Ontological Engineering

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- 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 Guidelines 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?
- ...
Limitations of current methodologies

- Methontology, On-To-Knowledge are for building ontologies from scratch
- They lack guidelines for:
  - building ontologies by reusing and reengineering existing knowledge aware resources
  - for contextualizing an existing ontology and plugging it in with existing ontologies that might be in continuous evolution
  - Building ontologies in a collaborative way
  - software developers that need to include ontologies into their IT developments
New 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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Too many activities…

Thesauri Reuse

Merging Ontologies

Ontology Reuse

Localizing Ontologies

Ontology Design Patterns

Ontology Learning

Ontological Resource Reengineering

Restructuring Ontologies

Classical
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.
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.
NeOn Scenarios

Knowledge Resources

Non Ontological Resources
- Dictionaries
- Lexicons
- Classification Schemas
- Taxonomies
- Thesauri

Ontological Resources
- O. Design Patterns
- O. Repositories and Registries
- Flogic RDF(S) OWL

Ontological Resource Reuse
- O. Aligning
- O. Merging

Non Ontological Resource Reuse
- Ontology Design Pattern Reuse

Ontology Design Pattern Reuse

Ontological Resource Reengineering

Ontology Restructuring
- Pruning, Extension, Specialization, Modularization

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

Introduction to the Semantic Web Tutorial: Ontological Engineering
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.
8. Building ontology networks by restructuring ontologies or ontology modules.
9. Building ontology networks by localizing ontologies or ontology modules.
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

Introduction to the Semantic Web Tutorial: Ontological Engineering
Helping Job Seekers on their way

LEGENDA
- Requester ES
- Responding ES
- ES not involved
- Job Seeker’s Candidacy
- Employer Job Vacancy

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**Ontology Specification**

**Definition**

Ontology 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.

<table>
<thead>
<tr>
<th>Input</th>
<th>Output</th>
</tr>
</thead>
</table>

**Goal**

The specification activity states why the ontology is being built, who the intended users are, who the end-users are, and what the requirements the ontology should fulfill are.

**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 in parallel with the knowledge acquisition activity.
# Ontology Requirement Specification

**Document Template**

## 1 Purpose

“Software developers and ontology practitioners should include in this slot the purpose of the ontology”

## 2 Scope

“Software developers and ontology practitioners should include in this slot the scope of the ontology”

## 3 Level of Formality

“Software developers and ontology practitioners should include in this slot the level of formality of the ontology”

## 4 Intended Users

“Software developers and ontology practitioners should include in this slot the intended users of the ontology”

## 5 Intended Uses

“Software developers and ontology practitioners should include in this slot the intended uses of the ontology”

## 6 Groups of Competency Questions

“Software developers and ontology practitioners should include in this slot the groups of competency questions and their answers, including priorities for each group”

## 7 Pre-Glossary of Terms

### Terms

“Software developers and ontology practitioners should include in this slot the list of terms included in the CQs and their frequencies”

### Objects

“Software developers and ontology practitioners should include in this slot a list of objects and their frequencies”
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Searching Resources

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

Knowledge Resources

- Non Ontological Resources
  - Glossaries
  - Dictionaries
  - Lexicons
  - Classification Schemas
  - Taxonomies
  - Thesauri

- Ontological Resources
  - O. Design Patterns
  - O. Repositories and Registries
    - Flogic
    - RDF(S)
    - OWL

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

- Search ontologies
- Compare ontologies in the same domain using a set of criteria
- Assess if the ontologies cover the set of competency questions
- Select the best ontology based on
  - Coverage of the domain
  - Expressivity of the Implementation language
Searching Ontologies in Watson

Ontology Requirement Specification Document

Introduction to the Semantic Web Tutorial: Ontological Engineering
The Time Ontology Selection

Checking which temporal properties are needed for answering the CQ

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. ......

