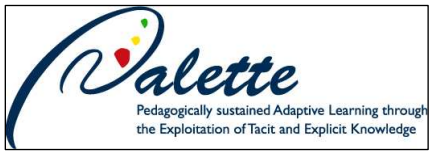

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Integrated Project
Technology-enhanced learning

D.KNO.02
CoP-dependent ontologies

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Deliverable manager: Amira Tifous (INRIA)

List of contributors:
Rose Dieng-Kuntz (INRIA)
Priscille Durville (INRIA)
Adil El Ghali (INRIA)
Christina E. Evangelou (CTI)
Alain Giboin (INRIA)
Amira Tifous (INRIA)
Géraldine Vidou (CRP-HT)

List of evaluators:
Liliane Esnault
Thibaud Latour

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Summary

This deliverable D.KNO.02 describes the O'CoP ontology developed in the framework of Task 3.2 in WP3. It first presents the method used for building the ontology, and then details the results of each phase, as well as our return of experience for each step (e.g. information source analysis, contextualised lexicon proposal, validation by CoPs representatives and observers, terminological analysis, ontology conceptualisation and structuring, formalisation). The ontology obtained from analysis of information sources from eleven CoPs involved in Palette is composed of a concept hierarchy and a relation hierarchy, with concepts related to Community, Actor, Competency, Learner-profile, Collaboration, Process/Activity, Decision-making and Resource. We also describe the ECCO tool that supported the method, and our return of experience on its use.

1 INTRODUCTION ---- **6**

ONTOLOGY DEVELOPMENT METHODOLOGY ---- **8**

INFORMATION SOURCE COLLECTION ---- 10
2.1 Information sources: Definition and typology ---- *10*
2.2 Approach for collecting information sources ---- *11*
CONTEXTUALISED LEXICON BUILDING ---- 12
3.1 Contextualised lexicon: Definition ---- *12*
3.2 Approach for building a Contextualised lexicon ---- *12*
3.3 Format of Contextualised lexicon ---- *14*
FINAL TERMINOLOGY (VOCABULARY) IDENTIFICATION ---- 16
4.1 Vocabulary: Definition ---- *16*
4.2 Approach for identifying the Vocabulary ---- *16*
4.3 Format of Vocabulary ---- *17*
4.4 Validation ---- *17*
Validation criteria ---- 17
Procedure ---- 18
HIERARCHY BUILDING ---- 20
5.1 Hierarchies: Definition ---- *20*
5.2 Approach for building the Hierarchies ---- *20*
5.3 Format of the Hierarchies ---- *22*
5.4 Validation ---- *23*
ONTOLOGY FORMALISATION ---- 24
6.1 Definition ---- *24*
6.2 Format of the ontology ---- *24*
6.3 Validation ---- *24*
RETURN OF EXPERIENCE ON THE METHOD USE ---- 25

MAIN RESULTS ---- **30**

INFORMATION SOURCE COLLECTION ---- 31
8.1 Information sources: some examples ---- *31*
8.2 Palette Information sources ---- *35*
TERMINOLOGICAL ANALYSIS ---- 36
9.1 Main results ---- *36*
9.1.1 Characteristics of the terms w.r.t. the different concepts ---- 36
Community and Actors ---- 36
Competency ---- 37
Learner profile ---- 37
Collaboration and Process ---- 38
Decision making ---- 38
Resources and Tools ---- 38
9.1.2 Characteristics of the terms w.r.t. the different CoPs ---- 40
9.2 Return of experience ---- *44*
ONTOLOGY CONCEPTUALISATION AND STRUCTURING PHASE ---- 50
10.1 Main results ---- *50*
10.1.1 Structure of the O'CoP ontology ---- 50
10.1.2 Description of the main concepts of the ontology ---- 51
Community related concepts ---- 51
Actor related concepts ---- 57
Competency related concepts ---- 63
Learner-profile related concepts ---- 67
Collaboration and Activity/Process related concepts ---- 68
Decision making related concepts ---- 71
Resource related concepts ---- 72
Lessons-learnt related concepts ---- 78

10.2 Return of experience ---- *79*

TOOLS SUPPORTING THE ONTOLOGY DEVELOPMENT PROCESS ---- **81**

ECCO (EDITEUR COLLABORATIF D'AIDE À LA CONCEPTION D'ONTOLOGIES) ---- 82
11.1 Data sources and ontology selection ---- *82*
11.2 Term extraction ---- *84*
11.3 Validation of extracted terms ---- *85*
11.3.1 Add a synonym or a translation ---- 87
11.3.2 Add a definition ---- 87
11.3.3 Modify the status of the term ---- 87
11.3.4 Delete or move the term ---- 88
11.3.5 Save your work!! ---- 88
11.4 Hierarchy building ---- *88*
11.5 Ontology formalisation ---- *89*
OTHER TOOLS USED ---- 92
12.1 Term extraction ---- *92*
12.2 Construction of the hierarchy ---- *93*
RETURN OF EXPERIENCE ON ECCO USE AND EVOLUTION ---- 94

CONCLUSIONS ---- **97**

Cooperative Building of the Ontology ---- 97
Comparison with Related Work ---- 98
Further Work ---- 98

TABLE OF AUTHORS ---- **100**

BIBLIOGRAPHY ---- **101**

LIST OF FIGURES ---- **104**

LIST OF TABLES ---- **105**

Chapter 1

Introduction

WP3 aims at offering knowledge management (KM) services for efficient and effective management of the CoP knowledge resources, so as to improve: (i) the access, sharing, and reuse of this knowledge, which can be tacit or explicit, individual or collective, and (ii) the creation of new knowledge. A CoP knowledge resource can be not only a document (report, mail, forum, etc.) materializing knowledge acquired and shared through cooperation between the CoP members but it can also be a person holding tacit knowledge.

The Task 3.3 focuses on a CoP-oriented KM tool offering basic CoP-oriented KM services such as knowledge creation and enrichment, knowledge retrieval or dissemination, knowledge presentation and visualisation, knowledge evaluation, knowledge evolution and maintenance.

As we chose a semantic web-based approach, these KM services will rely on an ontology (describing concepts useful about a CoP, its actors and their competences, its resources such as documents used or produced, its activities, etc.) and on annotation of the CoPs knowledge resources w.r.t. these ontologies.

Task 3.1 proposed generic models useful for understanding a group activity, collaboration, competencies, learners profiles, and lessons-learnt. A CoP being a specific kind of such a group, the CoP-dependent ontology to be developed in Task 3.2 is based on these generic models. This CoP-dependent ontology consists of CoP-dependent concepts and relations, and with which the CoP resources can be annotated. The CoP-oriented KM services to be specified and developed in Task 3.3 will rely on the O'CoP ontology (the complete ontology obtained after Task 3.1 and Task 3.2).

This deliverable D.KNO.02 describes this O'CoP ontology developed in the framework of Task 3.2:

- The first part describes the method used for developing this ontology, with, in particular, the collection of information sources (chapter 2), the constitution of a contextualised lexicon by each team (chapter 3), the determination of the final terminology/vocabulary after validation by representatives of the

CoPs (chapter 4), the conceptualisation leading to the concepts and relations kept in the ontology, the building of the concept and relation hierarchies by the different teams (chapter 5), the integration of the different hierarchies built by the different teams, the formalisation of the ontology in RDF(S) (chapter 6) and the final validation by the CoPs' representatives. Chapter 7 sums up our return of experience on the use of this method.

- Then, in part II, we analyse the results obtained after each step of application of the method. First, the collection of the information sources is described in chapter 8.

- Then, chapter 9 describes the terminological analysis performed on the terms such obtained. In particular, the results of the validation by the CoP mediators and representatives will be presented.

- The chapter 10 analyses the ontology conceptualisation and structuring phase. It presents the final global structure of the ontology, with the concept hierarchy, the relation hierarchy and the description of the main concepts of the ontology: concepts related to Community, Actor, Competency, Learner-profile, Collaboration, Process/Activity, Decision making, Resource and Lessons-learnt as well as the description of the main relations of the ontology.

- Finally, Part III presents the tool, ECCO, supporting the use of this method, as well as other tools used during the ontology development process. Then, it gives our return of experience on the use of ECCO and the evolution of its functionalities.

- The conclusion offers an analysis of our return of experience on this cooperative building of the ontology by several teams, a comparison with related work and a description of further work.

Part I

Ontology Development Methodology

This part of the deliverable details the proposed **method for the O'CoP ontology building**. This method defines an iterative process, made up of five steps. Each one of these steps is described into a chapter, in which we detail its aim, the underlying principles as well as the specifications for its outcome. The objective of setting up the specifications is to ensure the easy integration of the contributions of the partners involved in the task 3.2, without imposing them the use of a same tool.

The stakeholders intervening during this process are both the Knowledge engineers (or ontologists) for performing the different tasks of the process, and the CoPs observers and delegates for validating the outcomes of each task, thus we call them "Validators" throughout the deliverable. Knowledge engineers are assisted by the Validators when performing the Ontology development process, whereas Validators are assisted by Knowledge engineers when validating the results provided during this process.

The methodology relied on in this process involves five steps:

- **Information sources collection** (chapter 2). It is necessary, for the development of the O'CoP ontology, to identify information sources related to Palette's CoPs, so as to rely on them and gather as much knowledge as possible to describe Palette's CoPs.
- **Contextualised lexicon construction** (chapter 3). By selecting, from the *information sources*, the terms that are possibly relevant for describing the CoPs, w.r.t. the generic models produced in the deliverable D.KNO.01.
- **Vocabulary identification** (chapter 4). Consists of refining the *Contextualised lexicon* and producing, for each term, a definition and some examples of use.
- **Hierarchy building** (chapter 5). By first identifying the terminological concepts and relations, and then structuring them.
- **Ontology formalisation** (chapter 6).

As for the last chapter, it offers a summary of the methodology developed and reassembles the experience feedback from relying on the proposed methodology.

Chapter 2

Information source collection

The first step of the ontology construction process is to collect the information sources to be used to elaborate the CoP-dependent ontology.

2.1 Information sources: Definition and typology

Information sources (also called "inscriptions" in the terminology of the Action-Network Theory) are documents which can be used either as *corpus* or *grids* for building the CoP-dependent ontologies.

The term "corpus" refers to the documents from which candidate terms for the ontology will be extracted.

The term "grid" refers to any kind of structured information that can be used to orient the selection of candidate terms within corpus.

A document can be sometimes used both as a corpus and as a grid. Table 1 presents the types of available Palette documents that can be used as corpus or grids.

DOCUMENT TYPES	DOCUMENT SUB-TYPES AND INSTANCES	USED AS
Rough-Data Documents	Audio records/files of CoP's interviews Transcriptions of CoPs' interviews Minutes of interviews	Corpus Corpus Corpus
Data-Analysed Documents	Syntheses • Syntheses of interviews of each CoP (including instantiated MOT diagrams[1], also called "MOT depictions of CoPs internal processes" in the context of Palette) • General document "Description of CoPs" Vignettes and Scenarios	 Corpus – Grid Corpus Corpus
Methodological and theoretical documents	Palette generic models Palette methodological documents • MOT modelling methodology[2] Palette modelling documents	Grid Grid

[1] Diagrams elaborated with the graphic modelling editor (or "knowledge editor") MOT [Paquette et al., 2006].
[2] See, e.g., [Paquette & Rosca, 2004]

	• Internal document "A general and some specific activity related models of Communities of Practice (CoP) for Evaluation and Scenario Writing - A joint result of WP1 (task 1) and WP4" by Manfred Künzel, Amaury Daele, March 2, 2006. Palette reference theories • Action Network Theory (ANT) • Wenger's articles offering generic descriptions of CoPs	Grid Grid Grid
Other documents	Existing thesaurus and ontologies	Grid – Corpus

Table 1 Types of available Palette's documents related to CoPs

2.2 Approach for collecting information sources

This step consists in collecting all knowledge sources available and reliable for the ontology building. To each source, we need to associate a description containing information about:

- the provenance
- the authors
- the availability
- ...

Chapter 3

Contextualised lexicon building

3.1 Contextualised lexicon: Definition

By context of a linguistic item, we mean a textual window that includes this linguistic item and which is necessary for understanding it. In order to preserve the context in which the extracted candidate terms appear in the sources, we define a Contextualised lexicon as follows:

> A Contextualised lexicon is a set of units, each unit is composed of three fields: a *term* which will potentially be kept as a concept or relation of the ontology, a *list of contexts* in which the term appears (for each context we include information about the source containing the context), and optionally *remarks* of the ontologist.

The units must also contain information about their authors.

3.2 Approach for building a Contextualised lexicon

Relying on the information sources selected during step 1, Knowledge engineers have to extract a term - i.e., a word (e.g., “competence”) or several successive words constituting a multiterm (e.g., “technical competence”, “pole of competencies”, “competencies of the group members”) - together with the context of the term - i.e., the part of the source text that surrounds the particular word or phrase extracted and helps determine its meaning.

From technical viewpoint, the analysis of the sources should provide a set of terms that will be picked up and each of the terms will be described in a form (with one form dedicated to each term), using its label and reporting the context in which the term appears, thus avoiding ambiguities.

This context may be of two types:

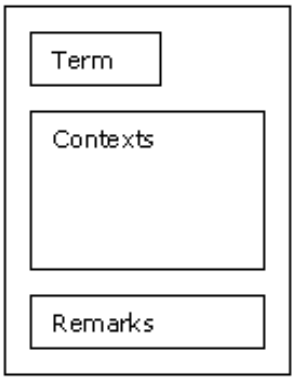
- a mere “copy/past” of the text or paragraph embedding the term, thus showing its usage;

- or a set of parts of text (terms, sentences, …) chosen to index the term, considering them as relevant to determine the term context. This way of doing would also allow us to link the contexts of different terms as well as the terms themselves (specifying generic /specific relations, for instance).

The field allotted to the context description should also contain links to its originating sources.

Since the context associated to a term can constitute the term definition, we suggest enriching the form with a field which might contain this information as a remark. This field could also be used to express that the term denotes a concept or a relation.

We illustrate the structure of the form below (which should be produced with respect to a particular DTD):



Note: The form might also be provided with an additional field to justify the choice of the term for the lexicon.

Term elicitation perspective — Each Knowledge engineer has to elicit candidate terms from a "generic model perspective", i.e. the engineers should use as a main grid one of the generic models elaborated during the first task of WP3 and described in D.KNO.01, namely:

- Learner Profile
- Competency
- Collaboration
- Process/Activity
- Lessons Learnt

to which we added new generic models:

- Actors and Community (described in [Vidou et al., 2006]),
- Decision Making.

These models are supposed to guide the extraction of elements for the ontology. In theory, the generic models represent the higher layers of the global Palette ontology. So, concepts and relations of the CoP-dependent ontologies might appear as specialisations of the concepts and relations of the generic models: the former might be related to the latter. For example, the Competency model (see Figure 1) invites to search for terms describing not only competency, but also "Resources" defining competency, the "actors" owning or offering it, and "environment" in which it is involved.

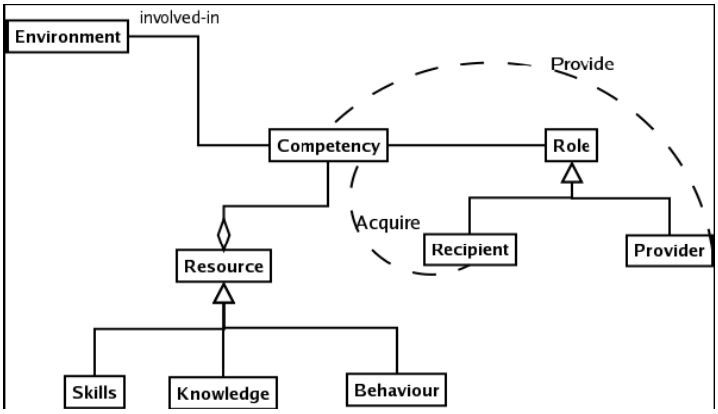


Figure 1 The Palette Competency model

3.3 Format of Contextualised lexicon

We choose to use an XML format to represent the Contextualised lexicon. This choice is motivated by several reasons:

- XML is an evident standard for exchanging documents or (semi)-structured data.
- Various software enable to produce XML documents and to validate them. This offers a certain freedom to all the developers: they can make their own contribution to the lexicon while using their preferred word processor or spread sheet application, and export a document that can be validated.
- It is easy to import a well structured XML document in most current ontology management platforms.
- The produced document can be post-processed to deliver different views of the lexicon to the different actors who participate in the development cycle.

The chosen format for lexicon is quite simple and is described by the following DTD:

cl.dtd

```
<?xml version="1.0"?>
<!-- Palette Project, WP3 task 2 -->
<!-- XML representation of a Contextualised lexicon -->
<!-- INRIA -->
<!ELEMENT lexicon (clu*)>
<!ATTLIST lexicon author #REQUIRED >
<!ELEMENT clu (term, contexts, remark?) >
<!ATTLIST clu num ID #REQUIRED >
<!ELEMENT term (#PCDATA)>
<!ELEMENT contexts (context+)>
<!ELEMENT remark (#PCDATA)>
<!ELEMENT context (sourceid, content) >
<!ELEMENT content (#PCDATA)>
<!ATTLIST sourceid num ID #REQUIRED >
```

Here is an example of the expected XML documents representing the Contextualised lexicon:

Example_cl.xml

```
<?xml version="1.0"?>
<!DOCTYPE cl SYSTEM "cl.dtd">
<lexicon author="adil">
<clu>
<term>term1</term>
<contexts>
<context>
<sourceid>source1</sourceid>
<content>..... term1 .... </content>
</context>
</contexts>
<remark> </remark>
</clu>
<clu>
<term></term>
<contexts>
<context>
<sourceid>source1</sourceid>
<content>..... term1 .... </content>
</context>
</contexts>
</clu>
</lexicon>
```

At the end of this step, a list of terms with their related contexts is obtained; its characteristics and format enable to process some operation, like to sort the global lexicon into partial ones corresponding to the terms related to each of the Palette CoPs, the terms that are common to some CoPs, etc. for the purpose of being validated by the CoPs representatives and finally identifying the Vocabulary to be used in the Ontology.

Chapter 4

Final terminology (vocabulary) identification

4.1 Vocabulary: Definition

By vocabulary (or final terminology) we mean the set of terms from the *Contextualised lexicon* that the actors of the development process consider interesting to keep in the ontology. Formally, we represent it as a set of *vocabulary units* that contain the term (characterised by its id and label), its definition and an example.

In order to ensure that the developed ontology can evolve and to solve conflicts during the process, we also need to keep information about the authors, the version and the validation.

4.2 Approach for identifying the Vocabulary

The analysis of the Contextualised lexicon should lead to the identification of the vocabulary. This task can be divided into the following sub-tasks:

- **Defining the terms**: The definition of a term is deduced from the information provided by the Contextualised lexicon forms (context, remark, link with other contexts or terms). It can also be directly created by a domain expert.
- **Adding synonyms and translations**: One or more labels can be added to each term to deal with synonymy, or to provide a translation in the CoP's language.
- **Choosing the relevant terms**: The domain experts have to decide which terms are relevant for their CoP, and may exclude some terms or some of their contexts. This validation information will be collected for each term.
- **Grouping some terms**: Some extracted terms that correspond to the same concept will be grouped, to produce one vocabulary unit.

4.3 Format of Vocabulary

The format of vocabulary is inspired from SKOS (Simple Knowledge Organization System) to express the vocabulary. SKOS is widely used to represent vocabulary and thesaurus, this particularity allows us to include existing thesaurus in our process without having to adapt them.

This format permits to encode all the information needed to describe the terms. We add an attribute order to the format in order to express proximity relations between terms

Each term of the vocabulary is summarised in this document as a table. Each table may have the following rows:

Term of the vocabulary	
URI:	The Universal Resource Identifier.
Label:	A human-readable label.
Definition:	An explanation of the meaning of a term.
Comment:	Additional information about meaning and/or proper use.
Example:	An example of the use of a term.
Order:	The order of a term in the list of terms
Status:	The status (stability level) of the term.
Concept or Relation:	A boolean saying if the current term is a concept or a relation
Issued:	Date on which the term was issued.
Modified:	Date on which the term was last modified.
Replaces:	Any deprecated term which the given term has replaced in recommended usage.
Version info:	A note about the modification and/or history of a class or property.
Replaced By:	(Deprecated terms only) the term to use instead of the deprecated term.
Deprecated:	(Deprecated terms only) the date of last modification (i.e. deprecation) of the term.

The formal RDF/OWL description of the SKOS Core Vocabulary can be found at the following URL: [http://www.w3.org/2004/02/skos/core].

4.4 Validation

Validation criteria

Two kinds of criteria need to be distinguished in the validation of the vocabulary: (1) CoP representatives' criteria and (2) Knowledge engineers' criteria. It was argued that, for CoP validators, validation criteria are mainly usage criteria. So, for a CoP validator, a term can be supposed to be relevant if, e.g.:

- it can be used to annotate a resource about CoPs (in order to retrieve the resource);

- it can be used to query a resource base about CoPs to get some resource as an answer.

In other words, the criteria for CoP representatives are Relevance to querying and Relevance to annotation.

Knowledge engineers are concerned both by usage criteria and technical criteria (or technical-usage criteria). For example, from technical viewpoint, a Term may be considered as relevant by engineers if:

- it can be considered as useful for becoming a concept or a relation of the future CoP-dependent ontology.
- it appears frequently: the Terms appearing in a great number of Contexts (N of Contexts ≥ a threshold x) will be kept, even if the Terms are not marked as validated (Frequency of use criterion).

From a usage point of view, a Term can be said appropriate if:

- it corresponds to a term that a user would naturally use when asking a question;
- it means what the user means by this Term.

The literature about the validation or evaluation of ontologies (see e.g., [Hartmann et al., 2005]; [Gangemi et al., 2005]; [Brank et al., 2005]; [Sabou et al., 2006]) provides sets of criteria which may help explicit the criteria which will be actually used by Knowledge engineers and by CoP representatives.

Procedure

CoP validators have to validate the lexicons of the CoPs of which they are members, observers or delegates. They have to assess the relevance of the terms of the lexicon, to provide a definition to these terms and an English translation when this translation was not already given, to solve the conflicts related to divergent contexts associated to a same term, and provide some comments about the validation actions and decisions. The specific instructions given to validators are:

[As a validator, your goal is:]

1. to assess the terms relevance: do you think the term is
   - representative,
   - useful for becoming a concept or a relation of the ontology,
   - useful for annotating resources, persons, ...

If a term is not relevant, please delete it. If you hesitate, you can tag the term - e.g. "to be argued", "to validate"- (see Appendix A for ECCO functionalities)

2. to give a definition to the terms that you assessed as being relevant; and add synonyms, homonyms, to tell whether the term might be critical (e.g. can have different meanings);
3. to make a remark explaining why you consider the term as being relevant + telling if you think the term is generic to the CoPs;

4. to make a remark in case a term is common to some CoPs (according to the contexts provided), to tell if you think that the meaning of the term is the same for these CoPs or not.

Concerning the validation of the CLs, if you think a term is NOT relevant, please tag it (see Appendix A for ECCO functionalities); deleting it would maybe be a little "radical" :-)

Expected validation operations from the validators were, e.g.:

- Given a Term,
  - Mark it as:
    - Validated | To be argued | To validate | Draft | Deprecated
    - Specific to CoP_i | Generic to any CoP
  - Comment it, e.g.:
    - Explain why the Term is not deprecated;
    - Explain why a validation decision is not taken;
    - Reformulate the term (e.g., instead of *Actor* propose *Agent*);
    - Specify a resource to be annotated thanks to the term;
    - Specify a resource base to be queried thanks to the term;
  - Split it (according to Contexts), e.g., *Actor→Actor* & *Agent*
  - If the term is an expression (= not a single word), find a word (to simplify)
- Given *n* different Terms,
  - If the terms are considered as synonyms, mix them and use one of the terms as a synonym of the other.
- Given a Context,
  - Comment it
  - Suggest a corresponding Term other than the one elicited, that could be also elicited from this Context.

At the end of this step, two ordered lists of terms are obtained, respectively containing future concepts and relations of the ontology. These terms are defined and validated by the domain experts. And will serve as input to the hierarchy building step. This structuring will be performed efficiently if the lists of terms are produced correctly: complete and well ordered.

Chapter 5

Hierarchy building

5.1 Hierarchies: Definition

The hierarchies are the last step of « *informal* » ontology, they are organised sets of terms.

We will have two hierarchies: a concept hierarchy and a relation hierarchy. Each set contains respectively C-hierarchy units (for concepts) and R-hierarchy units (for relations).

A *C-hierarchy unit* contains the concept (characterised by its id and label), its definition, an example, and a list of its direct super-concepts. In the C-hierarchy unit, we also include information about authors, status, and information that enables to link the concept to the corresponding terms in the vocabulary.

An *R-hierarchy unit* contains the relation (characterised by its id and label), its definition, an example, and a list of its direct super-relations. In the unit, we also include information about authors, status, and information that enables to link the relation to the corresponding terms in the vocabulary.

5.2 Approach for building the Hierarchies

After the previous phase, we obtain a list of terms, among which there may be potential terminological conflicts such as the use of the same term to denote different concepts, or the use of different terms to denote the same concept, etc.

