ICOPER

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e*Content*plus

Table of Contents

1 INTRODUCTION 4

2 BACKGROUND 4

2.1 OUTCOME-BASED EDUCATION 4
2.2 LEARNING OUTCOME FRAMEWORKS AND MODELS 6
2.2.1 European Qualifications Framework (EQF) 7
2.2.2 European e-Competence Framework (eCF) 10
2.2.3 Bloom's taxonomy 12
2.2.4 The SHL Universal Competency Framework 12
*2.2.5 O*NET 13*
2.2.6 Context models 14

3 METHODOLOGY 16

3.1 UNIVERSITY CASES 16
3.2 STANDARDS 16

4 ANALYSIS OF UNIVERSITY EXPERIENCE WITH COMPETENCES 17

4.1 STRATEGIC QUESTIONS 17
4.1.1 Meaning of the term "learning outcome" at universities 17
4.1.2 Development of learning outcome oriented curricula 17
4.2 DESIGN/IMPLEMENTATION ISSUES 18
4.3 ASSESSMENT/GOVERNANCE ISSUES 19
4.4 CONCLUSION 19

5 RELEVANT LEARNING OUTCOME STANDARDS 20

5.1 IEEE REUSABLE COMPETENCY DEFINITION (IEEE RCD) 20
5.1.1 General introduction 20
5.1.2 Purpose and scope 20
5.1.3 Technical perspectives 21
5.1.4 Summary 21
5.2 IEEE COMPETENCY PROFILE STANDARD (DRAFT TO BE SUBMITTED (IEEE CP) 21
5.2.1 General introduction 21
5.2.2 Purpose and scope 22
5.2.3 Technical perspectives 22
5.2.4 Summary 23
5.3 HR-XML COMPETENCY STANDARD 23
5.3.1 Purpose and scope 24
5.3.2 Technical perspectives 25
5.3.3 Use of HR-XML in industry 25
5.3.4 Examples of use 26
5.3.5 Summary 26
5.4 CEN METADATA FOR LEARNING OPPORTUNITIES (MLO) 27
5.4.1 General introduction 27
5.4.2 Purpose and scope 27
5.4.3 Technical perspectives 28
5.4.4 Summary 28
5.5 JISC LEAP2A 28
5.5.1 General introduction 28
5.5.2 Purpose and scope 29
5.5.3 Technical perspectives 30
5.5.4 Summary 30
5.6 CONCLUSIONS 30

6 OUTCOMES 32

6.1 CONCEPTS 33
6.1.1 Learning outcomes 33
6.1.2 Learning outcome profiles 33

6.1.3 Context of learning outcomes ... *34*
6.1.4 Learning outcome qualifiers ... *34*
6.1.5 Evidence records ... *34*
6.2 OUTCOME-BASED LEARNING USE CASES ... 34
6.3 LEARNING OUTCOME STANDARDS ... 44
6.4 CHALLENGES AND OPPORTUNITIES ... 45
6.4.1 University experience with learning outcomes ... *45*
6.4.2 Learning outcome standards ... *45*

7 CONCLUSIONS ... 46

REFERENCES ... 47

8 APPENDIX 1 ... 50

9 APPENDIX 2 ... 51

1 Introduction

Following the European Qualification Framework (EQF, 2000) recommendation, the ICOPER project has the aim to provide best practice guidelines and specifications of learning outcome-based educational environments. This includes demonstration of efficient and effective approaches of describing and exchanging learning outcomes and their related units of learning.

Being the focus of WP2, the interoperability of learning outcome definitions constitutes a major challenge for outcome-based learning designs and its implementations. Currently, higher education institutions have not yet adopted standards for learning outcome definitions, resulting in inefficiencies for, both outcome-based learning design and outcome-based discovery, access and re-use of units of learning.

This report introduces and analyses the building blocks and standards related to learning outcomes. The goal of the report is to:

- Study the use and understanding of learning outcomes in the academic domain (universities).
- Evaluate the current learning outcomes (knowledge, skills and competences) standards and their applicability for the ICOPER project.
- Identify and define concepts, building blocks and use cases of a learning outcome-based learning system.

It is important to note that some communities differentiate between competence and competency. In the ICOPER project, both terms have the same meaning. The EQF uses the term competence and it's the term used in this deliverable. The term competency appears in this document in some places because it is part of an official name, diagram or function of a standard.

This report is structured as follows: Section 2 introduces the concept of outcome-based education. In Section 3, the methodology used to analyse (1) university experience with learning outcomes and (2) current standards related to learning outcomes is described. Results of university experience with outcome-based curricula development are provided in Section 4. Section 5 discusses standards used to describe learning outcome definitions and learning outcome profiles of learners. The ICOPER approach for modelling learning outcome building blocks is introduced in Section 6. Conclusions are given in Section 7.

2 Background

2.1 Outcome-based education

Nowadays we witness technological, economic, and organizational changes that have stronger impact on our society than ever in the past. Everybody is responsible for planning their career and to enhance her employability potential. Knowledge society demands continuous development and management of knowledge, skills and competences at the individual-, group- and organizational levels that represent distinct fields with their own approaches and tooling. Lifelong learning has become necessary as the abovementioned changes imply new requirements on people to keep or find interesting jobs.

The European Union is thus confronted with the challenge to prepare and accomplish the shift to a competitive and knowledge-based economy in order to ensure growth and employment on a long term. Realizing the envisaged goal to make Europe more responsive to the labour market's requirements heavily depends on providing graduates who are equipped with knowledge, skills and competences to meet the challenges of globally increasing competition. In 1999, education ministers from 29 European countries signed the Bologna Declaration and so committed to establish the European Higher Education Area (EHEA) that should promote coherence in European higher education by 2010. The EHEA is not intended to represent a centralized European-wide system of higher education, but rather offers reference points for national policies and actions and guides the implementation of common key features in the respective national educational systems, such as national qualification frameworks. The re-structuring of the educational systems to meet the requirements of the EHEA resulted in a change of paradigm promoting the idea of putting the learner into the center of the learning process and of concentrating on the intended learning outcomes of this process instead of what has been provided as input by teachers and instructors.

The Bologna process offers the instruments required to bring about the shift from a teacher centred to a more learner-oriented approach to education for formal study programs. That includes the ECTS to express students' workload, the two/three cycles system, the degree recognition to further the compatibility and portability of study programmes and the European Qualification Framework to make learning outcomes more transparent and comparable across Europe.

Of course, formal learning offerings (e.g. study programs) cannot satisfy all the requirements of lifelong learners, therefore informal learning opportunities become crucially important. Anyway, integrated support for informal and formal learning is missing. Learning outcome development typically starts in the initial education context, which includes traditional school settings. But dynamic changes in the society and economy demand more and more lifelong development of knowledge, skills and competences in the work context, encompassing both informal learning activities (i.e. intentional, but not accredited) as well as non-formal ones (i.e. as a side effect of other activities). A holistic picture of the educational process distinguishes its four phases: requirements analysis, development of learning offerings, provision of learning opportunities, and evaluation of learning outcomes. New approaches are needed to better map learning outcomes to units of learning, teaching methods, assessment methods and records, and context of study and work, analyse learning outcome gaps, and provide informal training to fill them. That is in addition to enabling exchange of graduates learning outcome profiles between universities and workplace systems and between European universities.

In ICOPER, one future key challenge will thus be to find ways that can effectively bring together educational attainments achieved within formal as well as informal learning settings. That should result in evidence records (based on assessment) of what a person knows and understands, and is able to do in terms of different application modes of knowledge and understanding at different levels of autonomy and responsibility.

2.2 Learning outcome frameworks and models

Learning outcomes, according to EQF (EQF, 2000)[1], means statement of what a learner knows, understands, and is able to do on completion of a learning process. Learning outcomes are defined in terms of knowledge, skills and competences (see Figure 1).

To provide a practical example that explains learning outcomes, we demonstrate here a medical nurse scenario:

- A nurse learns a lot about different types of medicine and its use during her study, here, she gains knowledge;
- She learns also how to administer intra-muscular medication, here, she obtains a skill.
- When she can correctly recognize which medicine is to be given when to a patient, we talk about competence. This is a practical example of the ability to apply knowledge and skill to solve problems – a competence.

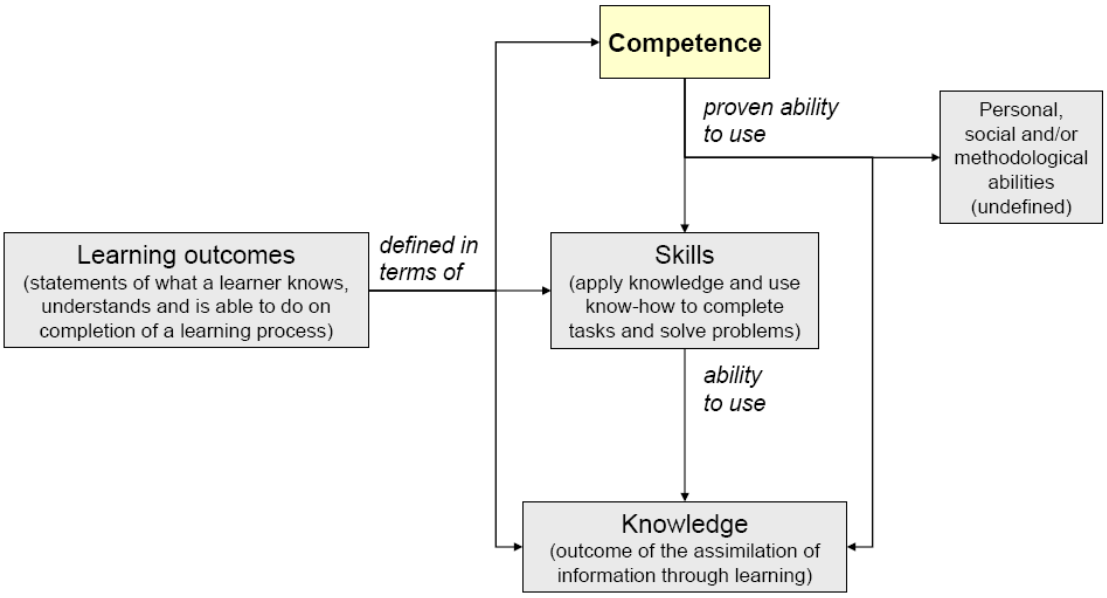

Figure 1: Relationships between knowledge, skills and competences as defined by EQF

One of the goals of the ICOPER project is to find the most convenient way to describe and exchange learning outcomes. The interoperability of learning outcome definitions constitutes a major challenge for outcome-based learning designs and their implementations at different curricular levels. Currently, continuing education centres and higher education institutions have not yet adopted standards for learning outcome definition, resulting in inefficiencies for, both outcome-based learning design and outcome-based search, retrieve and re-use of units of learning.

[1] The EQF was adopted by the European Parliament and Council in April 2008.

2.2.1 European Qualifications Framework (EQF)

2.2.1.1 Motivation of the EQF

This framework is defined in the European Qualifications Framework for Life Long Learning document published by the European Commission (EQF, 2000). The original goal of this framework is to make qualifications more readable and more understandable across different systems and countries in Europe by relating different countries' national qualifications systems to a common European reference framework.

This framework is introduced to:

- promote the mobility of learners & workers between member states,
- facilitate the adoption of life long learning.

Adopted in 2008 as a recommendation, the framework is expected to be in application by 2010 for national qualification systems of member states and by 2012 for personal qualification systems. The EQF is expected to relate each national framework to a common European framework with eight reference levels.

2.2.1.2 Structure of the EQF

The EQF defines eight levels of learning outcomes with respect to knowledge it also defines eight levels in terms of skills and competences. See Table 1 for the levels that differentiate knowledge related learning outcomes.

Table 1: Proficiency Levels of the EQF Framework for Knowledge

Level 1	Basic general knowledge
Level 2	Basic factual knowledge of a field of study
Level 3	Knowledge of facts, principles processes and general concepts in a field of work or study
Level 4	Factual and theoretical knowledge in broad contexts within a field of work or study
Level 5	Comprehensive, specialised factual and theoretical knowledge within a field of work or study and an awareness of the boundaries of that knowledge
Level 6	Advanced knowledge of a field of work or study, involving a critical understanding of theories and principles
Level 7	Highly specialised knowledge, some of which at the forefront of knowledge in a field of work or study, as the basis for original thinking and./or research Critical awareness of knowledge issues in a field and at the interface between different fields.
Level 8	Knowledge at the most advanced frontier of a field of work or study and at the interface between fields.

In the context of EQF, skills are defined as “cognitive (involving the use of logical, intuitive and creative thinking) and practical (involving manual dexterity as well as the use of methods, materials, tools and instruments)”. Competence is described in terms of responsibility and autonomy.

2.2.1.3 Structure of a National Qualification Framework (NQF)

As an example, based on Klein and Dang (2008), this section discusses NQF structure and its relation to EQF. The emphasis here is on professional training that focuses on providing the knowledge and the skills necessary to practise a profession, rather than general education.

