)
OWL
O. Assessment
SEEMP
Maintain
Use
O. Specification
O. Extension
O. Localization
O. Pruning
O. Specialization
O. Elicitation
O. Documentation


SEEMP
Ontology Specification
o·net
European Dynamics
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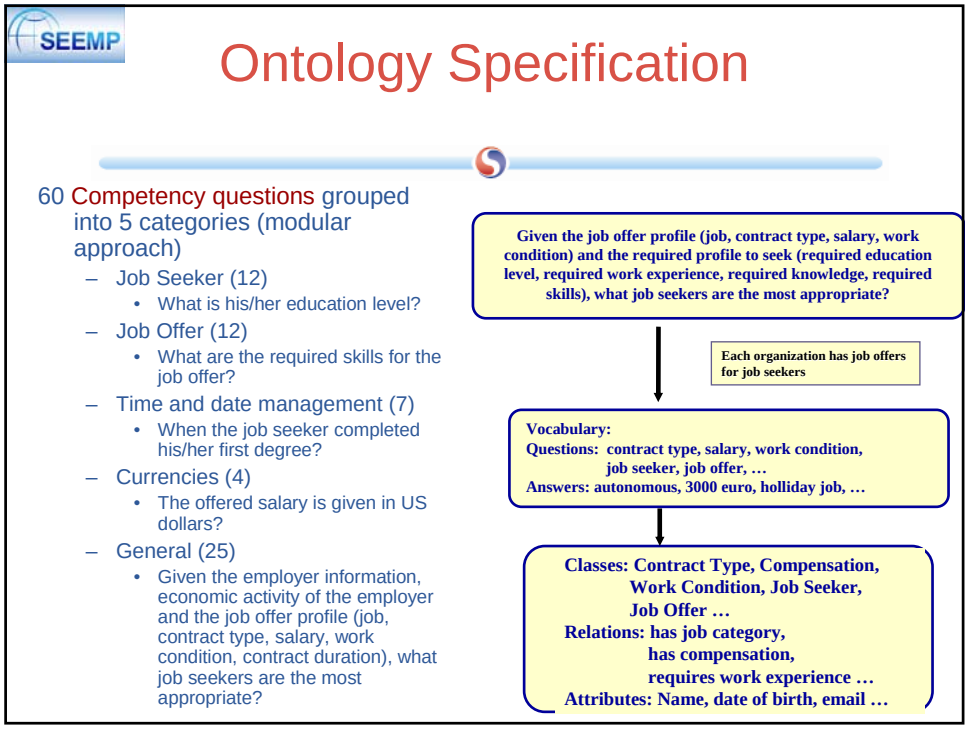
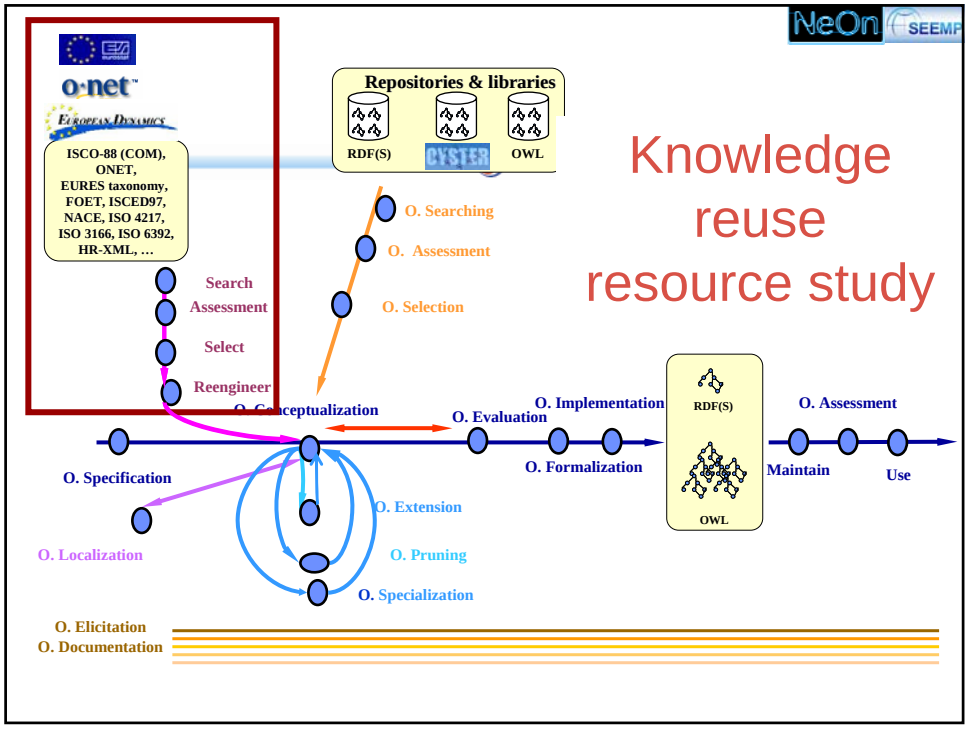