Therefore, the first step will consist of solving such terminological conflicts.

Then the terminological concepts and relations (i.e. the terms that will be kept to constitute concepts in the ontology) must be determined. The official name of the concept (as well as its synonym terms) must also be indicated.

The information provided by the validators about the links between the different terms (e.g. a term is synonym of another term, a term is more

specific than another term, a term is more generic than another, etc.) are useful for structuring the ontology.

Typically, if two terms are kept in the ontology, the links emphasised by the validators or found by the Knowledge engineers, will help to structure the ontology. If a term t_2 is more specific (resp. generic) than another term t_1, it will mean that the concept C_2 denoted by the term t_2 will be a sub-concept (resp. a super-concept) of the concept C_1 denoted by the term t_1. However, it may not be a direct sub-concept (resp. super-concept) since a validator may have indicated several terms as more specific than t_1, at various levels of detail.

Therefore, C_2 can be considered as a direct sub-concept of C_1 only if there is no other term more generic than t_2 and more specific than t_1.

Moreover, in addition to the terminological concepts (that come from the information sources analysed by the Knowledge engineers), some structuring concepts may be added, if they are useful for structuring the ontology: for example, if a given concept has several sub-concepts, according to different subdivision criteria (i.e. different viewpoints), it may be useful to add as many structuring concepts as such criteria in order to make them explicit.

Some existing hierarchies (WordNet, taxonomies, ontologies, even thesauri) on relevant fields for the ontology may be useful for guiding the structuring of the ontology, provided that the applicative objectives of such existing hierarchies are compatible with the objectives of the ontology.

Concerning the relations, the determination of their domain and of their range must be carefully performed.

To sum up, the hierarchy building consists of the following steps:

- Solving the potential terminological conflicts,
- Conceptualisation by choice of the terminological concepts (resp. relations), and addition of possible structuring concepts (resp. relations),
- Making explicit the specialisation links between all these concepts (resp. relations), so as to build the concept (resp. relation) hierarchy.

5.3 Format of the Hierarchies

We also use SKOS to describe hierarchies. At this step, this choice permits to express relations between concepts and relations that are fuzzier than what we need for the formal ontology. As described below:

C-hierarchy unit	
URI:	The Universal Resource Identifier.
Label:	A human-readable label.
Definition:	An explanation of the meaning of a concept.
Comment:	Additional information about meaning and/or proper use.
Example:	An example of the use of a concept.
Status:	The status (stability level) of the concept.
Issued:	Date on which the concept was issued.
Modified:	Date on which the concept was last modified.
Super-classes:	List of declared super-concept.
Replaces:	Any deprecated terms which the given term has replaced in recommended usage.
Version info:	A note about the modification and/or history of a concept.
Replaced By:	(Deprecated terms only) the term to use instead of the deprecated term.
Replaces:	Any deprecated terms which the given term has replaced in recommended usage.
Deprecated:	(Deprecated terms only) the date of last modification (i.e. deprecation) of the term.

R-hierarchy unit	
URI:	The Universal Resource Identifier.
Label:	A human-readable label.
Definition:	An explanation of the meaning of a relation.
Comment:	Additional information about meaning and/or proper use.
Example:	An example of the use of a relation.
Status:	The status (stability level) of the relation.
Issued:	Date on which the relation was issued.
Modified:	Date on which the relation was last modified.
Super-relation:	List of declared super-relation.
Replaces:	Any deprecated terms which the given term has replaced in recommended usage.
Domain:	The declared domain for the property.
Range:	The declared range for the property.
Additional types:	Any declared additional types (e.g. owl:TransitiveProperty) for the relation.
Inverse of:	Any declared inverse properties.
Replaces:	Any deprecated terms which the given term has replaced in recommended usage.
Version info:	A note about the modification and/or history of a relation.
Replaced By:	(Deprecated terms only) the term to use instead of the deprecated term.
Deprecated:	(Deprecated terms only) the date of last modification (i.e. deprecation) of the term.

5.4 Validation

The validation of the structured ontology must rely on:

- the CoP validators (typically those that had been involved in the validation of the Contextualised lexicon),
- the Knowledge engineers (ontologists) that must check consistency of the ontology, to ensure that good rules of modelling were followed in the ontology building (e.g. no concept is both ancestor and descendant of another concept, the domain and range of a relation are compatible with the domain and range of its super-relations, etc.),
- the comparison with existing ontologies having compatible applicative objectives.

Having the Hierarchies validated, the last step to perform, before making the ontology available to the CoPs, is to formalise it and express it in a more powerful format than SKOS, so as it can be exploited by the knowledge management services to be provided to Palette CoPs.

Chapter 6

Ontology formalisation

6.1 Definition

According to [Gruber, 1993], formal ontology is a *specification of conceptualisation*. It is a formal specification of concepts and relations describing a domain in a specific context. Practically, it is composed by a taxonomy of concepts and a hierarchy of relations linking the concepts, it also may contain a set of rules on these concepts and relations.

6.2 Format of the ontology

The format we choose for the ontology is RDFS, a semantic extension of RDF, and a standard of W3C. When necessary, we augment RDFS with some elements of OWL-Lite. A full description of these formats can be found in:

- http://www.w3.org/TR/rdf-schema/
- http://www.w3.org/TR/2004/REC-owl-ref-20040210/

6.3 Validation

The validation of formal ontology has two dimensions:

- A strictly formal validation: this includes (i) identification of non completely defined concepts and relations, (ii) identification of conflicts and logical inconsistency, (iii) verification of the completeness of the ontology.
- An end user validation: achieved through a set of queries, the end user asks questions (queries) to the ontology, which is used with a semantic search engine (e.g. Corese[3]) to answer them, and then the user checks the validity of the returned results. This validation is quite empirical.

[3] See D.KNO.03 for more details.

Chapter 7

Return of experience on the method use

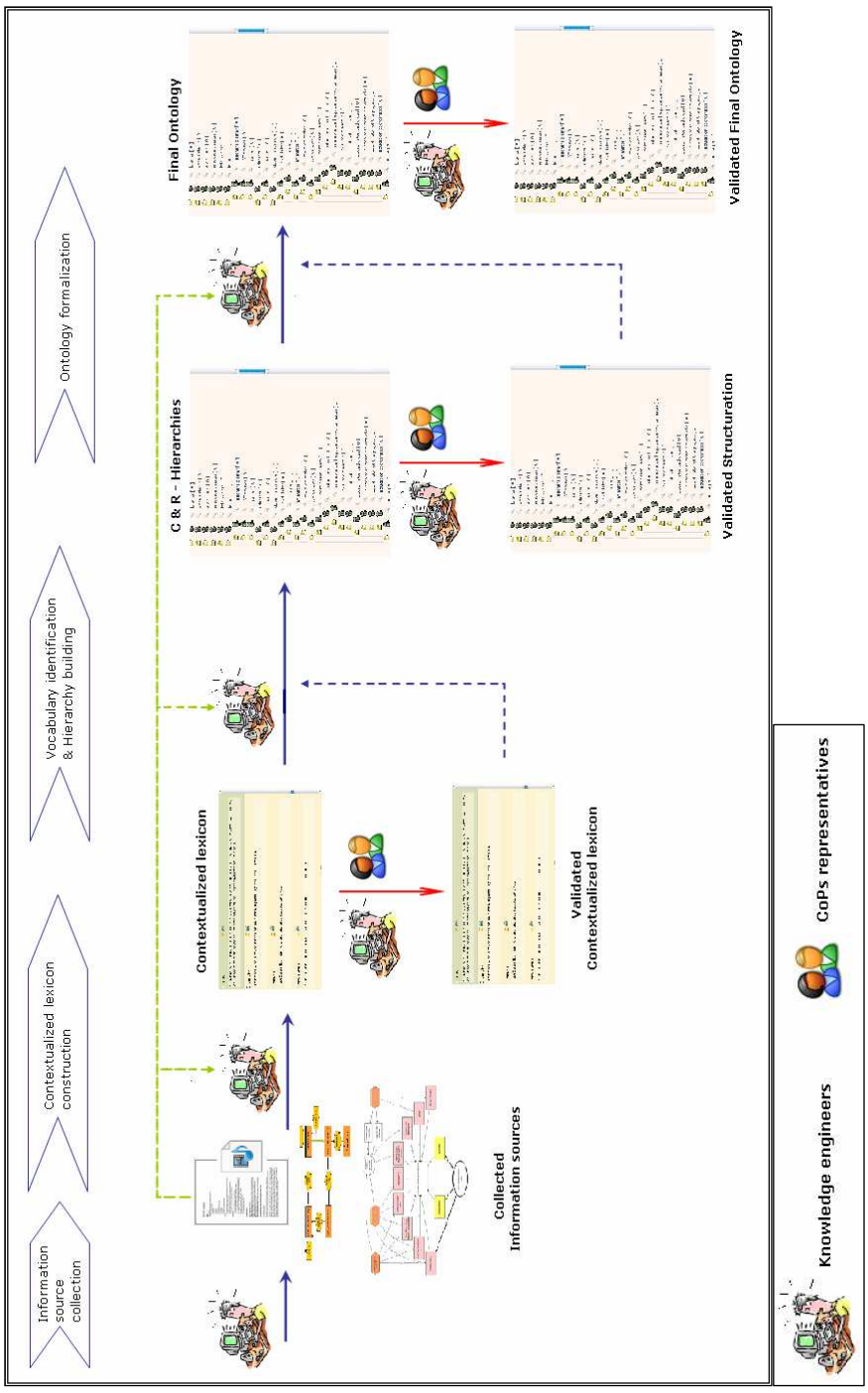


Figure 2 Schema summarising the Ontology development process

Figure 2 summarises the different steps leading to the development of the O'CoP ontology, as they have occurred. As shown, the process is iterative and involves many comebacks to the information sources (collected initially or new sources made available during the process) as well as to the intermediary steps.

According to this schema and the concrete realisation of the planned process, our experience feedback involves the following aspects:

Ontology development process: Sequential or parallel tasks?

As expected and illustrated in the summarising schema, the predefined ontology development steps (Contextualised lexicon construction, Vocabulary selection, and Hierarchy building) have not been processed in a strict sequential manner. They were performed iteratively, what supposes some parallelism. For example, during the construction of the Contextualised lexicon, Knowledge engineers envisage "candidate categorisations" of terms, or think of a Term-type when dealing with a Term-instance. At this stage, however, it was not possible with ECCO to explicitly mark candidate categories. We can say that the "interdependencies of tasks" (in the sense of [Fernández-López et al., 1999]), and what can be called "interdependencies of functionalities" (within ECCO) were not considered in depth. Hence, some "bastard solutions" for managing in parallel the different tasks, e.g. for one Knowledge engineer to create as a Term the sequence "Thematic group – Leader – member" in order to relate the different terms of this sequence.

Moreover, as the validation of the Contextualised lexicon (by CoPs representatives) was time-consuming, it has been preferred, for the Knowledge engineers, to go forward the steps of Vocabulary identification and Hierarchy building in parallel, by relying on the initial knowledge they had about Palette CoPs, the generic models proposed in D.KNO.01 as well as on the related works found in the literature. Some exchanges with the CoPs representatives were also necessary and useful for performing these tasks. Besides, as soon as the validated Contextualised lexicon has been provided by the validators, it was used by the Knowledge engineers to check and complete the Vocabulary and the primary Hierarchies produced.

Ontology development process: Cooperative realisation

Although the formats required for the outcomes of the different steps are very detailed, they were not fully respected by all the ontology building stakeholders (Knowledge engineers). We encountered this situation when processing the step 2 of the ontology development process (the "*Contextualised lexicon construction*"), where some parts of the lexicon were not compliant with the DTD agreed upon.

This kind of problem introduced a non-planned "transforming step", necessary for making all the outcomes conform to the format, so that they could be integrated to the ECCO tool (see Chapter 11) the CoPs observers were provided with for validating the Contextualised lexicon.

This step being time-consuming, in the further steps, we proposed to the partners to use the same tool (ECCO), thus ensuring to avoid this additional intermediary "making compliant" step.

Ontology development process: Validation procedure with CoPs representatives

- **Validation procedure: the possibility of using Competency questions as reference points**

A way of making both Validators' and Knowledge engineers' validation criteria (for validating the Contextualised lexicon, the Hierarchies and the Ontology) match or complement is to do it through "competency questions". *Competency questions* are a technique originally proposed by Grüninger and Fox in their TOVE ontology building method [Grüninger & Fox, 1995]. Given "motivating scenarios" (i.e., scenarios which "motivate" and orient the ontology construction), competency questions are queries that a user can potentially ask to the ontology-based system to be designed (a Palette KM service is such a system). Competency questions place demands on the underlying ontology (e.g., the Palette ontology): they are questions that the ontology must be able to answer; they delimit the "competence" of the ontology. In the original method, competency questions are used as a reference point for both designing and evaluating the ontology. Competency questions contain terms and phrases (and their underlying concepts and relations) which might be found in the ontology, if the ontology is to be used as a vocabulary for asking questions to the system. If the queries' terms and phrases (and their underlying concepts and relations) are not all found in the ontology, the ontology can't be said (entirely) appropriate. Two kinds of competency questions are distinguished in the original method: informal competency questions and formal competency questions (see Table 2). Here, we only consider informal competency questions i.e. questions not yet expressed in the formal language of the ontology.

Informal competency questions	Does the company comply to: ISO 9001 requirement 4.10.4 Final inspection and testing?
Formal competency questions	∃O∃s *holds(*agent_constraint**(**O**,**iso_9001_4.10.x_compliant),s)

Table 2 Examples of informal and formal competency questions

- **Validation procedure: Concrete realisation**

As for the validation of the Contextualised lexicon, as indicated previously, we offered to the validators to use the ECCO tool, explained them the purpose of this task as well as what exactly they were expected to perform. We also provided them with support to ECCO, *via* a web page dedicated to ECCO functionalities and a FAQ list initiated and enriched progressively thanks to the validators questions.

Nevertheless, in spite of this support, we received a lot of questions, both about the validation task and the use of ECCO, which brought us to provide an additional on-line assistance (by mail, phone and even *in situ*). This led us to two conclusions:
First, it is crucial to insist on the importance of reading the documentation: the tool users are sometimes so motivated that they try to use the tool directly and neglect the documentation provided, thinking that it is useless and finally, ask questions the answers of which are in the tool documentation. This may be explained by the fact that the documentation provided was quite long, and maybe discouraging, which implies that the quality of the documentation is also an important issue.

Secondly, it would have been worthy to organise a training to ECCO to familiarise the validators with its use..

Finally, but still concerning the validation task, several remarks and conclusions of different levels can be made:

- Some of the validators were very engaged in the validation task and strictly followed the recommendations; others did not fully perform it, in the sense that they did not systematically provide all the information they were asked (e.g. definitions of the terms of the lexicon). This assumes that they may be considered some terms as being obvious and therefore, neglected to define them or give synonyms. This also emphasises the importance of explaining the purpose of the validation task and the way its outcomes will be used for developing the O'CoP ontology.
- Some of the validators considered that all the extracted terms were obviously relevant because they came from documents describing the CoPs. This indicates that the first point that should have been dealt with is the objective of the O'CoP ontology, what it will describe and, maybe even what is an ontology.

The validations as well as discussions with the validators showed that the terms used in the syntheses were not always representative, because they did not always belong to the CoPs' "language", sometimes, they were the interpretations of the authors of the syntheses.

Likewise, the terms used in the interviews transcriptions were not always representative. For example, the persons interviewed usually tried to

avoid repetition; therefore, to evoke a same notion, they used different terms, which did not usually belong to the CoPs' vocabulary. This could lead to ambiguities to be solved by the ontologist performing the structuring task. This illustrates that it would be more fruitful to conduct the interviews differently by explaining to the interviewees the aim, the future use of the interviews, and better guide them (by emphasizing the fact that the content is more important than the form of the interviews: better repeat the same terms if they are the ones used in the CoP, by its actors).

Part II

Main results

This part II presents the analysis of the results obtained after each step of application of the method. First, our return of experience after collection of the information sources is described in chapter 8. Then, chapter 9 describes the terminological analysis performed on the terms such obtained. Chapter 10 analyses the ontology conceptualisation and structuring phase. It presents the final global structure of the ontology, with the concept hierarchy, the relation hierarchy and the description of the main concepts of the ontology: concepts related to Community, Actor, Competency, Learner-profile, Collaboration, Process/Activity, Decision making, Resource and Lessons-learnt as well as the description of the main relations of the ontology.

Chapter 8

Information source collection

8.1 Information sources: some examples

Transcriptions of CoP members' interviews

The first sources of information we are provided with in Palette are the transcriptions and minutes of interviews of CoP members. The Figure 3, show an excerpt of the transcription of the interview of a French-speaking member of the UX-11 CoP (in French), and an example of the minutes of the interview of a Did@ctic CoP member.

	donc c'est le logiciel libre, des outils qui sont gratuits et de façon à pouvoir en faire bénéficier le maximum de communautés. Donc, pour vous Frédérique, parce que Dominique Bouillet connaît bien ePrep, mais ça alors vous pourrez le conserver, je vous ai préparé un petit flyer qui présente aussi ePrep. Ça, je peux vous le laisser aussi, c'est ma carte. Donc, ePrep est une communauté de pratique, on peut l'appeler comme ça, qui regroupe depuis cinq ans des professeurs des classes préparatoires aux grandes écoles qui ont envie de… 'fin, des professeurs pionniers de la nouvelle technologie ou d'autres qui veulent s'y initier avec un certain nombre d'activités au sein desquelles une participation au projet Palette. Et donc, Christine V. de l'EPFL a fait cette présentation de Palette au colloque de l'ePrep 2006 qui a eu lieu ces derniers jours. Donc, voilà c'est une façon de voir Palette.
3'30"	*Arrivée de Djamel B.*
	N.VdeW. : Voilà, alors, je ne sais pas si Martin veut présenter l'Université de Liège dans le projet ?
3'57"	**M.E.** : L'Université de Liège fait partie du pôle pédagogique, mais je suis sociologue. L'objectif de Palette, c'est vraiment de rencontrer deux choses, c'est les outils d'une part et des communautés, qu'on peut appeler les communautés de pratique. Alors, que ça soit des communautés d'apprenants comme dans ce cas-ci ou des communautés de manager… Donc, il y a plusieurs types de communautés, on a plusieurs types d'outils et on aimerait bien essayer de créer des outils qui vont être adaptés pour chacune des communautés. Donc, il faut qu'on prenne beaucoup de renseignements sur les outils, beaucoup de renseignements sur les communautés pour savoir ce qui peut convenir, ce qui peut intéresser les communautés pour essayer de faire quelque chose de convenable.
4'43"	**Do.B.** : Je suis Dominique Bouillet. Enseignant de l'épreuve informatique. Actuellement, je suis à mi-temps entre l'épreuve informatique, donc la partie enseignement et un mi-temps avec Christine M. dans la cellule des ressources multimédias pour la pédagogie. Donc, nous accompagnons les enseignants pour tout ce qui est l'usage des TICE, donc pour leur

File 1: Ana Question1.aup (22'10")

(ce fichier a été traduit directement en anglais)

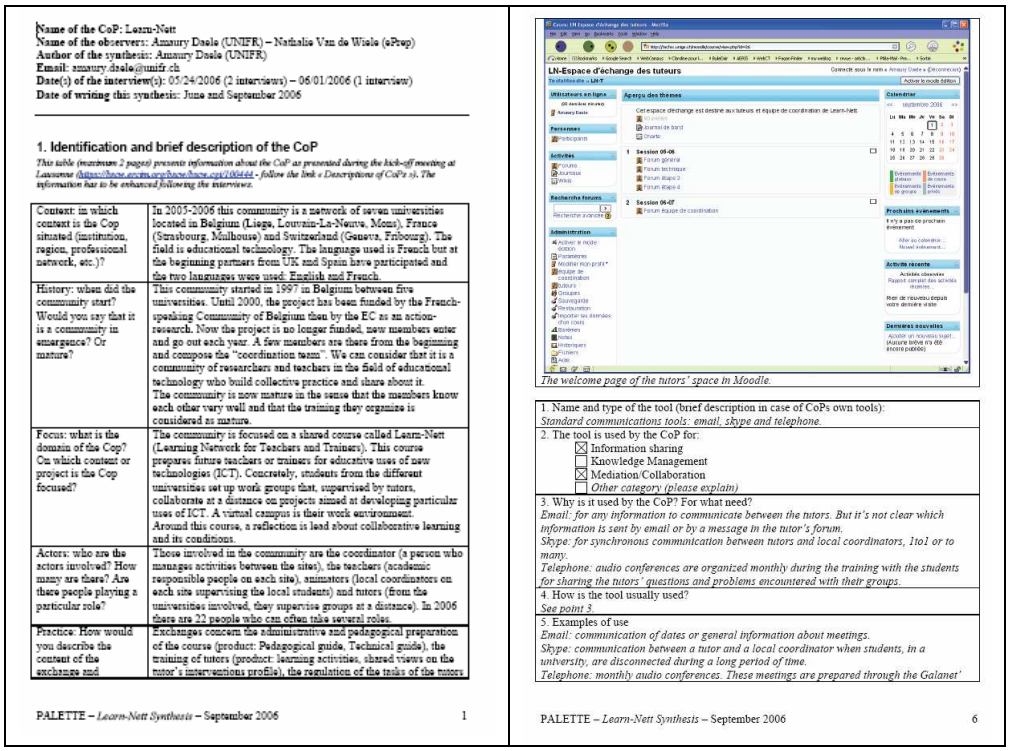
01'06"	(Description of the decision process that was followed by the CoP to start…)
	- The origin is the birth of the University Didactic Centre in November 2002.
	- The project concretized through the settling down
	  ○ of a training for the UniFR teachers
	  ○ and of the research activity axis of the Centre
	  ○ and of the services, mainly teaching support and accompaniment, and the other axis, information, to make useful resources available to the teachers for their practise…

02'20"	(about information service) - And for this axis a web site was created urgently not with a great reflexion but to answer a need. - This site enriched gradually also with the acquisition of a series of books that constitute a new category in the shelves of the university library
03'08"	(The context of creation of the Cop) - it was the creation of the University Didactic Centre - and of the positions of a professor, that Bernadette Charlier took, and of a post-graduate assistant, myself, in January 2003. - plus the arrival of Hervé Platteaux around June 2003 (just before the beginning of the post-diploma) - then, after the starting of the Centre, the training began in September 2003.
04'50"	(Then there is a difference (for the CoP) between the Centre and the Training?) - The starting made the engine work - and the starting of the training, in September 2003, allowed us to establish links and to know the teachers of the University
05'20"	(Actions done "during" the creation of the Cop) - There was an analysis of needs which touched about 20% of the teachers, that is about 200 people. - All the teachers and that means professors, assistants, every body that is implied in teaching. - Until September 2003 this was a phase of conception and gathering of information. - From that time, we really began to know these teachers because they had an individual accompaniment, they followed the training, etc. - we knew their training projects, their wishes, the problems they were encountering in teaching. - From that time, the CoP Did@cTIC began to grow up, to live and to emerge. - For the phase of reflexion, conception, gathering of info, there was only a very few people.

Figure 3 Example of transcription and minutes

A synthesis related to a CoP

The other important source of information is the synthesis of the CoPs. The Figure 4 gives an example of a synthesis.



Name of the CoP: Learn-Nett
Name of the observers: Amaury Daele (UNIFR) – Nathalie Van de Wiele (ePrep)
Author of the synthesis: Amaury Daele (UNIFR)
Email: amaury.daele@unifr.ch
Date(s) of the interview(s): 05/24/2006 (2 interviews) – 06/01/2006 (1 interview)
Date of writing this synthesis: June and September 2006

1. Identification and brief description of the CoP

This table (maximum 2 pages) presents information about the CoP as presented during the kick-off meeting at Lausanne (https://base.ecrm.org/base/base.cgi/10644 - follow the link « Descriptions of CoPs »). The information has to be enhanced following the interviews.

Context: in which context is the Cop situated (institution, region, professional network, etc.)?	In 2005-2006 this community is a network of seven universities located in Belgium (Liege, Louvain-La-Neuve, Mons), France (Strasbourg, Mulhouse) and Switzerland (Geneva, Fribourg). The field is educational technology. The language used is French but at the beginning partners from UK and Spain have participated and the two languages were used: English and French.
History: when did the community start? Would you say that it is a community in emergence? Or mature?	This community started in 1997 in Belgium between five universities. Until 2000, the project has been funded by the French-speaking Community of Belgium then by the EC as an action-research. Now the project is no longer funded, new members enter and go out each year. A few members are there from the beginning and compose the "coordination team". We can consider that it is a community of researchers and teachers in the field of educational technology who build collective practice and share about it. The community is now mature in the sense that the members know each other very well and that the training they organize is considered as mature.
Focus: what is the domain of the Cop? On which content or project is the Cop focused?	The community is focused on a shared course called Learn-Nett (Learning Network for Teachers and Trainers). This course proposes future teachers or trainers for educative uses of new technologies (ICT). Concretely, students from the different universities set up work groups that, supervised by tutors, collaborate at a distance on projects aimed at developing particular uses of ICT. A virtual campus is their work environment. Around this course, a reflection is lead about collaborative learning and its conditions.
Actors: who are the actors involved? How many are there? Are there people playing a particular role?	Those involved in the community are the coordinator (a person who manages activities between the sites), the teachers (academic responsible people on each site), animators (local coordinators on each site supervising the local students) and tutors (from the universities involved, they supervise groups at a distance). In 2006 there are 22 people who can often take several roles.
Practice: How would you describe the content of the exchange and	Exchanges concern the administrative and pedagogical preparation of the course (product: Pedagogical guide, Technical guide), the training of tutors (product: learning activities, shared views on the tutor's interventions profile), the regulation of the tasks of the tutors

PALETTE – *Learn-Nett Synthesis* – September 2006 1

The welcome page of the tutors' space in Moodle.