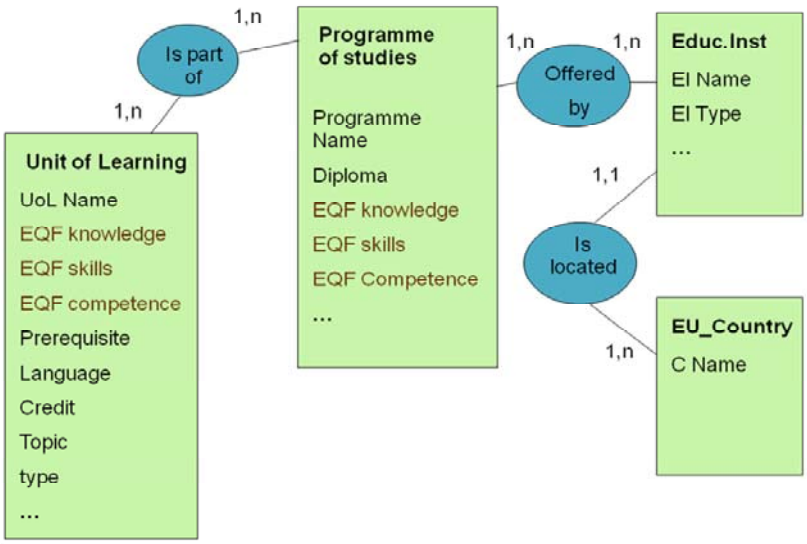

Figure 2: Structure of an example NQF

There is a large variety in the way professional training is organised in the member states; in some countries, traditional universities play a significant role, in addition to professional organisations and specialised companies. In other countries, for various industry sectors, Chambers of Commerce, professional associations as well as industry technical centres can provide training. For a list of the types of organisation offering professional training see (Klein and Dang, 2008).

For every member state, the organisation of professional training is based on programmes of studies provided by the various educational organisations offering professional training. A programme of studies or curriculum is organised in a certain number of units of learning, of various types, made up of courses, seminars and practical training periods mixing face to face and independent (including on-line) learning. (Klein 2008). A programme of professional studies is related to an economic sector. For example, medical studies are related to the sector of liberal medicine and public and/or private hospitals.

As described above, the EQF introduces eight levels on three criteria; knowledge, skills and competences. An interesting point of the EQF is its potential role in strengthening existing and future systems of credit transfer and accumulation in the EU.

2.2.1.4 Establishing a relation between the NQF and the EQF

The task that each member state has to perform by 2010 is to use the EQF as a reference tool to compare the qualification levels of the various qualification systems existing under its jurisdiction. In this way, all qualification certificates, diplomas or Europass documents should, by 2012, make reference to one of the eight levels of the EQF.

The member states are also expected to promote the validation of non-formal and informal learning. The task of the management of any professional programme of studies within the

EU will be to make the link between their programmes of studies and the EQF. This link can be made at the level of the programme itself, or at the level of each unit of learning forming part of a programme of studies.

This means, in practical terms, that one of the eight levels in terms of the three criteria should be associated to each unit of learning. As shown in Figure 2, only one level in each category can be associated with a unit of learning. One difficulty not shown in Figure 2 is that a given level of learning outcome proficiency, resulting from a programme of studies, and defined in terms of knowledge, skills and competence, may require a series of units of learning. For example, the professional qualification to be a lawyer in an EU member state not only requires knowledge of the law in the member state, but also the ability to work in the language of the member state.

The task of validating the level of each type of learning outcome for a unit of learning or programme is clearly a task, which can only be achieved by competent and experienced professionals who are in charge of the programme of studies.

2.2.1.5 Consequence with respect to on-line units of learning

An immediate consequence is that e-learning units forming parts of a programme of studies should allow for the possibility to define metadata (descriptive data) associated with the appropriate level of EQF for each of the three types of learning outcomes (knowledge, skills and competence).

2.2.1.6 Issues

Level at which the implementation is made

The implementation of the metadata for the three types of learning outcomes can be done at three levels: the level of the programme of studies, the course level, or the unit of learning level.

If the introduction of this description at the level of a programme of studies does not raise much difficulty, as there is an explicit relationship with the Framework for Qualifications of the European Higher Education Area, it may be a different matter altogether at the course or unit of learning level. Since the EQF description can probably be done efficiently at the course or unit of learning level only by the author of the course or unit of learning, the task is clearly of a different scope. In addition, the number of persons involved in the process at the course level is much larger, the risks of divergence in appreciation is also larger. In short, while higher education institutions can find it natural to establish a link between the degrees and the certificates they deliver and the EQF, establishing the link at a lower level requires a strong strategic, organization-wide, move with strong impact on the management of the faculty that may not be their top priority in the coming years.

Relevance of the classification according to the domain of application

An underlying assumption is that the EQF can be implemented in the same way whatever the domain of application. For instance, the e-Competence Framework (see Section 2.2.2) is presented as the application of the EQF to ICT-Business process.

Best use of technology according to the domain

We believe technology is not neutral and the relevance of using it in a given situation must be evaluated not only in terms of economic efficiency, but also in terms of potential risks, and of its ethical (including human rights), legal, environmental and social consequences.

2.2.2 European e-Competence Framework (eCF)

2.2.2.1 Motivation of eCF e-Competence

The European e-Competence Framework (eCF, 2008) is a European wide reference framework of information and communication technologies (ICT) competences that can be used and understood by ICT professionals and human resources managers from ICT user and supply companies, small and medium sized enterprises, the public sector, as well as educational and social partners across the European Union.

The framework has been developed by a large number of European ICT and human resources (HR) experts in the context of the CEN / ISSS Workshop on ICT Skills.

2.2.2.2 Structure of eCF

The European e-Competence Framework is structured from four dimensions. These dimensions reflect different levels of business and human resource planning requirements in addition to job/ work proficiency guidelines.

Table 2: Dimensions of eCF

Dimension 1:	**5 e-Competence areas, derived from the ICT business processes PLAN – BUILD – RUN – ENABLE – MANAGE**
Dimension 2:	A set of reference e-Competences for each area, with a generic description for each competence. 32 competences identified in total provide the European generic reference definitions of the framework.
Dimension 3:	Proficiency levels of each e-Competence provide European reference level specifications on e-Competence levels e-1 to e-5, which are related to the EQF levels 3 to 8.
Dimension 4:	Knowledge and skills related to the e-Competences are indicated as optional framework components for inspiration. They are not intended to be exhaustive.

The eCF makes a link between national and company systems. It jointly defines 32 ICT practitioner and manager competences, classified according to their corresponding ICT business areas. These are further specified on five proficiency levels (e-1 to e-5) which are related to the European Qualifications Framework (EQF) levels 3-8.

Table 3: Overview of eCF

Dimension 1	Dimension 2	Dimension 3				
5 e-Comp. areas (A – E)	32 e-Competences identified	e-Competence proficiency levels e-1 to e-5, related to EQF levels 3-8				
		e-CF levels identified per competence				
		e-1	e-2	e-3	e-4	e-5
A. PLAN	A.1. IS and Business Strategy Alignment					■
	A.2. Service Level Management			■	■	
	A.3. Business Plan Development			■	■	■
	A.4. Specification Creation		■	■	■	
	A.5. Systems Architecture			■	■	
	A.6. Application Design	■	■	■		
	A.7. Technology Watching				■	■
B. BUILD	B.1. Design and Development		■	■	■	■
	B.2. Systems Integration		■	■	■	
	B.3. Testing	■	■	■		
	B.4. Solution Deployment	■	■	■		
	B.5. Technical Publications Development	■	■	■		
C. RUN	C.1. User Support	■	■	■		
	C.2. Change Support		■	■		
	C.3. Service Delivery	■	■			
	C.4. Problem Management			■	■	
D. ENABLE	D.1. Information Security Strategy Development				■	■
	D.2. ICT Quality Strategy Development				■	■
	D.3. Education and Training Provision		■	■		
	D.4. Purchasing		■	■	■	
	D.5. Sales Proposal Development		■	■	■	
	D.6. Channel Management			■	■	
	D.7. Sales Management				■	■
	D.8. Contract Management		■	■	■	
E. MANAGE	E.1. Forecast Development			■	■	
	E.2. Project and Portfolio Management		■	■	■	■
	E.3. Risk Management		■	■	■	
	E.4. Relationship Management			■	■	
	E.5. Process Improvement			■	■	
	E.6. ICT Quality Management		■	■	■	
	E.7. Business Change Management			■	■	■
	E.8. Information Security Management		■	■	■	

eCF provides detailed description of each of those 32 e-competences with respect to different dimensions and identified levels.

2.2.2.3 Main concepts of eCF and relation with EQF

The European e-Competence Framework makes reference to some common concepts also defined and used within the European Qualifications Framework (EQF); namely knowledge (K), skill (S) and competence (C).

- Knowledge and skill express the same meanings in both frameworks.
- Competence is described in terms of "responsibility" and "autonomy" in the EQF, whilst "responsibility" and "autonomy" are not explicitly emphasised in the eCF definition. The eCF definition does not make these notions explicit because they can be difficult to interpreted by organisations when applied to individual competences.

In the EQF, a competence is "the proven ability to use knowledge, skills and personal, social and/or methodological abilities in work or study situations and in professional and personal development". In the eCF, a competence is "a demonstrated ability to apply knowledge, skills

and attitudes for achieving observable results". In these two definitions, we see that the expression "abilities" mentioned in the EQF is close to "attitudes" indicated in the eCF.

Although the meaning of the two definitions is similar there are three reasons why the eCF competence definition has been created:

1. Definitions provided in the eCF are aligned to company needs and views and are expressed in their language.
2. The eCF reflects company requirements and expectations for workplace capability, which is different from the EQF, even though it can be compared.
3. The eCF is designed to relate to specific skills and job profiles frameworks (e.g. (AITTS, Cigref, Eucip, SFIA, etc) coming from different cultures and experiences across Europe. It must provide a translation of these approaches as well as provide a European identity.

To support understanding, adoption and use of the European e-Competence Framework, complementary CWA incorporating user guidelines for the European e-Competence Framework are also provided.

2.2.3 Bloom's taxonomy

The most widely known and used support instrument for instructional design may likely be the cognitive learning objectives taxonomy by Bloom et al. (1956), which was revised by Anderson & Krathwohl (2001) nearly half a century later.

In Bloom's taxonomy three domains of educational activities are identified:

- Cognitive: mental skills (Knowledge)
- Affective: growth in feelings or emotional areas (Attitude)
- Psychomotor: manual or physical skills (Skills)

The taxonomy was originally used to classify student learning outcomes to promote the exchange of test items (Shulman, 2007). Eventually, it found its way into instructional design, where the taxonomy was used to classify and then align learning objectives with learning activities and assessment items in order to establish accuracy in the instructional approach (Anderson & Krathwohl, 2001). The taxonomy has since then served other purposes, for instance, to determine the order of teaching specific kinds of knowledge (Shulman, 2007).

2.2.4 The SHL Universal Competency Framework

SHL (Bartram, 2006) is a world-wide operating people performance assessing company that aims to improve people's work performance through aptitude tests, personality tests and expert consulting services. SHL has developed over the years a performance measuring framework that allows one to describe the key behaviours that drive performance in virtually any job in any organisation, based on a competence model that identifies eight major domains of behaviour in professional situations, also known as the Great Eight. These eight major domains of behaviour in professional situations cover all aspects that managers are considering when seeking improving staff performance.

The model consists basically of eight large distinct areas of human behaviour (Leading and Deciding, Supporting and Cooperating, Interacting and Presenting, Analysing and Reporting,

Creating and Conceptualising, Organising and Executing, Adapting and Coping, Enterprising and Performing).
The Great Eight level, which acts as a grouping level for strongly related competences, breaks down into a sublevel called the 20 Dimensions competence level, a set of 20 general competences that unpack the Great Eight level as it were into more usable competences that will be actually used for assessment. Each company will typically pick its own set of general competences to work with from these 20 general competences.

The 20 Dimension competence level is further broken down into 112 competences that act as low-level building blocks, allowing composing virtually any competence model. Each of these competences has a workable balance between specificity and generality, making it a concise, general and practical model and eliminating the need for further break-down. The competences themselves are composed of different behavioural statements, called anchors.

The SHL competence framework is multi-purpose and multi-context framework. As one company might suffice to work with the 20 Dimensions model, or a subset of this model, another company might want to re-factor their existing model in terms of the SHL model, while yet another company without a competence model might want to build under guidance of SHL their own model from the anchor building blocks upwards. All of these models can be directly plugged into the SHL framework for any kind of defined assessment.

In order to arrive at the Great Eight competence model, SHL put together all their own generic models they made over the years and the specific models they developed for customers, and tried to come up with a common denominator capturing all aspects that companies want to assess the performance of staff against. After three years of content analysis, empirical study, and data restructuring, the Great Eight started to emerge.