SEEMP
Ontology Specification
60 Competency questions grouped into 5 categories (modular approach)
– Job Seeker (12)
• What is his/her education level?
– Job Offer (12)
• What are the required skills for the job offer?
– Time and date management (7)
• When the job seeker completed his/her first degree?
– Currencies (4)
• The offered salary is given in US dollars?
– General (25)
• 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?
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?
Each organization has job offers for job seekers
Vocabulary:
Questions: contract type, salary, work condition, job seeker, job offer, …
Answers: autonomous, 3000 euro, holliday job, …
Classes: Contract Type, Compensation, Work Condition, Job Seeker, Job Offer …
Relations: has job category, has compensation, requires work experience …
Attributes: Name, date of birth, email …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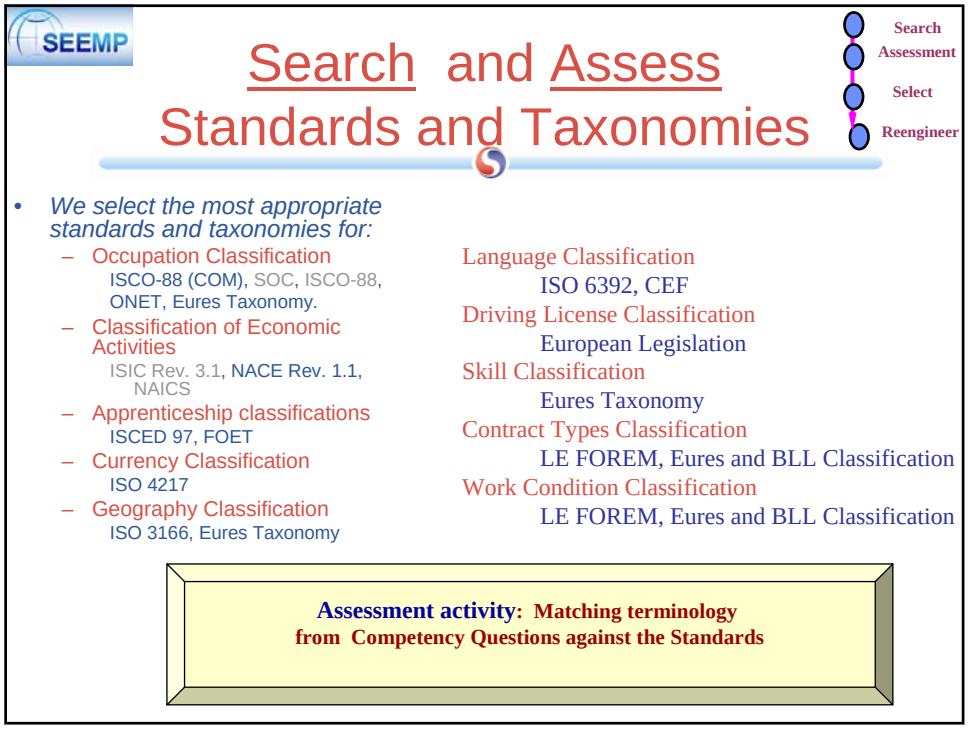