1. Name and type of the tool (brief description in case of CoPs own tools): *Standard communications tools: email, skype and telephone.*
2. The tool is used by the CoP for: ☒ Information sharing ☐ Knowledge Management ☒ Mediation/Collaboration ☐ *Other category (please explain)*
3. Why is it used by the CoP? For what need? *Email: for any information to communicate between the tutors. But it's not clear which information is sent by email or by a message in the tutor's forum.* *Skype: for synchronous communication between tutors and local coordinators, 1to1 or to many.* *Telephone: audio conferences are organized monthly during the training with the students for sharing the tutors' questions and problems encountered with their groups.*
4. How is the tool usually used? *See point 3.*
5. Examples of use *Email: communication of dates or general information about meetings.* *Skype: communication between a tutor and a local coordinator when students, in a university, are disconnected during a long period of time.* *Telephone: monthly audio conferences. These meetings are prepared through the Galanet'*

PALETTE – *Learn-Nett Synthesis* – September 2006 6

Figure 4 Excerpt from the synthesis of Learn-Nett CoP

CoP activity/practice description diagrams

Material developed for other WPs like scenarios and interviews questions can also be used. Tables 3 and 4 give examples of these information sources.

A first approach when starting or observing a CoP is to answer a list of basic questions. As researcher-observer, we can use these questions as static descriptors.

3 **WHAT:** What is the domain of the CoP? In what field (of research, of know-how, of questions, of problems…) is it integrated?
4 **FOR WHAT, FOR WHO:** What are the objectives of the CoP, in terms of questions to ask, of actions to lead, of problems to resolve…? Who is the recipient (people, organisation, groups of workers…)? What are the individual objectives of the CoP members (exchange, experience sharing, analysis, debate, creation…)? Are the objectives only cognitive or also social, psychological, affective… (to feel member of a group, to direct oneself, to feel useful, to find a group for expressing anger, happiness, fears…, to get power…)?
5 **WHY:** What is the general purpose (effectiveness of the company, productivity, knowledge management into the company, integration of external reforms…)?
6 **FOR WHAT RESULTS:** What should be the results for the organisation and for the members of the CoP? What will they look like (documents, know-how,

	tools…)? What will be visible or only tacit? What will be shared outside the CoP?
7	**WHO:** Who are the participants? Where do they come from? What are their prior skills and knowledge?
8	**HOW:** What will be the organisation? Has the CoP to negotiate its objectives, its actions…? Has the CoP to share the tasks, to divide the work…? How will the leadership be organised? How will the responsibilities be distributed?
9	**WHICH TOOLS:** for the communication, for repository of files, for the organisation, for the awareness…?

Table 3 Scenarios descriptors of CoPs [Künzel & Daele, 2006]

Context:	In which context is the Cop situated (institution, region, professional network, etc.)?
History:	When did the community start? Would you say that it is a community in emergence? Or matured?
Focus:	What is the domain of the Cop? On which content or project is the Cop focused?
Actors:	Who are the actors involved? How many are there? Are there people playing a particular role?
Practice:	How would you describe the content of the exchange and production of the CoP? Could you give a typical example illustrating the content of the exchanges?
Communication tools:	Which virtual environment or communication software does the Cop use? For which purpose?
Archive:	Do you have archives for your CoP? How do you reify (formalise) the contents of your exchanges? Do you use specific tools or methodology to explicit and share your knowledge?
Cultures:	How could you describe the value shared by the community?
Links:	Can you give some references to tools (Websites, forums …) that you use inside your Cop?

Table 4 Interview questions for CoP observers

A Palette generic model

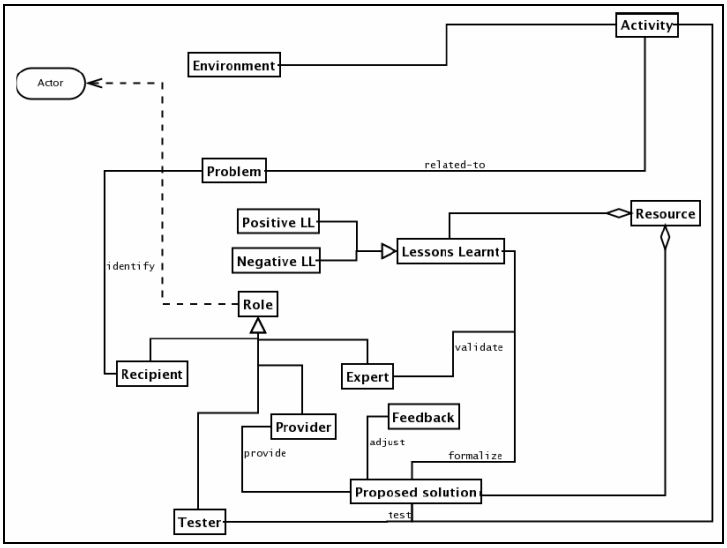


Figure 5 The Palette Lessons-learnt model

An ontology/model and a taxonomy

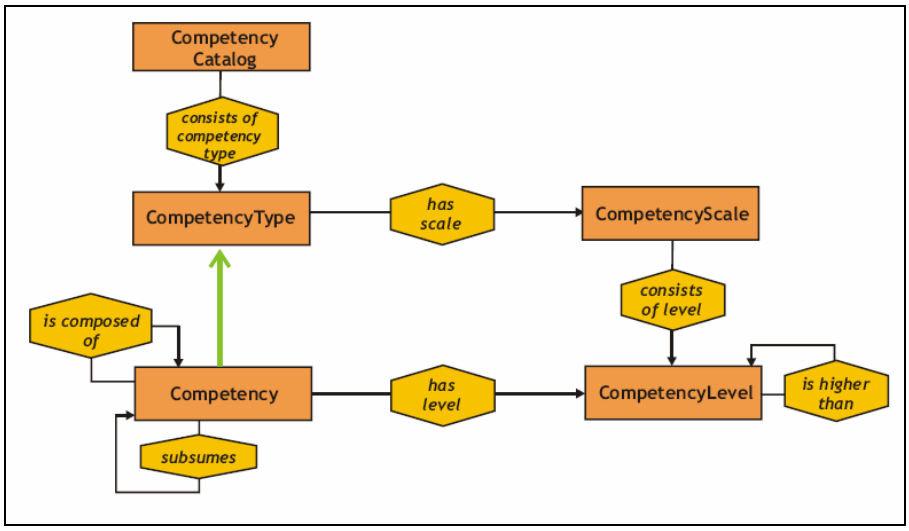


Figure 6 Competency as represented in the [Schmidt & Kunzmann, 2006] model. In the model, competencies are defined as "bundles of work-relevant skills, knowledge and abilities"

Cognitive Skills Taxonomy Levels			Active meta-knowledge (Pitrat)	Generic problems (KADS)	Cognitive objectives (Bloom)	Skills cycle (Romiszowski)
1	2	3				
Receive	1. Acknowledge					Attention
	2. Integrate	2.1 Identify 2.2 Memorize			Memorize	Perceptual acuteness and discrimination
Reproduce	3. Instantiate / Specify	3.1 Illustrate 3.2 Discriminate 3.3 Explain	Knowledge Search and Storage		Understand	Interpretation
	4. Transpose/ Translate					Procedure Recall Schema Recall
	5. Apply	5.1 Use 5.2 Simulate	Knowledge Use, Expression		Apply	
Create	6. Analyze	6.1 Deduce 6.2 Classify 6.3 Predict 6.4 Diagnose	Knowledge Discovery	Prediction, Supervision, Classification, Diagnosis	Analyze	Analysis
	7. Repair			Repair		Synthesis
	8. Synthesize	8.1 Induce 8.2 Plan 8.3 Model/ Construct		Planning, Design, Modelling	Synthesize	
Re-invest	9. Evaluate		Knowledge Acquisition		Evaluate	Evaluation
	10. Self-manage	10.1 Influence 10.2 Self-control				Initiation, Continuation, Control

Table 5 Taxonomies of Cognitive Skills [Paquette et al., 2006]

8.2 Palette Information sources

Table 6 summarises the information about Palette sources.

CoP	Resources	Authors	Delegate	Contact
ADIRA	Synthesis	L.Esnault	L.Esnault	L.Esnault
@pretic	Interviews minutes	É.Vandeput	É.Vandeput	É.Vandeput, M.Erpicum
	Synthesis			
BADGE	Interviews audio file		N.Van de Wiele	N.Van de Wiele, M.Erpicum
	Interviews minutes	N.Van de Wiele		
	Synthesis	M.Erpicum		
Did@cTIC	Interviews minutes - EN	H.Platteaux	A.Moura	A.Daele, H.Platteaux
	Interviews minutes - FR	H.Platteaux		
	Validated MOT model	A.Daele		
Doctoral Group Lancaster	Synthesis	P.Ashwin	P.Ashwin	P.Ashwin
ePrep	Presentation document	N.Van de Wiele		N.Van de Wiele
Form@Hetice	Interviews audio files		B.Denis	A.Daele
	Interviews transcriptions	[student]		
	Interviews minutes	A.Daele		
	Synthesis	A.Daele		
Learn-Nett	Interviews audio files		N.Deschryver	A.Daele
	Interviews minutes	A.Daele		
	Synthesis (many)	A.Daele		
Odysseia	Interviews transcriptions	D.Nousia, C.Evangelou, …	D.Nousia	C.Evangelou
	Synthesis	F.Pironet		
UX11	Interviews audio files		N.Van de Wiele	N.Van de Wiele, M.Erpicum
	Interviews transcriptions	[student]		
	Interviews minutes	M.Erpicum		
	MOT models	M.Erpicum		
	Synthesis	F.Pironet, M.Erpicum		

Table 6 Summary of Palette sources

Chapter 9

Terminological analysis

9.1 Main results

9.1.1 Characteristics of the terms w.r.t. the different concepts

We adopt a hybrid approach to develop the ontology, mixing bottom-up and top-down approaches. The first steps[1] (terms extraction and vocabulary) were achieved using a pure bottom-up approach. Then, from the hierarchy building step, we adopt a mixed approach by relying on existing models.
The terminological phase is then "data-guided". And this particularity implies a number of terminological issues, ambiguities, synonymy, homonymy, etc. In this section, we try to illustrate these issues by examples we encountered during the terminological analysis.

Community and Actors

- **Homonymy**
  During the analysis of the documents related to the CoPs, we found several terms that are common to some CoPs but used to evoke different concepts. For instance, the term "*student*" is used in UX11 to designate engineer-students, persons who have not yet finished their studies and are in a scholar establishment; whereas in Learn-Nett, the same term is used to talk about workers (future teachers) who undertake the position of learners in this CoP.

  The same problem occurs with the term *"professor"*, which is used by different CoPs, to evoke respectively the concepts of: teacher, university professor, or tutor.

  Another example is the use of the term « *haute école* » translated by the CoP interviewers into *"high school"*. This last term is usually used to refer to the last part of secondary school curriculum, but in

[1] Excerpts of the extracted lexicons can be found at http://www-sop.inria.fr/acacia/project/palette/ocop/terms

Form@Hetice, it is used differently (it designates a kind of short-cycle program attended after the secondary school), due to differences in the usage of the French language depending on the culture and location of the CoP (Form@Hetice is from Belgium and thus, the use of the French language is different than it is in France).

- **Ambiguity**
  Some CoPs use different terms to designate the persons in charge of particular tasks in the CoPs. In addition, the lack of exhaustive information on these tasks for the concerned CoPs makes it a little bit difficult to detect and reveal if these terms refer to a same concept or not. Let's see some examples: *"coordinator of the project"*, *"local coordinator"*, *"manager"*; *"facilitator"*, *"educator"*, *"trainer"*.

Competency

In the Palette corpora, we did find Competency-related terms (and supposedly their underlying concepts) that already exist in the generic model of competency. We also found terms which are (a) specifications (or instantiations) of these terms (e.g., *technical competency*, *competencies in programming*, *pole of competencies*) ; or (b) antonyms, i.e. terms meaning the opposite of another term (e.g. *Non-competence* as opposed to *competence*); or (c) enters in the definition of the concept underlying the term (e.g., *experience* for *skills*).
We identified also synonyms (e.g., *expertise* for *competency*) or similar phrases (e.g., *expression of ideas* and *brainstorming*).

Note. The term "Behavior" appeared to be ambiguous when employed alone because it may refer either to an *attitude* or to an *action*: see, for example, the American Heritage Dictionary[2], which makes the distinction between "1. The manner in which one behaves", and "2.a. The actions or reactions of a person or animal in response to external or internal stimuli. 2.b. One of these actions or reactions". To raise the ambiguity, we decided to replace it in the ontology by the more explicit word *attitude*.

Learner profile

The terms identified for the ***Learner Profile*** ontology mostly refer to concepts from the teaching domain. The majority of terms describe teaching practices and artifacts. A little number of terms directly refers to learners, whilst the concepts related to learning activities mostly describe learning situated within the context of tradition teaching methods.

[2] Available online: http://www.answers.com/topic/behavior.

Collaboration and Process

In the information sources we studied for building the CoP-oriented ontologies, we found several terms used by CoPs, to define the same concept.
For instance, concerning the activity concept, we found similar terms such as discussions, or learning, that can have different meanings.
The CoP Form@Hetice has a page dedicated to discussion in its wiki. The members of this CoP want to keep traces of these discussions and of the decisions taken through the discussions.
In the CoP ADIRA, the discussions take place after a conference, and allow members to share their opinions. It would be interesting to keep traces from these discussions, but this is not the case, since there is the will to let the members talk freely without the feeling to be "spied". We can see with these examples that the discussions are differently considered and in one case, discussion is seen as a main activity, while in the other case, discussion is an informal activity, without trace.
Several terms describing the same concepts were found, such as "will", "goal", and "reason", to deal with the concept of objective.
Concerning the concept of role, we also found several terms to deal with a same concept: member, participant, partner. In the CoP ADIRA for instance, "participant" and "member" are terms used to define the members of the CoP. In addition, in the CoP Learn-Nett, "partner" and "participant" are both used to define the members of this CoP.

Decision making

As regards the ***Decision Making*** ontology, the terms identified from the Palette CoPs related resources mostly refer to activities performed by community members towards reaching a decision. Thus, the majority of terms belong to the domain of group decision making activities. Another interesting point concerns the lack of terms describing the outcomes of decision making. In the resources available, decision making terms were identified in parts referring mostly to organisation and scheduling issues. For that reason, there are no specific terms describing the topic of the decision to be made, representing the problem domain.

Resources and Tools

This part of the ontology aims at representing the resources and the tools used by the CoPs. This dimension did not have a dedicated model in the generic models developed in D.KNO.01, but it appears in almost all other models. The material we had in our possession gave a lot of information about the resources and tools that the CoPs manipulate.

- **Homonymy**

Some terms are used in the context of CoPs to designate different concepts. For example, the use of the term *Platform* is very ambiguous, it is used to designate:

- a useful website ***(1)***
- a workspace for the CoP, that may contain its documents and where the discussions of members are hosted ***(2,3)***
- a workspace used by CoPs members inside and outside the CoP ***(4)***
- a dedicated software e.g. e-learning platform ***(5)***

> ***(1)*** *« On a adhéré à une **plateforme** d'info. Webpalette elle informe sur les formations d'enseignants pour toute la Suisse du primaire au tertiaire. Adhésion pour se faire connaître et pour rendre accessible le fait qu'on a ici un centre à leur disposition »* (Did@ctic)
>
> ***(2)*** *« Donc, dès maintenant, la réflexion se porte sur l'usage de la **plateforme** et la distribution des ressources entre la **plateforme** et le site. Dans le nouveau portail, accessible à partir de l'été, on veut mettre tous les documents créés par les participants, sauf ceux touchant leur intimité, et plus sur la **plateforme**. Sur celle-ci, on ne mettrait plus que l'espace travaux non publiables: carnet de bord, etc*. » (Did@ctic)
>
> ***(3)*** *"Communication between the members by emailing tools: the learners use the **platform** or their own email for collaborative work"* (Badge)
>
> ***(4)*** *"First need remaining to be answered: to have a unique **plateform** for all accesses"* (Learn-Nett)
>
> ***(5)*** *"About the convenience of the **platform**: she finds it very convenient for the online courses"* (UX11)

- **Synonymy**

  Some CoPs use different terms to designate the same concepts, these terms must be associated to the same concept in their ontologies in order to avoid redundancy. For example, the terms *Journal* ***(6)*** and *Logbook* ***(7)*** are used to designate the record of activities or practices of a CoP member.

> ***(6)*** *"a journal for instance can be a good mean even if in these CES learners have busy personal and professional lives and may not find enough time to contribute to a **journal**"* (Badge)
>
> ***(7)*** *"we can show to the participants' **logbooks** containing real experiences that they will live"* (Did@cTIC)

- **Ambiguity**

  Some terms are used to ambiguously designate concepts, for example, in the extract from UX11***(8)*** there is confusion between the *online course* and the tool hosting the course, the feature is not added to the course but to the tool used to host the course.

(8) *"they decided to add feature on the **online course**"* (UX11)

9.1.2 Characteristics of the terms w.r.t. the different CoPs

The figures below aim at illustrating the results of the Contextualised lexicon construction, through some statistical data processed on the content of the lexicon according to the generic models developed in D.KNO.01.

Figure 7 represents the number of extracted terms and contexts per generic model, we can see that we have few terms on Learner profile and Decision making, due to the penury of information on these parts in the sources, but also for Collaboration and Process generic model.

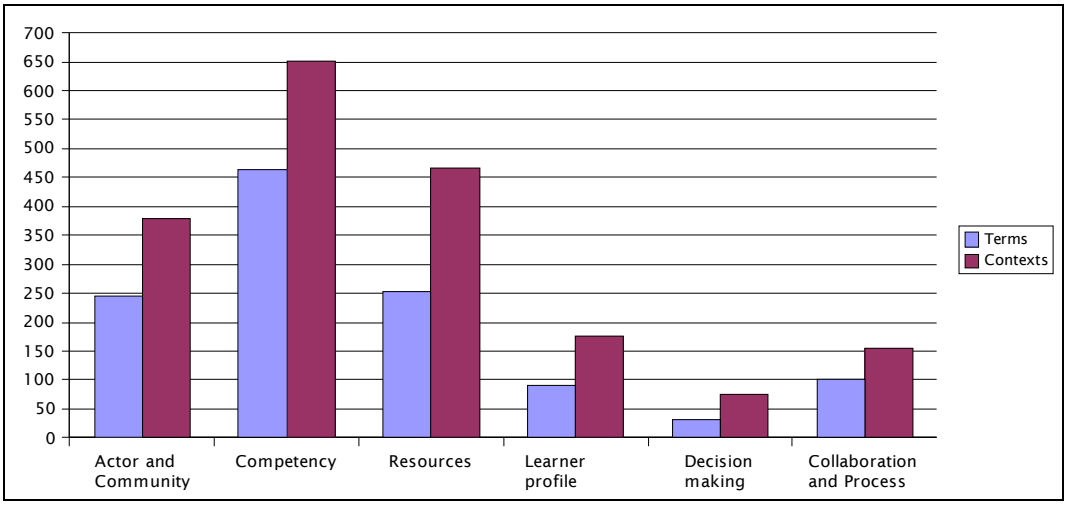


Figure 7 Number of Terms and Contexts per Generic model

Figure 8 represents the average number of contexts per term, we can see that it is quite homogenous, the general average is around 1.75, and this mean that there was a non-negligible number of terms that need more than one context to be understood.

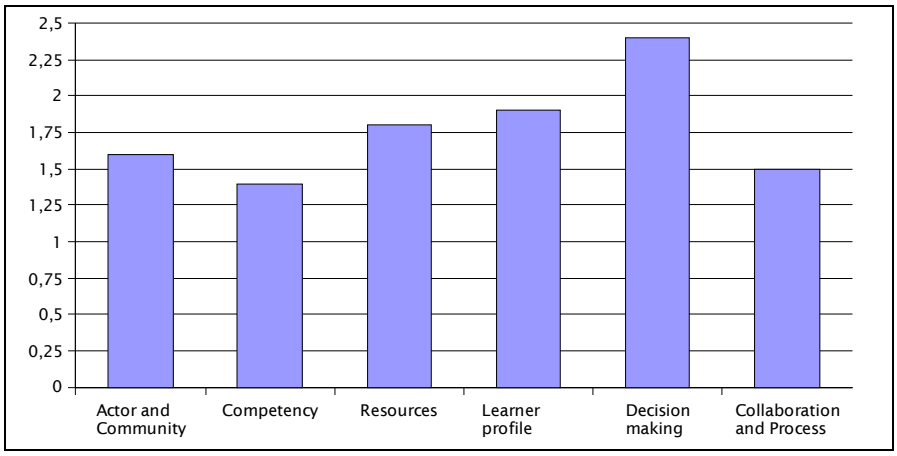


Figure 8 Average number of Contexts per Term

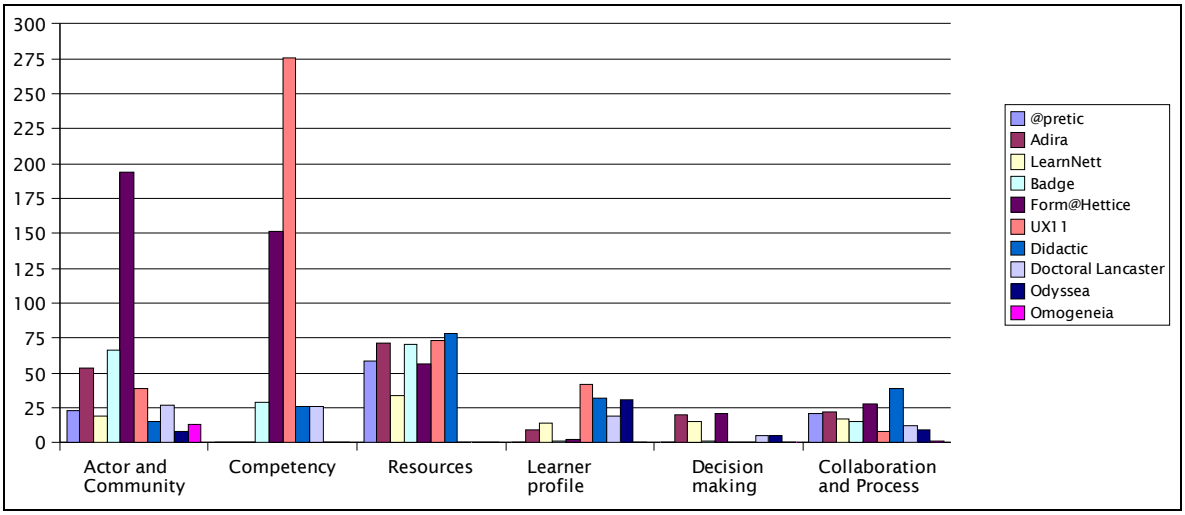


Figure 9 Distribution of the Contexts per CoPs

Considering the main concepts of ***Actor and Community***, the figure 7, 8 and 9 show that the documents analysed are rather rich in information, since the number of extracted terms is high (around 250) and the number of their related contexts is even higher (Fig.7).

However, the figure 8 shows that the average number of contexts per term surrounds 1.5 contexts per term, this illustrates what we noticed during the Contextualised lexicon building: some terms that are common to some CoPs and therefore they are accompanied by several contexts to explain them and try to find if the term is used with the same meaning in these CoPs; whereas other terms are not frequent and do not have related contexts, since the excerpts in which they appear do not offer information to explain them or make their usage in the CoP explicit enough. These two situations, though they have contradictory aspects, contribute to explain the necessity of the validation process and active exchanges with the validators (CoPs representatives).

Finally, the figure 9 shows that the number of extracted contexts is not homogeneous among Palette's CoPs, this is due to the variety of documents provided: for some CoPs, we could only rely on syntheses or minutes of interviews (-e.g. ePrep, Doctoral Group Lancaster), whereas for others, we had more information sources (e.g. Form@Hetice, the full interviews transcriptions were available).

But, even when the CoPs are described through a lot of material, there are still ambiguities and lack of information. For instance, the terms related to the roles of the CoPs members are often used without having been defined, information on the activities undertaken by these roles is not often mentioned explicitly. So, it makes it difficult to detect the roles that are common to several CoPs. The same happens when trying to make the structural organisation of the CoPs explicit.

The fluctuating results obtained from the Contextualised lexicon construction demonstrate the need for an iterative process to collect more information on the CoPs while the O'CoP ontology development process goes on.
As well, the need of relying on some theoretical resources is necessary, since they constitute a consensus and a basis for finding the similarities and specificities between the CoPs. This is the approach used to produce the Community and Actor Contextualised lexicon, in addition to relying on the general generic model developed in D.KNO.01.