The SHL competence model makes a difference between the actual competence and the competence potential. The actual competences reflect how you currently behave and interact with other people. They would typically result from a line manager evaluation or a 360° review. The competence potential reflects how you would behave in a particular role in a given context. As it tells you something about the future, it is a powerful tool for companies to take a head start in the race to more efficiency.

A lot of effort was put into making sure that the Great Eight competence model would work in any given cultural setting. SHL's concern was to come up with intercultural competence model, a universal language that would not only work in an Anglo-Saxon context and that was easily translatable. Being a multinational, SHL gathered information about foreign competence models from SHL consults all over the world.

2.2.5 O*NET

The Occupational Information Network (O*NET, 2008) is a comprehensive system for collecting, organizing, describing, and disseminating data on occupational characteristics and worker attributes developed by the U.S. Department of Labor (USDOL). The O*NET System allows for easier access to data on occupations at different levels of detail, to facilitate its utility for different consumers; see example below.

O*NET Identifier	Title	Description
1.A.1.a.1	Oral Comprehension	The ability to listen to and understand information and ideas presented through spoken words and sentences.
1.A.1.a.2	Written Comprehension	The ability to read and understand information and ideas presented in writing.
1.A.1.a.3	Oral Expression	The ability to communicate information and ideas in speaking so others will understand.
1.A.1.a.4	Written Expression	The ability to communicate information and ideas in writing so others will understand.
1.A.1.b.1	Fluency of Ideas	The ability to come up with a number of ideas about a topic (the number of ideas is important, not their quality, correctness, or creativity).

Businesses and human resources professionals can use O*NET products and tools for different purposes:

- the development of job descriptions
- expanding the pool of quality candidates for open positions
- aligning organizational development with workplace needs
- refining recruitment and training goals.

Job seekers may use O*NET information to identify jobs that fit their interests, skills, and experience. Workers may use this information for job satisfaction and develop their understanding of what it takes to be successful in their field and in related occupations. The O*NET Program is an important resource for researchers who study issues related to the U.S. workplace and labour market. The O*NET System includes the Content Model, a skills based structure that serves as the framework for organizing the information describing the world of work presented within O*NET products and tools.

In an example demonstrator (Ostyn, 2005) transformed, using XSLT, O*Net database of knowledge skills and competences into IEEE RCD (2007) XML format, by extracting title, description and language of the reusable competence definitions, see below.

```
<rcdList>
  <rcd>
    <identifier>www.onetcenter.org/content_model_reference-7.0-Element_Id-
1.A.1.a.1</identifier>
    <title>
      <langstring lang="en">Oral Comprehension</langstring>
    </title>
    <description>
      <langstring lang="en">The ability to listen to and understand information and
ideas presented through spoken words and sentences.</langstring>
    </description>
  </rcd>
…..
<rcdList>
```

The export of the O*Net learning outcomes into IEEE RCD format increases their reusability and exchange between different communities of practise.

2.2.6 Context models

The term context can be defined generally as the circumstances in which an event occurs; a setting. We are considering it as the characteristics of the environment. Some of these parameters are represented as various types of metadata. We can distinguish objective and subjective context metadata, which can be captured by means of suitable sensors – physical as well as semantic ones. They can be created manually, automatically or semi-automatically (a person approves suggestions of the system). Automatically generated metadata about the learner and the current context should enrich information about learning outcomes and enable finding relevant units of learning and their delivery in the appropriate settings.

In our big picture of outcome-based learning, we have to distinguish various types of context:

- Context of knowledge, skills and competences modelling: various communities may understand the same learning outcome profile and their proficiency levels differently
- Context of authoring: authors usually create their learning objects having in their mind a certain domain, target group, and learning outcomes
- Context of learning provision: learners encounter a learning experience in a certain context with its constraints and opportunities
- Context of assessment: the situation in which learners are assessed influences their results

In (Kravčík & Gašević, 2006), several references related to the term context are introduced. In the literature, various definitions and models of context are found. Dey (2001) defines context as any information that can be used to characterize the situation of an entity, where an entity is a person, place, or object that is considered relevant to the interaction between a user and an application, including the user and application themselves.

The 3D model (Schmidt, et al., 1999) distinguishes three context classes:

- Self: device state, physiological, cognitive,
- Environment: physical, social,
- Activity: behaviour, task.

Another model (Ranganathan, & Campbell, 2003) classifies context information into seven groups:

- Physical context: location, time,
- Environmental context: weather, light, sound levels,
- Informational context: stock quotes, sports scores,
- Personal context: health, mood, schedule, activity,
- Social context: group activity, social relationships, other
- People in that situation,
- Application context: email, websites visited,
- System context: network traffic, status of printers.

Context based systems usually deal with such issues as automatic acquisition of context metadata or contextualized delivery of content, activities, and services. An example of such a contextual model is an ontology for capturing learning object context (Knight et al., 2006) that bridges a learning design ontology (based on IMS Learning Design) and the learning object content structure ontology proposed in (Jovanović et., al, 2006). In fact, this research is inspired by and extends the ecological approach proposing a more flexible method to creating learning object metadata, for example, by relating all learners' interactions (e.g., captured by user model snapshots) to learning objects. Note that it is very difficult to isolate context independent knowledge, which is often needed when building ontologies.

ICOPER definition of context and its relation to learning outcomes is introduced in Section 6.

In this section, we introduced some of the common conceptual learning outcome frameworks and models. Standards that are used to describe (by attaching metadata to reusable knowledge, skills and competences) instances of learning outcomes, like IEEE RCD (2007), IEEE CP (2008), HR-XML (2008), CEN MLO (2008) and LEAP2A (2008) are analysed and discussed in Section 5.

3 Methodology

This section introduces a methodology used to analyse the learning needs building blocks and standards. We conducted two separate surveys to collect data on universities experience with learning outcomes and to review the standards related to learning outcomes and competences. It is important to note that some of the standards reviewed (like IEEE RCD and HR-XML) describe skills and knowledge as competences.

3.1 University cases

The main goal of the first survey was to collect data on the way universities practise the development of learning outcome-based curricula, following the Bologna process and the European Qualification Framework (EQF).

The survey was done by means of interviews and based on a questionnaire (see Appendix 1). The questionnaire consists of three major sections targeting different stakeholders at university, namely strategic questions, design/implementation questions, and assessment/governance questions. The first part of the questionnaire covers issues related to learning outcome definitions used by the universities and development of learning outcome-oriented curriculum. The second part focuses on development of curricular qualifications profiles, linkage of learning outcomes to courses and modules, and alignment of the profiles with labour market. The last set of questions are aimed at investigating how universities asses learning outcomes and how they ensure that learning outcomes are really achieved and proper educational methods employed.

Eleven universities from seven European countries were surveyed by the project members in November and December 2008. The list of institutions includes Faculty of Arts, University of Ljubljana, Faculty of Organizational Sciences, University of Maribor and Jožef Stefan International Postgraduate School from Slovenia, UK Open University, Vienna University of Economics and Business Administration and University of Vienna from Austria, Tallinn University from Estonia, HEC and University of Evry from France, Open University Netherland, and Universidad Carlos III de Madrid from Spain. The universities were selected according to different criteria, such as geographical coverage, size and type of a university (e.g. open university, graduate school or full university), and partnership within the project. Responsible project partner for each institution conducted an interview with the target people in their university to collect the data. Summary of the interviews is given in Section 4.

3.2 Standards

The main goal of the second survey was to review the standards related to learning outcomes and competences.

In the first two months of the project, the partners briefly reviewed a long list of learning outcomes and competence standards, competence content models, and other relevant standards. Only the very relevant standards were analysed in detail at the end of 2008. The analysis was based on a template (see Appendix 2) that includes the following components:

- An overall overview of the analysed standard; such as its title, description, producer, conceptual model and data bindings, scope and purpose, documentation, selection of elements and value domains;
- Capability for extension and customization.

The relevant selected standards are generic and can be, to some extent, customised to serve the needs of ICOPER community, while other standards are either not stable or specific for some subject domain. The selected standards are CEN MLO (CEN Metadata for Learning Opportunities), HR-XML, IEEE RCD (IEEE Reusable Competency Definition), IEEE CP (IEEE Competency Profile Standard), and JISC LEAP2A ePortfolio Standard; selected standards are presented in Section 5. The applicability of those standards for ICOPER needs is discussed in Section 6.

4 Analysis of University Experience with Competences

The purpose of this section is to summarize the responses from the surveyed universities. This enables drawing the full picture of how different universities handle learning outcomes and units of learning in their respective study programmes.

Results of this analysis formed the basis for developing the concepts and use cases of outcome-based online learning, presented in Section 6.

4.1 Strategic questions

4.1.1 Meaning of the term “learning outcome” at universities

There was a mixed response showing that there is no common way to define learning outcomes (knowledge, skills and competences). One respondent stated that they have a definition only for scientific competences. The answers also show, for example, that some universities do not have a formal definition of learning outcomes, or that they do not have a clear definition in a sense that they do not have an official taxonomy. Nevertheless, the respondents recommend for curriculum development teams to divide knowledge, skills and competences between subject-specific and generic ones.

The universities use different classification and definitions for learning outcomes. Reported common learning outcomes concepts are knowledge, cognitive skills, key skills, professional skills, and practical skills. Two respondents have added learning outcomes to their online courses. However, those universities do not use a common taxonomy of learning outcomes, but a free text provided by instructors. This approach hinders the reuse and interoperability of learning outcomes across units of learning and universities.

4.1.2 Development of learning outcome oriented curricula

All the respondents reported to be developing learning outcome oriented curricula. The ways of supporting the implementation and assessment of the curricula vary largely: lists and vocabularies of knowledge, skills and competences, support realized by advising and tutoring or by quality procedures, students’ feedback, and analysis of assessment methods. Learning outcomes for each course are formulated also by individual dialogues/interviews of teaching staff at the faculty. During the process of formulating subject-specific and generic learning outcomes of the course, teachers reflect the content, teaching method and assessment methods of the course and often identify content-related dependencies to other modules of the curriculum. In many responses, guidelines, advising, supporting, staff training seminars, and

students' feedback are mentioned. Other instruments include interaction with professional community, internal workshops, discussions with students, reviews by external boards and experts, cooperation with other universities.

Seven surveyed universities do not use a National Qualification Framework. At one university, some faculties use both NQF and EQF whereas some others use their own framework, which is based on the Bologna agreement (with Dublin Descriptors[1]). At another place, they use their own framework which is based on the two NQFs and EQF. At two universities, NQF follows EQF. Distinctions between learning outcomes and competences have been identified in a project called the project called "Tuning Educational Structures in Europe" (Tuning, 2000). According to that viewpoint, academic staff formulates learning outcomes, while competences are something that learners need to develop and can be difficult to measure.

The alignment of the NQF with the curricula qualification profiles is normally made by some appointed academic supervisor such as the dean, the university board, the vice deans and assistant directors of every undergraduate programme, or special curriculum committees. At one university, the alignment is evaluated during an international curriculum accreditation process once in every three years. At another institution, the alignment is made by providing teachers with a guidance template for the whole process of outcome-based curricula development. In many cases, there are internal experts in each university offering support for aligning the NQF and the qualification profile.

4.2 Design/Implementation issues

In most of the universities there are special working groups being responsible for developing and approving curricular qualification profiles. Some administrative personnel such as the senate, the dean, the university board, may have the responsibility of the development. At the grass roots level, the development is done by vice deans and assistants directors, or professors, students, tenured lecturers, appointed academic supervisor, dean and university board whose work is supported by instructional designers.

Every respondent reported to include generic knowledge, skills and competences in the curricular qualification profiles. In some responses, generic competences were precisely defined like academic writing, presenting, and argumentation where as in some other responses they were seen in a broader way like interpersonal skills and skills concerned with intrapersonal competences. The concepts of skills and competences were used very often side-by-side. Even if the type of generic competences varied to great extent, there can be seen a common classification principle. In the most of the responses, skills and competences seem to be divided in two basic groups: interpersonal skills (e.g. team competence, communication skills, and social competences) and intrapersonal competences (e.g. cognitive competence, self-organized and self-directed learning).

The practices of the alignment of the overall aims of a study program with learning outcomes at the level of modules and courses naturally vary according to institutions. For example, the alignment is done through a template-based iterative process or during accreditation process. At one institution, a special computer programme guides the implementation of curricula. At another institution, the alignment is coordinated both vertically (teachers) and horizontally

[1] Joint Quality Initiative. http://www.jointquality.nl/

(committees and finally academic board). Learning outcomes, for example, are also assigned to courses and at different levels. In ICOPER, linking learning outcomes to units of learning (courses or modules) will be covered in the ICOPER deliverable D3.1; which is due in September 2009.

Four responding institutions claim to have means to manage dependencies and consistency issues among learning outcomes, e.g. ActiveCC project (Kabicher, et al., 2008), or the programme committee's framework guide the management). The board sometime follows the alignment.