<table>
<thead>
<tr>
<th>Property</th>
<th>Cyc's Upper Ontology</th>
<th>Unrestricted Time Ontology</th>
<th>Simple Time Ontology</th>
<th>Reusable Time Ontology</th>
<th>Kestrel Time Ontology</th>
<th>SRI's Time Ontology</th>
<th>SUMO Time Ontology</th>
<th>DAML Time Ontology</th>
<th>AKT Time Ontology</th>
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<tr>
<td>Convex and non convex intervals</td>
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<td>Explicit modeling of proper intervals</td>
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<td>Concatenation of intervals</td>
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<tr>
<td>Different temporal granularities</td>
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<td>✓</td>
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<tr>
<td>Provides axioms</td>
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</tr>
</tbody>
</table>
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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.

- **Waterfall**

- **Incremental Model**

- **Iterative Model**

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

- There is **no unique life cycle model** valid for all the ontology development projects.
How software developers and ontology practitioners select the **ontology life cycle model** and the **particular ontology life cycle** for developing his/her ontology?

**Step 1:** Identify ontology network development requirements

**Step 2:** Select the ontology network life cycle model (ONLCM) to be used

**Step 3:** Select activities to be carried out

**Step 4:** Map the selected activities into the selected ontology network life cycle model

**Step 5:** Set the order of the activities: the result is the ontology network life cycle for the ontology network

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**NeOn Deliverable D5.3.1 (2007)**
**I-SEMANTICS 2008**
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The resource type and its data model influence the reengineering process.
Reengineering resources

EURES Taxonomy
(proprietary)
Oracle DB

ONET
HTML

ISCO-88 (COM)
MS Access

Integrate

Extend
Specialize
Prune
Ad hoc wrapper
WSML exporter

Occupation Ontology
Knowledge Resource Reengineering

Excerpt of the Geography Ontology

ISO 3166-1 (XML)

```xml
<ISO_3166-1_Entry>
  <ISO_3166-1_Country_name>SPAIN</ISO_3166-1_Country_name>
  <ISO 3166-1_Alpha-2_Code_element>ES</ISO 3166-1_Alpha-2_Code_element>
</ISO_3166-1_Entry>
```

Regions Table (Eures Oracle DB)

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<thead>
<tr>
<th>ISO31661 Code</th>
<th>Region</th>
</tr>
</thead>
<tbody>
<tr>
<td>101 ES</td>
<td>Cataluña</td>
</tr>
<tr>
<td>102 ES</td>
<td>Canarias</td>
</tr>
<tr>
<td>103 ES</td>
<td>Galicia</td>
</tr>
<tr>
<td>104 ES</td>
<td>Asturias</td>
</tr>
<tr>
<td>105 ES</td>
<td>Cantabria</td>
</tr>
<tr>
<td>106 ES</td>
<td>La Rioja</td>
</tr>
<tr>
<td>107 ES</td>
<td>Melilla</td>
</tr>
<tr>
<td>108 ES</td>
<td>Aragon</td>
</tr>
</tbody>
</table>

Excerpt of the Geography Ontology

Ontology model

Country

Region

Spain

Cataluña

Canarias

Galicia

Andalucía

Ontology instances

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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
Ontological Resource Reuse is defined as the process of using available ontological resources (ontologies, modules, statements) in the solution of different problems.
Detailed descriptions in D5.4.1

Reuse Common Ontologies

Reuse Domain Ontologies

Reuse Ontology Statements

Reuse ODPs by naive users

Watson plug-in
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
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Conceptualization:
Modular approach for ontology construction

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
Conclusions

- The NeOn methodology leads the way to a new paradigm for ontology development
- Guidelines are focused on engineering for software developers
- Reuse and reengineering of knowledge aware resources
  - decreases the time spent in ontology development
  - eases sharing
  - improves quality and consensus because agreement was previously reached by domain experts
- There are more enabling technologies that support this new paradigm
Main References

http://www.neon-project.org

D5.3.1. NeOn Development Process and Ontology Life Cycle

D5.4.1. NeOn Methodology for Building Contextualized Ontology Networks
Ontological Engineering
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