As regards the data collection for the development of the ***Learner Profile*** ontology, an analysis of the entire Palette identified CoPs resources was performed for selecting the appropriate concepts. The terms identified from the available resources refer mostly to the learning activities performed by tutors and learners.

As shown in Figure 9, terms regarding the ***Learner Profile*** were extracted from resources referring to the UX11, the Did@cTIC, the Odysseia and the Lancaster communities. That is because the dominant practice of these communities is training, thus the transversal analysis of the interviews taken mostly focused on learning issues. Nevertheless, learning appeared to be an intrinsic issue for the ADIRA and the Learn-Nett communities as well. Another interesting point concerns the amount of terms identified for the Learner Profile ontology. As regards to the terms per se, the identified terms mostly refer to the learning activities performed by learners, and the resources employed for learning purposes. Another set of terms refers to learning styles.

In the same vein, for developing the ***Decision Making*** ontology, an analysis of the entire Palette identified CoPs resources was performed. Due to fact that most of the resources available did not refer to decision

making issues, additional documents related to CoP specific decision making activities were used. More specifically, a review of the related literature was performed, in addition to a transversal analysis of the Palette CoP related resources, so as to produce a short review commenting on CoP specific decision making issues.

As shown in Figure 9, the ADIRA, the Learn-Nett and the Form@Hetice communities were the three communities that mostly referred to ***Decision making*** issues. That is because these three communities comprise a large number of participants and decision making often is an issue of importance, as making a final decision is most of the times a collaborative issue. The identified terms for Decision Making ontology mostly refer to activities, due to the fact that the investigated communities mostly engage in teaching, decision making even though an every day practice is not perceived as a high value activity. For that reason, not many terms were identified for describing a community's member role as a decision maker.

Another interesting point regarding the terms identified for structuring the Decision Making ontology concerns the average number of contexts per terms. As shown in Figure 8, decision making related terms appeared in an average of more than 2,25 contexts. This means that even though the total sum of terms identified was not very large compared to the terms related to the rest of the ontologies (see Figure 7), the terms appeared often within the textual resources.

Concerning ***Collaboration and Process***, we have seen that CoPs concerned by the same domain (teaching for instance) use, the same terms, logically: professor, teacher, tutor to design a same concept.
We also found a lot of common activities to all CoPs such as mails, discussions, learning, but they can be seen differently according to the context of the CoP. For instance, a discussion can be seen as an exchange of mails for a CoP, while for another CoP, a discussion is a face-to-face activity between two or more members.
Concerning the Resource concept, we found common concepts to all CoPs, such as experience, knowledge or information, and more specific term for each CoP.
During the structuring phase, it appeared that CoPs have their specific vocabulary to describe their activities, and their mode of collaboration.
We have to notice that the CoPs involved in Palette are heterogeneous from maturity viewpoint. Some CoPs are in emergence, and their members have not yet defined precisely their domain and practice.
For example, the members of the CoP Aradel do not exchange on their practices, this group is a professional organization. There is a circulation of the information, but not about the practice itself.
On the contrary, in the CoP Form@Hetice, the members exchange a lot by mails about the practice and they have regurarly face-to-face meetings.

Concerning the CoP UX11, there are exchanges between the professors and the students about their courses. These exchanges allow the professor to improve his/her course, however there is no exchange concerning the practice itself.
According to this, the activities occurring within these emerging CoPs cannot yet be well defined, and modelled. In order to obtain CoP-specific ontologies for such CoPs, a closer collaboration with the CoPs members and delegates is necessary, so as to get a better knowledge on these CoP, and a more accurate definition of their activities.

As for the ***Tools and Resources*** used by the CoPs, in general, the material we have in our possession (CoPs interviews, syntheses, etc.) contains more information about the tools used by the CoPs than about the resources they manipulate, since the questions in the interviews were centred on the tools. The information about the manipulated resources is implicit, so they are less precise. But as shown in Figure 9, all CoPs material contains terms describe this dimension of the ontology.

The other issue concern the domains of the CoPs: to describe the resources of a CoP the members use vocabulary from their domain, making it difficult to unify terms that are extracted from different CoPs.
But even in the same domain, we were confronted to some terminological conflicts explained by the different geographical locations of the CoPs, since the terms used in the education in France and in Belgium are different.

Finally, almost no information on the ***Lessons-learnt*** was found and extracted from the material analysed. This is due to the fact that the interviews had not been oriented towards this axis.

9.2 Return of experience

Term extraction procedure: adjustments

Some of the terms put in the Contextualised lexicon are the exact terms used by the interviewees and the interviewers, e.g. « *Enseignant-chercheur* » (“Teacher-Researcher”), found in the passage: « *Je suis enseignant-chercheur au département informatique* ». Other terms are adaptations, for example « *Enseignement traditionnel* » (“Traditional teaching”), composed from the passage: « *J’avais fait des interventions au niveau de ce cours avec la façon traditionnelle* ». When the term is not exactly the term used by the interviewees/interviewers, it is asterisked, e.g.: « *Enseignement traditionnel** ».
Such an adjustment of the term extraction procedure has been also motivated by the use of tools not considered in the planned methodology (see Section 12.1)

Validation procedure: Validators' perspective vs. Knowledge engineers' perspective

In the planned procedure for validating the vocabulary, the validators take the place of the Knowledge engineers the time necessary to perform the validation. In a certain way, Knowledge engineers lent the ECCO tool to the validators, and delegated a task to them. It was as if both Knowledge engineers and validators shared the same perspective exactly. We can't say that it really was the case. For example, the validators didn't have in mind the generic models (Collaboration, Actor, etc.) that Knowledge engineers used to extract candidate terms.

Presupposing a strong matching between validators and Knowledge engineers leads to:

- *an overlapping of tasks:* the validators were sometimes supposed to act as Knowledge engineers;
- *an overlapping of workspaces:* the validators worked in exactly the same ECCO workspaces as the Knowledge engineers;

Whereas it would have been necessary to make a distinction between the tasks, and between the workspaces.

Validation procedure: Validators' actual view of the validation goals and criteria

Table 7 presents two examples of formulations of validation goals and criteria by two different validators; Validator A and Validator B. Validator's A formulation matches the validation goals and criteria envisaged for the validators in the methodology, that is:

For members of CoPs, validate the terms which they think they will probably use:

- *to annotate various resources (such as documents, actors, etc.);*
- *to formulate queries (using them, e.g; as "keywords").*

Validator A's formulation denotes a service-oriented perspective. Validator's B formulation doesn't exactly match the envisaged goals and criteria, but it corresponds to the goals that CoP observers had when interviewing CoP members and analyzing what were their respective CoPs. Validator's B formulation denotes a theoretical perspective

Validators	Validation goals	Validation Criteria
Validator A	Validation of the lexicon in relation to the intended exploitation of the lexicon : • annotation of mails • base of tags for a SweetWiki application , etc.	Relevance of the concept according to the type of application
Validator B	The lexicon must allow to	The selected terms having

	describe CoPs (generally and specifically)	been used by CoP members to describe themselves and to describe their CoP, they are then representative of the CoPs, and consequently valid

Table 7 Examples of formulations of validation goals and criteria by two validators

To help Validator B re-orient her validation goals, a tactics used was to refer the validator to the kind of Palette KM service she wants to get for her CoP, and to specific examples of use of terms/keywords/tags with such a service. Table 8 shows an example coming from Validator B discussing about WikiPrepas, an application based on the KM service SweetWiki (http://www-sop.inria.fr/acacia/soft/sweetwiki).

Information-search goal	Expected tags (ontology)	Expected answer
Searching information about **Isaac Newton** using a Wiki Tag like IsaacNewton	++ GrandScientifique +++++ **IsaacNewton** +++++ PierreGillesDeGennes	WikiPrepas displays the page and image devoted to **Newton** and signals that PierreGillesDeGennes is in the same category as Newton

Table 8 A specific example of a possible use of tags in WikiPrepas (SweetWiki)

Validation procedure: Knowledge engineers' actual view of term selection criteria

When they elicited candidate terms for the Contextualised lexicon, Knowledge engineers did it with certain criteria in mind. It would be interesting to make explicit these criteria in order (a) to write down more specific instructions for Knowledge engineers who may want to replicate the method used in the Palette project (see Table 9 for an example of the criteria used by a Palette Knowledge engineer), and (b) to determine the degree of matching between Knowledge engineers' criteria and validators' criteria. For example, both validators and Knowledge engineers attach importance to the *Correctness of term translation*: they spotted when the French-to-English translation was misleading (e.g., the French term « *réflexion* » translated as "reflection").

Criterion	Definition / Example / Procedure
Relevance of the practice/wish/problem to the domain of the lexicon	Domain of lexicon = the contextual lexicons related to the generic models (e.g., learner profile or to decision making)
Relevance of term to Decision Making	1. The term is used to describe the decision making process (or sub-processes) 2. The term is used to describe actors participating in a decision making process 3. The term is used by actors during the decision making process

Relevance of term to Learner Profile	1. The term is used to describe the learner 2. The term is used to describe one of the fields defined in the Palette learner profile generic model, e.g. cognitive style, learning activity, learning object, etc.
Frequency of appearance	Frequency of appearance of a term in the one synthesis and the all the syntheses
Domain expertise of the context lexicon author	(This is a meta-criterion.) The choice of terms by people who have background on the specific field could be considered more "valid" or in other terms if we speak about candidate terms, we can say that we recommend them in a scale of {weak, medium, strong}.

Table 9 The term selection criteria of the Palette Knowledge engineer working with the Learner Profile and Decision Making generic models of Palette

Validation procedure: Extraction of competency questions

During the term extraction phase, we elicited some "competency questions" to be used as reference points for validating the vocabulary. The elicited questions came from interviewers (CoP observers) and from interviewees (CoP members: teachers, tutors, students, etc.). They are "explicit questions" or "inferred questions": literal questions are questions actually asked by the interviewers or the interviewees; "inferred questions" are questions that can be inferred from the interviews.

Validation procedure: Solicitation of competency questions

In order to make CoP observers participate more to the construction of ontologies, a Knowledge engineer directly asked (by mail) one of them - an observer of the Learn-Nett CoP - to provide "competency questions" (this phrase was not used with the CoP observer). The CoP observer claimed that "CoP members are interested in searching for information about the practices exchanged/built/debated within the community, or annotating these practices".

The Knowledge engineer requested the CoP observer to specify the kinds of information about practices searched for by CoP members (e.g., tutors), and to provide examples of queries that CoP members could formulate about practices. Doing this could help specify and "negotiate" the criteria of validation of the contextual lexicons.

As a response, the CoP observer provided two documents: (1) a list of real problem-cases that Learn-Nett tutors encountered when tutoring their groups of students, at a given step of the tutoring process or "transversally"; these cases were analysed, discussed and debated by tutors during their training, in order to find out solutions; (2) a synthesis of the groups of tutors' thinking about their roles and tasks as tutors. The CoP observer suggested that "the names of the roles could be the subject of queries because it's really their common vocabulary, as well as the types of problems evoked in the problem-cases".

The documents provided by the CoP observers can be processed in order to elicit competency questions together with concepts and relations. These elements can then be used to validate the vocabulary; to assess, for example, that the term "meta-cognitive approach" (« *démarche métacognitive* ») is in the vocabulary.

Problem-case: « *Comment fais-tu pour induire une démarche métacognitive auprès des étudiants par rapport à leurs apprentissages ? »*[3] Elicited Competency questions: « *Comment fais-tu [= tutor] pour induire une démarche métacognitive auprès des étudiants par rapport à leurs apprentissages ? »* Elicited Concepts: *Démarche métacognitive, étudiant, tuteur* Elicited Relations: *Tuteur* **Induit-démarche** *Démarche métacognitive*

Support to validators

It was necessary to support CoP representatives in performing the validation task (in understanding the validation procedure, in using the ECCO validation tool, etc.). Various means were used to provide such a support.

- **Online user guide:** Every validator could access an online ECCO user guide.
- **"Hotline":** Validators were assisted when necessary by mail or by phone.
- **Training:** Some validators asked for being trained to use the ECCO system. Some did have such a training, through mail exchanges or during a face-to-face meeting (see Table 10 for a description of the training procedure used in such a meeting). During the training a validator preferred not to use directly ECCO, but to dictate her validation instructions to the trainer who manipulated the ECCO system. A not trained validator, after having done the validation, said she liked have such a training.

Training phases	Description
Orientation phase	The validator sets the validation goals and criteria with the validator: (1) setting the goals (the validator and the trainer discuss the intended use of the terms of the vocabulary); (2) setting the criteria.
Familiarisation phase	The validator is familiarized with the validation procedure and the ECCO validation tool: (1) "Paper-pencil" familiarisation (i.e.

[3] Source: Document on the problem-cases encountered by Learn-Nett tutors when tutoring their groups of students: cases related to the topic "Development of thinking about one's learning".

	familiarisation without ECCO); (2) Direct familiarisation with ECCO.
Systematic validation phase	Assisted on demand by the trainer, the validator successively validates each term of the vocabulary (giving synonyms and definitions, commenting her decisions, etc.).
Debriefing phase	The validator is invited to give some feedback about the validation procedure and the validation tool.

Table 10 A training procedure used with one of the validators

Impacts on the information sources

During the validation task, CoP representatives became more aware of the limitation of the existing Palette information sources as providers of relevant vocabulary. They consequently decided to complete the existing sources, or to create new ones by performing new interviews of CoP members (see Chapter 8).

Impacts on the ECCO tool

The validation task (and more generally the ontology construction task) performed with the ECCO tool led to suggest modifications to this tool in order to make ECCO better suit the Knowledge engineers' and CoP representatives' tasks. Some of these modifications were performed by the ECCO's main designer, Priscille Durville. Other modifications - more complex or less urgent - were delayed. An example of a complex modification is related to what we have called "the interdependencies of functions".

Support provided by the CoP representatives to Knowledge engineers

In turn, validators helped "ontologists" in constructing the vocabulary. For example, they help Knowledge engineers to define terms (e.g. what is an « *organisme professionnel* »? - "professional organisation"), and make distinctions between them (e.g., Is an « *organisme professionnel* » a synonym of « *entreprise* » - "company"? or Is « *entreprise* » a type of « *organisme professionnel* »? or is there another relation between « *entreprise* » and « *organisme professionnel* » - ADIRA).

Chapter 10

Ontology conceptualisation and structuring phase

10.1 Main results

10.1.1 Structure of the O'CoP ontology

In the structure of the O'CoP ontology[7] (see figure 10), we can distinguish three main layers:

- The high level ontology (corresponding to the generic models presented in [Vidou et al., 2006]);
- A layer corresponding to concepts common to all CoPs;
- A specific layer corresponding to the concepts specific to each CoP.

To construct the different levels of the ontologies, the tool ECCO was used.

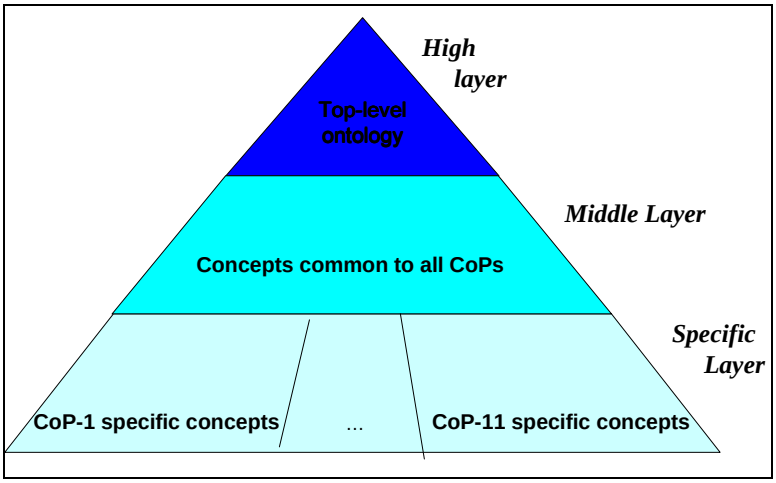


Figure 10 Structure of the O'CoP ontology

[7] Excerpts of the RDF(S)-formalized ontology can be found at http://www-sop.inria.fr/acacia/project/palette/ocop/schemas

Top-level ontology

The high level of the O'CoP ontology was proposed in the deliverable D.KNO.01 and in [Vidou et al., 2006]. It corresponds to the concepts emphasised in the generic models described in [Vidou et al., 2006].
These generic models served as a grid for analyzing the information sources in order to build the other layers of the ontology.

Common layer to all CoPs

According to the generic models determined in D.KNO.01 and the documents studied, in the vocabulary extracted from the information sources, the relevant terms related to CoPs were identified. Some of these terms seemed to be relevant to all CoPs and to express common concepts while others were specific to a given CoP (or to a few CoPs). Validation by the validators helped to confirm the terms common to all CoPs.
Such terms finally kept as terminological concepts in the ontology will thus correspond to concepts of the middle layer, such concepts being specialisations of the high-level ontology concepts.
Moreover, some concepts stemming from literature on CoPs could be included in this common layer, provided that they are attested by at least the information sources on some CoPs.

Low layer specific for each CoP

The concepts of the low layer correspond to terms confirmed by the validators as specific to a given CoP or to very few CoPs.
In the following sections, we will describe the main concepts of the ontology (Community related concepts, Actor related concepts, Learner profile related concepts, Collaboration related concepts, Activity related concepts, Competency related concepts, Resource related concepts, Lessons-learnt related concepts), and in their description, we will try if possible to distinguish these three layers of the O'CoP ontology.

10.1.2 Description of the main concepts of the ontology

Community related concepts

In [Vidou et al., 2006], we proposed the following generic model for a community (see figure 11). A community is characterised by:

- its domain;
- its practice constituted by outcomes developed by the CoP (artifacts, stories, routines, documents);
- its members: these individual actors will be characterised by their individual competence, their social relationships in the CoP, their modes of participation in the CoP and of collaboration, their

profiles, their roles, their learning profile, their activities inside and outside the CoP;

- its external environment that can be constituted by other actors (e.g. stakeholders in the organisation that play a role of support to the CoPs, other CoPs, etc.);
- the resources used by the CoP (e.g. the CoP tools that, according to [Wenger et al., 2005], we classify into publishing tools, tools ensuring individual participation, tools ensuring community cultivation, tools for asynchronous interaction and tools for synchronous interactions);
- its decision-making process;
- its history and its life: in particular, its life status corresponds to its current stage of development (potential, coalescing, active, disperse or memorable according to [Wenger, 1998a]).

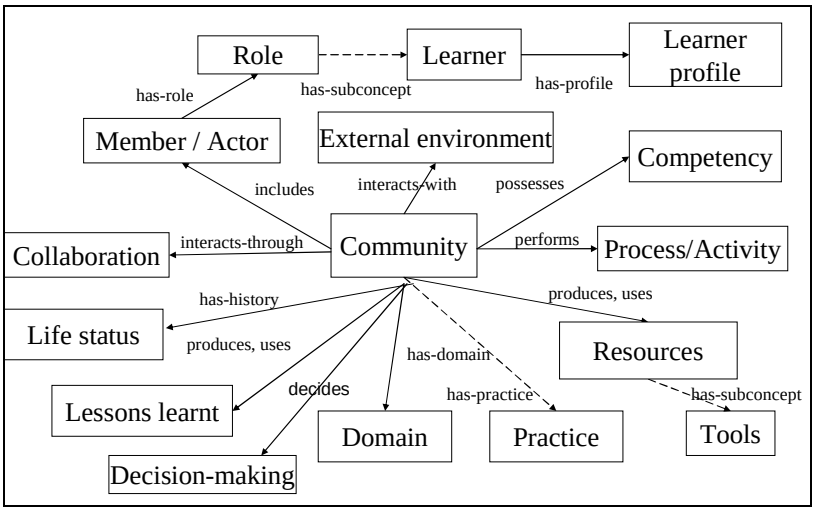
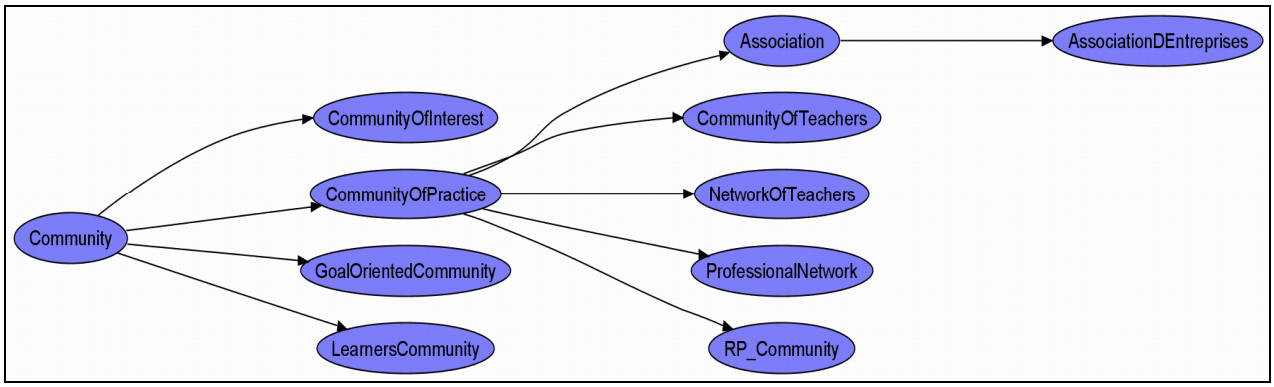


Figure 11 Generic model for a community

This generic model was used as a grid of analysis of the information sources and for the conceptualisation.

Common layer to all CoPs

The main concepts related to the community in the O'CoP ontology are:



- **Community:** we obviously consider the concept of "Community", which can be, according to the information collected from Palette's CoPs as well as from [Lessard et al. 2006]: a "community of interest", a "community of learners", a "goal-oriented community" or a "community of practice".

Also by analyzing the CoPs' related documents, we find that the CoP members consider that the community to which they belong ("community of teachers", "network of teachers", resource-persons community", "association of companies") is a (kind of) CoP.
We must notice that the terms used emphasise the common nature of the members of the community (cf. companies, teachers, resource-persons, etc.). Moreover, the proposed conceptualisation maintains a difference between a network and a community.

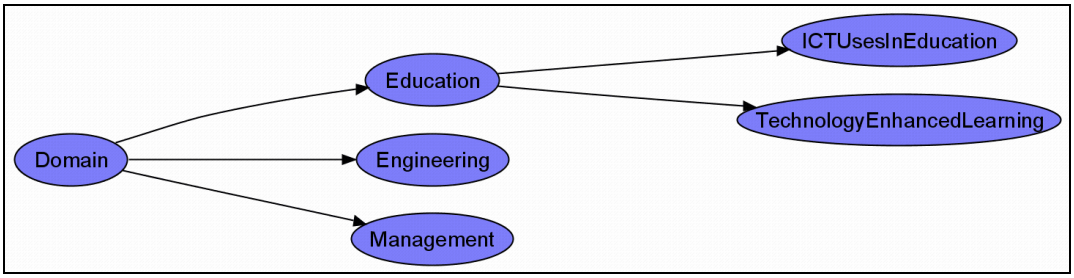
As stressed in [Wenger, 2004], a CoP can be characterised by its "Domain", meaning the area of knowledge that brings the community together, gives it its identity and defines the key issues that the CoP's members need to address. [Henri, 2006] emphasises that the CoP's domain of knowledge differs from its field of knowledge; it is the focus of the community and evolves over its life span in response to new, emerging challenges and issues.

Therefore, we distinguish the two concepts of Domain and Field:

- **Domain vs. Field:**
  - ***Domain (knowledge domain)***: it is the scope of the CoP, "A community of practice is not just a personal network: it is *about* something. Its identity is defined not just by a task, as it would be for a team, but by an "area" of knowledge that needs to be explored and developed." [Wenger, 2004]

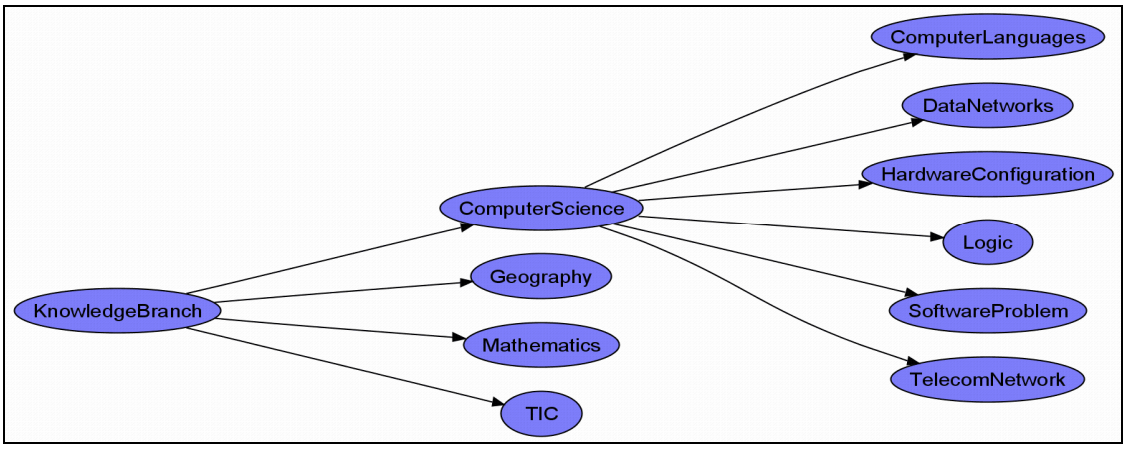
Considering Palette's CoPs, roughly, we have the domains of "Management", "Education" and "Engineering" which can be specified according to the specificities of the CoPs. For instance, the CoP

Form@Hetice has as domain the "Education", more particularly "educative uses of ICT". In the case of ePrep, the domain is also the "Education", but specifically the '"technology-enhanced learning".
As for ADIRA, which domain is "Management", it focuses on "IT/IS contribution/impact to the business world". Thus, whereas the concept of "Domain" is common to all the CoPs of Palette, its subconcepts are specific to each CoP.