The employability issues were taken into consideration in the most of the cases. It is done through, for example, analyzing online job offers, in cooperation with companies, considering vocational skills, work-based learning and the Foundation Degree[1].

4.3 Assessment/governance issues

The assessment is normally done through examination, evaluation process in progress (or continuous assessment), projects or even through games, and it is done at the level of courses. At one institution for executive education, the assessment is done by customer satisfaction questionnaire. There seems to be tendency to relate assessments to learning outcomes, but none of the respondents reported on processes of linking learning outcomes to different types of assessment methods. Linking learning outcomes to assessment methods will be covered in the ICOPER deliverable D6.1; which is due in September 2009.

The universities ensure that the curricular learning outcomes can be achieved by taking the courses mostly by groundwork done before the course e.g. clear module descriptions, good instructional design and content or curriculum maps. Other answers include students' feedback and teachers "self-evaluation" or testing by students before implementation and quality assurance instruments.

The last question on ensuring that teachers employ educational methods that facilitate the achievement of defined learning outcomes raised an important issue of teacher freedom. Although teacher creativity and freedom is highly valued, teachers can be supported by workshops and training courses towards outcome-based teaching. Students' assessment is also used for ensuring that goal. At one institution, distance learning courses are designed in advance and teachers cannot change them. At another institution, evaluation is done by analysing feedback to customer satisfaction questionnaires.

4.4 Conclusion

The results of the questionnaire revealed that there are multiple conventions considering learning outcomes and how they are applied in educational field. The results show that in many cases, knowledge, skills and competences are still rather loosely connected to curricula. Even the concepts seemed to be problematic; there is no single common way to define learning outcomes in European higher education institutions, though EQF framework provides a common definition for knowledge, skills and competences. There is a tendency to divide skills and competences in two separate groups: generic and specific. Some progress has been made regarding evidence assessment, i.e. many educational institutes align their

[1] www.findfoundationdegree.co.uk

curriculum qualification profiles with the labour market's requirements. Although, European outcome-based education initiatives have made a good progress so far, it seems that a lot of work is still to be done towards a common practice of outcome-based curricula development.

5 Relevant Learning Outcome Standards

In this section, standards that are used to describe learning outcomes are analysed. It is important to note that most of the reviewed standards consider both knowledge and skills as competences.

5.1 IEEE Reusable Competency Definition (IEEE RCD)

5.1.1 General introduction

IEEE Reusable Competency Definitions – IEEE RCD (2007) is a world-wide standard issued by the IEEE organization and sponsored by the Learning Technology Standards Committee of the IEEE Computer Society that defines a data model for describing, referencing and sharing competence definitions, primarily in the context of online and distributed learning.

This standard is based on the existing IMS Global Learning Consortium specification entitled IMS Reusable Definition of Competency or Educational Objective – IMS RDCEO (2002).

The IEEE RCD standard provides a formal way of representing the key characteristics of a competence, independently of the context (see Figure 3). The purpose of the standard is to enhance the interoperability of competence based learning systems by offering them a model of standardized competence definitions with standardized semantics.

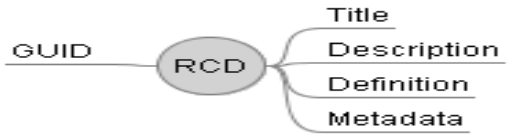

Figure 3: IEEE RCD elements

5.1.2 Purpose and scope

As the main purpose of the standard is to promote the interoperability of competence based learning systems, any person that is involved in the designing, authoring, reviewing and deploying of online and distributed learning belongs to the target audience.

In this standard, it is not specifically defined what the content of a competence definition should be. The specification does not make a distinction between skills, knowledge, abilities, attitudes or outcomes. Hence, according to IEEE RCD, a competence profile may for instance include a set of certificates.

This standard is intended to meet the simple need of referencing and cataloging a competence, not classifying it.

The documentation of the RCD specification provides also a conceptual data model but it does not provide any use cases. However, the draft specification contains an example of existing practice using an XML schema defined by the IMS Global Learning Consortium.

5.1.3 Technical perspectives

The metadata elements of the standard reuse some elements of the IEEE 1484.12.1 LOM (2002) standard. The value domains of this standard are not selected from other value spaces or ontologies.

IEEE RCD does not define a specific extension mechanism for the data model. Implementers may define bindings that allow additional elements or may create additional data models for competence data, but should not duplicate or redefine the semantics of elements defined in this standard. Extensions should also be provided by including the IEEE RCD data model inside an extended data model, rather than by inserting extension elements within the IEEE RCD data model itself.

As far as the XML binding is concerned, the IEEE RCD standard does not define any specific binding for the data model. However, related standards may reference the standard and define the bindings themselves.

5.1.4 Summary

Although this standard does not distinguish between knowledge, skills and competences, it is a good candidate standard to be used for describing (adding metadata) learning outcomes of learners in ICOPER project. This requires customizing the standard by adding a new element to capture the type (knowledge, skill and competence). It is important to note that IEEE RCD does not address the aggregation of smaller competences into larger competences nor does it address how competences are to be assessed, validated, certified, recorded, or used as part of a process, such as instructional design or knowledge management. It also does not specify how records of competences associated with an individual are structured, stored, or shared.

5.2 IEEE Competency Profile Standard (draft to be submitted (IEEE CP)

5.2.1 General introduction

The proposed IEEE Competency Profile standard - IEEE CP (2008) defines an information model for describing, referencing and exchanging data about the relationships between competences in a competence profile. That is in addition to capturing other competence related information like competence qualifiers (like proficiency level, weight, ageing and importance), context where competence is acquired and evidence data, see Figure 4 below.

Currently, various definitions are used for the terms competence model, context/domain ontology, competence taxonomy, learning outcomes. The proposed standard is needed because there is very little agreement on how a set of related competences (belongs to one person or task) can be described, grouped and exchanged, to support machine-readability.

This standard should allow the representation of relationships between competences or complementary aspects of a competence, such as they have often been captured in competence models. The term competence is used here in the broadest sense, including skills, knowledge and attitude.

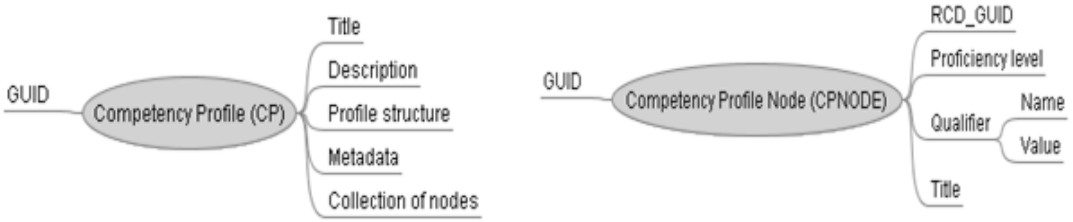

Figure 4: IEEE CP elements

5.2.2 Purpose and scope

The purpose of this proposed standard is to specify data models and processes that enable the broadest and most economical exchange of useful competence related data among and between communities of practice.

The scope of this proposed standard includes common data models and the specification of some common processes. It specifies a starting set of scenarios that take advantage of the common data models and processes involving competences. The scenarios meet specific business requirements identified in application areas such as education, personal development and learning content development as well as hiring, performance improvement and training.

This standard aims at enabling interoperability between and among learning systems and competence management systems that deal with competence information by providing a means for them to refer to common competence definitions through the use of interoperable competence profiles. This standard is not intended to define ontologies or to duplicate semantic mapping standards such as topic maps.

5.2.3 Technical perspectives

The IEEE CP data model is minimalistic and extensible. It is purposely neutral with regard to models of competences and the use of competences in order to allow different communities of practice to meaningfully exchange competence models, the structure of which can be very diverse between different communities of practice.

The standard specifies the shape of a Competence Profile (CP) as a directed acyclic graph (DAG). The directed acyclic graph allows each node to have more than one parent, as long as the parent is not a descendant of the node.

A simple topology for a DAG is a tree with a single root node and no commonality between sub-trees within the tree. A more complex topology may specify common children for more than one node or more than one origin node.

Nodes in a competence profile can have specific rules assigned to them useful for modelling. Different rules can apply to individual nodes. The fact that a rule is defined in the standard

does not imply that it is required in all applications of the standard. An application of the standard may add its own rules but this is outside the scope of the standard.

Competence profiles may be referenced by other competence profiles, so as to symbolically merge them. Any node in a competence profile may reference an RCD, another profile or both.

Application profiles may put constraints on the shapes that can be merged because of the complexity of the resulting competence profile. In order to guarantee maintainability, a few rules of thumb apply:

- A node cannot become a descendant of itself;
- The referencing node retains its properties as a child node but the properties of the referenced node in its role as parent remain intact;
- If the target of a reference is a DAG with more than one origin, the reference must specify which origin to use.

The data model contains the following mandatory elements:

- Identifier: A globally unique label that identifies the reusable competence profile. It uses the same data elements as the identifier defined in IEEE LOM.
- Title: A text label for the reusable competence profile. This is a short human readable name for the taxonomy.

The data model contains the following optional elements:

- Description: A human readable description of the competence profile as a text blob.
- Other information: Other information, including optional metadata.
- Graph: A structured collection of nodes. There is at least one node.

5.2.4 Summary

The IEEE CP standard is in its proposal phase. The standard captures a long list of metadata about learner application profiles. IEEE CP does not capture the context of the learning outcome. Since this standard is not mature yet and cannot be applied as is, the ICOPER project should advise a new specification of this standard for learning outcome profiles; by reusing, extending and adapting IEEE CP components relevant ICOPER community. Advising such standard will enable the exchange of leaner outcome profiles between the European universities. In addition, such standard enable the exchange of learner outcome profiles between universities and workplace.

5.3 HR-XML Competency Standard

HR-XML (2008) is a world-wide standard for the formalization and ranking of competences, supported by HR-XML Consortium.

HR-XML is used to capture information about evidence used to substantiate a competence, their ratings and weights (*Competency* module) and reusable data typed for referencing competences (*CompetencyTypes* module). Both schema are designed in order to be used in process-oriented environments and can be used to rate, measure, match and asses competence

(skills) against one that is demanded, required (e.g. as a prerequisite, skill requited to take training).

HR-XML defines competence as “a specific, identifiable, definable and measurable knowledge, skill, ability and/or other deployment-related characteristic (e.g. attitude, behaviour, physical ability) which a human resource may possess and which is necessary for, or material to, the performance of an activity within a specific business context”.

This definition needs to be extended with facts that competences are measurable, and some of them (that are hard to quantify) may be described simple as existing/non-existing, just subjectively recognized, when others may be complex and recursive (including other competences). Nevertheless, all of them need to be considered as attributes of single person - human resource that undergoes HR management processes not descriptors.

The HR-XML competence schema is intended to be incorporated as a module in a broader process-specific HR schema.

5.3.1 Purpose and scope

The ability to exchange data without having to write custom interfaces for proprietary systems is a big problem for organisations who want to collaborate over Web. The purpose of using HR-XML is to use standard formats to exchange data about human resource (including competences).

The objective of this standard is to create an XML schema in order to provide to trading partners a practical and standardized means of exchanging information about competences within a wide variety of business contexts.

The target audiences of the HR-XML competence standard are human resource management and businesses. Interoperability is already provided for major ERP/HRIS vendors such as ADP, Lawson, Oracle and SAP. Competences schema is being used to support assessments, 360-feedback, performance measurement, competence modelling, performance management, talent management systems, training plans, recruiting etc.
The competence model used makes a difference between skills, knowledge and attitudes, and competence profiles are mainly about applicant profiles, assessments, screening, benefits of outsourcing, compensation management, job offers, knowledge development payroll and performance.

In the area of competences, HR-XML schema can be useful in any process that requires checking, comparing, matching and rating. Standard schema can be used in all processes where business intelligence of particular process involves competences, supporting cross-disciplinary transfers.

Competence schema is designed to communicate structured and strictly defined competence, as well as unstructured one. This schema can be extended with and referring to CompetencyTypes schema which is container for competence-related data type. CompetencyTypes specification provides a flexible means to referencing a know competence by its identifier.

CompetencyTypes schema can be used to provide the exchange of taxonomies, proficiency levels and proficiency level scales.

The HR-XML documentation provides a conceptual model and a few use cases.

5.3.2 Technical perspectives

The bindings of the HR-XML competence standard are in XML schema format (see Figure 5). HR-XML is a web-compatible version of XML which is used to define text document formats. XML is a format that allows describing data and enables automated data exchange without custom programming. However, to use XML, two parties must define and agree on specific object tags and data schemas. HR-XML does not allow extending its XML instances. This means that schema never gets metadata elements for other schemas and never selects value domains from other value spaces or ontologies.