SEEMP
Search and Assess Standards and Taxonomies
Search
Assessment
Select
Reengineer
• We select the most appropriate standards and taxonomies for:
– Occupation Classification
ISCO-88 (COM), SOC, ISCO-88, ONET, Eures Taxonomy.
– Classification of Economic Activities
ISIC Rev. 3.1, NACE Rev. 1.1, NAICS
– Apprenticeship classifications
ISCED 97, FOET
– Currency Classification
ISO 4217
– Geography Classification
ISO 3166, Eures Taxonomy
Language Classification
ISO 6392, CEF
Driving License Classification
European Legislation
Skill Classification
Eures Taxonomy
Contract Types Classification
LE FOREM, Eures and BLL Classification
Work Condition Classification
LE FOREM, Eures and BLL Classification
Assessment activity: Matching terminology from Competency Questions against the Standards

SEEMP

Search
Assessment
Select
Reengineer

Selection of Standards

Reference Ontology shall be based on the international, European or de-facto industrial standards

	Occupation Classification				Classification of Economic Activities			Apprenticeship Classification	
	SOC	ONET	ISCO-88	ISCO-88 (COM)	ISIC Rev. 3.1	NACE Rev. 1.1	NAICS	ISCED 97	FOET
The degree of coverage		☑	☑	☑	☑	☑			☑
The current European needs				☑		☑		☑	☑

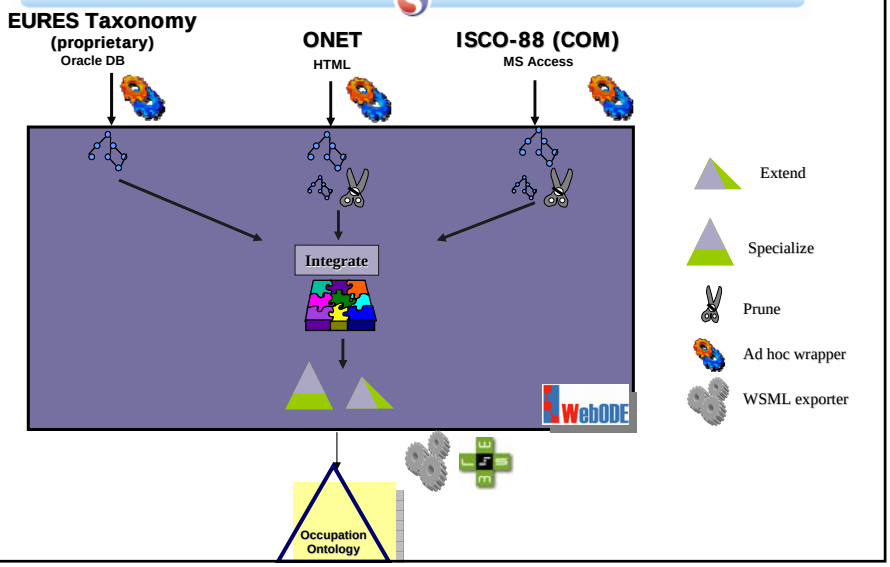
Currency Classification	Geography Classification	Language Classification	Driving License
ISO 4217	ISO 3166	ISO 6392	Community Driving License