- ***Field (knowledge branch, discipline)***, is the part that can be detailed by one or more ontologies describing the notions that are related to the field(s) of the CoP (thus, specific to each CoP).

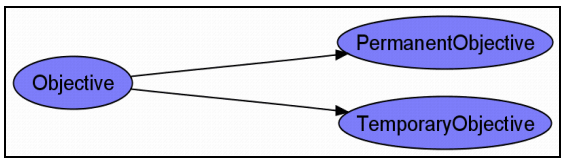
  e.g. Geography (Form@Hetice), Mathematics (Form@Hetice), Computer sciences (UX-11).



- **Objective:** it is related to the CoP as a whole, or to a part of it (a group, a project, a team, etc. depending on the CoP's organisation and functioning modes). An objective can be "Permanent", this is generally the case of the CoP when talking about "sharing knowledge and experience".

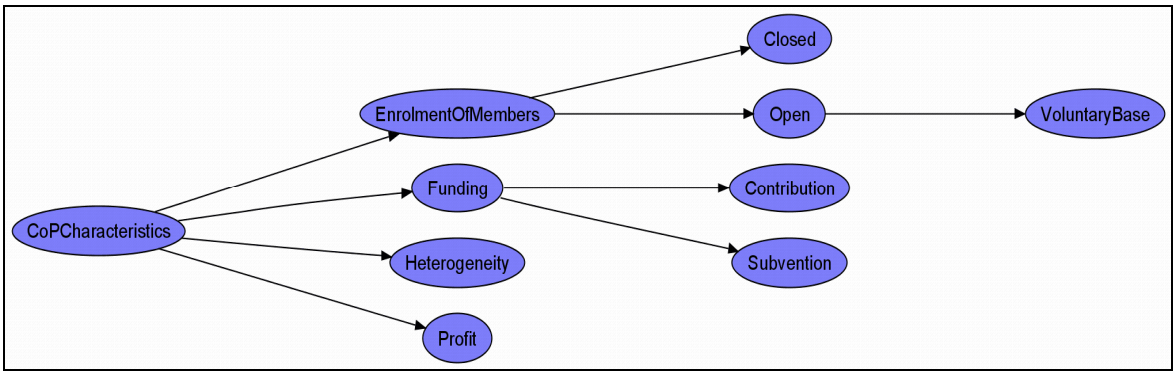
  It can also be "Temporary", for instance, a temporary objective can be decided when launching the CoP (e.g. when launching ADIRA, the objective was to sensitize the companies of the French Rhône-

Alpes region to computing). A "Temporary" objective can also be defined for answering a particular temporary need.



This sub-hierarchy is thus common to all the CoPs and can be refined according to the specific needs of each CoP.

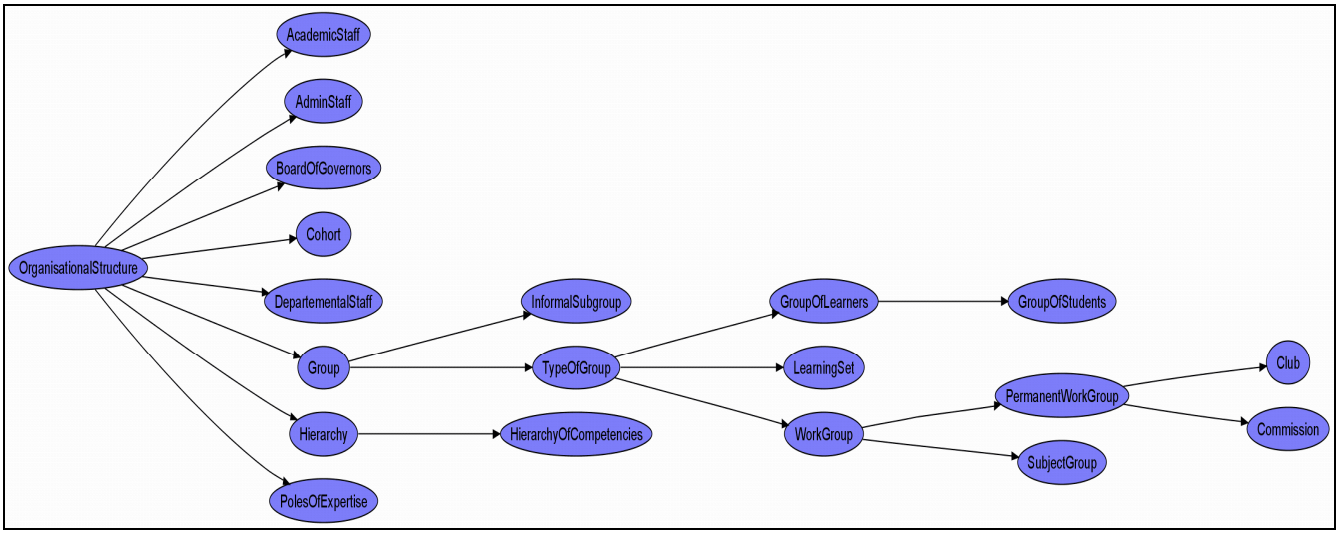
- **CoP's characteristics:** when analyzing the CoPs' documents, we found out that, besides the fact that they can be very different according to their internal organisation, kinds of roles involved, etc. they can also be very different at a lowest level, which defines the CoP's identity, characterised by:



- The **Membership**: is the CoP open to any person interested in it (based on a voluntary participation, "Open")? Or are there certain conditions/criteria to be compliant with so as to enter the CoP (such as the competency, being invited by a CoP member, etc.)?
- The cultural **Diversity** of the members: they can be of different natures, including the nationality, profile, organisational culture (culture of the organisation which the member belongs to [Langelier &Wenger, 2005]). Thus, the CoP can either be Homogeneous or Heterogeneous w.r.t. these criteria.
- The CoP's way of **Funding**: where do the CoP's financial resources come from? Is the CoP financially supported by a "Legal entity" by means of "subventions"? Does it depend on the "dues/contributions" of its members (when the membership implicates that the member pays dues)?
- **Profit**: indicates whether the CoP is non-for-profit or a profit-maker.

- **Organisational structure:** as shown in the figure below, the information extracted from the CoPs data led us to the following observation: the CoPs are very different according to their respective modes of organisation. Indeed, their organisations vary from very formal and structured ones (based on "admin staff" -Doctoral Group Lancaster-, "board of governors"[8] -ADIRA-, etc.) to very informal others (based on "informal subgroups" -Doctoral Group Lancaster-).

  By the same way, we notice the use of very various terms to describe these structures. Thus, we find the concepts of "cohort" (Doctoral Group Lancaster), "work group" (ADIRA and Learn-Nett), "subject group" (ADIRA and Form@Hetice), "groups of learners" (Learn-Nett), etc.



This great variety makes it difficult to distinguish the generic concepts to the Palette's CoPs structural organisations, and therefore implies more information and details on exactly what is beyond these terms and concepts. One concept that seems almost common to all the CoPs is the concept of "Group", which is quite general. However, the fact that most of the extracted terms come from data related to very few CoPs, doesn't allow making assumptions concerning the genericity degree of the concepts. This is why we're actually still dealing with the CoPs representatives to refine and improve this structuring.

[8] FR - Conseil d'administration.

Community related relations

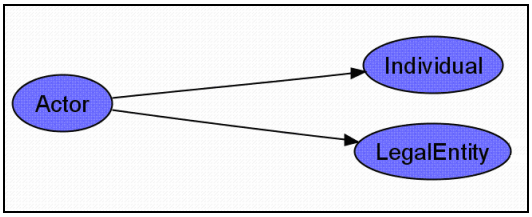
According to the identified Community related concepts common to all the CoPs, we summarise the main relations related to the concept of "Community" in the following table.

R-label	Sub-R-label	Domain	Range	Description
has-domain		CoP	Domain	A CoP focuses on a Domain.
has-field		CoP Actor	Field	A CoP, as well as an Actor has one or more Fields of knowledge.
has-objective		CoP	Objective	A CoP has an Objective to reach.
has-actor	has-member has-participant has-partner	CoP	Actor	A CoP involves Actors, which can be: Members, Participants, Partners.
has-characteristics		CoP	CoP's characteristics	A CoP has some characteristics (e.g. stage of development).
funded-by		Subvention	Legal entity	If a CoP is funded by means of Subventioning, then the Subvention is afforded by a Legal entity.
Initiated-by		CoP	Actor	A CoP can be initiated by an Actor, e.g. an Institution.
make-adhere		Individual	Company	Specific to ADIRA, where the membership of a person make its company adhere too.

Actor related concepts

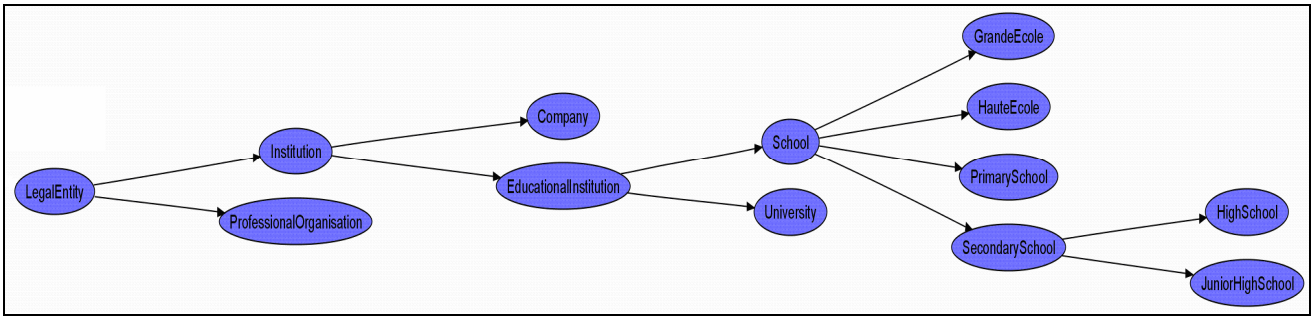
Common layer to all CoPs

The analysis of the documents related to Palette CoPs led us to define an **Actor** as being "an **Individual** or a **Legal entity** intervening in the CoP". This means that the Actors of a CoP are not only its members, but also the entities which interact with the CoP, which constitute its *environment*.



We categorised the "**Legal entities**" met in the CoPs documents, by relying on Wordnet as well as on the discussions and exchanges with the validators. We obtained two sub-concepts:

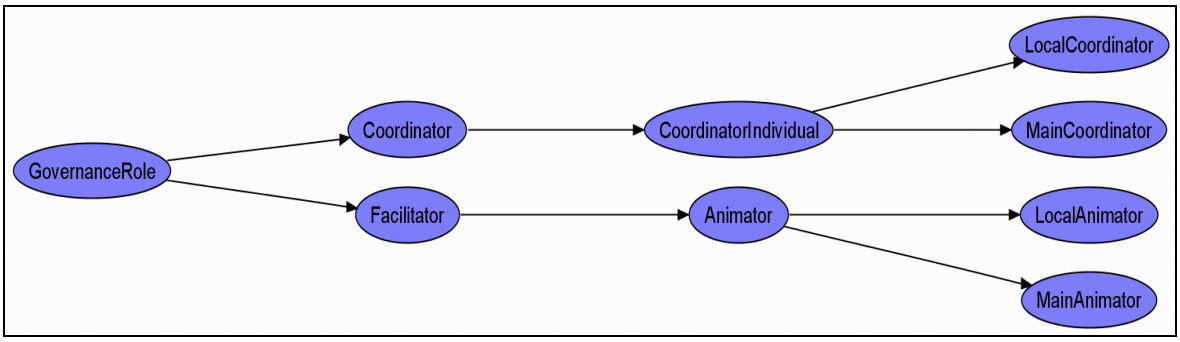
- Professional organisation[9]: an organisation of and for professional people [Wordnet]. This includes labour unions, federations … which are institutions dealing with ADIRA, making this concept specific to this CoP.
- **Institution**: an organisation founded and united for a specific purpose [Wordnet]. The institutions evoked in Palette's CoPs are the "companies" (e.g. ADIRA, BADGE) and the "educational institutions" (e.g. ePrep, Form@Hetice, @pretic).



The "Actors" of a CoP can be defined according to two axes:

- their personal characteristics, which have an implication on their being actors of the CoP, but still can identify them when outside the CoP. In particular, in the case of an "individual", this includes the profession, competencies, etc. We call these characteristics: the "**Individual profile**";
- the way they are involved in the CoP, which is defined by their engagement degree (member, partner, participant) as well as their position in the CoP: it's the Actor's "**Role in the CoP**".
  - **Governance role:** so as the CoP actors (particularly the members) interact, learn and share knowledge effectively, they need a support, which can take the form of different roles categorised as the "Governance roles". These consist of animating the community, organizing its life and activities, helping the members to engage in the community, etc.

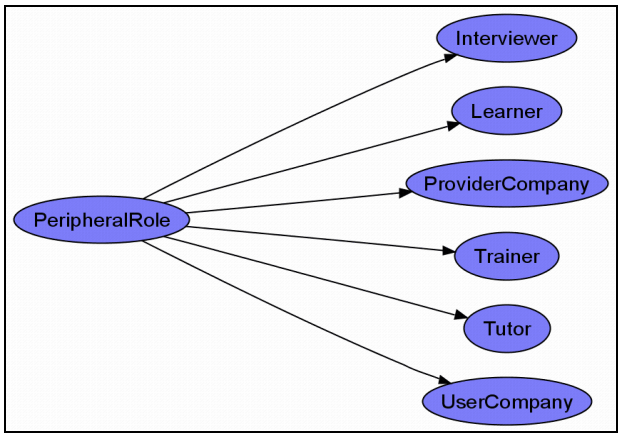
[9] FR - Organismes professionnels (ADIRA) : unions (e.g. Union des Industries Métallurgiques - UIMM), fédérations (e.g. SYNTEC), syndicats (e.g. MEDEF, CGPME).



- **Facilitator:** encourages the participation of the members, facilitates the interactions among them (e.g. Form@Hetice, Odysseia).
- **Coordinator:** organises and coordinates the activities and events of the community. The analysis of Palette's CoPs showed that there are two modes of coordinating the CoPs: the individual coordination (ensured by one main coordinator - e.g. ADIRA with the SGA - Executive secretary of the Association[10]) and the collective coordination (in the case of a CoP organised per groups or teams, where individual "local" coordinator belong to a coordination group or team - e.g. Form@Hetice with the Coordination team).
- **Animator:** guides and manages the community, ensures its development, relevance and effectiveness. An "Animator" thus plays both roles of "Facilitator" and "Coordinator" (e.g. Form@Hetice, Learn-Nett - where the term "coordinator of the project" is used to name the "Main animator" -, ADIRA - where the term "animator" is used to name the "Local animator" of a club or a work-group -).

o **Peripheral role:** they are the knowledge providers and receivers. We choose to characterise them as "peripheral" because they are more or less active in the CoP, more or less involved, their participation depends on the Actors who play these roles (personality, motivation, period, activity, etc.).

[10] FR - Secrétaire Générale de l'Association.



In ADIRA, among this category of roles, we find the companies which offer services (providers), and those which utilise these services (users). There's also the role of "Interviewer", who is a person which intervenes in some companies to interview the workers, so as to produce surveys on how the jobs and salaries evolve.

As for the roles of "Trainer" and "Tutor", they are met in several CoPs, such as Odysseia (the term "Educator" used in this CoP refers to the concept of "Trainer"), Form@Hetice, Did@cTIC, UX11, @pretic, and Doctoral Lancaster Program, Learn-Nett, BADGE, UX11 respectively.

Considering these two concepts, a deeper analysis may lead us to merge them.

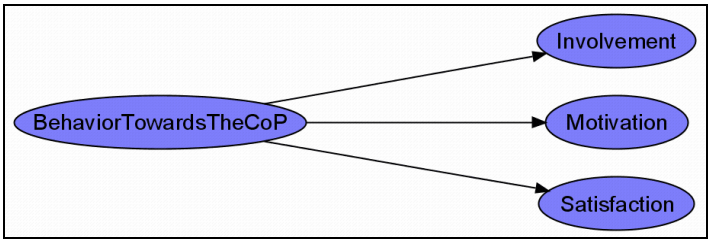
Finally, the sub-class "Learner" is probably the most significant role undertaken by almost all CoPs' members. This concept is explicitly mentioned in the documents related to the CoPs BADGE and UX11; and is referred to in Learn-Nett by use of the term "student"; by the same way, the concept of "Learner" is referred to in Did@cTIC by use of the term "participant".

- **Individual profile:** the "Individual profile" identifies a CoP member inside and outside the CoP he/she belongs to. The "Individual profile" comprises, for instance, the concepts of "Individual competency" and "**Occupation**". As CoPs deal with the concept of "Practice", CoPs' members are thus practitioners in the "Institution" they are affiliated to. Among the occupations which relate to Palette's CoPs we find, for instance: teachers, researchers, directors (department directors[11],

[11] FR - Directeurs des départements (Form@Hetice)

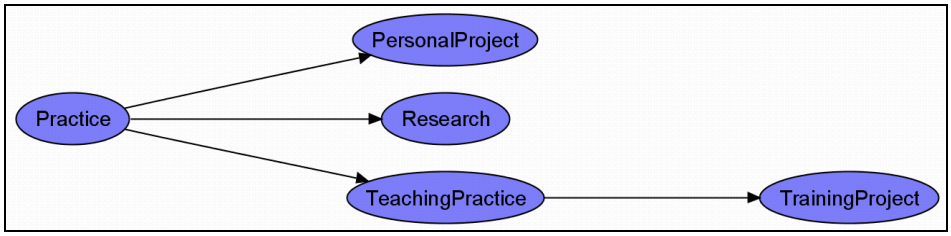
administration managers[12], etc.), educational developers, scientists, computer specialists, etc.

- **Behavior:** like the "Individual profile" and the "Role" contribute to characterizing the CoP member, the "Attitude" of the member towards the CoP s/he belongs to, provides more information about him/her inside the CoP, concerning the "motivation", "involvement" and "satisfaction" of the member. These sub-concepts give indication on the degree of activity of the member (more or less active in the CoP) and the benefits perceived by him/her.



- **Practice:** CoPs' members are practitioners in an "Institution", outside the CoP. They meet physically or virtually, by means of the CoP, which constitutes a channel for them to exchange about their common shared "Practice".

For instance, in Form@Hetice, the members (teachers in Belgian "Hautes Ecoles") exchange about their "personal projects", which are projects they conduct in their respective scholar establishments. The teachers involved in UX11 practice "Teaching" and "Research".



Low layer specific for each CoP

The subconcepts of "Practice", "Occupation" and "Peripheral role" are specific to each CoP. Moreover, the concepts of "User company", "Provider company", "interviewer and "Professional organisation" are specific to ADIRA.

[12] FR - Directeurs administratifs (ADIRA)

Actor related relations

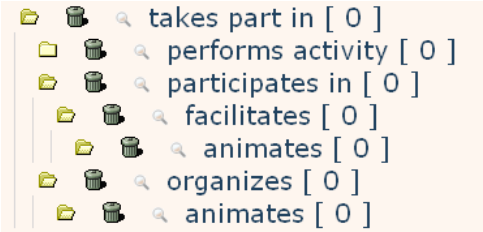
R-label	Domain	Range	Description
has-practice	Actor	Practice	An Actor of the CoP has a Practice outside the CoP.
has-field	CoP Actor	Field	A CoP, as well as an Actor has one or more Fields of knowledge.
interested-in	Actor	Domain Field Activity	An Actor can be interested in a Domain, a Field of knowledge, an Activity performed inside the CoP.
has-profile	Individual	Individual profile	An Individual has a profile, which defines him/her.
has-occupation	Individual	Occupation	An Individual has an occupation outside the CoP, which is part of his/her profile.
part-of-individual-profile	Occupation	Individual profile	An Individual has an occupation outside the CoP, which is part of his/her profile.
employer-of	Actor	Individual	An Actor of the CoP can be the employer of another actor (an Individual) of the CoP (e.g. ADIRA).
contestant	Company	Company	A Company can be in competition with another one (both being Actors of the CoP - e.g. ADIRA)
colleague	Individual	Individual	Two Individuals of the CoP can be colleagues in their occupation outside the CoP.
has-attitude	Actor	Behavior towards the CoP	An Actor of the CoP has a certain behavior, considering his/her motivation, satisfaction and involvement degree towards the CoP.
ordered-by	Activity	Actor	An Activity can be ordered by an Actor (a particular Role or an Institution, etc.).
assesses-activity	Actor	Activity	An Actor assesses an Activity performed in the CoP as being interesting, motivating, boring, etc.
possesses-competency	Actor	Competency	An Actor possesses a Competency linked to his personal characteristics and profile.

Hierarchical relations

Actors of a CoP, and especially those who are Members, perform activities, depending on criteria such as their respective objectives, profiles or roles in the CoP.

In general, considering an Activity, we find that there are three ways of intervening: performing it if it's an individual activity, participating if it's a collaborative activity, and organizing it.

Taking the "Role" criteria, whether the Activity is individual or collaborative, it can be organised by the "Coordinator" role.
As for the facilitation of the Activity, as it involves a particular engagement, we can consider it as being a way of participating in the Activity.
Finally, the animation of the Activity involves organizing and participating, and is undertaken by the "Animator" role.



Competency related concepts

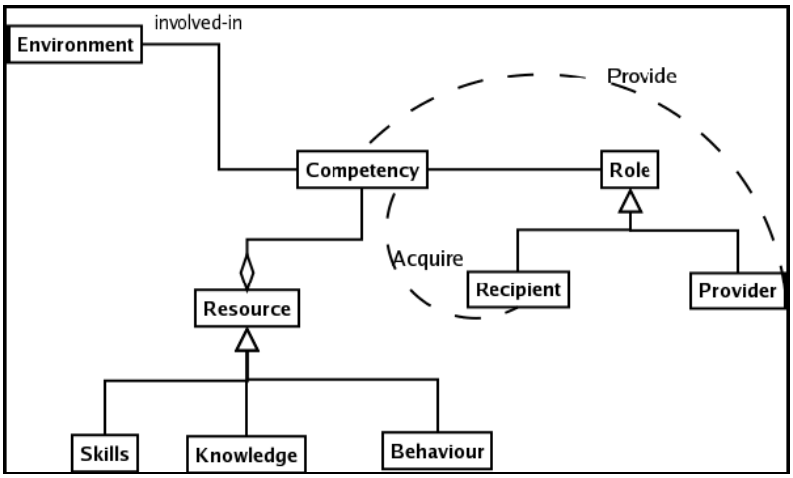


Figure 12 Competency generic model

The original generic model of competency (figure 12), proposed in D.KNO.01, contains the following *concepts* and *relations*:

- *Competency* which is defined as a set of Resources provided or to be acquired by an Actor that plays a particular Role in the Environment to perform an Activity;
- *Environment*, that describes the situation in which the Competency is involved: solving a problem, achieving an objective or a task;
- *Role* that is used to link Competency to the actors. An actor can be *Provider* or *Recipient* of a Competency;
- *Resource* which is the set of items that compose a Competency. It can be of three types: *Knowledge* (theoretical knowledge

(declarative or procedural)), *Skills* (capabilities of an actor to do something), *Behavior* (the way of behaving of the actor in a group or in a given situation).

The current CoP-dependent model of competency, which takes into account the terms, concepts and relations elicited from CoP information sources, is represented in Figures 13, 14, 15 and 16.