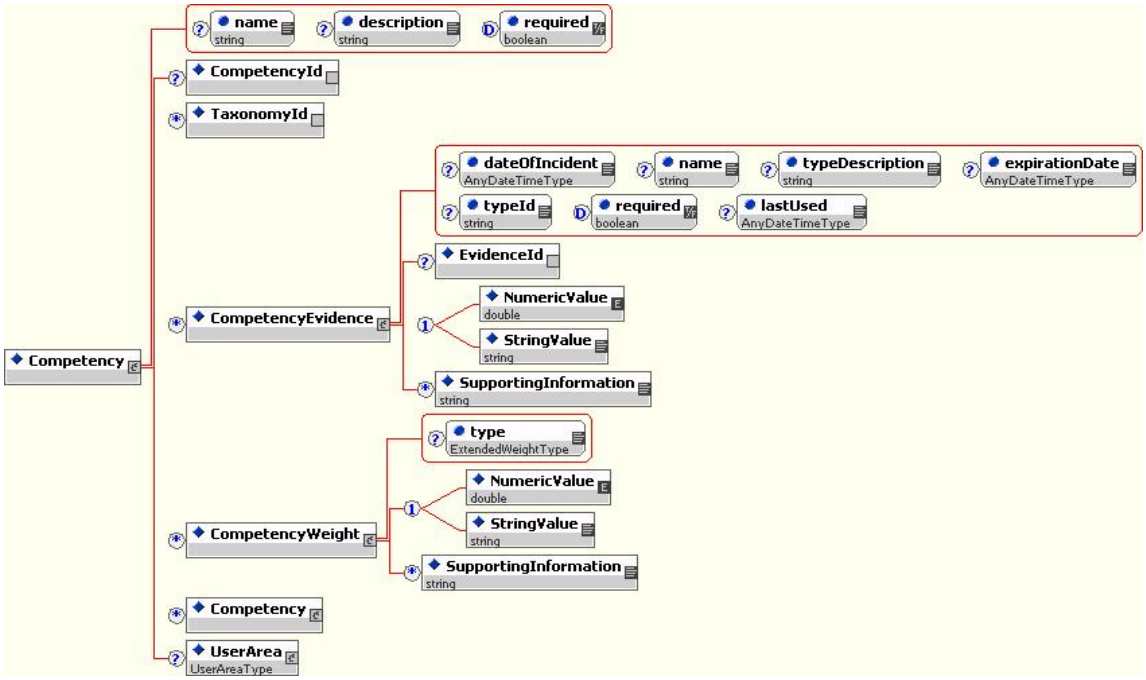

Figure 5: HR-XML Competency XSD schema elements

5.3.3 Use of HR-XML in industry

A widespread format in industry to store personal data is the HR-XML-Format. The use of HR-XML (3.0) standard in industry is promoted by the HR-XML consortium, an independent, non-profit, volunteer-led organization. It develops international HR-interoperability standards that allow an easy and economical integration of applications used in companies such as assessments, background checking, benefits, competences, payroll, recruiting, resume data, staffing, etc.

With more than 120 member organizations around the world, HR-XML is one of the largest and best-supported groups developing XML standards in support of specific business functions. Among the Consortium membership are companies such as Oracle, PeopleSoft, IBM, Monster.com, and Hire.com.

Active work in Europe is being undertaken by HR recruiters in the UK, Public Employment Services in the Netherlands and Flanders, SAP and Oracle, Staffing Industry Data Exchange Standards (SIDES) France and the development of HR-XML schemas for Europass, especially the CV led by EIfEL, that is based on HR-XML SEP Candidate specifications.

5.3.4 Examples of use

Staffing Exchange Protocol (SEP) 2.0 is a set of XML specifications that support many types of recruiting and staffing related transactions such as the posting of job or position opportunities to job boards and the exchange of a candidate resume and/or profile data independent of or related to those postings to other recruiting and sourcing venues. Germany's leading job portal has chosen the protocol for structuring the transfer of data from participating companies to its database.

Staffing Industry Data Exchange Standards (SIDES) is a set of standards for exchanging information between staffing companies, their clients (employers) and partners. SIDES offers a standardized interface to software providers at time work companies to interconnect to third offerers and firm customers. It has been deployed by Adecco, Manpower and others.

European work on employability ePortfolios initially made use of the IMS Portfolio specification but now is focusing on HR-XML.

The Bundesagentur für Arbeit has developed its own HR-BA-XML-standard. Based on the Staffing Exchange Protocol 1.2 (SEP) of the HR-XML-consortium it amends the HR-XML in respect of matching criteria such as mobility, willingness to travel or type of contractor. It is planned, to integrate the HR-BAXML-format into the HR-XML-format. Besides the Bundesagentur für Arbeit many companies are already using the format providing their vacancies by using the HR-BA-XML-standard.

Also the German Standard Curriculum Vitae (GSCV) and the British iProfile build up on the HR-XML standard. Both, the GSCV and iProfile focus on establishing a common standard for the storage of CV-related data. In Germany market-leading companies such as Lufthansa, Bosch, Commerzbank, Audi und Siemens are using the HR-XML based GSCV standard.

5.3.5 Summary

The target audiences of the HR-XML competence standard are HR management and businesses. It supports exchange of large sets of employment personal data, including competences. HR-XML does not provide a conceptual model of its components.

It is important to remark that HR-XML is not designed to capture learning outcome profiles of learners at higher education institutions. Nevertheless, relevant components of HR-XML should be included in the ICOPER Learning Outcome Profile schema. That is to increase the interoperability between education and workplace systems. Hence, enhance employability of graduates.

5.4 CEN Metadata for Learning Opportunities (MLO)

5.4.1 General introduction

MLO (2008), or Metadata for Learning Opportunities, supported by CEN/ISSS WS-LT, is a European standardized model for addressing metadata of learning opportunities. The standard defines the electronic representation of learning opportunities in order to facilitate their advertising and subsequent discovery by prospective learners.

The MLO standard is conceived as a lightweight model fitting well in existing business processes and technologies that is to be taken up rapidly by European countries. It is designed to facilitate semantic technologies and web architectures in supporting multiple information exchange and aggregation mechanisms of third party suppliers.

5.4.2 Purpose and scope

The goal of the MLO standard is to provide information to an interested learner about a learning opportunity and to enable the learner to make the decision whether she wants more information about the learning opportunity and where to get it.

The target audience of the standard are people who provide opportunities for learning and wish to advertise them, people who offer electronic search services that aggregate results from multiple learning opportunity providers and people who wish to compare learning opportunities that have been represented electronically.

The standard is mainly concerned with the metadating and representation of learning opportunities, not with competences. So, competence profiles are not described in this model.

There are three resources about metadata that can be stored: the learning opportunity provider (1), the learning opportunity specification (2) and the learning opportunity instance (3). The standard specifies relations between the three resources and recommends a core set of metadata for each, see Figure 6 below.

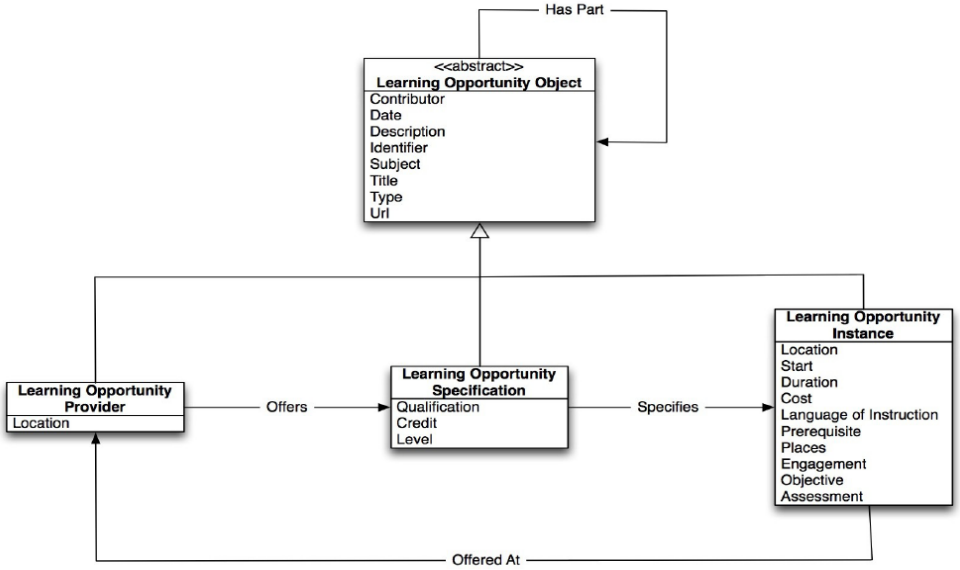

Figure 6: MLO elements

The documentation of the MLO specification provides also a conceptual data model and use cases.

5.4.3 Technical perspectives

The metadata elements of the MLO standard are selected from the ISO 15836:DC 1.1 schema. The value domains of the standard are selected from the Dublin Core Abstract Model DCAM (2007) value space.

Extension of the MLO standard is done by inclusion of properties, sub-properties, vocabulary encoding schemas and syntax encoding schemas, and by constraining the use of properties.

The XML bindings provided in the standard are in RDF and XML format. There are no bindings stated to other relevant schemas.

A strictly conforming binding is constituted only of bindings to an exchange format of the classes and properties defined by this standard and fully qualified refinements of the properties defined in this standard.

A conforming binding may contain additional properties that do not necessarily extend or map to the properties defined in this standard.

Both strictly conforming bindings and conforming bindings:

- Must be capable of generating and validating instances that can be automatically converted to a strictly conforming instance of this standard.
- May impose additional constraints upon the values of properties defined in this standard.
- May impose cardinality constraints on properties defined in this standard.
- May impost cardinality constraints on associations between instances of the classes defined in this standard.

5.4.4 Summary

The MLO standard is not intended to define the electronic representation of the learning objects, only of learning opportunities. Metadata collected and presented for the purpose of advertising learning opportunities may be used for other purposes. Guidance on the specification and organization of metadata other than the advertisement of learning opportunities is outside the scope of the MLO standard. The MLO standard enables linking learning opportunities to learning outcomes; using the objective element (see Figure 6).

5.5 JISC LEAP2A

5.5.1 General introduction

LEAP2A is an outcome of the JISC CETIS - (JISC Innovation Support Centre - Centre for Educational Technology & Interoperability Standards) project called Portfolio InterOperability Project (LEAP2A, 2008). It sets up the framework for the e-portfolio data interoperability. The purpose of this specification is to represent e-portfolio information collected by the individual (learner) and not the information stored by the others (teachers)

about this individual. This information can be digital artefacts and users reflection to some kind of information.

LEAP2A is based on Atom Syndication Format. Atom was designed for exchanging the blog feeds but fits also for exchanging the portfolio information. Information exchange is based on the XML format. In the LEAP2A the Atom is extended because Atom's vocabulary is not enough for representing all information stored in e-portfolio. Very few elements of LEAP2A are mandatory, expect if they are mandatory in Atom.

5.5.2 Purpose and scope

Below, few learning scenarios are provided for the use of LEAP2A around reflective learning, reuse of learning outcome evidence, transition of the data between e-portfolio systems or to ILP (Individual Learning Plan) systems.

Essay writing - example of reflective learning:

1. Student presents the first draft of the essay
2. Teacher provides feedback
3. Student and teacher discuss feedback
4. Action plan for essay improvement is drafted
5. Student fulfils the action plan:

5.1 Produce final version of the essay

5.2 Parallel reflect the learning process (in the blog)

6. The essay and the reflection are linked and graded together.

The portfolio entries can be initiated by the leaner or can be instructed by the teacher. In the same way each evidence of the learning can be reflected.

Reuse of learning outcomes

1. Teacher presents a list of learning outcomes that should be achieved when the course is finished.
2. During the course a teacher links students evidences and reflections with the relevant outcome (converts statements of expectations to the statements of outcomes).

When a learner decides to apply for another course (some other speciality or curriculum), she can reuse here existing learning outcomes (or some of them) if they fit the new curriculum. The outcomes are not rewritten but represented in a different structure.

Interoperation scenarios

Examples of what data can be transferred between systems:

1. Complete portfolio information - to avoid loosing valuable materials or to re-enter the information that is already stored. This transfer is needed when student moves from one school to another or finish the school and desires to transfer collected information to an employer-based system.
2. Specific information supporting transition - various kinds of transitions e.g. transfer of CV information from e-portfolio to the job application form.

3. Intra-institutional services - e.g. university has separated systems: e-portfolio and VLE. Some information is common for both systems. Both systems should have ability to ask and to get the needed information in the suitable format.

5.5.3 Technical perspectives

LEAP2A has an Atom extended XML schema that covers the following portfolio fundamental information types:

1. digital artefacts made by the portfolio holder
2. short expressions by the portfolio holder
3. information about the portfolio holder

Selection of those units of information items can appear together as portfolio items and can be imported or exported individually or together from different systems.

Digital artefacts: (audio, video, multimedia, plain text) have associated information - metadata (author, date, title,). Portfolio holder presents them as evidence of their abilities.