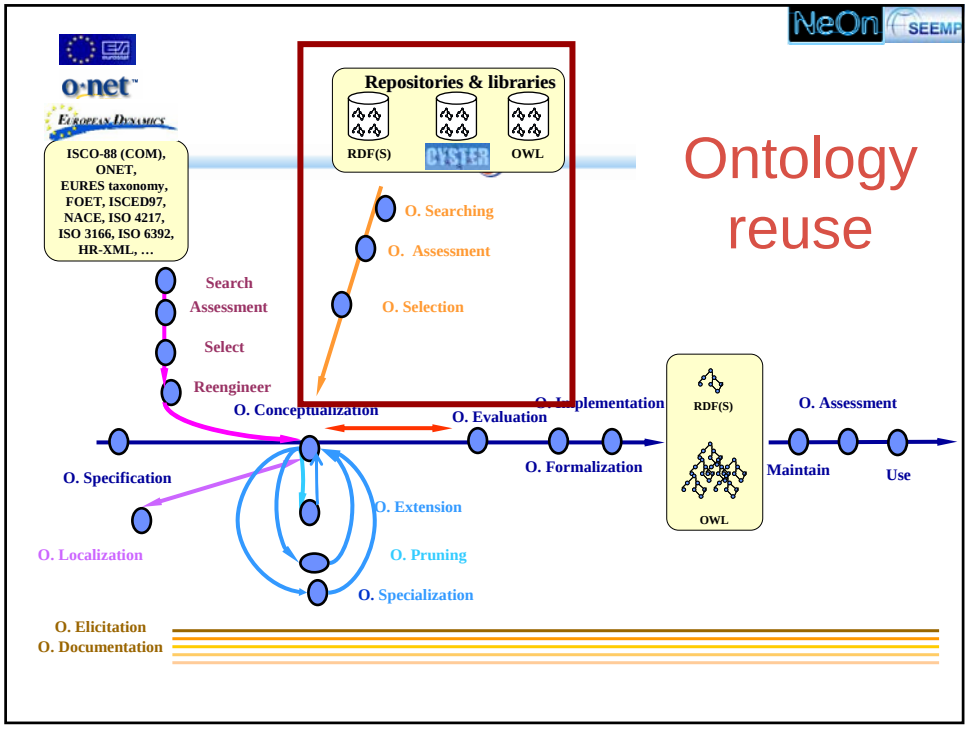
But, we need also proprietary taxonomies ...

NeOn SEEMP

Search
Assessment
Select
Reengineer

Reengineering resources





Assessing Time Ontologies

O. Searching
O. Assessment
O. Selection

1. Identification of criteria for comparing the candidate set of temporal ontologies

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

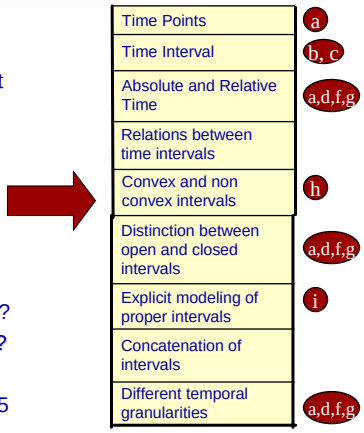
2. Assess all existing temporal ontologies against the criteria

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

Process for assessing Time Ontologies (II)

O. Searching
O. Assessment
O. Selection

3. Checking which temporal properties are needed for answering the Competency questions
   a. When the job seeker completed his/her first degree?
   b. Is the job seeker older than 30 years?
   c. How much time did the job seeker spend completing his/her first degree?
   d. How long is the duration of the contract?
   e. Which job offers were posted in last 24 hours?
   f. Which job offers were posted in last 7 days?
   g. Which job offers were posted in last month?
   h. Was the job seeker unemployed?
   i. Was the job seeker a student between 1995 and 2000?