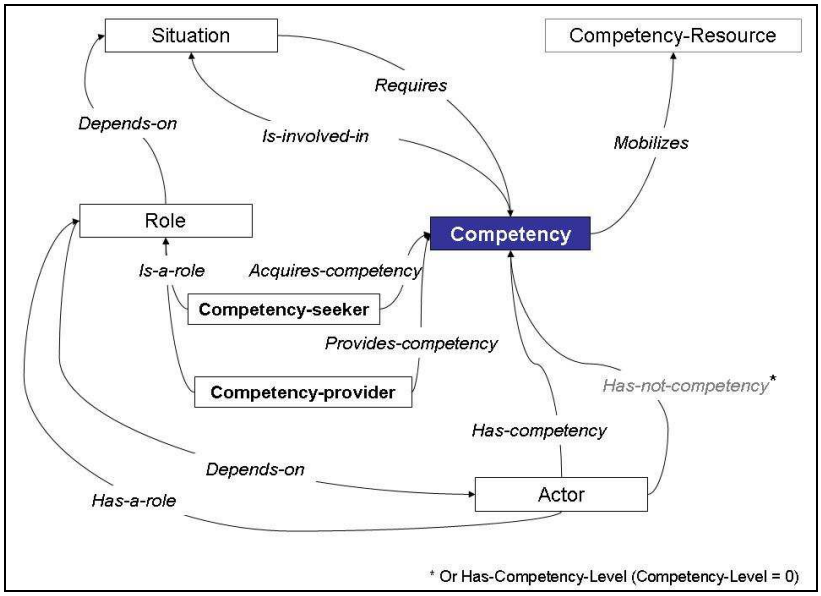


Figure 13 CoP-dependent competency model (1)

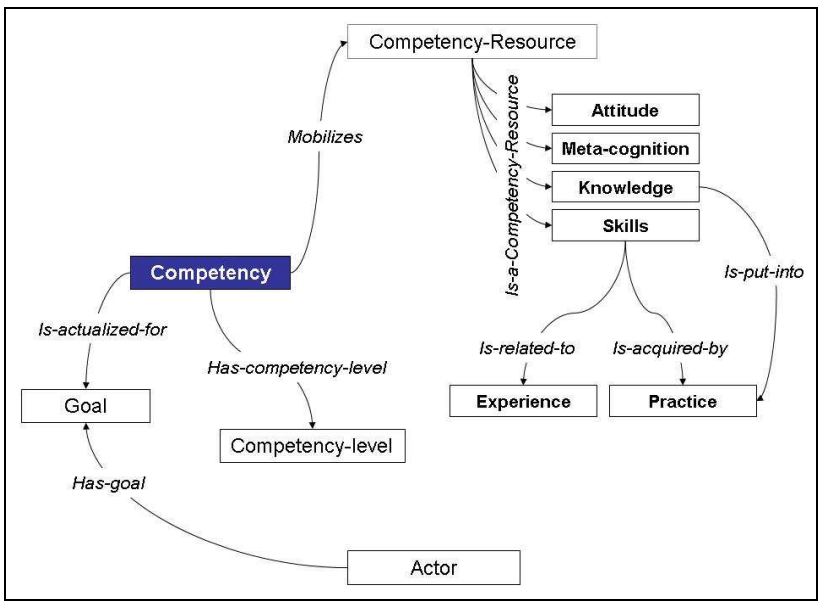


Figure 14 CoP-dependent competency model (2)

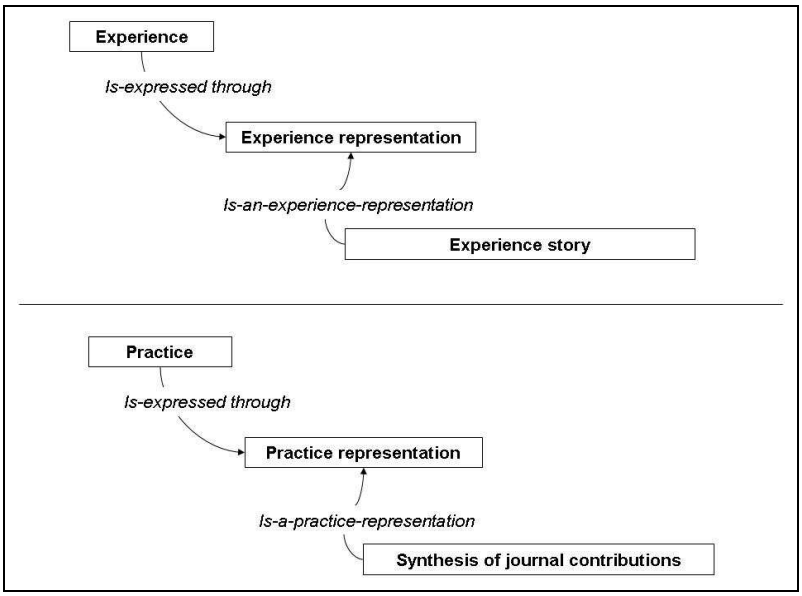


Figure 15 CoP-dependent competency model (3)

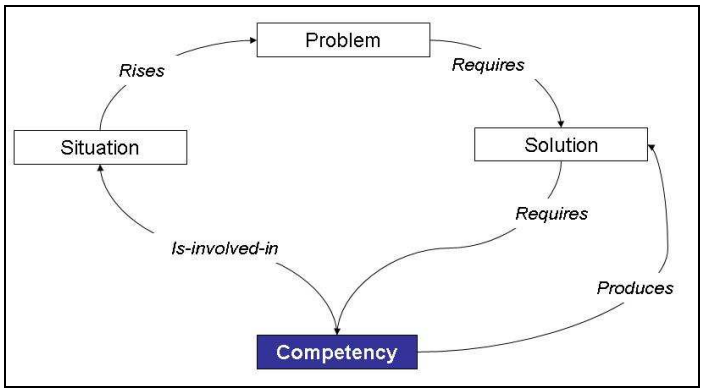


Figure 16 CoP-dependent competency model (4)

Knowledge can be decomposed into:

- *Knowledge of things*
  - Technical knowledge (e.g., Knowledge of Linux, Knowledge of Internet, Knowledge of the module UX11, Knowledge of Wikipedia; Knowing to ask a question)
  - Theoretical knowledge (e.g. knowledge of some theory)
- *Knowledge of people*
  - Knowledge of individuals (e.g., Knowledge of co-workers, Knowledge of the other group-members, Knowledge of each other's projects)
  - Knowledge of groups (e.g., Knowledge of community)

Knowledge can also be decomposed into:

- *Personal knowledge*

- *Common Knowledge*. This kind of knowledge can be also referred to as "Culture" (see, e.g., Community culture, Teaching culture)

Practice can be decomposed into:

- *Learning practice*
  - Practice of a tool (e.g., Practice of a platform, Practice of a forum)
- *Teaching practice*
  - Practices related to preparation of lectures
  - Practices related to management conflicts

Attitude can be decomposed into, or referred to as:

- *Attitude*
  - Attitude towards things (e.g., Attitude towards a forum)
  - Attitudes towards people
- *Mentality or Spirit* (e.g., Mentality about teaching; Community spirit; Evaluation spirit; Critical spirit)
- *View*
  - View of things
  - Learner's view
  - Tutor's view
  - Double view (embedding Learner's + Tutor's views)
- *Investment* and *Motivation*
- *Enrolment* and *Mobilization*
- *Value*
- *Feeling*
  - Fear (e.g. fear to ask questions in the forum)
  - Reassurance (e.g., to be reassured by the presence of the teacher)
- *Desire* and *Belief*

Goal (and *Project*) can be decomposed into, or referred to as:

- *Personal goal (project)*(e.g., personal technological project)
- *Common goal (project*)(e.g., Common project of students, Community common project)

Competency related relations

Relations dealing with competency are graphically represented in Figures 13, 14, 15 and 16 above. They can also be represented textually, e.g.:

- Is-involved-in (Competency, Situation)
- Requires (Situation, Competency), or (as a chain of relations) :
  - Rises (Situation, Problem)
  - Requires (Problem, Solution)
  - Requires (Solution, Competency)

  - Provides (Competency, Solution)
- Mobilizes (Competency, Competency-Resource)
- Is-a-competency-resource (Attitude | Meta-cognition | Knowledge | Skills, Competency-Resource)
- Is-related-to (Skills, Experience)
- Is-acquired-by (Skills, Practice)
- Is-put-into (Knowledge, Practice)
- Has-competency-level (Competency, Competency-level)
- Has-competency (Actor, Competency)
- Has-role (Actor, Role)
- Depends-on (Rose, Actor)
- Is-a-role (Competency-seeker | Competency-provider, Role)
- Acquires-competency (Competency-seeker, Competency)
- Provides-competency (Competency-provider, Competency)
- Has-goal (Actor, Goal)
- Is-actualized-for (Competency, Goal)
- Is-expressed-through (Experience, Experience-representation)
- Is-expressed-through (Practice, Practice-representation)
- Is-an-experience-representation (Experience-story, Experience-representation)
- Is-a-practice-representation (Synthesis-of-journal-contributions, Practice-representation)

Learner-profile related concepts

In order to build a CoP specific Learner Profile ontology, the Learner Profile generic model, originally introduced in the Palette deliverable D.KNO.01 (see the figure 17), was employed as a backbone.

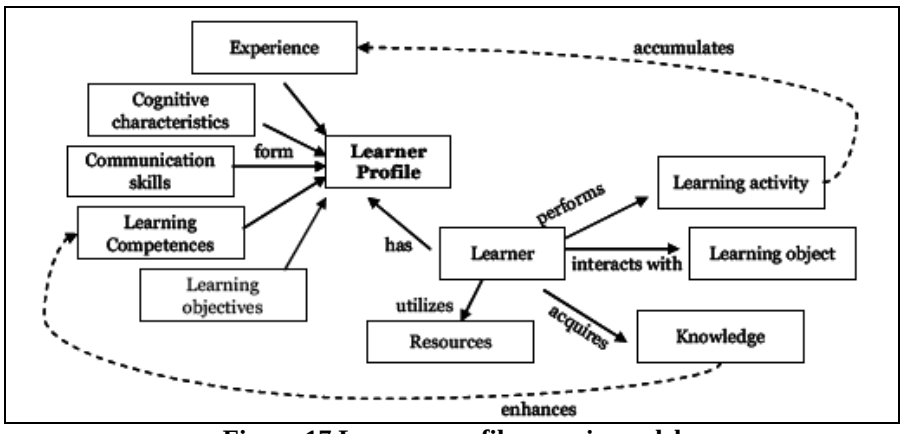


Figure 17 Learner-profile generic model

Despite the fact that this generic model was used, numerous terms were classified under the main concepts of the generic model. This was because

the unclassified terms did not really represent directly a Learner's Profile, still they were closely related to learning environments and could be of help in representing a Learner's profile within a CoP's context. To become more specific, the main terms of the ontology represent concepts such as a learner's sentiments, his/her learning activities and learning objects with which he/she interacts in order to learn. Several terms referring to the tutors' part and teaching resources were also identified and included to the ontology. As stated above, the reason of being for these concepts in a Learner Profile is the fact that such concepts can be useful for annotating resources related to learning activities and as a sequence to learners.

Collaboration and Activity/Process related concepts

Collaboration

The model of collaboration is composed of four concepts:

- **Objective**: the specific aim of the collaboration and the goal to reach;
- **Activity**: tasks accomplished during collaboration, such as discussions, exchanges of knowledge, of experience in order to achieve the objective of the collaboration;
- **Actor**: members of the CoP who take part in the collaboration;
- **Resource**: all that supports the collaboration or is created during collaboration.

In addition, collaboration can be defined according to some dimensions. These dimensions [Dillenbourg, 1999] are related to:

- The **geographical** position: it indicates if the participants belong to the same company or if the collaboration has an international dimension, if the collaboration occurs in face-to-face or at distance;
- The **time**: it concerns the temporal dimension of the collaboration: short term (hours), medium term (days), long term (months-years), synchronous or asynchronous collaboration;
- The **media** used to support collaboration: audio/visual, oral/written …
- The type of **interactions** occurring: number of participants (provider and recipient): 1-1, 1-many, many-many, with possible hierarchical relations among the participants.

In order to identify the type of collaboration of a CoP, classes related to the main dimensions have been added to the high-level ontology (defined in D.KNO.01): Geographical dimension, Temporal dimension, Media and Interaction.

According to these different criteria, we can determine which type(s) of collaboration occur(s) within a CoP.
For example, a mail could be addressed from one member to another member or to a group of members that are geographically dispersed, it is a visual asynchronous way of collaborate, because you can not be sure that everyone will read your mail as soon as you send it.
Another example of collaboration could be an audio-conference, it is an audio synchronous way of collaborate that implies at least 2 members that are in different places.

Other dimensions (inspired by [Deaudelin & Nault, 2003], [Weiseth et al., 2006]) related to the collaboration[13] and presenting another aspect of the collaboration are:

- The **engagement** towards the community,
- The **communication**
- And the **coordination**.

The **engagement** towards the community represents the emotional and psychological disposition; it results in the involvement of the members and their participation to reach the goal of the collaboration.
The engagement could be decomposed around 3 axes: the belonging to the community (availability and involvement of the participants), the cohesion (behaviour of the participants and will to know each other) and the productivity (progression of the attack of the common goal and personal objectives).

The **communication** is related to the process of exchange and sharing of ideas that lead to the emergence of new knowledge.
The communication could be classified around 3 processes: express one's ideas in order to share them, establish links between ideas in order to make emerge new ideas and finally structure the ideas.

The **coordination** aims to optimize the work and result of collaboration, *via* the effective agency of the activities, the resources and participants to reach the goal.
The coordination can be divided into 3 categories: the task to accomplish (negotiate - inform, argue and conclude - around the project, realise the project and manage the realisation of the project), the composition and constitution of the team (size of the group, homogeneity or heterogeneity (competencies, experience, age of the members)) and the animation (*via* forum, discussions…).

We can notice that the above dimensions (engagement, communication and coordination) are strongly related to the actor.

[13] In [Deaudelin & Nault, 2003], the collaboration is approached in a context of learning.

Process

The model of process involves four concepts:

- Activity: this is the transformation of an input into an output object.
- Role: the responsibilities ensured by a function, it refers to a specific level of competency and specialized skills.
- Resource: all that supports the realisation of the process
- Outcome: the product of the process, it can be injected in the resources.

The activities occurring in a CoP can be classified around 4 categories:

- Communication (transmission of information);
- Interaction (exchange and sharing);
- Negotiation (agree on ideas, make consensus - can concern the task to accomplish, the communication or the management of the interactions);
- Learning (acquisition of new knowledge).

Moreover, we can also apply the following dimensions in order to classify an activity:

- The geographical dimension (same company, international, face-to-face, at distance);
- The temporal dimension (short term, middle term or long term);
- The media used to support the activity (audio. visual).

Common layer to all CoPs

The main concepts of theses ontologies are: Objective, Activity, Actor, Resources, and Outcome.
As you can notice, there are similar concepts in the collaboration and process models: Actor and Role which define the same concept, and we find the concepts of Activity and Resource in the both models.
For each of these main concepts, terms that are common to all CoPs have been identified.
The terms considered as common to all CoPs are:

- Objective: aim, need, goal, wish, expectation, will, waiting, reason;
- Activity: communication, exchange, sharing, learning
- Actor;
- Resource: information, knowledge, experience, practice, document;
- Outcome: result.

Concerning the common layer for the classification of the collaboration, all the dimensions identified above (geography, time, media, interaction) are common to all CoPs, because different types of collaboration can occur in a CoP.

Specific ontology for each CoP

From the documents studied, terms were identified as representative and relevant, related to the high-level ontology.

These terms could be generic to all CoPs or specific to one CoP.
According to their level of specificity, the terms were tagged either generic or specific, with the name of the CoP to which it was attached.
For example, the outcome “Pedagogical guide” concerns only one CoP, so it takes part in the specific ontology of the CoP.
Unfortunately the documents describing the CoPs are not exhaustive and do not defined precisely all what happens within the CoP.
To build the complete specific ontology for each CoP, interviews have to be conducted with the CoP’s members and delegates.

Decision making related concepts

In order to build a CoP specific Decision Making ontology, the Decision Making generic model presented in Figure 18 was employed as a backbone. This model comprises the following main concepts. *Decision making* that refers to the cognitive process leading to the selection of a course of action among alternatives. This concept was the root concept of the proposed ontology. The *Resources* concept was employed to represent all the input that is used for making a decision. The *Outcome* concept was employed to represent the result(s) of a decision making activity. Primary

outcomes of decision making activities are decisions, but this is not always feasible. Thus, consensus or conflicts sharing of knowledge, lessons learned, etc. can also be considered as decision making outcomes of such activities. Another concept used for structuring the Decision Making ontology is the concept of *Actor* that refers to all the entities involved in the decision making activity. The *Activity* concept refers to a set of tasks related either by topic, dependencies, data, common skills, or deliverables. For instance, some typical decision making activities are collaboration, discussion and coordination.

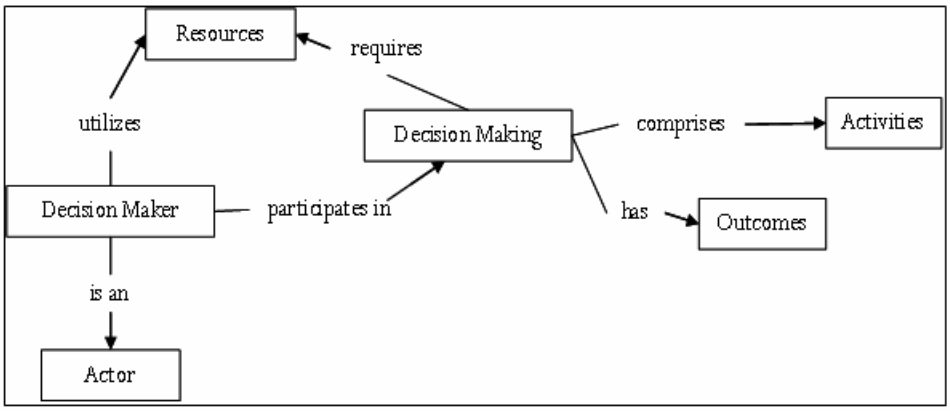


Figure 18 The decision making generic model

In structuring the hierarchy a set of problems occurred and decisions regarding the structuring had to be made. Even though the abovementioned generic model assisted as a guide, several terms identified during the extraction of terms from the Palette CoP sources were not easy to be classified.

Resource related concepts

Many studies are available in the literature on Resources and Tools, some of them can be directly used to build an ontology for CoPs, but the majority offers just a reduced viewpoint on resources that must be adapted to CoPs. We try to take some of these studies into account when they can be transformed to be compatible with what we obtain in the bottom-up phase (the terms extracted from the CoPs material).

On the one hand, tools used by CoPs were exhaustively described in [Wenger, 2001]. On the other hand, many existing ontologies tackle the issues of resources, but in the majority of cases this aspect was not a priority. The use of these existing ontologies about resources is then difficult. Nevertheless, we try to re-use as much material[14] as possible.

[14] Here is a list of the some resources we use:

We pay a specific attention to studies about ontologies of Documents: those which concern applications near to our domain e.g. [Dolog et al., 2003], but also some studies that make more general reflection on documents [Smith, 2005]. And we try, as much as possible, to remain compatible with standardized descriptions (Dublin Core) and with description of resources contained in e-learning standards (LOM and IMS).

Top level ontology of Resources and Tools

According to [Wenger, 2001] the tools that can support Communities of Practice offer the following facilities:

- Knowledge portals: the knowledge worker's desktop
- Team work: on-line project spaces
- Community management: website communities
- On-line conversations: discussion groups
- Synchronous interactions: on-line meeting spaces
- On-line instruction: community-oriented e-learning spaces
- Knowledge exchange: access to expertise
- Knowledge repositories: documenting practice
- Combining dimensions: convergence in the market

The extracted terms from Palette CoPs material contain description of tools that offer most of these facilities. However, in Palette CoPs material, we were confronted to a confusion, on the one hand, between tools (or the facilities they offer) and their functionalities (the needs of the CoPs). A clarification of this point, will allow us to use the ontology to answer for example the following questions by a CoP:

i. Which tool(s) can offer the functionality X?
ii. What functionalities did the tool Y offer?

And makes it possible to use the knowledge of a CoP about tools by another CoP, or to answer new needs of a CoP with a tool that may already exist in its universe.

The other confusion we've been confronted with is between tools and the resources or data they produce or use. These considerations led us to the necessity of describing in the ontology:

i. the facilities and functionalities that the CoPs need
ii. the tools implementing these functionalities
iii. the nature of data manipulated by these tools
iv. the status of the tools in the CoPs

---

http://www.imsglobal.org/metadata/index.html
http://dublincore.org/documents/2002/05/15/dcq-rdf-xml/

The previously cited dimensions represent a "macroscopic vision" of the tools in CoPs, *i.e.* the way a CoP, as an atomic entity, sees and interacts with tools. But, to be really useful, an ontology of tools should also describe a "microscopic vision" of the tools in the CoPs, *i.e.* the way members interact with tools and use them. This led us to describe dimensions like:

- Access rights
- Roles of users

One of the main objectives of a CoP is learning through *participation* and *reification* [Wenger, 1998b]. The description in an ontology of resources manipulated and produced by CoP should reflect these aspects. In particular, we should be able to represent *tacit knowledge* and the ways of capturing, codifying and storing it. In order to achieve these objectives, we need to propose a way to describe the resources that takes into account the following dimensions:

i. The nature of resources
ii. The roles they play in the CoP life (in Activities, Collaborations and Competences)
iii. How they are managed in the CoP
iv. The consequences they have on the CoP life

We also need to describe as for tools a "microscopic vision" of resources including:

i. Access rights to resources
ii. Roles of users in regard to resources

Taking these considerations into account, we represent the resources in a CoP following the dimensions describing:

- the nature of resource : answering the question "what kind of resource?". We distinguish three types Documents, Tools and Interactions
- the access rights to a resource : describing how a resource can be accessed and used
- the ownership of a resource : describing the owners of resources
- the temporal properties and versioning of resources: to describe validity and versions of resources

The exploration of these dimensions let us produce the common layer of the Resources and Tools ontology, in its presentation we will also include some examples of concepts specific to some CoPs that compose the specific layer of this ontology.

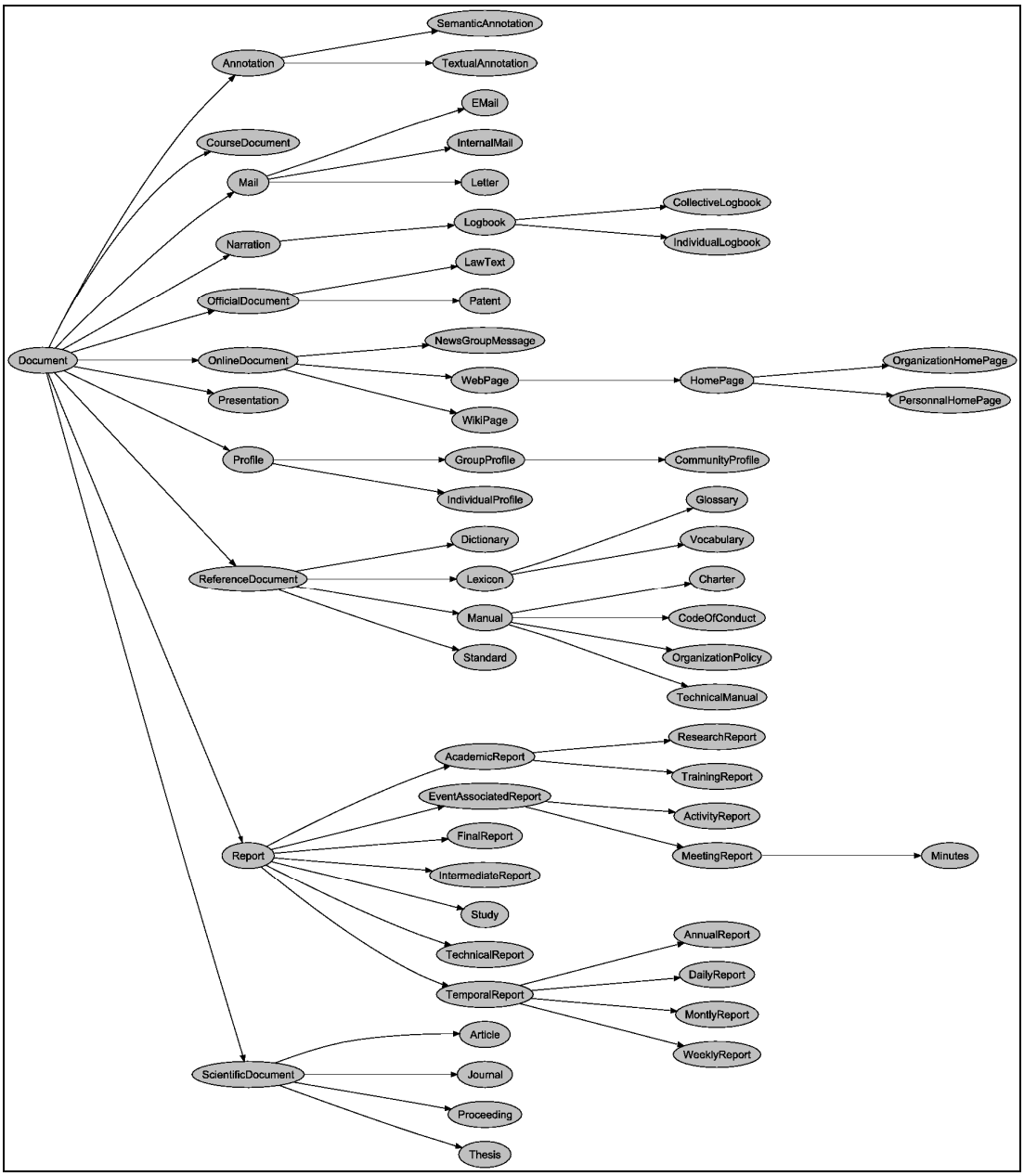
The common layer of Resources and Tools ontology

Let us see in details the dimensions of the Resources and Tools ontology:

Document

The CoPs use and produce a number of documents, these documents can be of different types. Some of these documents are associated to a specific to CoP life. For example, organisation policy that describes the rules organizing the community life, - or specific charter for the usage of information system of the CoP (e.g. in ADIRA). From the resources point of view, the capitalisation of knowledge takes different forms, reports are produced in many Palette CoPs', they can be final or intermediate, and associated to CoP activities. Another type of report is the logbooks that can be individual or collective (Meta-journal in Did@ctic). The CoPs members can also produce documents related to their practice (Training reports in UX11) or scientific documents (Doctoral Lancaster). The collaboration in the production of use of documents can take the form of annotations that can be either textual or semantic depending on the tools used to produce them. Some documents are associated to a specific domain, Pedagogical documents in the education domain (Learn-Nett, Did@ctic, UX11), or Official documents that are useful in management domain (ADIRA).