Short expressions: (blog entries,) that can be understood in its context. They nevertheless exist and can be managed separately. Metadata stores information about dates, authors, rights, Portfolio holder.

Items: Information in e-portfolio and LEAP2A is grouped into items. Each item can be presented as Atom entry (each item corresponds to just one entry). Each item has type. Each item type has literal attributes, relationships and categories.
Items are connected (LEAP2A predicates) with metadata (literal values, properties). Similar predicates are used for connecting different items with each other. Data can be grouped in following groups:

1. Literal metadata - related directly to item
2. Personal data - not related with portfolio core processes; e.g. name, nationality, contacts, ID
3. Organizational data - part of personal data - awarding and provider organizations.
4. Structured content - similar to references but also related with page layout
5. Relationships - data about links between items and other entries.

5.5.4 Summary

Description of metadata and richness of the vocabulary seams promising for reflecting, importing and exporting learning outcomes and other learning assessment and evidences records of learners. In the ICOPER project, this specification can be used as an export format of learner learning outcomes. However, further testing about how adequate is the data model and its vocabulary for capturing learning outcome data is needed.

5.6 Conclusions

This section provided an illustration of the difficulties of drawing the line between what is a learning outcome standard and what is not. This is of course dependent of the definition of the concept of learning outcomes, but it is also dependent of how technical delimitation are regarded, as well as on how information models are defined. One example that illuminates this is when learning outcomes standards are compared, such as the specifications from IEEE

(for example the IEEE RCD) and the specifications from the HR-XML family. Although the IEEE RCD specification has a rather narrow scope, focusing on representing the key characteristics of a learning outcomes, it offers technical and semantic interoperability and (to some extent) extensibility. The HR-XML provides its model based on the use of XML, hence an information model that is based on the recursive container model that is built in to XML and which in the HR-XML schema provides no mechanisms for extensibility.

The two approaches have their respective advantages and disadvantages, but the point being that it is not always obvious to determine when the one standard or the other is more appropriate to use. If the scope and objective fits the ones of the HR-XML standards and there is no need for modifications, and XML is sufficient for the needs, then HR-XML is a reasonable choice. If extendibility is important, and the scope and objective is a moving target in a constantly evolving learning environment, then the choice might fall on another standard, like the IEEE CP.

One complicating circumstance when choosing the standard to use is that there are many factors involved that need to be considered:

- what is actually needed to support, which is the most technically suitable standard, what standard offers the highest degree of interoperability, is the standard a de jure and/or a de facto standard,
- what standard is supported by most vendors, politics, and so forth.

There will always be trade offs and compromises when it comes to the choice and use of standards and this complicates the development of best practice. The IEEE RCD is for example rather neutral to learning outcome definitions and also to semantics, at least to a certain extent, however this also means that there is more room for interpretation regarding the implementation and by that also a potentially higher risk for incompatibility between different ways of implementing the standards, which in turn makes best practice, guidelines, examples and recommendation even more important. This need is probably even more strengthened by the fact that IEEE RCD has no standard mechanism for adding extensions to it. The IEEE RCD data model does not define any bindings (see Section 5.1.3) and example bindings might very well be a contribution from ICOPER that could add value and make the IEEE RCD standard more accessible for developers that would like to support it.

The second analyzed IEEE spesification, in proposal phase, (the IEEE Competency Profile) is also a rather small and minimalistic. The IEEE CP provides common data models and it specifies some common processes that are likely to be a result of the specifications focus on data exchange and interoperability between systems, which makes such properties necessary.

HR-XML on the other hand has a strong focus on management and business and makes use of very clear and in that respect non-extendable semantics expressed by the XML structure, which is likely to make the standard less flexible, but easier to maintain compatibility on a basic level. This is obviously a result of the firmly demarcated scope and focus of HR-XML (see Section 5.3).

LEAP2A specification focuses on capturing all types of ePortfolio information of a person. LEAP2A extends ATOM syndication format to allow representation of such rich data. In ICOPER project, this specification can be used as one of the supported export format of learner learning outcomes and other learning assessment and evidences records.

Even though both IEEE RCD and IEEE CP are specifications from the same organization, it is not entirely clear and distinct in every case where the boundaries between the both specifications are to be set. The IEEE CP specifies a small set of scenarios (or cases) that clarifies some of the issues that might occur, but there is still a grey zone. This is another area were results from the ICOPER project could contribute to best practice by adding to those scenarios from the perspective learning outcomes in a higher education context related to digital units of learning and repositories.

The CEN Metadata for Learning Opportunities (MLO) is a bit different from the other standards that were analyzed. MLO focuses on learning opportunities rather than specifically on learning outcomes. It is, never the less, of interest as MLO indirect also targets learning outcomes, but in relation to learning opportunities. This means that there are overlaps with the other standards and at the same time the MLO provides a bridge between definitions and representations of learning outcomes and the description and representation of learning opportunities. The role of MLO in relation to other learning outcomes related standards is an issue that should be explored by the ICOPER project. One interesting quality of MLO is that it is based on an abstract data model (i.e. the DCAM) that allows it to be represented using different technologies and bindings, such as by semantic technologies, for example by RDF or Topic Maps. Semantic technologies could potentially be used as an interoperability mechanism between suitable learning outcomes standards and MLO (as well as other) this is an approach that could be explored within ICOPER in order to prototype and develop best practice guidelines. This would, however, involve the development of RDF bindings for learning outcomes standards, whereas the IEEE standards are likely to be the most suitable for the purpose.

6 Outcomes

This section introduces the ICOPER learning outcomes building blocks; see Figure 7 below. Learning outcomes concepts, definition and relations among them are based on the ICOPER survey of university experience with outcome-based education and analysis of learning outcomes standards. This section also introduces also proposed use cases for implementation that support outcome-based online learning.

6.1 Concepts

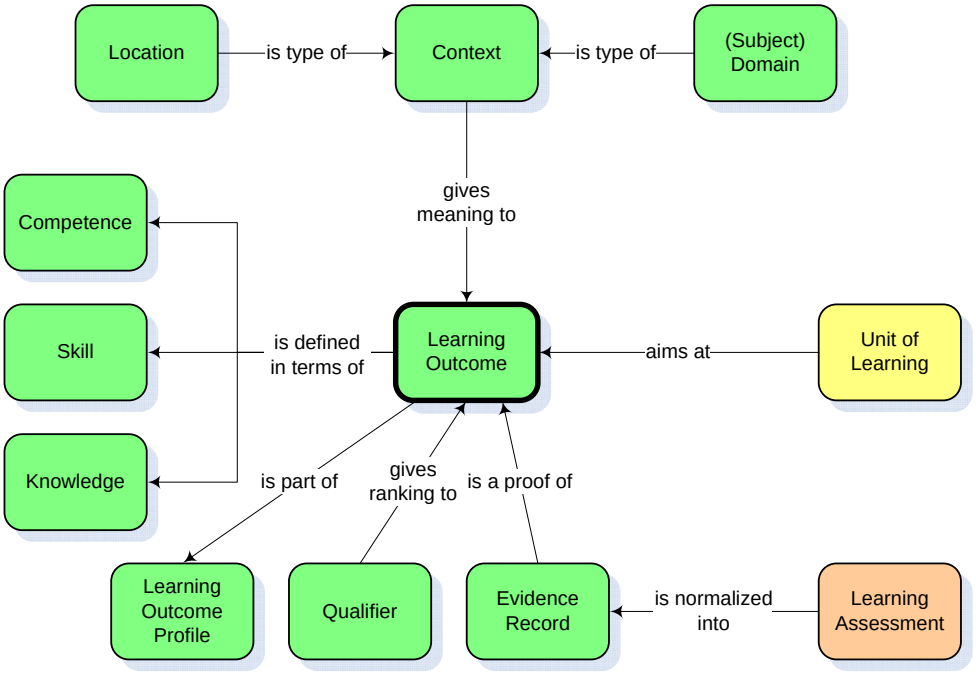

Figure 7: Learning outcomes concepts and relations

6.1.1 Learning outcomes

Learning outcome means statement of what a learner knows, understands and is able to do on completion of a learning process. It covers knowledge, skills and personal, social and/or methodological abilities that a learner should have when successfully having finished a unit of learning (*definitions and relations of unit of learning will be available in D3.1, due September 2009*).

- Knowledge can be part of a learning outcome and means the outcome of the assimilation of information through learning.
- Skills can be part of a learning outcome and means the know-how to solve problems and tasks.
- Competence can be part of a learning outcome and means the proven ability to use knowledge, skills and personal, social and/or methodological abilities, in work or study situations and in professional and personal development. In the context of the European Qualifications Framework (EQF), competence adds to the ability to use knowledge and skill the dimension of responsibility and autonomy. It is important to note that some communities differentiate between competence and competency. In the ICOPER project both terms have the same meaning.

6.1.2 Learning outcome profiles

Learning outcome profile is a representation of a set of (acquired/required) aggregated knowledge, skills and competences of a learner. This includes the *context* (e.g., subject domain, location) and *qualifiers* (e.g., proficiency level, complexity of situation) attached to learning outcomes.

6.1.3 Context of learning outcomes

Context is the set of elements that is external to and gives meaning (Azouaou & Desmoulins, 2006) to a learning outcome. For instance, subject domain and location (e.g., lab, classroom) are contextual information that gives meaning to the learning outcome. Learning outcomes can be context-free and context bound.

6.1.4 Learning outcome qualifiers

A qualifier is the set of elements that assigns ranking to a learning outcome. In the context of the ICOPER project, proficiency level (ranking from 1 to 8 of EQF) is used to qualify learning outcomes.

- The proficiency level for knowledge learning outcome ranges between general (rank 1) and highly specialized (rank 8).
- For skills learning outcome, proficiency level represents the complexity of the task or problem; from simple (rank 1) to highly complex (rank 8).
- For competence, proficiency level represents the autonomy and responsibility; work under supervision with low responsibility (rank 1) and supervise others taking full responsibility (rank 8).

6.1.5 Evidence records

An evidence record captures the proof that a learner has obtained the learning outcome through learning assessment. This covers the type, result and source (institution) of assessment followed by the student; *definitions and relations of learning assessment will be available in 6.1 due September 2009*).

6.2 Outcome-based learning use cases

The use cases presented in this section were identified based on the analysis of data collected by the ICOPER questionnaire on university experience with learning outcome-based education; discussed in Section 4.

Glossary

The actors involved in the use cases are;

- Learner: the role who carries out the learning using the provided system to achieve some level of knowledge, skill or competence.
- Teacher: the role who provides the learning content and/or prepares the teaching methods and guides/helps the students in their learning process.
- Institution system: the system that is responsible for the university/institution learning data storage and management, e.g. students' learning profiles and also the units of learning management.
- Placement system: the system that serves as a "bridge" between the students and the recruitment systems. Its goal is to help students easily find a placement position after achieving some level of knowledge, skill and competence as well as to help recruitment systems easily find competent students.

All use cases, in forms of a diagram, illustrate the relations between the actors and each individual use case, and the expanded descriptions, which describe the process in more detail.