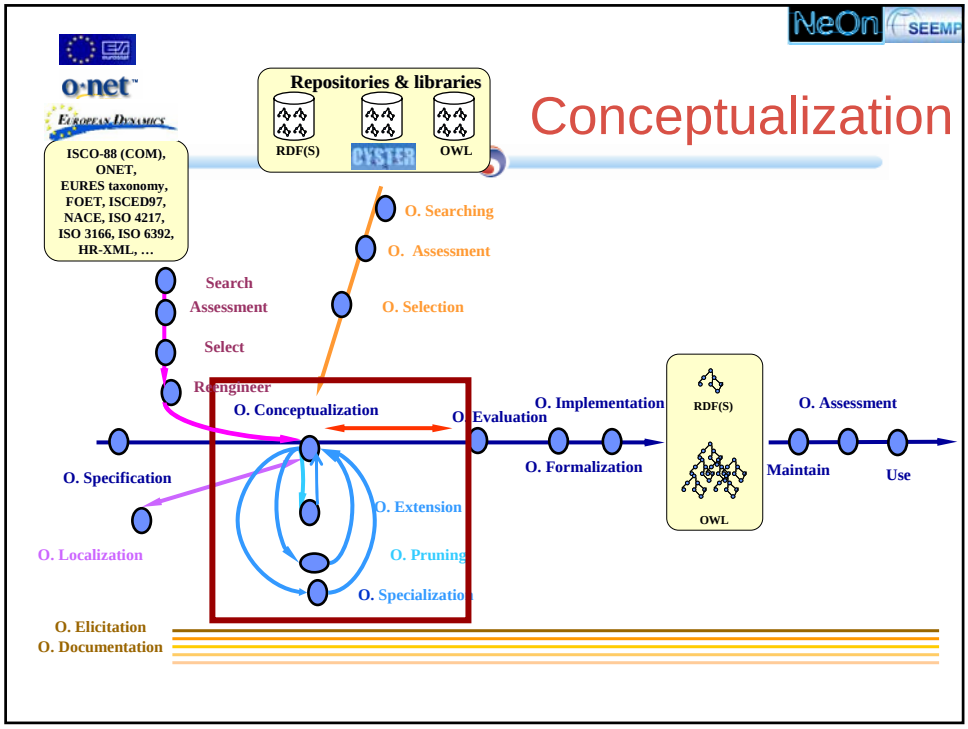


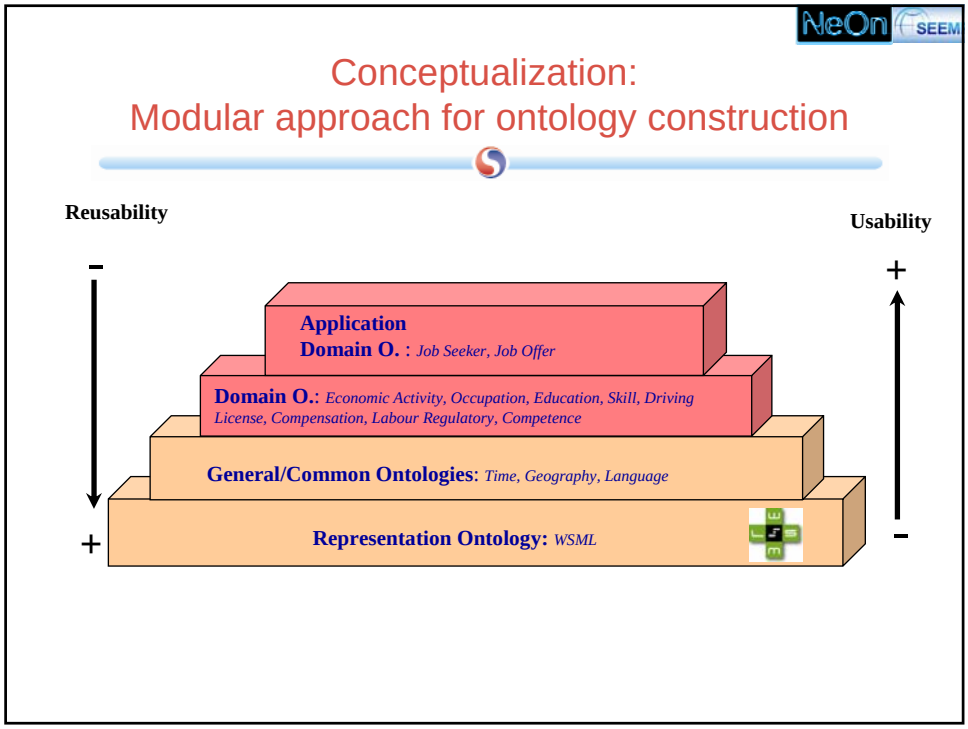
4. Checking which temporal properties are needed for answering the Competency questions