The Figure below gives a global view on the hierarchy of concepts describing documents.

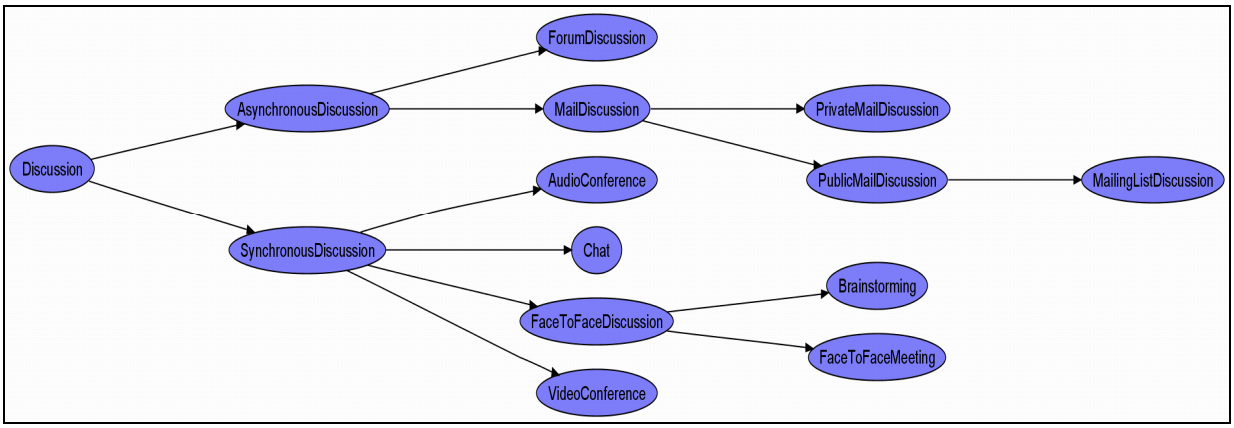


Excerpt of hierarchy of concepts describing documents

Interactions

The other important type of resources in the CoPs is associated to the interactions/discussions that hold within the CoP. These discussions can be synchronous (chat, audio and video conferences, etc.) or asynchronous (mail, forum, etc.). Almost all Palette CoPs are interested on easily access these interactions and archive them.

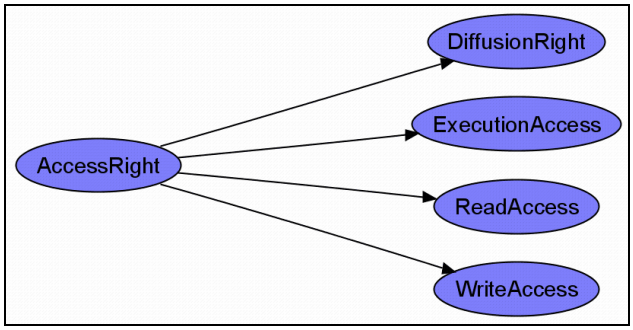
The figure below gives a view of the hierarchy of concepts describing the interactions:



Concept hierarchy describing discussions

Access rights

All the resources and tools inside the CoP is associated to an associated access right, these access rights can be on different types depending on the nature of resources and the actor who will access it. We have read (resp. write) access for resources that can be used to define the way an actor can view (resp. modify) resources present in the space of the CoP. We also have execution access to describe the permissions to use a tool.



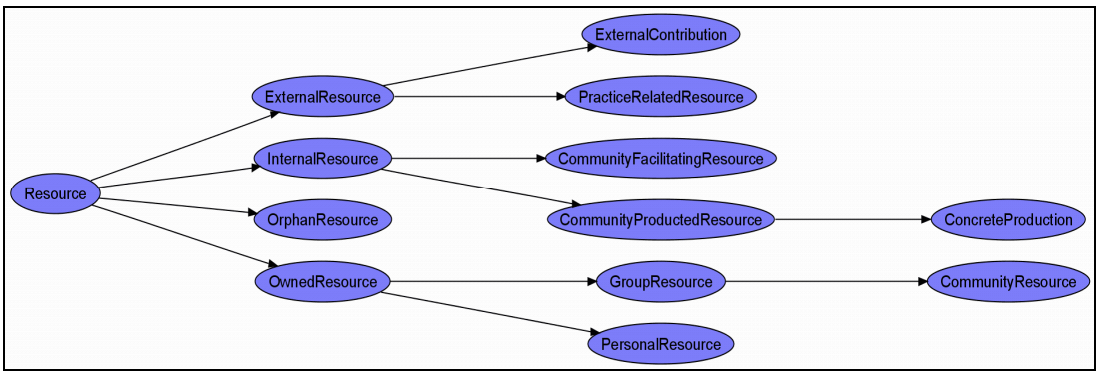
Access right concepts

Ownership

The resources manipulated by a CoP, can be either:

i. Internal *i.e.* the resources produced by the CoP or used to facilitate the CoP life, or related to the Practice.

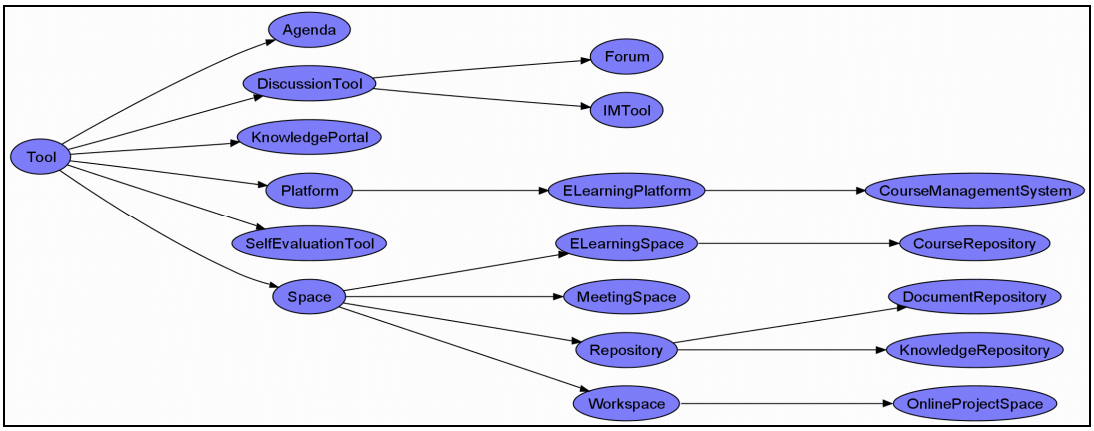
ii. Or external *i.e.* the external contribution to the CoP, or resources related to the practice, used to illustrate a problem or initiate a discussion … but that are not owned by the CoP, because of privacy issue for example.



Categorisation of resources ownership

Tools

Many tools are used in CoPs, the first category of tools is those who serve to store, archive, exchange resources: Spaces, that can be, generic *e.g.* repository for document, knowledge; task oriented *e.g.* e-Learning space… The second category of tools aim to facilitate the collaborations in the CoP, we find here discussion tools, common and individual agendas. We also found knowledge management and capitalisation tools.



Excerpts of hierarchy of tools

Lessons-learnt related concepts

So as to build a CoP specific Lessons-learnt ontology, the Lessons-learnt generic model, originally introduced in D.KNO.01 (see the figure 19), was employed as a backbone for elicitating terms from Palette CoPs' material.

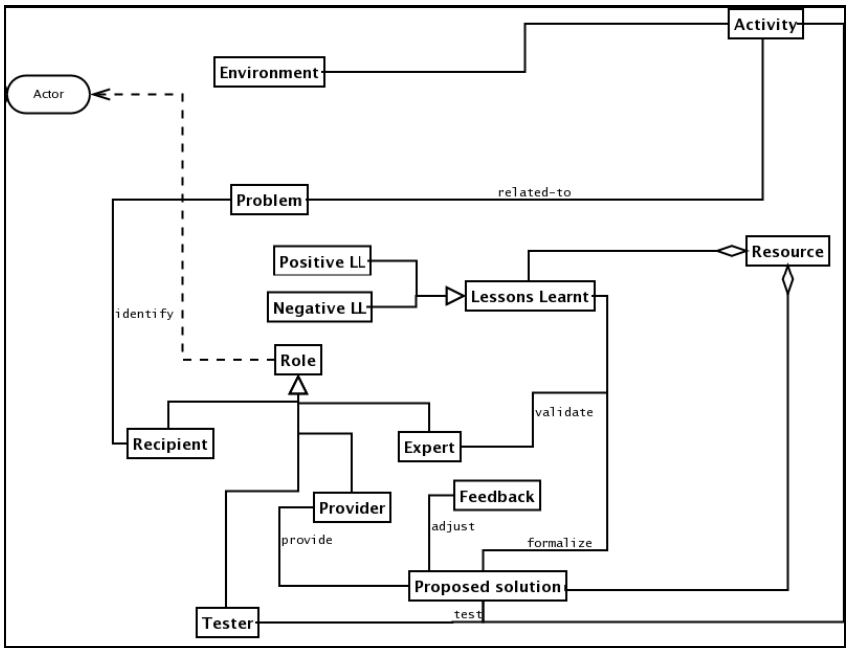


Figure 19 Lessons-learnt generic model

As a reminder, a *Lesson-learnt* is considered as the result of a process, collectively performed by the CoP's members; this process consists of analyzing ones' practices in given situations, and of drawing useful recommendations, from this analysis, that the CoP's members can refer to when encountering similar situations of practice.

Considering the information sources used in the Ontology development process, it appeared that the CoPs members interviews had not been conducted towards the evocation of the Lessons-learnt and their related aspects, thus conducting to a very poor set of extracted terms, not sufficient for eliciting a process of Lessons-learnt production within a CoP.

10.2 Return of experience

Model-guided construction of the hierarchy: which model(s)?

According to the Palette ontology construction methodology, each Knowledge engineer structured his/her set of concepts and relations according to the generic models elaborated in task 3.1 of WP3, e.g., the Collaboration model or the Competency model. These models have been designed independently of the modelling work about the notion of community of practice. Looking at this kind of work leads us to change our view of the models.

If we take for example the notion of a "competence" as it is defined by [Wenger, 2000] (see Table 11), we can see that this notion includes a social aspect that doesn't appear in the Competency generic model:

Competence must be understood as a part of a "social learning system"; competence is social. We can see also that the notion of "social competence" complements the notion of "personal experience", and that the two notions define the notion of learning.

Social learning system
Learning = social *competence* + personal *experience* Socially defined competence is always in interplay with our experience
Social standards of competence of our communities Competence is historically and socially defined. We define with each other what constitutes competence in a given context
Knowing is a matter of displaying competences defined in social communities

Table 11 Competence as defined by [Wenger, 2000] (Excerpts)

Concerning the **Collaboration model**, the construction of the O'CoP led us to revise our initial generic model and to complete it with other dimensions (such as geographical or temporal dimensions), in order to better identify and classify the different types of collaboration and activities occurring in a CoP, and to have more CoP-oriented models.

By the same way, in [Vidou, 2006], in our **Actor model**, we distinguished different roles of leaders, as suggested in [Wenger, 2008a]: inspirational leadership by thought leaders and recognized experts, day-to-day leadership by those who organize activities; classificatory leadership; interpersonal leadership; boundary leadership by those who connect the community to other communities; institutional leadership by those who maintain links with other organizational constituencies (in particular the official hierarchy); cutting-edge leadership. But since none of these terms related to leaders appeared in the information sources on the CoPs, these concepts were not considered as relevant and were not included in the ontology.

Part III

Tools supporting the Ontology Development process

Part III describes the tools that were offered to the knowledge engineers and to the validators for supporting the different steps of ontology development. Chapter 11 describes, from an end-user viewpoint, the tool ECCO that was recommended, chapter 12 some other tools used by a knowledge engineer and chapter 13 our return of experience on the use of the tools.

Chapter 11

ECCO (Editeur Collaboratif d'aide à la Conception d'Ontologies)

ECCO is a tool for collaborative creation of contextualised ontology, developed at INRIA.
It is accessible at http://argentera.inria.fr/ecco/index.jsp. The welcome screen is shown in Figure 20, you have to log in using the provided login and password.

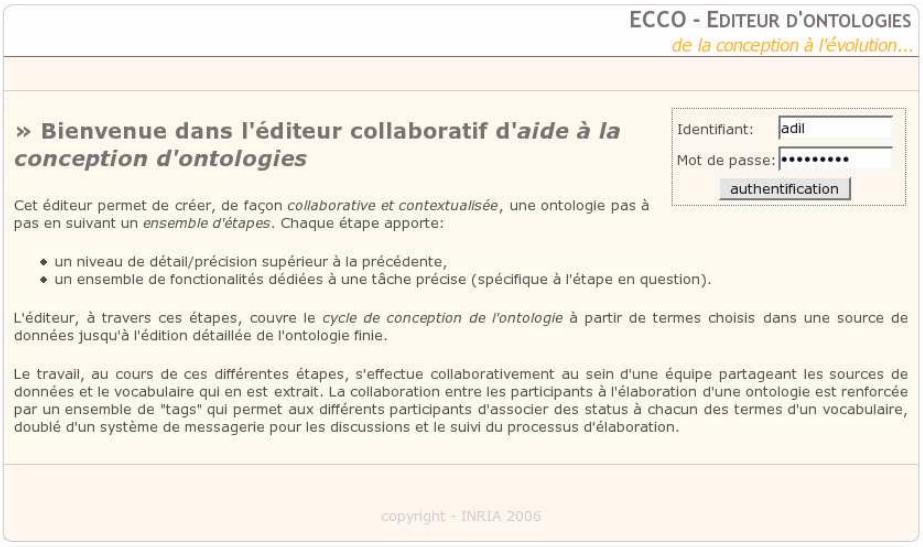


Figure 20 Welcome screen

11.1 Data sources and ontology selection

When you log into ECCO, the pages of the application are divided into three zones, of which a header and a footer that are the same during the whole process.
The header (Figure 21) is a navigation menu corresponding to the different steps in the ontology development process.

Figure 21 Header - Navigation menu

And the footer (Figure 22) gives some information (name and status) about the online users.

Figure 22 Footer - Information about online users

The central part of the page corresponds to the different sub-tasks of ontology development.
The first step consists of choosing a data source and an ontology, the first page presents the data sources contained in the system, the Figure 23 gives some details about the content of this page.

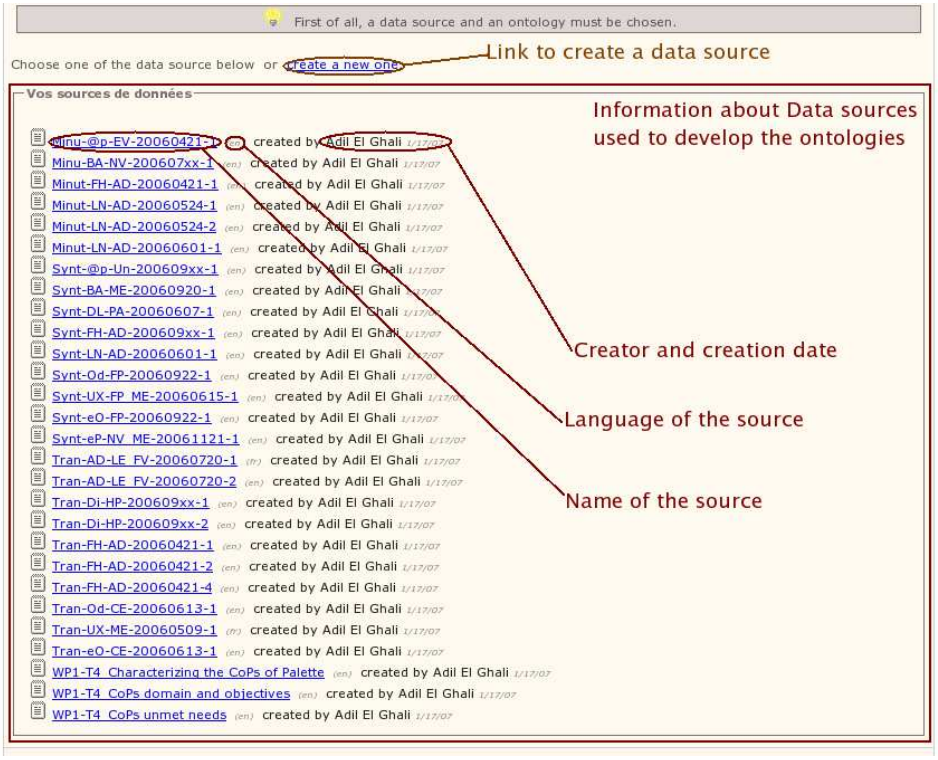


Figure 23 Data sources

To go further, you have to choose the data source you want to work on or create a new one, as shown in Figure 24, you have to give the source a name and to choose its language.

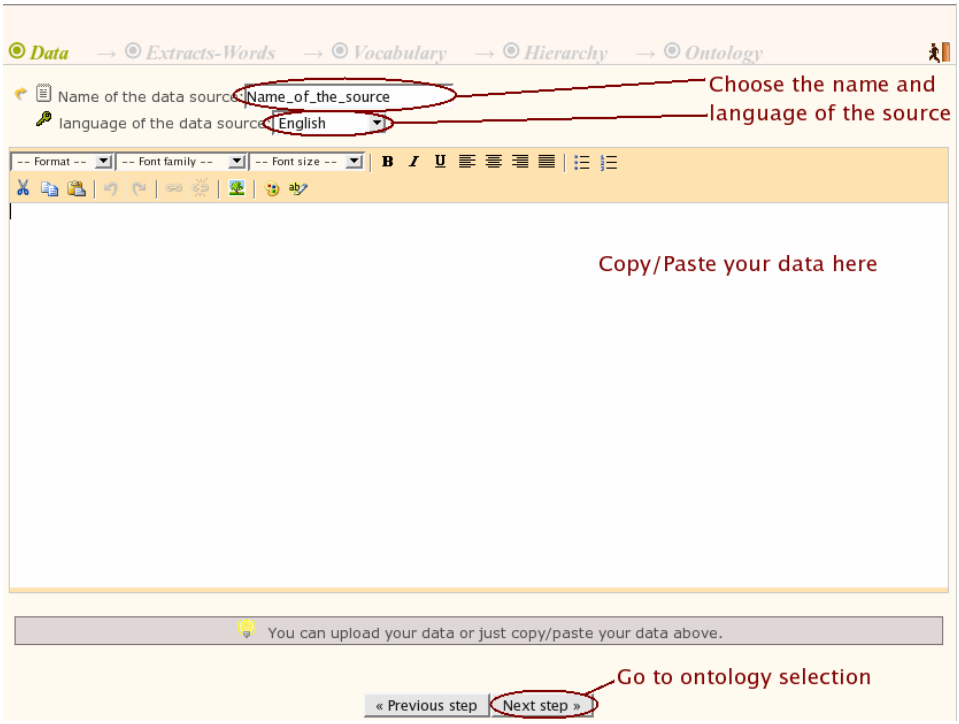


Figure 24 New source creation

After choosing a data source or creating a new on, you have to choose an ontology or create a new one.

11.2 Term extraction

At this step, ECCO shows the chosen data source and the list of the terms that have already been extracted. To extract a term you need to select it and to use the arrow between the text and the list. Then, you have to choose a context for the term by selecting it in the text and associating it with the term using the button (with question mark) on the right of the term. See Figure 25.

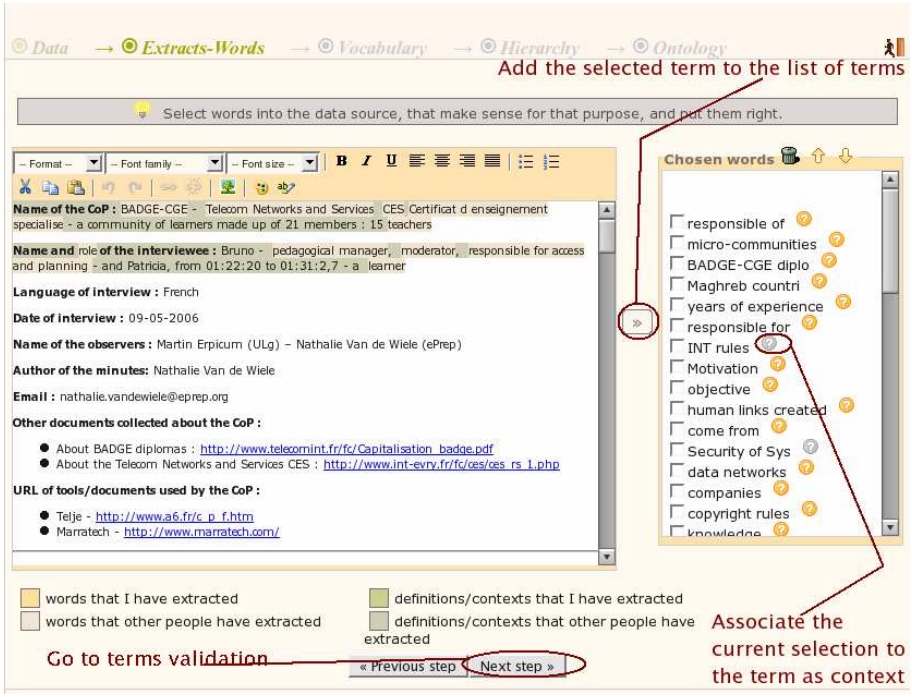


Figure 25 Terms and context selection

11.3 Validation of extracted terms

The vocabulary phase lets you define the chosen terms and validate them. The interface displays a list of terms and their contexts as shown in Figure 26. The language of the term and the contexts is displayed (the flag) if the language is different from the user's default one.

Figure 26 Vocabulary: the interface

You can (should) add a remark using the button  . And you can specify that a term will become a concept or a relation in the ontology using the button  .

You can filter the list of the terms by language (display only the terms in your default language), status (deprecated, draft, to be argued, to validate, validated), type (concept or relation) using the filtering menu (see Figure 27).

Figure 27 Vocabulary - Filtering menu

For each term (you must select the term by "coche la case") a number of operations can be performed:

11.3.1 Add a synonym or a translation

You can also add a synonym or a translation (specify the language) of the term, using "Add synonym" (Figure 28)

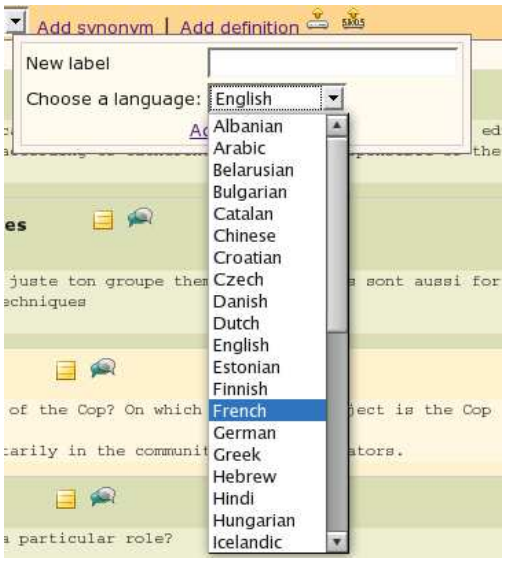


Figure 28 Add a synonym or a translation

11.3.2 Add a definition

You can (should!) add a definition of the term in your preferred language, using "Add definition". (Figure 29)

Figure 29 Add a definition

11.3.3 Modify the status of the term

You can modify the status of the term (deprecated, draft, to be argued, to validate, validated) using the menu "Tag as:", see Figure 30.

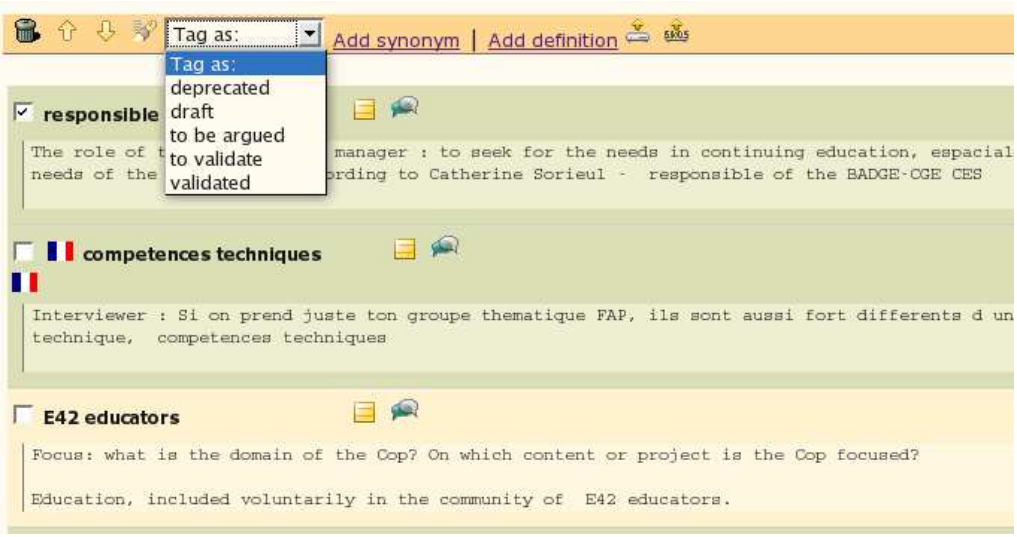
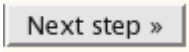


Figure 30 Change the status of a term

11.3.4 Delete or move the term

You can delete a term or change its position in the list by using  .