6.2.1 Learning outcome-based search

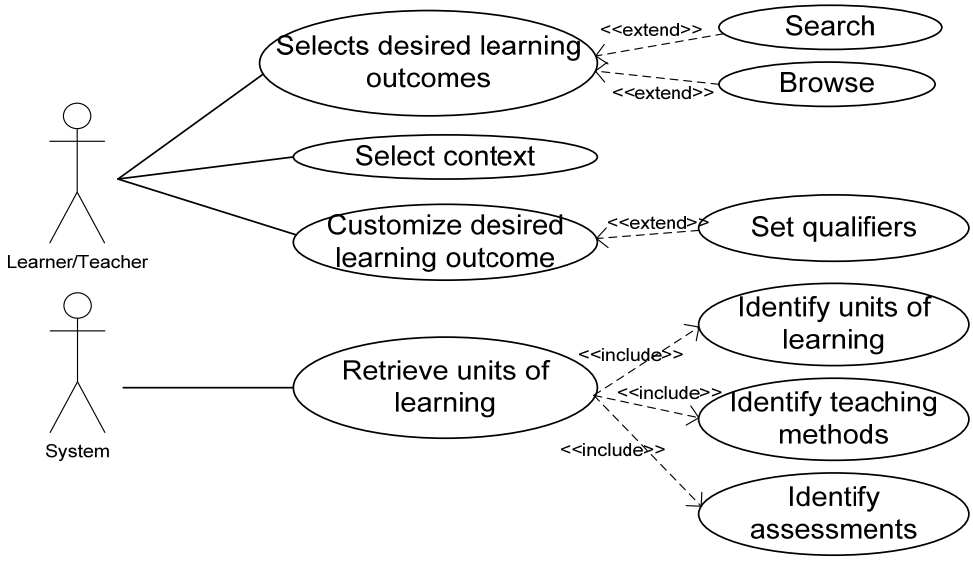

Figure 8: Learning outcome-based search

Use case: <**Select desired learning outcomes**>

- Goal: The actor selects the desired learning outcomes from the Open ICOPER Content Space (OICS)
- Actors: Learner/Teacher
- Conditions: The learner/teacher is authorised to use the OICS to select the desired learning outcomes
- Description: The learner/teacher accesses the OICS and selects the desired learning outcomes. The OICS accesses its repository/repositories and returns the requested learning outcomes
- Steps (or course of events):

Actor action	System response
1. This use case begins when a learner/teacher accesses the OICS with the intention to select one or more desired learning outcomes	
	2. The OICS provides the learner/teacher with the "Search" and "Browse" options
3. The learner/teacher sends requests (using keywords in <Search> or using the <Browser> option) to the OICS to look for the desired learning outcome	
	4. The OICS looks for the desired learning outcome-based on the provided request from the learner/teacher
	5. The OICS returns the results to the learner/teacher (different kinds of results representations may be considered)
6. The learner/teacher gets the results from the OICS	

- Result
  - Success: The learner/teacher finds his/her desired learning outcomes
  - Failure: The leaner/teacher does not find his/her desired learning outcomes

- Variations
  - <Step 3> The learner/teacher uses Search function → see Use case <**Search desired learning outcomes**>
  - <Step 3> The learner/teacher uses Browse function → see Use case <**Browser desired learning outcomes**>

<**Search desired learning outcomes**> extends <**Select desired learning outcomes**>

- Goal: The actor searches for the desired learning outcomes
- Actors: Learner/Teacher
- Conditions: The learner/teacher is authorised to use the OICS to search/select the desired learning outcomes
- Description: The learner/teacher accesses the OICS and selects the desired learning outcomes. The OICS provides search functionality. The teacher/user provides some keywords that allow the OICS access its repository/repositories and return the requested outcomes
- Steps (or course of events):

Actor action	System response
1. This use case begins when the learner/teacher uses the search functionality provided by the OICS	
2. The learner/teacher provides some keywords	
	3. The OICS use the provided keywords to look for the corresponding learning outcomes from its repository/repositories
	4. The OICS may or may not find the desired learning outcomes. In either case, it returns the results to the learner/teacher
5. The learner/teacher gets the results from the OICS	

- Result
  - Success: The learner/teacher finds his/her desired learning outcomes
  - Failure: The leaner/teacher does not find his/her desired learning outcomes

<**Browse desired learning outcomes**> extends <**Select desired learning outcomes**>

- Goal: The actor browses the learning outcomes to look for the desired ones
- Actors: Learner/Teacher
- Conditions: The learner/teacher is authorised to use the OICS to browse/select the desired learning outcomes

- Description: The learner/teacher accesses the OICS and selects the desired learning outcomes. The OICS accesses its repository/repositories and provides a list of learning outcomes. The teacher/user browses the list and select the desired ones
- Steps (or course of events)

Actor action	System response
1. This use case begins when the learner/teacher uses the browse functionality provided by the OICS	
	2. The OICS accesses its repository/repositories and provides a list of learning outcomes
3. The learner/teacher browses the list	
4. The learner/teacher may or may not find the desired learning outcomes	

- Result
  - Success: The learner/teacher finds his/her desired learning outcomes
  - Failure: The leaner/teacher does not find his/her desired learning outcomes

Use case: <**Select context**>

- Goal: The actor selects the context of learning from the OICS, to give meaning to the desired learning outcomes.
- Actors: Learner/Teacher
- Conditions: The learner/teacher is authorised to use the OICS to select the context
- Description: The learner/teacher accesses the OICS and selects the context of learning. A context can be scientific domain (e.g. biology, maths), a location (e.g. lab, classroom) or a situation (e.g. normal, emergency or unknown). The OICS accesses its repository or repositories and returns the requested context
- Steps (or course of events):

Actor action	System response
1. This use case begins when the learner/teacher accesses the OICS to select a context	
	2. The OICS provides a list of contexts
3. The learner/teacher selects the desired context	

- Result
  - Success: The learner/teacher finds his/her desired context
  - Failure: The learner/teacher does not find his/her desired context

Use case: <**Customise desired learning outcome**>

- Goal: The actor customises the desired learning outcome; customization covers, for example, adding the desired proficiency level to the learning outcome
- Actors: Learner/Teacher

- Conditions: The desired learning outcome exists and the learner/teacher is authorised to use the OICS to customise the learning outcome
- Description: The learner/teacher customises the desired learning outcome.
- Steps (or course of events)

Actor action	System response
1. This use case begins when the learner accesses the system to customise the desired learning outcome	
2. The learner customises the learning outcome	
	3. The system updates the learning outcome and informs the learner
4. The learner gets the return information from the system	

- Variation
  - <Step 2>: the learner could not customise the learning outcome. He/she may quit the system
  - <Step 3>: the system could not update the customised learning outcome. It stops further processing and informs the learner
- Result
  - Success: The learner customises his/her desired learning outcome
  - Failure: The leaner does not customise his/her desired learning outcome

<**Set qualifiers**> extends <**Customise desired learning outcome**>

- Goal: The actor sets qualifier to help customise desired learning outcome
- Actors: Learner
- Conditions: The desired learning outcome exists and the learner is authorised to set qualifiers to help customise it
- Description: The actor sets qualifier to help customise desired learning outcome
- Steps (or course of events):

Actor action	System response
1. This use case begins when the learner set qualifiers to help customise desired learning outcome	
2. The learner sets the qualifier (such as the proficiency level) to knowledge, skill or competence	
	3. The OICS accepts the qualifiers set, updates the learning outcome and informs the learner
4. The learner gets the results from the system	

- Result

- Success: The learner sets qualifiers
- Failure: The learner/teacher doesn't set qualifiers

Use case: <**Retrieve units of learning**>

- Goal: The actor retrieves one or more units of learning
- Actors: Learner/Teacher
- Conditions: The actor is authorised to retrieve the units of learning
- Description: The actor provides the system with the desired learning outcomes and the corresponding context and qualifiers. From such input, the system returns one or more units of learning
- Steps (or course of events):

Actor action	System response
1. This use case begins when the learner/teacher accesses the system with intention to retrieve one or more units of learning	
2. The learner/teacher provides the system with the learning outcome and the context	
3. The learner can provide more requirements	
	4. The system checks the input and search in its repository/repositories for the appropriate unit(s) of learning
5. The learner gets the results from the system	

- Variation
  - <Step 3>:
    - The learner requires one or more units of learning. In this case, the system identifies the requested unit(s) of learning in <Step 4>
    - The learner requires one or more teaching methods associated with a unit of learning. In this case, the system identifies the requested teaching method(s) in <Step 4>
    - The learner requires one or more assessments. In this case, the system identifies the assessment(s) in <Step 4>

- Issues
  - <Units of learning>: More details about units of learning will be available in D3.1
  - <Teaching methods>: More details about teaching methods will be available in D3.1
  - <Assessment>: More details about assessments will be available in D6.1

- Result
  - Success: The learner/teacher retrieves one or more units of learning
  - Failure: The learner/teacher does not retrieve any unit of learning or retrieves only some of the requested units of learning

6.2.2 Portable Learning Outcome Profiles

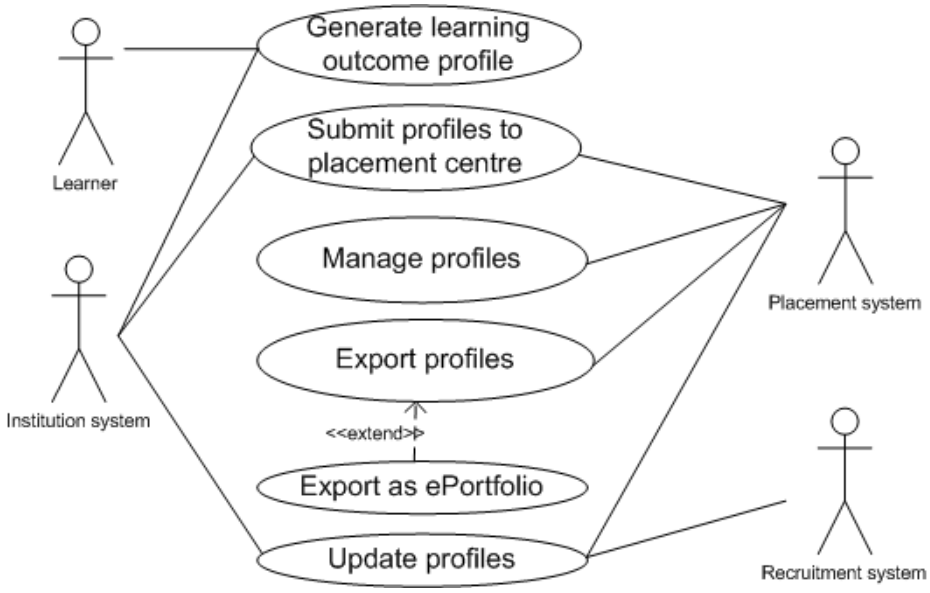

Figure 9: Portable learning outcome profiles

Use case: <**Generate learning outcome profiles**>

- Goal: The actor generates the learning outcome profiles
- Actors: Learner or Institution system
- Conditions: The learner is authorised to use the system
- Description: After finishing the study/training program, either the learner him/herself or the Institution system generate the corresponding learning outcome profile
- Steps (or course of events):

Actor action	System response
1. This use case begins when a learner or the Institution system requests to generate a learning outcome profile	
	2. If the learner is authorised, the system collects information about the learner's achieved learning outcome
	3. The system generates the learning outcome profile and informs the learner or Institution system
4. The learner or Institution system gets the result from the system	

- Result
  - Success: The learning outcome profiles are generated and the learner/Institution system is properly informed
  - Failure: The system does not generate the learning outcome profiles

Use case: <**Submit profiles to Placement system**>

- Goal: The actor submits the learning outcome profiles to the Institution Placement system
- Actors: Institution system, Placement system

- Conditions: The learning outcome profile exists
- Description: After having generated the learner's learning outcome profile, the Institution system submits that profile to the Placement system
- Steps (or course of events):

Actor action	System response
1. This use case begins when the Institution system submits the learning outcome profile to the Placement system	
	2. The Placement system verifies the profile to see if it is qualified to be processed
	3. The Placement system stores the learning profile and informs the Institution system
4. The Institution system gets the results from the Placement system	

- Variations
  - <Step 2>: the profile is not qualified. The Placement system stops further processing and informs the Institution system
  - <Step 3>: the Placement system could not store the profile. It stops further processing and informs the Institution system
- Result
  - Success: The learning outcome profile is submitted to the Placement system and the Institution system is properly informed
  - Failure: The system could not submit the learning outcome profile

Use case: <**Manage profiles**>

- Goal: The actor manages the learning outcome profiles
- Actors: The Institution Placement system
- Conditions
- Description: The system at Placement centre manages the learning outcome profiles. Several management activities should be considered and implemented, e.g. searching, sorting, importing, exporting, updating, etc.
- Steps (or course of events): Different courses of events may be considered
- Issues
  - <Composition of management activities>: The use case <Manage profiles> can be composed of several sub-use cases, each represents a management function (i.e. course of interactions between the Placement system and any other institutional systems that deal learner's data)

Use case: <**Export profiles**>

- Goal: The actor exports the learning outcome profiles into exchangeable formats
- Actors: The Placement system
- Conditions: The learning outcome profiles to be exported exist

- Description: The Placement system exports some specific learning outcome profiles into appropriate formats readable by social network tools (e.g. LinkedIn) or recruitment systems
- Steps (or course of events):

Actor action	System response
1. This use case begins when the Institution placement system receives a request to export some specific learning outcome profiles	
	2. The system selects the requested profiles from its repository/repositories
	3. The system exports them into appropriate formats and informs the Placement system
4. The Placement system gets the results from the system	

- Variation
  - <Step 2>: the system could not find the requested profiles. So the system stops any further processing and informs the Placement system
- Issues
  - <Request to export profiles>: The request may be internal (e.g. the Placement system generates periodically and automatically the learning profiles) or external (e.g. the requests come from some recruitment systems
  - <Appropriate formats>: The formats may depend on the context. For example, they may be in forms of interoperable formats that are readable by social network tools such as LinkedIn
- Result
  - Success: The profiles are exported into appropriate formats
  - Failure: The requested profiles could not be found or the profiles could not be exported

Use case: <**Export profiles as ePortfolio**> extends <**Export profiles**>

- Goal: The actor exports learner's learning outcomes into an ePortfolio format
- Actors: Placement system
- Conditions: The learning outcome profiles to be exported exist
- Description: The Placement system exports some specific learning outcome profiles into ePorfolio formats, e.g. LEAP2A so the learner can include his/her learning outcomes into his/her ePorfolio

Use case: <**Update profiles**>

- Goal: Some specific profiles are required an update
- Actors: The recruitment system, The Placement system, The Institution system
- Conditions
- Description: The recruitment system contacts the Placement system to require some profiles' update. The placement system requests the internal system to update the requested profiles and then informs the recruitment system about the new profiles' version

- Steps (or course of events):

Actor action	System response
1. This use case begins when the recruitment system contacts the placement system to require some profiles' update	
2. The Placement system gets the information from the recruitment system and passes the request to the Institution system	
3. The Institution system verifies the submitted profiles information	
4. The system identifies a set of units of learning and assessment that the learner should follow to update his/her profile	
	5. The system retrieves the specified set of units of learning and assessment
6. The Institution system updates the learner profile and sends the update back to the Placement system	
	7. The system updates the profiles in the repository/repositories
8. The Institution system informs the learner about the update	
9. The Placement system informs the recruitment system about the update	

- Variation
  - <Step 5>: The system could not find or retrieve the requested set of units of learning and assessment. It returns errors to the Institution system. The Institution system then contacts the learner for more information
  - <Step 6>: The Institution system may contact the learner to get more information from the learner for the update
- Result
  - Success: The profiles is updated and the recruitment system is informed
  - Failure: The requested profiles could not be updated

Please note that other use cases could also be considered, for example

- The learner directly exports his/her learning outcome profiles to a professional social network or a recruitment system (without passing by the Institution or placement systems) by him/herself
- The learner sends his/her profiles directly to the Placement system.