The Time Ontology Selection

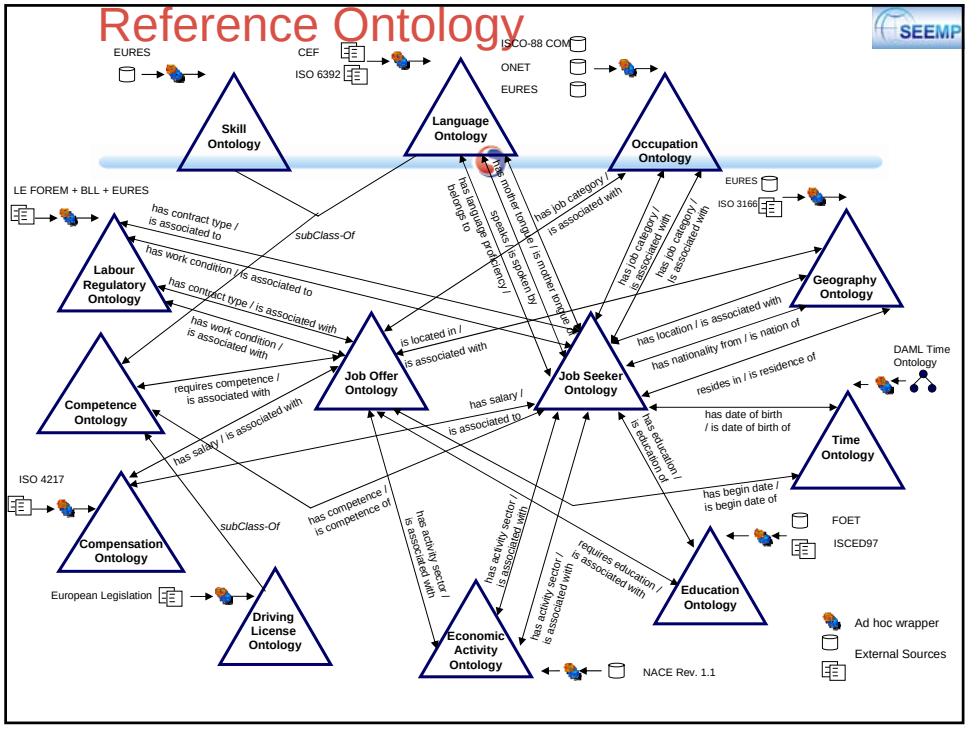
O. Searching
O. Assessment
O. Selection

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

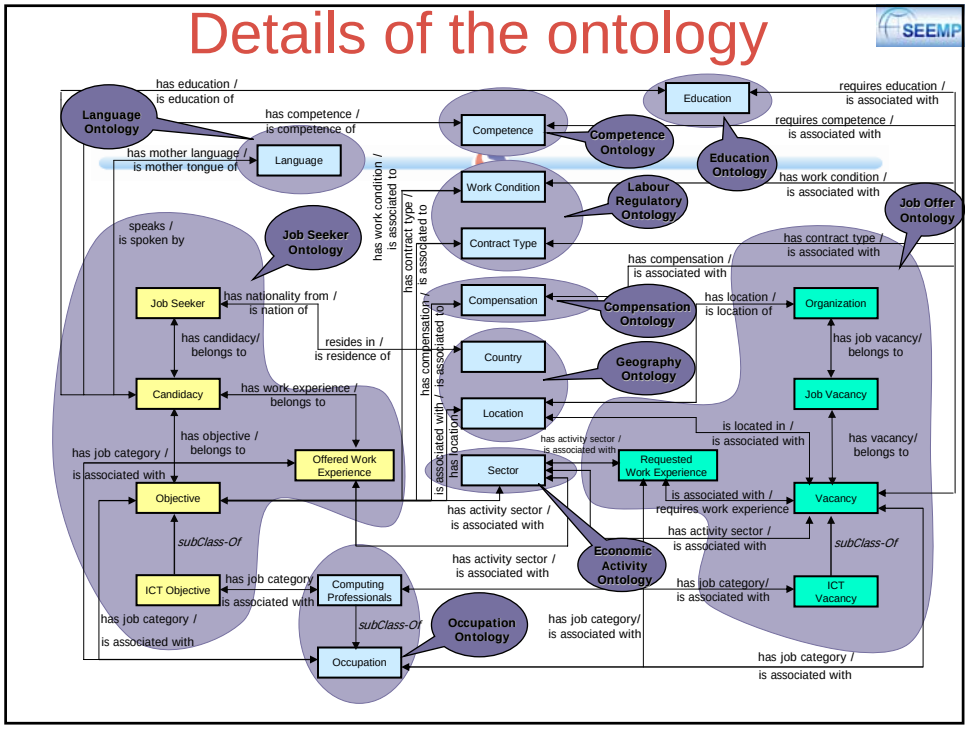

Conceptualization
Repositories & libraries
RDF(S)
OWL
ISCO-88 (COM), ONET, EURES taxonomy, FOET, ISCED97, NACE, ISO 4217, ISO 3166, ISO 6392, HR-XML, …
O. Searching
O. Assessment
O. Selection
Search
Assessment
Select
Reengineer
O. Conceptualization
O. Evaluation
O. Implementation
O. Formalization
RDF(S)
OWL
O. Assessment
Maintain
Use
O. Specification
O. Extension
O. Localization
O. Pruning
O. Specialization
O. Elicitation
O. Documentation