11.3.5 Save your work!!

When you want to interrupt your session, you have to click on the button  so that your work is saved. Then, you can close your session using  . Your session can stay opened during 1h30mn, so think to save your work regularly.

11.4 Hierarchy building

The next step allows one to build a hierarchy of the extracted terms. This can be done in the tree editor, you can drag-n-drop any concept (respectively property) into a concept (respectively property) that will become its parent. The Figure 31 shows this operation.

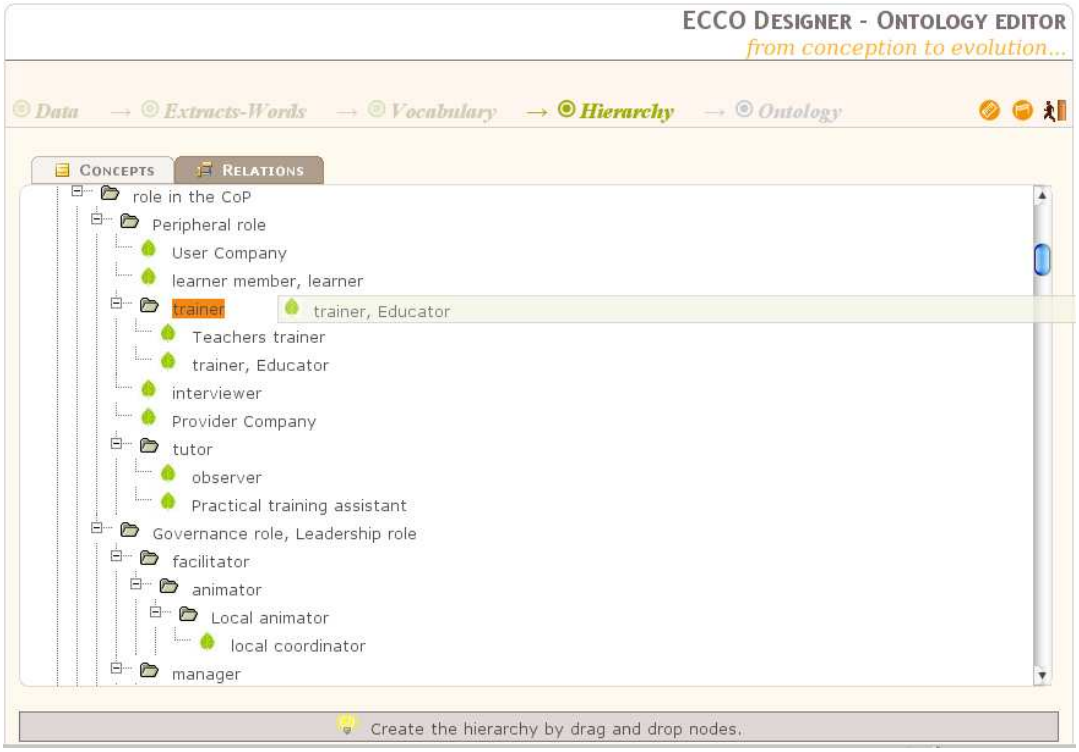


Figure 31 Hierarchy building

Since the number of terms to structure can be important, this phase will be easily achieved if the terms were grouped correctly in the previous phase.

Otherwise, multiple inheritance can not be represented at this step, and you have to encode it in the next one.

11.5 Ontology formalisation

At this step you can view and edit all the information associated to concepts and relations (ID, labels, super-classes/properties, characteristics of properties).

The Figure 32 shows the hierarchical view of concepts in this step, you can here collapse or expand any branch of the tree. Or view the ontology in a flat way.

Figure 32 Hierarchical view in the formalisation phase

For each concept or property the editor offer the possibility to change any characteristic. Figure 33 (respectively Figure 34) shows the edition interface for concepts (respectively properties)

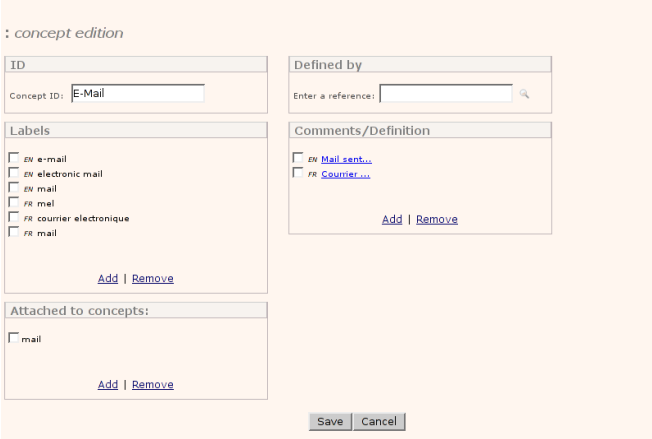


Figure 33 Concept characteristics edition

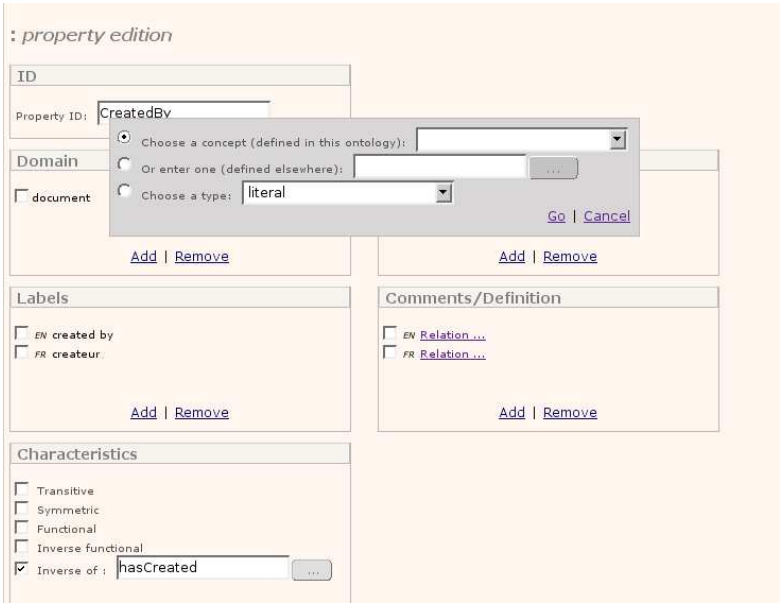


Figure 34 Properties characteristics edition

Chapter 12

Other tools used

12.1 Term extraction

To extract « candidate terms », one Knowledge engineer used a tool not initially considered in the methodology: the indexing function of Word (see Figure 35). With this tool, the Knowledge engineer coded the "term" as an "*Entrée*" (Entry) of the index, and the "context" part as a "*sous-entrée*" (subentry). The final index (Word format) was translated into a format legible by ECCO through a script[15].

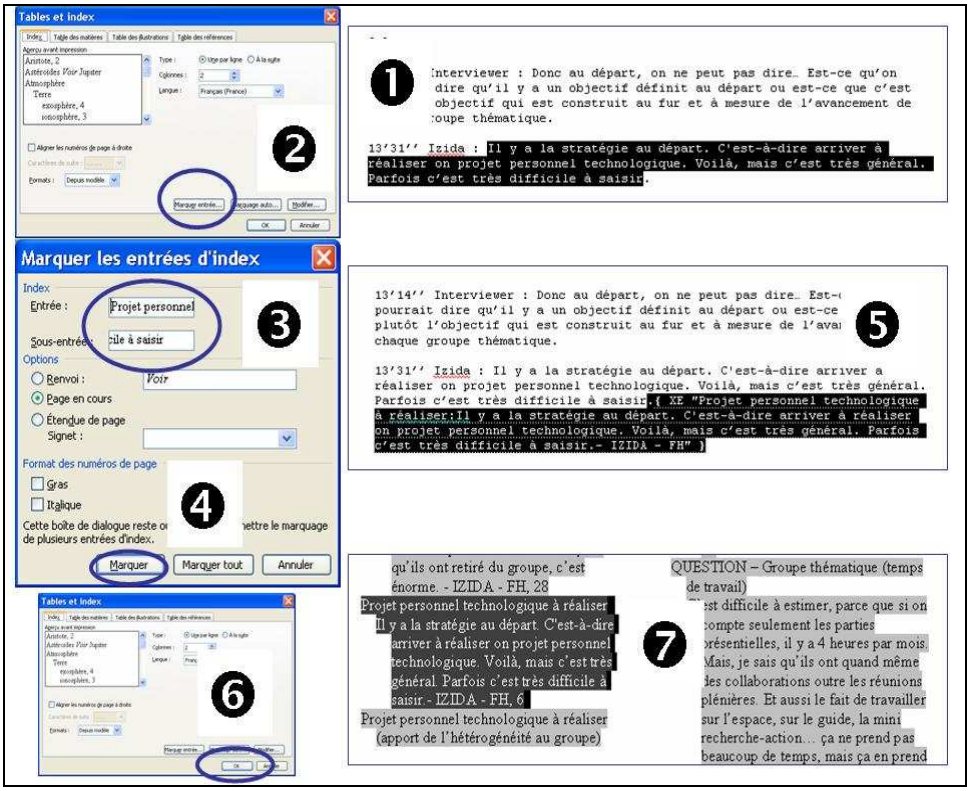


Figure 35 The indexing functionality of MS Word

[15] Written by Sylvain Dehors (INRIA, Acacia project).

12.2 Construction of the hierarchy

If ECCO was the main tool used to construct the hierarchy of concepts and relations, other tools were occasionally used to help perform the construction of the hierarchy, e.g. FreeMind.

- **FreeMind for preliminary categorisations**

FreeMind, a MindMap-like tool, was used to rapidly construct preliminary (informal, candidate) categorisations (see Figure 36).

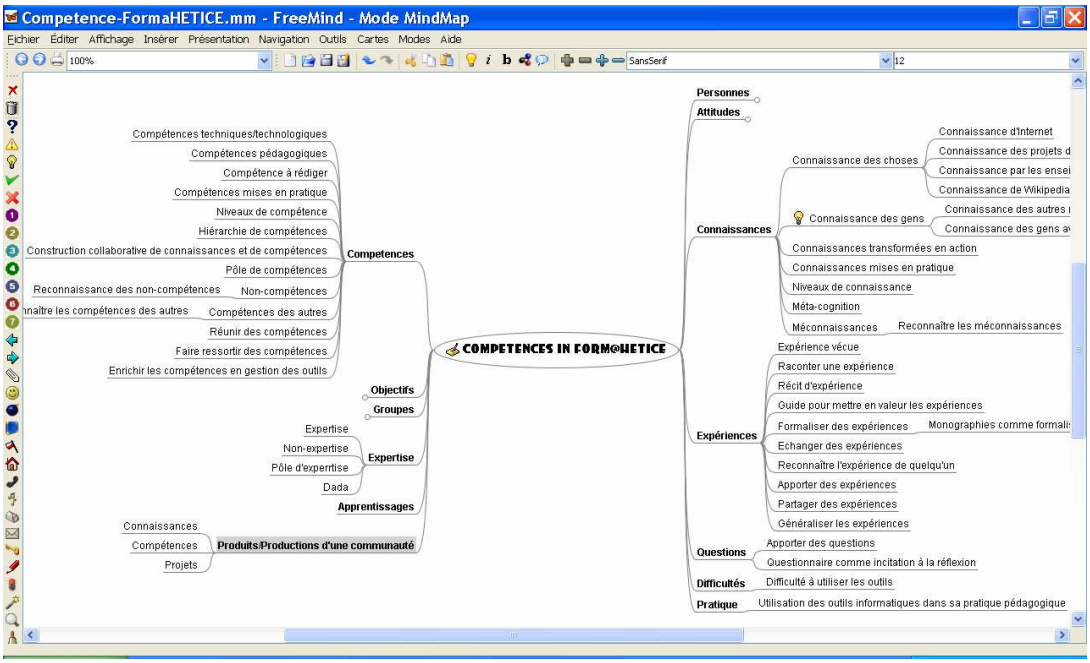


Figure 36 An example of use of FreeMind to get a preliminary informal categorisation of concepts related to competencies for the CoP Form@Hetice

Chapter 13

Return of experience on ECCO use and evolution

The use of ECCO led Knowledge engineers and CoP representatives to explicit their needs about an ontology editor (e.g., through the evocation of problems met with ECCO). This allowed or will allow making ECCO evolve to meet ECCO users' needs, by modifying existing functionalities or adding new functionalities. Below are some examples.

- **Creating a new higher-level concept**

The Knowledge engineer wanting to create a new higher-level concept (e.g., "Spirit") can't do it at the "Hierarchy" stage of ECCO. What a Knowledge engineer did in this case (see Table 12) was to take an existing lower-level concept (e.g., "Community spirit") as the concept which will represent the higher-level concept, without losing its status of sub-concept (in the mind of the Knowledge engineer). This term is both a concept and a sub-concept, or a concept and a super-concept. This way of doing biased the hierarchy. The possibility should be given in ECCO to create a new higher-level concept.

List of terms	Intended hierarchy	Implemented hierarchy
Community spirit Critical spirit and self-confidence Evaluation spirit	Spirit -**Community spirit** -Evaluation spirit -Critical spirit and self-confidence	**Community spirit** -Evaluation spirit -Critical spirit and self-confidence

Table 12 An example of a biased hierarchy due to a limitation of the ontology editor

- **Fusioning similar concepts**

The task of constructing the hierarchy with ECCO is, for example, the occasion of noticing multiple occurrences of what could be considered as the same concept (see Figure 37). A Knowledge engineer would like to solve this multiplicity of occurrences, using e.g. a fusioning functionality. Another possibility is to add a function "Synonym of", which will attach a term to a term already present in the Vocabulary.

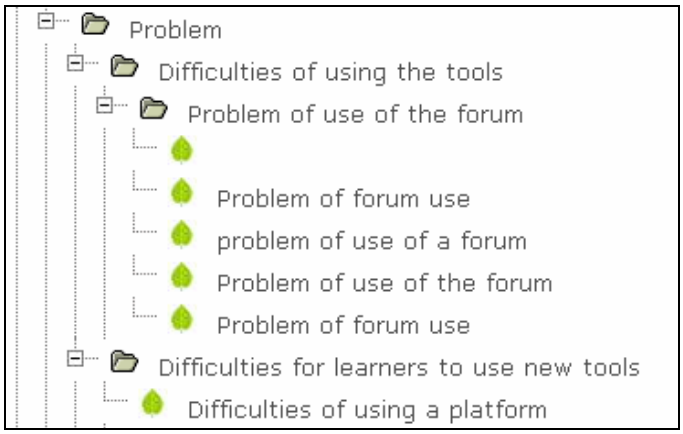


Figure 37 Noticing multiple occurrences of the "same" concept at the "Hierarchy" stage of ECCO.

- **Visualizing several hierarchies simultaneously**

As far as the current hierarchy depends on another hierarchy available in ECCO, it would be useful to simultaneously display the two hierarchies.

- **Transferring terms from the "Vocabulary" step to the "Hierarchy" step**

In ECCO, the terms gathered in a "Vocabulary" workspace are integrally transferred in the corresponding "Hierarchy" workspace, where the Knowledge engineer will perform the hierarchy construction task. When the number of concepts is large, the construction task is heavy. A solution could be to have two workspaces (or two windows in the workspace) at the Hierarchy stage: a "source" space (where all the concepts coming from the "Vocabulary" space will be gathered) and a "target" space (where concepts are put once sorted).

- **Searching for the meaning of terms**

To be sure of the meaning of a concept, a Knowledge engineer would have liked to display a definition or a context of the concept at hand. With ECCO, it was necessary to go back to the Vocabulary step to get this definition or context. A future version of ECCO could provide the user with a function displaying the definition or the context of a term at the Hierarchy step.

Chapter 14

Conclusions

Cooperative Building of the Ontology

The construction of the O'CoP ontology was a distributed, cooperative process between:

- Ontologists stemming from different teams and focusing on different aspects of the ontology since each ontologist was guided by one generic model and focused on a kind of concept
- Validators offering the viewpoints of CoP representatives.

This led to the need of integration of different viewpoints. The different ontologists had various ways of modelling knowledge: for example, the concept of Activity was needed for modelling Collaboration, but was also useful for modelling Competency and for modelling Resource. Three different ontologies modelled such concepts related to Activity, but with various detail grains and various perspectives.

Our approach was both bottom-up (since it relied on a deep analysis of the information sources on the CoPs) and top-down (since this analysis was guided by the generic models previously proposed in D.KNO.01 and in [Vidou et al., 2006]).

As emphasised in the chapter on terminological analysis, the different CoPs adopted different terminologies, sometimes quite specific to the CoP and rather different from the terminology usually found in literature on CoPs. Therefore, it was not possible to consider the concepts offered by researchers on CoPs as part of the common layer of the ontology as it would have seemed natural. For example, the various kinds of leaders stressed in [Wenger, 1998a] did not appear in the information sources about the Palette CoPs and therefore were not considered as relevant to be included in the ontology.

Comparison with Related Work

We must also recall the objective of the O'CoP ontology, i.e. to enable to annotate the CoP members and the CoP resources. This ontology partially relies on a model of CoP since it must enable annotation of the CoP members. But since the aim of this model of CoP is specific and guided by our applicative objective, our model of CoP differs from the CoP model presented in the document "WP 1 - Task 4 - Transversal analysis", (Version 0.5, 02-02-2007). This difference is due to the fact that an ontology is not a universal ontology but is influenced by its applicative objective (here, annotation of CoP members and resources).

The link between CoPs and ontologies was also studied in some recent work. In [O'Hara et al, 2002], the authors present a method based on analysis of the relationships between instances of a given ontology in order to identify potential CoPs in an organisation. In [Bettahar et al., 2006], the authors develop an ontology aimed at enabling services among a civil servant CoP; [Floyd & Ulena, 2005] studies the design of situated ontologies for knowledge sharing in a CoP. But the role of all these ontologies is quite different from our ontology that aims at both modelling the notion of CoP, and at annotating CoP's resources.

Further Work

Another aspect emphasised is the fact that for each CoP, some specific domain concepts can be useful for annotating the CoP resources: for example, a CoP constituted of resource-persons supporting the use of ICT (Information and Communication Technologies) in schools may exchange mails and discussions in forums, that should be annotated by concepts about ICT. Therefore the CoP-dependent ontology needs to be extended through other information sources more detailed than the CoP interview transcriptions. Moreover, each CoP may need to make evolve its own ontology coherently. Therefore, evolution techniques and user-friendly interfaces are needed in this purpose. Some ontology-based tools of the partners such as ECCO, SweetWiki or Generis are available for enabling the CoPs to make evolve their ontology manually or collaboratively.
As a further work, we will thus offer a support to development of at least one CoP's ontology.

Moreover, the use-cases identified through the work in teams A, B and C, enabled us to determine the Knowledge Management Services that will be developed for each of these teams. They will rely on the O'CoP ontology possibly extended in case of need.

Table of authors

INTRODUCTION	*Rose Dieng-Kuntz*
ONTOLOGY DEVELOPMENT METHODOLOGY	*Adil El Ghali, Alain Giboin, Amira Tifous, Rose Dieng-Kuntz*
RETURN OF EXPERIENCE ON THE METHOD USE	*Alain Giboin & Amira Tifous*
MAIN RESULTS	
INFORMATION SOURCE COLLECTION	*Alain Giboin*
TERMINOLOGICAL ANALYSIS	
Characteristics of the terms w.r.t. the different concepts	
Community and Actors	*Amira Tifous*
Competency	*Alain Giboin*
Learner profile	*Christina E. Evangelou*
Collaboration and Process	*Géraldine Vidou*
Decision making	*Christina E. Evangelou*
Resources and Tools	*Adil El Ghali*
Characteristics of the terms w.r.t. the different CoPs	
Community and Actor	*Amira Tifous*
Learner profile	*Christina E. Evangelou*
Decision making	*Christina E. Evangelou*
Collaboration and Process	*Géraldine Vidou*
Tools and Resources	*Adil El Ghali*
Lessons-learnt	*Amira Tifous*
Return of experience	*Alain Giboin*
ONTOLOGY CONCEPTUALISATION AND STRUCTURING PHASE	
Structure of the O'CoP ontology	*Rose Dieng-Kuntz*
Description of the main concepts of the ontology	
Community related concepts	*Rose Dieng-Kuntz & Amira Tifous*
Actor related concepts	*Amira Tifous*
Competency related concepts	*Alain Giboin*
Learner-profile related concepts	*Christina E. Evangelou*
Collaboration and Activity/Process related concepts	*Géraldine Vidou*
Decision making related concepts	*Christina E. Evangelou*
Resource related concepts	*Adil El Ghali*
Lessons-learnt related concepts	*Amira Tifous*
Return of experience	*Rose Dieng-Kuntz, Alain Giboin, Géraldine Vidou*
TOOLS SUPPORTING THE ONTOLOGY DEVELOPMENT PROCESS	
ECCO	*Adil El Ghali & Priscille Durville*
OTHER TOOLS USED	*Alain Giboin*
RETURN OF EXPERIENCE ON ECCO USE AND EVOLUTION	*Alain Giboin*
CONCLUSIONS	*Rose Dieng-Kuntz*

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List of figures

Figure 1 The Palette Competency model ---------- 14
Figure 2 Schema summarising the Ontology development process---------- 25
Figure 3 Example of transcription and minutes---------- 31
Figure 4 Excerpt from the synthesis of Learn-Nett CoP ---------- 32
Figure 5 The Palette Lessons-learnt model ---------- 33
Figure 6 Competency as represented in the [Schmidt & Kunzmann, 2006] model. In the model, competencies are defined as "bundles of work-relevant skills, knowledge and abilities" ---------- 34
Figure 7 Number of Terms and Contexts per Generic model ---------- 40
Figure 8 Average number of Contexts per Term ---------- 41
Figure 9 Distribution of the Contexts per CoPs---------- 41
Figure 10 Structure of the O'CoP ontology ---------- 50
Figure 11 Generic model for a community ---------- 52
Figure 12 Competency generic model ---------- 63
Figure 13 CoP-dependent competency model -------- **Erreur ! Signet non défini.**
Figure 14 CoP-dependent competency model -------- **Erreur ! Signet non défini.**
Figure 15 CoP-dependent competency model -------- **Erreur ! Signet non défini.**
Figure 16 CoP-dependent competency model -------- **Erreur ! Signet non défini.**
Figure 17 Learner-profile generic model---------- 67
Figure 18 The decision making generic model ---------- 72
Figure 19 Lessons-learnt generic model ---------- 79
Figure 20 Welcome screen---------- 82
Figure 21 Header - Navigation menu ---------- 82
Figure 22 Footer - Information about online users ---------- 83
Figure 23 Data sources ---------- 83
Figure 24 New source creation---------- 84
Figure 25 Terms and context selection ---------- 85
Figure 26 Vocabulary: the interface---------- 85
Figure 27 Vocabulary - Filtering menu---------- 86
Figure 28 Add a synonym or a translation ---------- 87
Figure 29 Add a definition ---------- 87
Figure 30 Change the status of a term ---------- 88
Figure 31 Hierarchy building---------- 89
Figure 32 Hierarchical view in the formalization phase ---------- 90
Figure 33 Concept characteristics edition---------- 90
Figure 34 Properties characteristics edition ---------- 91
Figure 35 The indexing functionality of MS Word ---------- 92
Figure 36 An example of use of FreeMind to get a preliminary informal categorization of concepts related to competencies for the CoP Form@Hetice- 93
Figure 37 Noticing multiple occurrences of the "same" concept at the "Hierarchy" stage of ECCO. ---------- 95

List of tables

Table 1 Types of available Palette's documents related to CoPs----------11
Table 2 Examples of informal and formal competency questions ----------27
Table 3 Scenarios descriptors of CoPs [Künzel & Daele, 2006]----------33
Table 4 Interview questions for CoP observers----------33
Table 5 Taxonomies of Cognitive Skills [Paquette et al., 2006] ----------34
Table 6 Summary of Palette sources----------35
Table 7 Examples of formulations of validation goals and criteria by two validators ----------46
Table 8 A specific example of a possible use of tags in WikiPrepas (SweetWiki) ----------46
Table 9 The term selection criteria of the Palette Knowledge engineer working with the Learner Profile and Decision Making generic models of Palette--------47
Table 10 A training procedure used with one of the validators----------49
Table 11 Competence as defined by [Wenger, 2000] (Excerpts) ----------80
Table 12 An example of a biased hierarchization due to a limitation of the ontology editor. ----------94