However, within the ICOPER context, the profiles exchange between the learners and the external social network or recruitment systems should be managed by the Placement system, which serves as a "bridge" that closes the gap between the learner and the industry.

Furthermore, by using the Placement system, the Institution can keep track of the learners' learning profile as well as the recruitment activities.

6.3 Learning Outcome Standards

Figure 10 presents an early proposal for the use of learning outcome standards to enable the use cases presented in the previous section. Nevertheless, a more detailed and concrete model description of ICOPER learning outcome standards will be elaborated later in the ICOPER deliverable D2.2 due in September 2009.

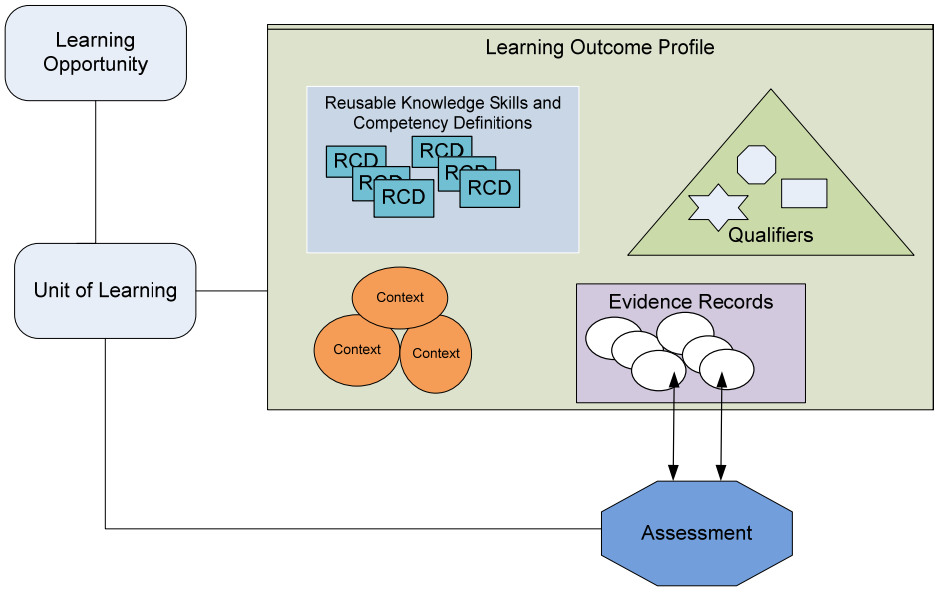

Figure 10: Learning outcome standards

IEEE RCD will likely be used to describe the reusable individual generic knowledge, skills and competences.

IEEE CP and HR-XML will likely be used for the description of learning outcome profiles of learners - which describes relation between RCDs, evidence, context and qualifiers of learning outcomes. Those two standards are in draft versions. Therefore, ICOPER may need to customize and reuse components of these two standards to produce the ICOPER learning outcomes profile specification that is adapted to the needs of ICOPER community.

CEN MLO will likely be used to describe learning opportunities and link them to units of learning. IMS LD (in WP3) will likely be used to describe units of learning and link them to learning outcomes profiles.

As far as standards are concerned, in the ICOPER project, the focus will be on making small components of learning outcomes standards loosely jointed. That is to increase the interoperability of learning outcomes data across relevant systems and domains.

6.4 Challenges and opportunities

6.4.1 University experience with learning outcomes

Universities use different classification and definitions for learning outcomes. Based on the survey discussed in Section 4, reported common learning outcomes concepts are knowledge, cognitive skills, key skills, professional skills, and practical skills. Universities do not use a common taxonomy of learning outcomes, but a free text provided by instructors. This approach hinders the reuse and interoperability of learning outcomes across units of learning and inter-/intra-institutional study programmes.

In addition to that, most of the surveyed universities do not use a National Qualification Framework. At one university, some faculties use both NQF and EQF whereas some others use their own framework, which is based on the Bologna agreement (with Dublin Descriptors).

The two challenges mentioned above are an open opportunity for ICOPER to provide best practice guidelines for implementing an interoperable approach of learning outcome-based online education.

6.4.2 Learning outcome standards

Section 5 analysed a number of standards that are used, or proposed, to describe reusable learning outcomes and learning outcome profiles of persons. The analysis shows that there are several competing and complementing standards related to learning outcomes. All the analysed standards and specifications have slightly different objectives and scopes, also are overlapping in many ways. Although the harmonization of these approaches is a tough challenge, it creates interesting opportunities for both flexibility and interoperability.

As with most other standards and specifications in the field of IT and learning technology standardization, the standard itself is not enough. There is also a need for patterns, usage scenarios, working implementations and practical work, which lead forward to a stable and functional “best practice” in terms of recommendations and guidelines. There are always problems with the wide space for interpretation of standards and their related specifications, and learning outcomes standards are no exception. On the other hand, there is an extra room for interpretation created by the existence of a number of different ways of defining the concept of learning outcomes. This is also one of the areas where the work within ICOPER can make a contribution, by suggesting definitions and by developing use cases, patterns and proof of concept. That is in addition to implementing working prototypes that support the suggested best practice in relation to the used standards.

In the above context, it is important not only to regard best practice for how to use a certain standard or specification, but also to regard best practice as when to use what standard, and which other standards to combine it with. The fact that there are a number of overlaps between standards with different objectives and scopes makes it important to develop rules and guidelines supporting people in how to use a standard and in deciding whether to combine it with another one or not. This is, however, not only a matter of standards for learning outcomes, but also a matter of standards and specifications in related areas, such as metadata LOM (2002), or DC-education (2006), pedagogical process and learning design,

such as IMS-LD (2003), or for representation of curriculum, such as the Curriculum Exchange Format (CEF, 2008), and so on. These are all issues that need to be explored and that could all benefit from contributions by the work in the ICOPER project. Especially interesting is this to explore from the point of view of the relatively new and upcoming standards and specifications, such as Metadata for Learning Opportunities (MLO, 2008), Curriculum Exchange Format (CEF), Metadata for Learning Resources – MLR (Currier, 2008), and likewise, since very few (if any) implementations of those standards exist. One of the biggest challenges is to position each standard in the right place in the standardization landscape and to maintain interoperability in terms of both technical interoperability and semantic interoperability. For the sake of the latter, exploration of semantic web technology is highly interesting as it may be used to bridge between different standards information models or schemas by complementing the syntactic capabilities of XML with the semantic capabilities of RDF.

7 Conclusions

This report presented learning outcomes frameworks, models and standards. Results of the analysis of ICOPER university partners with learning outcomes curricula developed is presented. In addition to that, analysis and results of learning outcome standards is given. Moreover, the report introduces the ICOPER approach for modelling learning outcomes and connecting them to units of learning. That is to enable online finding and delivery of outcome-based learning.

The results of the university questionnaire revealed that there are multiple conventions considering learning outcomes and how they are applied in educational field. The results show that in many cases, knowledge, skills and competences are still rather loosely connected to curricula. Although, the concepts seemed to be problematic; there is no single common way to define learning outcomes in European higher education institutes, though EQF framework provides a common definition for knowledge, skills and competences.

Some progress has been made regarding evidence assessment, i.e. many educational institutes align their curriculum qualification profiles with the labour market's requirements. Although, European outcome-based education initiatives have made a good progress so far, it seems that a lot of work is still to be done towards a common practice of outcome-based curricula development.

The ICOPER project could contribute to best practice by providing scenarios from the perspective of learning outcomes in a higher education context related to digital units of learning and repositories. The relation between learning outcomes and the Open ICOPER Content Space (OICS) contains several potentially interesting cases and challenges (as well as possible "killer applications"). One such challenge is the combination of specifications in order to obtain the most benefit.

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8 Appendix 1

Questionnaire

Learning outcomes in Higher Education: Needs Requirements for Universities

The purpose of this questionnaire is to collect data on the way universities practise the development of learning outcome based curricula, following the Bologna process and the European Qualification Framework (EQF). Unlike the traditional teaching-centred approach, learning outcome learners obtain in each study program/course are the core of learning-outcome approach. In this questionnaire, the goal is to explore the university experience with learning outcome based curriculum development.

Questions to be asked to stakeholders at universities:

STRATEGIC QUESTIONS

- Do you have a clear definition for learning outcomes (knowledge, skill, competence) at your university? If yes, what is it?
- Are you developing learning outcome oriented curricula? If yes, please answer the following sub-questions:
    - How do you support the implementation and assessment of learning outcome based curricula (e.g. experts providing advice and support to the faculties, projects, funding, incentives etc.)?
    - Are you using a National Qualification Framework (NQF) when implementing learning outcome oriented curricula? If yes, does it follow the structure of the European Qualification Framework (main reasons, differences, problems)? How do you align the NQF with the curricular qualification profiles? Who or which authority is responsible for aligning the NQF and the qualification profile?

DESIGN/IMPLEMENTATION QUESTIONS

- Who is responsible for developing curricular qualification profiles at your university?
- Are generic knowledge, skills, competences considered in the curricular qualification profiles?
    - If yes, what are these generic competences?
- How does your university ensure the alignment of the overall aims of a study programme with the learning outcomes at the level of modules and courses?
- How do you manage dependencies and consistency issues among learning outcomes defined at the different curricular levels (study programme, module, course), e.g. using ontology, conceptual models, etc.?
- How do you align a curricular qualification profile with the labour market's requirements (employability)?

ASSESSMENT/GOVERNANCE QUESTIONS

- How do you assess the learning outcomes stated in the qualification profile?
- How do you ensure that the curricular learning outcomes can be achieved by taking the courses?
- How do you ensure that teachers employ educational methods that facilitate the achievement of defined learning outcomes?

9 Appendix 2

WP 2: Learning Needs and Opportunities Testbed

Template for analysis of learning outcomes standards: knowledge, skills and competences

1. General Information on the standard

Title of the standard	
Short Description of standard	
Organization producing/providing standard	
Language(s) of standard	
URL location of standard	
Geographical coverage of standard	
Targeted user community(ies) of standard	
Current Institutions using of the standard	
Does the standard describe competence definitions or competence profiles?	
Learning outcome profiles are about: People, CVs, business processes, functions, roles, jobs, learning and knowledge material, etc?	
What aspects does the standard cover? (knowledge, skill, attitude)	
Date that standard was published	
Date of this analysis	

2. Documentation

2.1 Is a Conceptual Data Model of the standard provided?
2.2 Are there any Bindings provided for the standard? In which format? (e.g. RDF, XML, other)
2.3 Does the standard technical binding state conformance to bindings of other relevant schema?

3. Scope & Purpose

3.1 Is a clear scope and purpose statement provided in the standard documentation?
3.2 Are there any use cases included in the standard documentation?

4. Selection of elements and value domain

4.1 Are the metadata elements of the standard selected from other schema? If yes what schemas?
4.2 Are the Value domains selected from other standard value spaces/Ontologies? What are they?
4.3 Does the standard allow extending of its elements?

How? (Introduce new elements or qualifiers, etc?)
5. Modifications Checklist (Yes/No)
Does the standard allow?:
Mandatory selection of non-mandatory data elements
Changing/defining size and smallest permitted maximum
Change obligation of Data Elements (mandatory, conditional, recommended, optional)
Value space(s) modifications
Altering the relative location of an existing data element (e.g. moving a parent element to a child one)
Creating a new element that mimics the semantic intent of an existing element
Changing the meaning of an existing element
Changing the name of an element
Extending a schema other than at a specified extension point
Making a mandatory element optional (extensive modification)
Extending cardinality of an element
Adding new items in a controlled vocabulary list
Other modification? (please describe)

6. Your comments:

……
……
……
……

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[1] OJ L 79, 24.3.2005, p. 1.