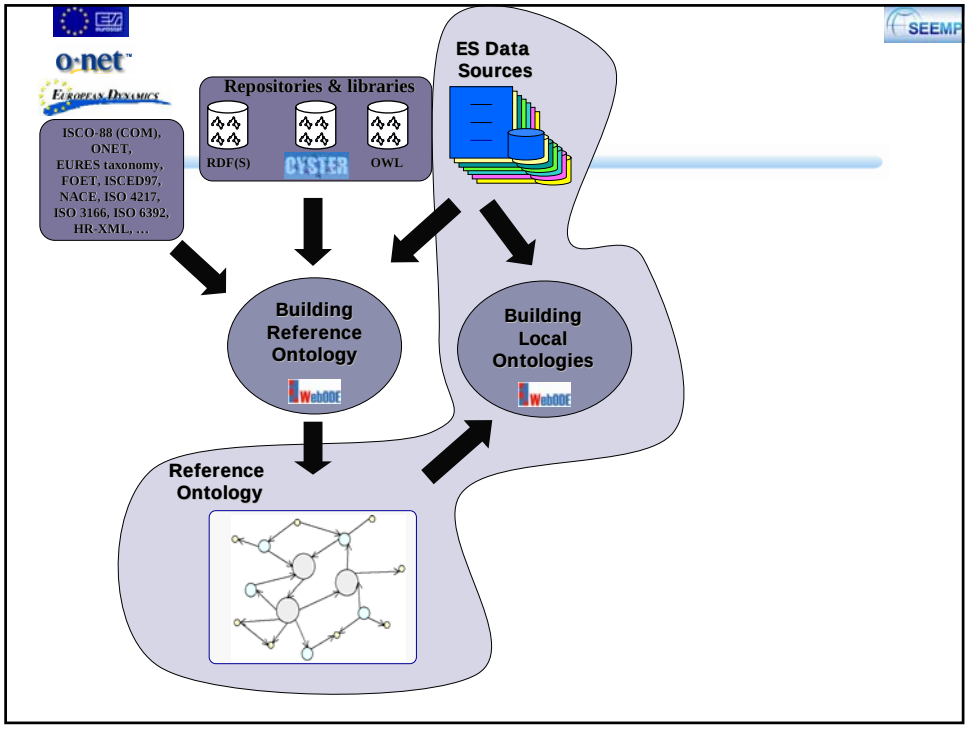

Conceptualization:
Modular approach for ontology construction
Reusability
Usability
Application
Domain O. : Job Seeker, Job Offer
Domain O.: Economic Activity, Occupation, Education, Skill, Driving License, Compensation, Labour Regulatory, Competence
General/Common Ontologies: Time, Geography, Language
Representation Ontology: WSML

Reference Ontology



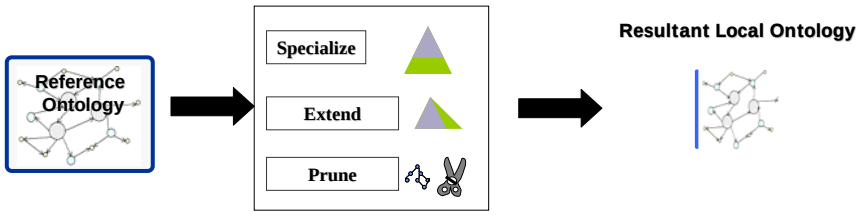
Details of the ontology



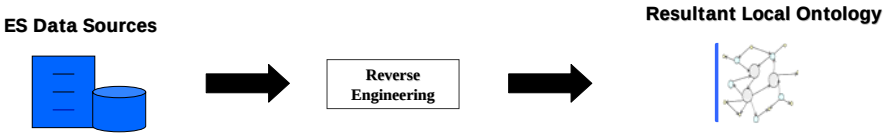


Local Ontologies Building Process

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



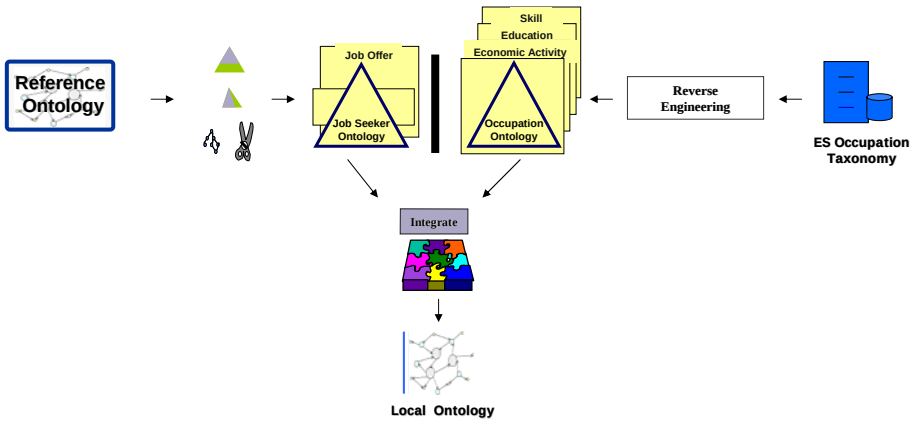
- Option 2: *Building Local Ontologies as a reverse engineering process from ES Data Sources.*



Hybrid approach for building Local Ontologies

A hybrid approach

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



Conclusions

- Which one are the activities involved in the ontology development process?
- Which one is the goal of each activity?
  - NeOn Glossary of Activities
  - NeOnTable of "Recommended and If-Applicable"
  - NeOn Development Process
- 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
- Where can I find ontologies with the goal of reusing them?
  - Ontology Metadata Vocabulary
  - Ontology registries
- How can I build the ontology for my application?
- Do I need a single ontology or an ontology network?
  - Example of building an ontology in the *Employment Mediators Marketplace*

Acknowledgement

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